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Policy
for

Radiation Safety Program

REVISION

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College of Nanoscale Science & Engineering (CNSE)

RADIATION SAFETY MANUAL

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EMERGENCY PHONE LIST

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PROBLEMS INVOLVING RADIATION/CONTAMINATION

RSO 437-8627
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1 PURPOSE AND SCOPE

The required procedures contained in this document have been established for the following purposes:

- To provide for the protection of the CNSE population and of the general public against radiation hazards associated with:

  a) CNSE's possession, use, transportation, and disposal of radioactive materials; and

  b) CNSE's use of machines and equipment that emit radiation.

- To provide for CNSE compliance with applicable regulations of Federal, State, and Local agencies.

1.1 Scope

This program applies to all CNSE employees, tenants, contractors and students who use and work with radiation producing equipment, materials and/ or sources.

2 DEFINITIONS

2.1 **Bioassay** – a chemical experiment used to measure the effects of a substance on a living organism. Radionuclides are used to track these substances.

2.2 **CNSE** – College of Nanoscale Science and Engineering.

2.3 **Dosimetry** – the measurement of ionizing radiation.

2.4 **GM Meter** – Geiger-Muller survey meter to measure ionizing radiation.

2.5 **mrem** – 1000 mrem = 1 rem

2.6 **RAD** – Radiation Absorbed Dose, measures the amount of radiation energy transferred to some mass of material, typically humans.

2.7 **Radionuclides** – an atom with an unstable nucleus that undergoes radioactive decay and emits ionizing radiation. Also referred to as radioactive isotopes or radioisotopes.

2.8 **RAM** – Radioactive Material

2.9 **REM** – Roentgen Equivalent Man is a unit that relates the dose of any radiation to the biological effect of that dose.

2.10 **RSC** – Radiation Safety Committee.

2.11 **RSO** – Radiation Safety Officer.

2.12 **SOP** – Standard Operating Procedure

2.13 **TLD** – The radiation badge (Thermoluminescent Dosimeter [TLD]) is the main method for determining to how much radiation a worker is exposed.

3 DELEGATION OF AUTHORITY

3.1 The ***Radiation Safety Committee*** receives its authority from the President of CNSE, Alain Kaloyeros.

3.1.1 The Committee is charged with the following responsibilities:

1. The establishment and continuing review of an adequate radiation protection program at CNSE.
2. CNSE compliance with radiation protection regulations promulgated by Federal, State, and local agencies.
3. Ensure that all individuals who work with or in the vicinity of radioactive material and/or radiation producing equipment have sufficient training and experience to enable them to perform their duties safely and in accordance with Department of Health regulations and the conditions of our Radioactive Materials license.
4. Ensure that all use of radioactive material and/or radiation producing equipment is conducted in a safe manner and in accordance with Department of Health regulations and the conditions of our Radioactive Materials license.

3.1.2 To meet these responsibilities, the Committee has been given the following authority:

1. To grant authorization, after appropriate application, to an individual or department for the use of radioactive materials and/or equipment that emits radiation on CNSE property.
2. To suspend an individual's authorization to use radioactive material or equipment that emits radiation.
3. To apply restrictions on the amount of occupational radiation exposure that an individual may receive during his CNSE association.

3.1.3 The Committee shall:

1. Be familiar with all pertinent New York State Department of Health regulations, the terms of the license, and information submitted in support of the request for the license and its amendments.

2. Review the training and experience of all individuals who use radioactive material and determine that their qualifications are sufficient to enable them to perform their duties safely and in accordance with New York State Department of Health regulations and the conditions of the Radioactive Materials license.

3. Be responsible for monitoring CNSE's program to maintain individual and collective doses As Low As Reasonably Achievable (ALARA).

4. Review semi-annually, with the assistance of the Radiation Safety Officer, occupational radiation exposure records of all personnel working with radioactive materials.

5. Establish a table of investigational levels for occupational radiation exposure, which when exceeded, will initiate an investigation and consideration of action by the Radiation Safety Officer.

6. Establish a program to ensure that all individuals whose duties may require them to work in the vicinity of radioactive material and/or radiation producing equipment (e.g., security and housekeeping personnel) are properly instructed as required by Section 16.13, New York State Sanitary Code (10 NYCRR 16).

7. Review for approval all requests for use of radioactive material and/or radiation producing equipment within CNSE.

8. Prescribe special conditions that will be required during a proposed use of radioactive material such as requirements for bioassays, physical examinations of users, and special monitoring procedures.

9. Review the entire radiation safety program at least annually to determine that all activities are being conducted safely and in accordance with New York State Department of Health regulations and the conditions of the Radioactive Materials license. The review shall include an examination of all records, reports from the Radiation Safety Officer, results of New York State Department of Health inspections, written safety procedures, and the adequacy of the institution's management control system.

10. Recommend remedial action to correct any deficiencies identified in the radiation safety program.

11. Maintain written records of all Committee meetings, actions, recommendations, and decisions for a minimum of three years.

12. Ensure that the radioactive materials license is amended, when necessary, prior to any changes in facilities, equipment, policies, procedures, radioactive material, possession limits, and personnel, as specified in the license.

3.1.4 Meetings:

1. The Radiation Safety Committee shall meet as often as necessary to conduct its business, but not less than once in each calendar quarter.

2. A quorum shall consist of at least one-half of the Committee's membership, including the Radiation Safety Officer and the EHS Officer.

3.2 The ***Radiation Safety Officer*** is responsible for developing and making recommendations on policies and procedures for a broad program in radiation safety and is to implement those programs and policies as approved by the Radiation Safety Committee.

3.2.1 The Radiation Safety Officer has the following duties and responsibilities:

1. Be a member and secretary of the Radiation Safety Committee and maintain records on Committee deliberations.

2. Keep current and maintain the file for the CNSE's radiation equipment registrations and radioactive materials license.

3. Review protocols and applications for authorized use of radioactive materials and/or radiation producing equipment under the license/permit and provide assistance in completing such applications.

4. Be responsible for supplying advice and assistance on all matters involving the use of radioactive materials and other radiation sources.

5. Interpret and implement regulations which govern the use of sources of radiation.

6. Maintain an up-to-date manual of safety regulations and procedures for the CNSE and advise the Radiation Safety Committee of any needed changes.

7. Coordinate the dosimetry service and maintain personnel exposure records. Be responsible for the timely notification of exposures to the supervisor, as well as individuals exposed when abnormal results are received or upon request.

8. Be responsible for the procurement, receipt, delivery and shipment of all radioactive materials and all radiation producing equipment coming to or leaving the CNSE.

9. Maintain records on procurement and receipt of radioactive materials and of radiation producing equipment.

10. Be responsible for the supervision of radioactive waste disposal. The Radiation Safety Officer shall provide current information concerning all aspects of radioactive waste disposal.

11. Maintain radioisotope disposal records and records of transfer of any radiation producing sources.

12. Maintain an inventory of all radionuclides at CNSE and limiting the quantities of radionuclides to the amounts authorized.

13. Instruct individuals on proper procedures for handling radioactive materials and radiation producing equipment. Be available for consultation on laboratory design, shielding and other radiation exposure control methods.

14. Oversee the completion of periodic radiation surveys and wipe tests in laboratories and storage areas. The RSO may conduct periodic surveys of work areas to supplement and audit routine monitoring by authorized users.

15. Conduct periodic leak tests of sealed sources pursuant to applicable regulations and maintain the necessary records.

16. Be responsible for calibration of monitoring and survey instruments under his/her supervision.

17. Conduct training programs and otherwise instruct personnel in the proper procedures before they are allowed to use radioactive material and/or radiation producing equipment.

18. Verify and report to appropriate authorities any incident involving sources of radiation, when required by applicable regulations.

19. Note and take steps in order to correct laboratory and general radiation safety problems.

20. Perform duties of Radiation Safety Officer as listed in State Sanitary Code Chapter 1, Part 16.

21. Direct and prescribe decontamination procedures. Provide assistance with decontamination in emergency cases, and maintain an adequate inventory of decontamination supplies.

3.3 The ***Principal Investigator/ Tool Owner*** is responsible for the protection of personnel listed on his protocol, prevention of contamination of CNSE

facilities, and compliance with all rules and regulations of Federal, State, Local and CNSE regulations.

3.3.1 The following responsibilities are required to be met as specified:

1. Provide adequate planning of experiments so that all necessary precautions may be taken before, during and after the execution of the experiment.

2. Comply with all radiation protection guidelines for safe handling of radioactive material and radiation producing equipment.

3. Conduct and document initial training for all personnel on laboratory and tool specific policies and safety procedures. Conduct and document annual refresher training of these policies and procedures highlighting new regulatory changes and CNSE policy changes.

4. Notify the Radiation Safety Officer of changes which may possibly affect radiation safety requirements, such as (but not limited to); changes in personnel, changes in room use, changes in experimental technique, problems in the receipt, use or disposal of radioactive material/radiation producing equipment.

5. Limit participation in the use of radioactive material and/or radiation producing equipment to persons with appropriate training.

6. Maintain adequate inventory of the amount of unsealed sources of radioactive material possessed and ensuring that it does not exceed authorized possession limits. This information must be submitted quarterly to the Radiation Safety Officer.

7. Maintain adequate records of disposal of radioactive material. This information must be submitted quarterly to the Radiation Safety Officer.

8. Ensure that personnel wear assigned personnel monitoring, if required.

9. Ensure that adequate facilities, equipment and calibrated instruments are provided.

10. Ensure that *all* sources of radiation are <u>secured</u> against unauthorized use or removal from their place of storage or use.

11. Comply with all responsibilities of an individual radiation worker.

12. Properly label and store all sources of radiation.

13. Notify the Radiation Safety Officer when a woman under his/her supervision is known to be pregnant.

14. Provide for decontamination of facilities or equipment which may become contaminated as a result of procedures involving unsealed sources of radiation.

15. Perform required contamination and radiation surveys and maintain adequate records of the results of all required surveys or tests.

16. Notify the Radiation Safety Officer at least 30 days in advance of intentions to vacate or relinquish possession of an area where radioactive materials are used or have been used or stored. An exit survey of the area(s) will be performed by the Radiation Safety Officer. If necessary, the Principal Investigator shall decontaminate the premises to the contamination and radiation levels specified in Chapter 1, Part 16 of the New York State Sanitary Code. The Radiation Safety Officer will verify that decontamination has been satisfactorily performed.

3.4 Each individual ***Radiation Worker*** who may use radioactive material or who may use equipment that emits radiation is responsible for complying with the procedures and precautions contained in this document; with those established by a protocol for use of the material or equipment; and with applicable regulations of Federal, State and Local agencies.

3.4.1 Specific responsibilities of the radiation worker are:

1. Read this Radiation Safety Manual prior to using any radioactive material and/or radiation producing equipment and comply with the general requirements for safe handling of radioactive material and/or radiation producing equipment.

2. Be familiar with and follow specific instructions for radiation protection provided by the Principal Investigator/ Tool Owner and the Radiation Safety Officer.

3. Keep radiation exposure to the lowest practical levels by wearing all protective devices and using all appropriate handling equipment.

4. Wear appropriate radiation monitoring devices, if required.

5. Monitor the area and all equipment prior to, during and after the use of unsealed sources of radioactive material.

6. DO NOT smoke (or chew), eat, drink or apply cosmetics in areas approved for use of radioactive material.

7. Maintain clean work habits and conduct good house-keeping practices.

8. Label, when required, all containers, sinks in which radioactive material may be deposited, refrigerators and freezers containing radioactive materials.

9. Report suspected spills or contamination immediately to the Radiation Safety Officer.

10. Conduct decontamination procedures under the direction of the Radiation Safety Officer and Principal Investigator/ Tool Owner.

11. Report promptly to the Radiation Safety Officer any condition which may lead to or cause a violation of any regulation under the conditions of our Radioactive Materials license or unnecessary personnel exposure to radiation or radioactive material.

12. Become familiar with appropriate responses in the event of any occurrence or malfunction that may involve personnel exposure to radiation or radioactive materials.

4 ASSOCIATED DOCUMENTS

4.1 **EHS-00016-F1** – New Equipment and Process Change Checklist

4.2 **EHS-00016-F2** – Radiation Device Inventory

4.3 **EHS-00016-F3** – Radiation Survey Sheet

4.4 **EHS-00016-F6** –Radiation Sealed Source Inventory

4.5 **EHS-00066-F1**– Maintenance Radiation Survey Sheet

5 PREGNANT WORKERS

5.1 Each woman working with radiation sources should notify her supervisor and the Radiation Safety Officer that she is pregnant as soon as she becomes aware of the pregnancy. Contact your specific employer Human Resource group for specific policies. The informational booklet, "Instruction Concerning Prenatal Radiation Exposure" published by the US Nuclear Regulatory Commission, is available through the Radiation Safety Officer on request. This information will be kept in strict confidence.

6 PERSONNEL TRAINING PROGRAM

ALL individuals shall be given initial training by the Radiation Safety Officer, or his designee, prior to the use of radioactive materials and/or radiation producing equipment, where a possible exposure exists. It shall not be assumed that safety instruction has been adequately covered by prior training at other institutions. Even experienced professionals will need instruction in the local policies, procedures and conditions of the CNSE Radioactive Materials license.

6.1 Personnel to be instructed:

6.1.1 Individuals who work in the lab or clean room areas where radiation sources are present shall receive radiation awareness training during Advance Safety training prior to accessing these areas.

6.1.2 Individuals who perform maintenance on radiation producing equipment (i.e. removing shielding, adjusting x-ray beams, etc) shall receive additional radiation equipment safety training.

6.1.3 Individuals who work with radioactive materials shall receive radioactive material safety training, as well as, annual refresher training.

6.2 Radiation Safety Training shall cover the following topics:

1. Basic units of activity, exposure, dose and dose equivalent.

2. The concepts of linear energy transfer, quality factor, RAD and REM.

3. Modes of decay and interactions with matter.

4. External Radiation Protection - principles of time, distance, shielding and contamination control.

5. Biological effects from radiation exposure. The NRC Regulatory Guide 8.29, “Instructions Concerning Risks from Occupational Exposure” is discussed.

6. Instrumentation - Use of GM survey meters and associated meters, as applicable.

7. Personnel Monitoring - Use of whole body TLDs and extremity dosimetry, when personnel monitoring is required, location of exposure history reports, bioassay results. Advise individuals as to the radiation exposure reports which workers must be given or may request.

8. Applicable regulations and license/permit conditions.

9. Areas where radioactive materials and/or radiation producing equipment is used or stored.

10. Potential hazards associated with radioactive materials and/or radiation producing equipment in each area where the individuals will work.

11. Appropriate radiation safety procedures.

12. Licensee's in-house work rules.

13. Each individual's obligation to report unsafe conditions to the Radiation Safety Officer.

14. Appropriate response to emergencies, spills or unsafe conditions.

15. Worker's right to be informed of occupational radiation exposure and bioassay results.

16. Location where the licensee has posted or made available notices, copies of pertinent regulations, and copies of pertinent licenses and license conditions (including applications and applicable correspondence), as required by New York State regulations.

7 PERSONNEL DOSIMETRY

7.1 Personnel dosimetry (whole body TLD badges and TLD ring badges) is issued to individuals based on the type and amount of radioactive materials being used as indicated on the Principal Investigator's/ Tool Owner's application for authorization to use radioactive materials. Most personnel dosimeters cannot detect the presence of low energy beta particles such as those emitted by ^{3}H, ^{14}C, and ^{35}S. If you use only these isotopes, you will not be issued a dosimeter.

7.2 The whole body TLD badges and the TLD rings are generally exchanged on a quarterly basis. The Radiation Safety Officer maintains a file of radiation exposure history reports in the Environmental Health and Safety office. If you are interested in finding out the amount of exposure you have received, contact the Radiation Safety Officer. ***It is each individual's responsibility to be aware of their received exposure.***

7.3 **General Guidelines:**

1. Wear your whole body TLD badge on the frontal part of the chest or waist. Your ring badge should be worn on the inside of your protective

gloves with the label turned toward the palm of your hand. Double glove your “badged” hand to prevent contamination of your ring badge due to a tear in the glove.

2. Clip the whole body TLD to your lab coat/ clean room suit so that the front stays upright and faces away from your body. Never allow clothing such as lapels, ties, buttons, etc. to shield the front of the badge.

3. **A badge is to be worn only by the person to whom it is issued.** You should only wear CNSE badges for CNSE related exposures. If you are required to travel to other facilities contact the RSO for consultation and possibly an issuance of a second badge.

4. Badges should be protected against damage from heat, moisture, and pressure.

5. Badges must NOT be worn during non-occupational exposure, such as during procedures involving medical or dental x-rays.

6. Badges must be stored in areas remote from radioactive material work areas and radioactive material storage areas. Dosimetry badges shall ***NOT*** be taken home.

7. Notify the RSO if;

   a. an individual no longer needs personal monitoring,

   b. an individual not presently monitored requires badging,

   c. an individual loses or damages his/her dosimetry badge.

8 RADIATION PRODUCING EQUIPMENT

8.1 Introduction

8.1.1 All radiation producing equipment at CNSE must be registered with the New York State Department of Health. The Radiation Safety Officer must approve any radiation producing equipment entering or leaving the CNSE facility via EHS-00016-F1 “New Equipment and Process Change Checklist”. EHS-00016-F2 “Radiation Device Inventory” shall also be submitted for all radiation producing equipment. This equipment is primarily electron microscopes and analytical x-ray equipment.

8.1.2 Electron microscopes produce radiation in the form of x-rays when they are in use. They result when the primary electron beam or backscattered electrons off the sample have sufficient energy to produce x-ray radiation.

X-ray leakage is a concern near the junctions of the casing however modern electron microscopes are well shielded and generally do not produce exposure rates above background.

8.1.3 The radiation safety problems associated with analytical x-ray equipment are unique. Most analytical x-ray equipment has extremely intense, narrow, low energy beams. Dose rates on the order of 4×10^5 R/min. at the port of ordinary diffraction tubes are not unusual. Exposure to the primary beam for even a few seconds can cause severe and permanent damage to the area of the body exposed.

8.1.4 Typical potentials for x-ray diffraction tubes are 25-50 kVp and 25-100 kVp for those used in fluorescent analysis. The upper limit for the energy of x-ray photons is, therefore 50-100 keV. The x-ray continuum is assumed to extend from 5-100 keV, with an intensity maximum in the 20-30 keV range. Superimposed on this continuum is the characteristic spectrum of the anode. Energies involved here range from 5.4-17.5 keV.

8.1.5 Radiation monitoring problems associated with x-ray diffraction and x-ray fluorescence units are various and difficult. Hazardous radiation may come from the following sources:

1. The primary beam;
2. Leakage or scatter of the primary beam through cracks in ill fitting or defective equipment;
3. Penetration of the primary beam through the x-ray tube housing, shutters, or diffraction apparatus;
4. Secondary emission from the sample or other material exposed to the primary beam;
5. Diffraction x-rays;
6. Radiation generated by rectifiers in the high-voltage power supply.

8.1.6 The leakage or scatter of the primary beam through apertures in ill fitting or defective equipment can produce very high intensity beams of small and irregular cross-section. Diffraction beams also tend to be small and irregular in shape. They may be directed at almost any angle with respect to the primary beam. Exposure rates on the order of 80 R/hr for short periods of time are not unusual.

8.1.7 The hazard resulting from penetration of the useful beam through shutters or the x-ray tube housing is slight in well-designed equipment. Adequate shielding can be readily obtained at the energies commonly used for diffraction and fluorescent analysis. Radiation surveys prior to initial use

of analytical x-ray equipment and annually afterward are essential to detect any of the situations discussed above. Surveys shall be done with Geiger (GM) counters with thin window pancake probes. The survey is done 2'' above the surface of the area surveyed. All results are to be recorded on EHS-00016-F3 "Radiation Survey Sheet."

8.1.8 Radiation from the high-voltage power supply may be a result of gassy rectifiers. The effective potential is twice the potential applied to the x-ray tube, and the radiation produced is extremely penetrating. This condition may arise at any time, therefore shielding the assembly that contains the rectifiers, and annual radiation leakage surveys are strongly recommended.

8.2 Additional Responsibilities (Radiation Equipment Users)

8.2.1 Principal Investigator/ Tool Owner is responsible for ensuring compliance with this section. At their discretion, alternate means of assuring an equivalent level of safety may be required for programmatic reasons. Such variations will be documented and referred to the Office of Environmental Health and Safety. The Radiation Safety Committee/ RSO is responsible for ensuring that all new Principal Investigators are informed of local procedures and policies for ordering/purchasing any type of radiation producing equipment.

Principal Investigators/ Tool Owners are responsible for direct implementation of this section. Specifically, principal investigators, users and/or faculty will:

1. Ensure that operational procedures pertaining to radiation safety are established and executed;

2. Provide adequate instruction in safety practices for all personnel who work with or near analytical x-ray equipment and radiation producing equipment;

3. Approve all individuals who are to operate any analytical x-ray equipment and radiation producing equipment. Such approval will be based on the individual's competence as an operator, and the extent of radiation safety training that he/she has received;

4. Review and approve (after consultation with the Radiation Safety Officer) all modifications to x-ray equipment and radiation producing equipment that may significantly alter the safety status of the facility or the unit itself;

5. Shall ensure that all protective devices such as interlocks, safety switches, fume hoods, filters and trapping devices for radioactive gases are maintained in good repair and proper operating condition.

Perform operational tests of all radiation safety devices at regular intervals. Records of these tests should be maintained and kept on file.

6. Survey equipment after any preventative maintenance or changes that may affect the x-ray/ radiation producing equipment or shielding. Results shall be recorded on EHS-00066-F1 “Maintenance Radiation Survey Sheet.” This form should be kept on or near the equipment.

8.2.2 Users are responsible for complying with all provisions of this section.

8.2.3 Radiation Safety Officer is responsible for assisting in the implementation of this section. Specifically, the Radiation Safety Officer, or his designee, will:

1. Assist the Principal Investigator/Tool Owner in establishing operational procedures pertaining to radiation safety;

2. Review the Principal Investigator’s/ Tool Owner’s plan for providing adequate instruction in radiation safety procedures to personnel who work with or near analytical x-ray equipment. These instructions may be devised as orientations, formal written procedures or formal training sessions;

3. Assist the Principal Investigator/ Tool Owner in reviewing and approving modifications pertaining to the radiation safety program;

4. Audit for compliance with this guide and report to the Radiation Safety Committee

5. Perform annual and initial radiation surveys.

6. Maintain a current inventory of all radiation producing devices on site.

8.3 Area Requirements

8.3.1 Radiation Area - means any area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.05 mSv (0.005 rem) in 1 hour at 30 centimeters from the source of radiation or from any surface that the radiation penetrates. These areas shall be posted “CAUTION, RADIATION AREA.”

8.3.2 Controlled Area or Restricted - Any area in which the dose equivalent received by individuals may exceed 500 mrem in any year, but does not exceed the levels that would require it to be designated a radiation area. Each controlled area should be identified by an appropriate and easily recognizable sign posted at each entrance.

8.3.3 Noncontrolled Area or Unrestricted - Any area to which access is not controlled for purposes of radiation protection.

8.4 **Operational Safeguards**

8.4.1 The following recommendations are applicable to all x-ray producing equipment:

1. A warning light or device of fail safe design labeled with the words “X-Ray ON”, or other words having similar meaning, shall be located near any switch which energizes an x-ray tube.

2. A fail-safe light or indicator on a conspicuous location near the radiation source housing shall be used to indicate when the x-ray tube is on or the port of the radioactive source is open.

3. A label bearing the conventional radiation symbol and the words, **CAUTION: THIS EQUIPMENT PRODUCES X-RAYS WHEN ENERGIZED--TO BE OPERATED ONLY BY QUALIFIED PERSONNEL,** or other words having similar meaning, shall be attached near any switch which energizes an x-ray tube. See Appendix A of this document for examples of sufficient warning labels.

4. Systems that contain an x-ray tube shall be equipped with an interlock that shuts off the tube if it is removed from the radiation source housing or if the housing is disassembled.

5. A label bearing the conventional radiation symbol and the words, **CAUTION: THIS EQUIPMENT CONTAINS RADIOACTIVE MATERIAL--TO BE OPERATED ONLY BY QUALIFIED PERSONNEL,** or words having similar meaning, shall be attached to the control panel of each x-ray system that contains a radioactive source. See Appendix A of this document for examples of sufficient warning labels.

6. A label bearing the conventional radiation symbol and a statement of (a) the type of radioactive material, and (b) the activity in curies or millicuries, and (c) the date of measurement of the activity shall be attached to the radiation source housing of each x-ray system that contains a radioactive source. See Appendix A of this document for examples of sufficient warning labels.

7. Normal operation procedures and alignment procedures shall be documented by the manufacturer of the x-ray system, or by the Principal Investigator if the radiation source housing and x-ray accessory apparatus are not compatible components supplied by the same manufacturer.

8. All safety devices (shutters, warning lights, etc.) should be tested quarterly by users to insure their proper operation. Records of these tests shall be maintained.

9. Any attempt to alter safety devices either temporarily or on a permanent basis shall be approved by the Principal Investigator and the Radiation Safety Officer. A warning of the alteration shall be conspicuously posted. Radiation protection surveys shall be performed after each alteration of safety devices. Records of these surveys shall be maintained.

10. Radiation protection surveys should be conducted in the immediate vicinity of the x-ray apparatus by qualified personnel on a routine basis. These surveys may be performed by the operator under the guidance of the Radiation Safety Officer.

11. Operators of analytical x-ray equipment will be required to use personnel monitoring devices provided by the Radiation Safety Officer.

8.4.2 Requirements for Enclosed Beam X-Ray Systems in addition to the general requirements:

1. The radiation source, sample, detector, and analyzing crystal (if used) shall be enclosed in a chamber or coupled chambers that cannot be entered by any part of the body during normal operation.

2. The inherent shielding of the chamber walls shall be sufficient to limit the dose rate in all regions 2” (inches) from its outer surface to 0.25 mrem/h during normal operation.

3. The sample chamber closure shall be interlocked with the x-ray tube high voltage supply or a shutter in the primary beam so that no x-ray beam can enter the sample chamber while it is open unless the interlock has been consciously and deliberately defeated. This interlock shall be of fail-safe design.

4. If there is more than one port in the radiation source housing or more than one radiation source, all requirements above must be satisfied for **each** port, in every source housing, associated with the system.

8.4.3 Requirements for Open Beam X-Ray Systems in addition to the general requirements: (Systems that do not meet the requirements of an enclosed beam system).

1. All shutters will be provided with a “SHUTTER OPEN” indication of fail-safe design.

2. Radiation levels external to the x-ray tube housing, with all shutters closed, shall not exceed 2.5 mrem/h as measured 2'' from the surface of the housing within which an x-ray tube is operating at full rated power at maximum rated accelerating potential.

3. Each port of the radiation source housing shall be provided with a beam shutter interlocked with the x-ray accessory apparatus coupling, or collimator, in such a way that the port will be open only when the coupling or collimator is in place. Shutters at unused ports shall be secured to prevent casual opening.

4. A guard or interlock which prevents entry of any part of the body into the primary beam should be utilized.

5. A system barrier will be provided so that the dose equivalent received by individuals in the controlled area is as low as reasonably achievable, but does not exceed 5 mrem in any one (1) hour or 100 mrem in any five (5) consecutive days.

9 RADIOACTIVE SEALED SOURCE POLICIES

9.1 A list of radioactive sources, owned by CNSE, is available from the Radiation Safety Officer. These sources must not leave their storage locations unless authorization is given by the Radiation Safety Officer. Contact the Radiation Safety Officer to check-out/check-in radioactive sources.

9.2 **CNSE Policies:**

1. All personnel using radioactive sealed sources must be trained in the hazards, safety precautions, and proper use of the radioactive material.

2. Always store sources in their original storage containers in a designated locked cabinet or room. Do not store sources in the vicinity of dosimeter storage locations. Do not use sealed sources in non-controlled areas without specific approval of the Radiation Safety Officer.

3. Be aware of external and surface dose rates. Use time-distance-shielding techniques whenever possible. Use remote handling devices where appropriate. This should be considered for even small check sources to reduce finger exposure.

4. Whenever handling or removing a source from its container, look for abnormalities. If in doubt about the condition of a source, return it to storage and contact the Radiation Safety Officer immediately to perform a leak test.

5. Do not leave any source that produces more than 5 mrem/hr at 12 inches unattended unless specific arrangements are made with the Radiation Safety Officer.

6. Wear a radiation dosimeter when using sources that can produce whole body dose rates in excess of 2 mrem/hr.

7. Have a radiation survey instrument immediately available when radiation levels in excess or 2 mrem/hr are being produced.

8. Maintain a use log for those sources that can produce significant personnel exposure (>5 mrem/hr at 12 inches). This log should contain sufficient detail so that any operation with the source can be reconstructed.

9. Contact the EHS office and Radiation Safety Officer prior to ordering a sealed source for approval and submit EHS-00016-F6 “Radiation Sealed Source Inventory”.

10. All devices/ tools containing a radioactive sealed source must be labeled appropriately. See Appendix A of this document for an example of a sufficient label.

11. The RSO or his designee will maintain a current inventory of all radioactive sealed sources.

9.3 **Leak Test Requirements**

9.3.1 Each sealed source, containing radioactive material other than H-3, with a half-life greater than 30 days and in any form other than a gas shall be tested for leakage as follows:

9.3.2 Beta/Gamma Emitters, Ni-63: (source must contain greater than 100 μCi)

1. Prior to initial use;

2. Every six months;

3. Damaged or suspected leakage;

4. Leak test is not required if the source is designated in storage and not being used routinely with the requirement that;

   a. The source shall be tested prior to any use,

b. The source shall be tested prior to transfer to another person unless it has been tested within the last six months.

9.3.3 Alpha Emitters, Po-210: (Source must contain greater than 10 μCi)

1. Prior to initial use;
2. Every three months for alpha sources;
3. Damaged or suspected leakage.

10 STANDARDS RELATING TO LABORATORY PRACTICES

10.1 Authorization to Use Radioactive Materials

10.1.1 CNSE is issued a general Radioactive Materials license through the New York State Department of Health, Bureau of Environmental Radiation Protection, which allows the possession, use, transfer, and disposal of radioactive materials. All Principal Investigators/ Tool Owners using radioactive materials must be authorized to do so by the Radiation Safety Committee. Authorizations are granted to qualified individuals who are the Principal Investigators/ Tool Owners of research projects and/or responsible for supervising radioactive materials use by associate users or students in their area or on their tool.

10.1.2 All laboratory areas where radioactive material will be used must be approved by the Radiation Safety Committee.

10.1.3 An individual requesting approval to use radioactive materials must submit the following information to the Radiation Safety Officer and EHS office.

1. The requested isotope, quantity, physical/ chemical form and activity in mCi.
2. Submit the protocols for each intended use of radioactive materials.
3. Resume with specifics on previous radioactive material use of the Principal Investigator.

10.1.4 All applications for the use of radioactive materials are reviewed by the Radiation Safety Officer for regulatory and license compliance. All applications for the use of radioactive materials are forwarded to the Radiation Safety Committee for review. If the application is approved, the Radiation Safety Officer sends a note to the Principal Investigator/ Tool Owner establishing what isotopes he/she has been approved for by the Committee and what the maximum activity limits are for each isotope. Any stipulations that the Committee has mandated will be included in this note. A Radioactive Materials license certificate is issued and must be

posted in the laboratory. The Radiation Safety Officer oversees all preliminary lab setups, postings, and initial radiation safety training.

10.1.5 All Principal Investigators/ Tool Owners approved to use radioactive material must complete an annual radiation safety review/renewal application sent out by the Radiation Safety Officer.

10.2 Ordering Radioactive Materials

10.2.1 Prior to the purchase of any quantity of radioactive materials, an individual must have the approval of the Radiation Safety Committee for that specific isotope, amount of activity, and general chemical form to be ordered. NO QUANTITY OF RADIOACTIVE MATERIAL IS EXEMPT FROM THIS PROCEDURE.

10.2.2 All radioisotope orders must be approved by the Radiation Safety Officer. (This includes samples, regardless of whether or not there is a charge for them). Quantities ordered may not allow the area to exceed its authorized possession limits. Principal Investigators must maintain a record of all radioactive material in their possession.

10.2.3 To Order:

1. Fill out purchase requisition including; isotope type, chemical form, quantity (μCi), vendor, and principal investigator's name.
2. The requisition should be signed by an authorized principal investigator/ tool owner or his/her approved designee.
3. Take the requisition to the Radiation Safety Officer for review and approval. The requisition must have the RSO's signature for purchasing to process the order.
4. Take or fax to purchasing. Purchasing must place order to the attention of the EHS Department.

10.3 Receiving Radioactive Materials and Sources

10.3.1 Radioisotopes and sources are delivered to CNSE via the NFN loading dock. The RSO or the RSO's designee will check-in, survey, wipe test and inspect all radioactive material packages prior to them being released to the laboratories or clean room for all quantities of radioactive material that exceeds the Type A_2 quantities of NYSDOH Part 16 under Appendix 16-B. The principle investigator/ tool owner is responsible for inspecting and surveying inside the primary packaging during initial opening. If the internal container is damaged or contamination found, contact the RSO immediately.

10.3.2 As soon as your lab receives a package of radioactive material from the RSO or EHS Dept. follow the SOP in Appendix B, SOP for Opening Packages of Radioactive Material.

10.3.3 If the RSO or his designee is not available toinspect and survey delivered packages the laboratory will use the following procedure for opening packages.

1. Put on gloves to prevent hand contamination.

2. Visually inspect the package for any sign of damage (i.e., wetness, crushed). If damage is noted, stop and notify the Radiation Safety Officer as soon as possible.

3. Measure exposure rate, using an ion chamber, at 3 feet (or 1 m.) from the package surface, as well as, adjacent to the package surface and record the reading. If it is higher than usual (>0.5 mR/hr), stop and notify the Radiation Safety Officer as soon as possible.

4. Open the package while following precautionary steps:

   a. Open the outer package (following manufacturer's directions, if supplied) and remove packing slip.

   b. Open the inner package and verify that contents agree with those on the packing slip. Compare requisition, packing slip and label on container.

   c. Check the integrity of the final source container (i.e., inspect for breakage of seals or vials, loss of liquid, or discoloration of packaging material).

5. If there is any reason to suspect contamination, wipe external surface of source container and remove wipe to low background area. Assay the wipe and record the amount of removable radioactivity (i.e., dpm/100 square centimeters, etc.). Check wipe with a thin window GM survey meter, and take precautions against the spread of contamination, as necessary.

6. Monitor the packing material and packages for contamination before discarding.

   a. If contaminated, treat as radioactive waste.

   b. If not contaminated, obliterate radiation labels before discarding in regular trash.

7. Maintain records of the results of checking each package.

10.4 Radiation Protection Procedures

10.4.1 Each Worker should be aware of the methods or procedures that can be used to reduce his/her radiation exposure when working with radiation sources. To limit external radiation exposure, you can reduce the time spent using radioactive materials, increase the distance between you and the radiation source, and/or use shielding between the radiation source and the body.

10.4.2 For prevention of internal exposure, wear the appropriate protective clothing (lab coats, gloves, etc.), perform work in a fume hood, minimize the amount of radioactive materials handled, and make sure the radioactive materials are properly contained. The policies outlined below should be followed whenever you use radioactive materials.

10.5 Policies for Safe Use of Radioactive Materials

1. Prior to performing operations with quantities of radioactive material which may produce significant external or internal exposure, attention shall be given by the user to precautionary measures including the use of remote handling devices, hoods, shielding, etc. The Radiation Safety Officer must be consulted before beginning any new use of radioactive material.

2. There shall be no eating, drinking, (chewing), applying of cosmetics, or preparation of food in any location where unsealed sources of radioactive materials are used or stored.

3. Smoking is prohibited in locations where unsealed sources of radioactive materials are used or stored.

4. Do not store food, drink, or personal effects with radioactive material.

5. MOUTH PIPETTING IS PROHIBITED in radioactive material work areas.

6. Segregate pipetting devices used with radioactive materials from those used with non-radioactive solutions.

7. Clean room suits/ lab coats and disposable gloves shall be worn during operations involving the handling of unsealed sources of radioactive material. The clean room suit/ lab coat and gloves should be removed before leaving the work area. Care must be taken such that other items (i.e., pens, pencils, notebooks, door knobs, telephones, etc.) are <u>not</u> handled with gloves used during work with radioactive materials.

8. Work which may result in contamination of work surfaces shall be done over plastic-backed absorbent paper. Trays made of impervious

materials (i.e., stainless steel, porcelain-coated, etc.) and lined with absorbent paper provide excellent work arrangements to help prevent the spread of contamination.

9. Work surfaces should be monitored prior to, during and after working with unsealed sources of radioactive material. Personnel should monitor themselves including hands, body, hair, shoes, and clothing. If contamination is present, decontamination shall be completed before leaving the area. Hands should be washed before leaving the laboratory.

10. Where there has been a spill of radioactive material involving personnel contamination the Radiation Safety Officer shall be informed immediately.

11. Objects and equipment that may have been contaminated with radioactive material shall be surveyed by the Radiation Safety Officer and demonstrated to be free of contamination prior to their removal from a laboratory, or transferred to other laboratories, repair shops, surplus, etc.

12. Radioactive materials areas must be **locked** when unattended unless all radioactive sources are otherwise secured. When areas with radioactive material are unoccupied they shall be locked.

13. Radioactive material must always be locked when in storage. Either in a lockbox inside a refrigerator or in a locked refrigerator is appropriate.

14. Label all containers and equipment that comes in contact with radioactive materials. Beakers, flasks, and test tubes used transiently in lab procedures do not need to be labeled.

15. Issued personnel monitoring devices should be worn at all times when in areas where radioactive materials are used or stored. These devices should be worn as prescribed by the Radiation Safety Officer. Personnel monitoring devices should be stored in designated low background areas when they are not being worn to monitor occupational exposures. They shall not be shared with another individual.

16. Dispose of radioactive waste only in the manner designated by the Radiation Safety Officer and maintain records as instructed.

17. Always transport radioactive material in shielded containers

18. Radioactive material lab rules shall always be posted, see Appendix C

19. No radioactive labels or markings including the radiation symbol shall be disposed of in regular trash.

20. Areas of radioactive work shall be always kept separate from non-radioactive work.

10.6 Radioactive Materials Surveys

10.6.1 Routine surveys of radioactive materials use/work, storage and disposal areas are required by the New York State Department of Health as part of the conditions of the CNSE's Radioactive Materials license. Maintaining adequate records of laboratory surveys is also required by the Department of Health. These surveys are ***mandatory***, and are considered part of the conditions of your principle investigator/ tool owner's authorization to use radioactive materials as granted by the Radiation Safety Committee.

10.6.2 Types of Surveys

10.6.2.1 Laboratory surveys are performed to identify radioactive contamination that is present and to prevent its spread. Basically, there are two (2) types of laboratory surveys you will be expected to perform. There is a portable instrument, direct frisk survey and a wipe test survey using a liquid scintillation counter or portable instrument.

10.6.2.2 Geiger (GM) counters with thin window pancake probes can be used to detect beta emitting isotopes with energies above 70 KeV. This includes 14C, 35S, and 32P. Geiger (GM) counters with thin-window end-window probes should only be used to detect high energy beta emitting isotopes (i.e., 32P). Low energy beta emitting isotopes, such as 3H, can only be detected using a liquid scintillation counter. Low energy gamma emitting isotopes, such as 125I, can be detected with a sodium iodide (NaI) probe, gamma counting system or liquid scintillation counter.

10.6.2.3 Before using any portable survey instrument, you should be familiar with its proper operation. For example, because of their low energies, 14C and 35S may be difficult to detect with an end-window GM meter. Unless you are reasonably certain of the area contaminated, or there is a large quantity of contamination present, you may overlook an area contaminated with either of these isotopes if you use only an end-window GM meter for your survey.

10.6.2.4 To perform a survey using a portable instrument, scan the area with the instrument's probe. Hold the probe close to the surface and move the probe slowly. Watch the instrument's meter response while you are moving the probe. Listening to the audible "clicks" can be very helpful while performing this type of survey. The probe should remain within 2" of

the surface but not touch the surface to minimize potential contamination of the probe. If you find a "hot" area, it should be decontaminated to the lowest levels possible before you leave the lab at the end of the day.

10.6.2.5 The "wipe test" is the most common procedure to detect removable contamination. A cotton swab or piece of filter paper (Whitman 4.25 cm Qualitative circles or the equivalent) is moistened with 70% isopropanol or another appropriate solvent and then wiped over an area of approximately 100 cm2 (16" x 1" S-shape wipe or 4" x 4" box wipe). The wipe samples are analyzed in different ways. For beta emitting isotopes, particularly those with energies below 200 keV (3H, 14C, 35S), a liquid scintillation counter should be used. Wipe samples for x-ray or gamma emitters (125I) should be analyzed using a gamma counting system or sodium iodide (NaI) probe. High energy beta emitters (32P) may be counted with either the GM meter or liquid scintillation counter. Results must be recorded in dpm whenever counting with the liquid scintillation counter. To convert your cpm results to dpm:

$$\text{dpm} = \frac{\text{gross counts - bkg. counts}}{\text{efficiency}}$$

EFFICIENCIES:

^{3}H - determine by use of calibration standard

^{14}C - determine by use of calibration standard

GM Meter:

44-7 (End window type)		44-9 (Pancake type)	
P-32	S-35	P-32	S-35
~20%	~5%	~50%	~10%

10.6.3 Frequency of Surveys / Recording Surveys

10.6.3.1 Surveys for radiation and radioactive contamination must be performed after each use of radioactive materials. The purpose of this survey is to identify any contamination present and to prevent its spread. This survey does not need to be recorded.

10.6.3.2 A formal survey for contamination and radiation levels must be performed on a weekly basis in all radioactive material waste storage areas and work areas where greater than 200 µCi of isotope is used for any procedure. If you use only 32P, you need only perform direct frisk surveys with a GM

meter as long as the background counts are ≤100 cpm. Records of these area surveys and wipe tests should be kept on file in each laboratory.

10.6.3.3 ALL RADIOACTIVE MATERIAL WORK, USE, WASTE, AND STORAGE AREAS MUST HAVE MONTHLY WIPE TESTS, REGARDLESS OF THE ISOTOPE(S) HANDLED IN THESE AREAS. This includes all centrifuges in which radioactive samples are spun, incubators where tagged cells are held, Cold Room equipment and bench areas you use for radioactive materials work, waste containers and their storage areas (such as cabinets), and refrigerators and freezers where radioactive materials are stored. Monthly contamination surveys will be done using the liquid scintillation counter regardless of radioisotope being used. Along with wipe tests the monthly survey should also include a direct frisk of all lab bench areas. A designated technician in each lab will perform monthly surveys in the lab areas. A copy of the monthly surveys should be sent to the Radiation Safety Officer after completion. If a copy of your labs previous months surveys is not received by the first Friday of each month, no radioactive material orders will be approved.

10.6.3.4 If you are not actively using radioactive materials, but have them stored in your lab, monthly wipe test of the storage areas is required. The results should be kept on record in your lab. Copies of these recorded surveys should also be sent to the Radiation Safety Officer.

10.7 Removable Contamination Limits

10.7.1 The CNSE's policy is to keep contamination levels **as low as reasonably achievable (ALARA)**. Items or areas that could come in contact with skin or personal clothing should be decontaminated until undetectable by a wipe test. When measurable contamination is found on skin or personal clothing, notify the Radiation Safety Officer immediately.

10.7.2 For removable contamination greater than 1000 dpm/100 cm2, the item(s) or area(s) must be cleaned up to the lowest practical levels within one work day. Removable contamination levels greater than 2000 dpm/100 cm2 must be decontaminated immediately. These area survey results should be documented on the survey maps along with corrective action. The results of subsequent surveys during and after decontamination should be recorded and kept on file. If necessary a remarks sheet should be included with the survey to explain the circumstances surrounding the incident.

10.7.3 Items that could be used in other non-controlled areas (e.g., centrifuges to be sent out for repair) must be cleaned until NO contamination is detectable by a wipe test or direct frisk. RSO must authorize the release of **ALL** items for unrestricted use.

10.7.4 Labs that are “Inactive” are not required to perform and submit monthly radiation contamination surveys. These labs are required to file quarterly reports, in response to the Radiation Safety Officer, and are subject to periodic inspection.

10.7.5 A lab is considered “inactive” when:

- No handling of radioactive material of any kind (stock material, experiments, or waste) has occurred for a period of greater than two (2) months.
- The PI in the lab has submitted a written statement to the Radiation Safety Officer stating such.
- The PI is required to inform the Radiation Safety Officer when work with radioactive material recommences. A request for an order of radioactive material will automatically reactivate the lab.
- A full wipe test survey by the RSO or the EHS department is completed.
- All inactive labs must have the correct posting. See appendix A for an example.

10.7.6 The Radiation Safety Committee may choose to review labs that remain inactive for greater than six months to verify the continued need for radioactive material use approval. Provide a listing or table of key parameters, requirements, time limits and process control points.

10.7.6.1 For a lab to go from “inactive” status to “decommissioned” status a full survey by the RSO or EHS department using a gas proportional meter, or acceptable alternative, must be performed. Once a lab is decommissioned no radioactive material can be used until authorization from the RSO and Radiation Safety Committee is given.

11 RADIOACTIVE WASTE DISPOSAL

11.1 Current instructions for the disposal of each category of radioactive waste is available through the Radiation Safety Officer. These instructions should be carefully followed. In view of the recent problems with shallow-land burial sites, volume and waste reduction methods should be implemented in all areas. Important steps in volume reduction are to segregate radioactive from nonradioactive waste, to hold short-lived radioactive waste for decay-in-storage, and to release certain authorized materials in the sanitary sewer.

11.2 The following recommendations should be implemented for waste reduction:

1. Separate "exempt" scintillation vials from other scintillation vials. "Exempt" vials refer to scintillation media containing less than 0.05 µCi/g of ^{3}H or ^{14}C.

2. Be sure only radioactive waste is placed in the designated container(s) supplied by the Radiation Safety Officer. Do a wipe survey or a portable instrument survey of the item if you are in doubt. If only a small portion of an item is radioactive (ex. bench paper), dispose of only the contaminated portion as radioactive waste.

3. **Decay-in-Storage.** Waste containing short-lived isotopes (<90 day half-life) can be stored until decay (minimum of ten half-lives). If you choose to decay waste, designated storage areas should be assigned and the areas posted in each lab. Prior to unrestricted disposal of the decayed waste the Radiation Safety Officer will survey the waste and approve its disposal.

4. **Sanitary Sewer System Disposal.** Only laboratories that have received specific permission from the Radiation Safety Officer can dispose of radioactive material via the sanitary sewer system. Radioactive material must be: 1) readily soluble in water; or 2) biological material that is readily dispersible in water. Regulations governing any other toxic or hazardous property of these materials must be considered prior to authorized disposal.

   a. Authorized laboratories may dispose of the following licensed material without regard to its radioactivity. (Certain cocktails may be subject to hazardous waste regulations).

      1) 0.05 µCi or less of ^{3}H or ^{14}C per gram of medium, used for liquid scintillation counting; and

      2) 0.05 µCi or less of ^{3}H or ^{14}C per gram of animal tissue averaged over the weight of the entire animal; provided however, tissue may not be disposed of under this condition in a manner that would permit its use either as food for humans or as animal feed.

   b. Individual laboratory limits for sanitary sewer disposal are as follows:

Isotope	Activity (µCi / month)
^{3}H	3000
^{14}C	1600
^{35}S	2000
^{32}P	600

^{33}P	160
^{36}Cl	160
All others combined	160

11.3 General Guidance

1. All radioactivity labels must be defaced or removed from containers and packages prior to disposal in in-house waste.

2. All long-lived waste (>90 day half-life) should be transferred to the Radiation Safety Officer for disposal. Records containing waste type, activity and volume must be submitted upon transfer.

3. High-energy beta emitter (i.e., P-32) waste should be stored in plastic waste cans and behind Plexiglas shielding.

4. All waste bags should be closed and labeled as soon as the bag is full. Waste cans should not be overflowing. If the waste bag has a hole in it put a second bag around it prior to placing in storage. Use designated labels on waste bags and include the following information; type of isotope, approximate activity, date of closing bag, date of decay.

5. Radioactive waste should not be stored under sinks.

6. Radioactive waste should not be stored with other hazardous chemicals.

12 BIOASSAY REQUIREMENTS

12.1 Radioiodine

12.1.1 Radioiodine exposure is monitored by thyroid bioassay. Thyroid monitoring is implemented whenever an investigator uses radioiodine in quantities which exceed those specified in Table 1 of Regulatory Guide 8.20 (Applications of Bioassay for I-125 and I-131). The Radiation Safety Officer shall be notified of Radioiodine use so that arrangements for a thyroid bioassay within 48-72 hours of use can be made, if necessary.

12.2 Tritium

Routine bioassay is necessary when quantities of tritium processed by an individual at any one time or the total amounts processed per month exceed those specified in Table 1 of Regulatory Guide 8.32 (Criteria for Establishing a Tritium Bioassay Program). The Radiation Safety Officer shall be notified whenever using large quantities of Tritium (>1mCi).

13 SPILL PROCEDURES

13.1 All spills of radioactive material should be cleaned up as soon as possible. The responsibility for cleaning up the spill rests with the individual(s) working in the area involved and/or responsible for the spill. Under no circumstance should an untrained person attempt to examine or clean up a spill of radioactive materials. If assistance is needed, contact the Radiation Safety Officer.

13.2 Major Incidents/Spills - Spills that cannot be contained or cleaned up readily (in excess of 200 µCi of any beta emitting isotope and any quantity of ^{125}I), widespread contamination, any personnel contamination or clothing contamination, ingestion of radioactive materials, contamination found outside controlled areas, overexposure to radiation.

13.3 Minor Incidents/Spills - Spills involving less than 200 µCi of any beta emitting isotope in a controlled area.

13.4 The following are general guidelines to be followed when dealing with spills involving radioactive material:

13.4.1 Minor Incidents / Spills

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

2. **Prevent The Spread:** Place absorbents such as paper towels or tissues over the spill to prevent its spread. If the material is a powdered solid, cover the spill area with a barrier such as a beaker, drip tray, or damp towels.

3. **Clean Up:** Use disposable gloves and remote handling tongs. Carefully fold the absorbent paper and pad. Insert into a plastic bag and dispose in the radioactive waste container. Also insert into the plastic bag all other contaminated materials such as contaminated gloves.

4. **Survey:** Check the areas around the spill with a GM meter. If Tritium was spilled take wipe surveys of the area and count in the liquid scintillation counter. Always frisk yourself and your clothing to ensure you are not contaminated.

5. **Report:** Document and report incident to the Radiation Safety Officer.

13.4.2 Major Incidents / Spills

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

2. **Close the Room:** If not personally contaminated, leave the room and lock the door(s) to prevent entry.

3. **Call For Help:** Call the emergency number (518) 437-8600 or 78600 from a campus phone.

4. **Minimize Your Exposure:** Minimize your exposure to surface contamination, radiation, and airborne contamination. Use rubber gloves, plastic shoe covers, and/or filter mask as necessary. Move to the edge of the spill area. Get contaminated personnel out of the area as soon as possible. Assemble a nearby safe or clean area. Begin monitoring and decontamination of affected personnel. Remove contaminated clothing at once, flush contaminated skin with lukewarm soap and water. Place all contaminated items in radioactive waste containers.

5. **Prevent the Spread:** Place absorbents such as paper towels or tissues over the spill to prevent its spread. If the material is a powdered solid, cover the spill area with a barrier such as a beaker, drip tray, or damp towels.

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

7. **Personnel Decontamination:** Contaminated clothing should be removed. If the spill is on the skin, flush thoroughly and then wash with mild soap and lukewarm water.

13.4.3 Supplemental Actions

1. **Decontaminate the Affected Area.** Provide adequate protection and supplies for personnel involved with the clean up. Begin at the periphery and work toward the center of the contaminated area. Cover clean areas with plastic or paper to prevent recontamination. Place all contaminated items in radioactive waste containers.

2. **Monitor the Progress of the Decontamination.** Use the appropriate survey techniques (wipe tests, direct frisk survey of the area with a GM meter, etc.). Verify that all personnel and equipment are properly decontaminated before allowing them in clean areas. Document all surveys taken and maintain a record of them. Write down a summary of the incident and attach to the survey map(s) if necessary. Submit to the Radiation Safety Officer.

3. **Corrective Action.** All individuals involved in the incident shall re-read this Radiation Safety Manual to ensure they understand the current

policy, safety practices and that all activities meet these requirements. Upon review by the Radiation Safety Officer the individuals may require additional or re-training.

14 APPENDICES

Appendix A – Common Stickers, Postings and Warning Labels

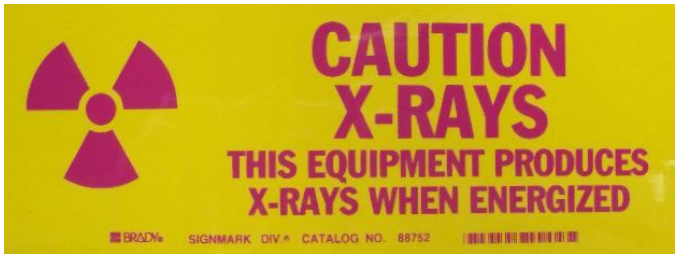
Appendix B – SOP for Opening Packages of Radioactive Material

Appendix C – Radioactive Material Laboratory Safety Rules

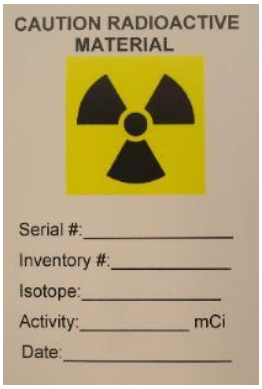
Appendix A

Common Stickers, Postings and Warning Labels

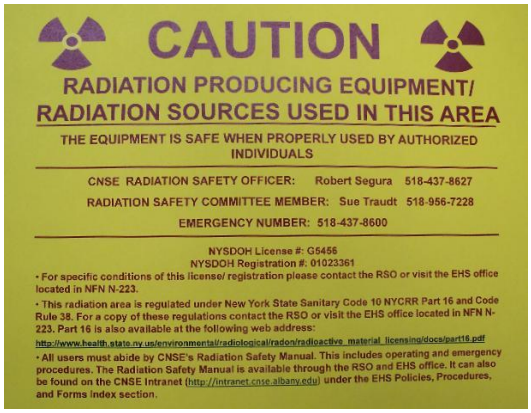
Stickers for Radiation Producing Devices:



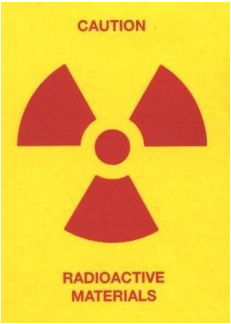
Sticker for Sealed Sources:



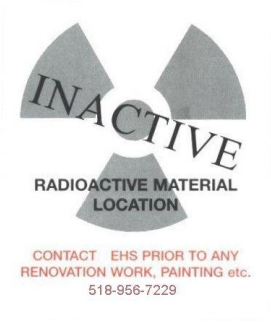
Posting for Radiation Producing Areas:



Postings for Radioactive Material Use Labs:



Posting for Inactive Labs:



Appendix B

SOP for Opening Packages of Radioactive Material

This SOP applies to all labs and individuals who receive packages of radioactive material (RAM) after it has been initially checked in, surveyed and delivered by the RSO or CNSE EHS Department.

Please follow these steps when you first receive a package of RAM immediately:

1. Before signing for the package, verify that the packing slip matches the isotope, material and quantity ordered.
2. Wear gloves, lab coat, safety glasses and dosimeter.
3. Wipe test the outside and inside of the package.
4. For all isotopes other than H-3, hold the wipe up to a survey meter (a pancake probe for C-14, P-32 and S-35 or a sodium iodide probe for I-125)
5. For H-3 a liquid scintillation counter must be used.
6. If the readings are consistent with background, you must deface ALL radioactive markings and symbols and dispose of the box in regular trash.
7. If the readings are above background place in solid radioactive waste and contact EHS (518-956-7229).
8. Retrieve correct shielding (lucite or plexiglass shielding for high energy beta emitters such as P-32 and lead shielding for gamma emitters such as I-125) and survey the lead or plastic pig and inner vial using the same method mentioned above for the packaging.
9. If the readings are consistent with background place the pig and vial in a secure area such as a lockbox in a refrigerator or a locked refrigerator.
10. If the readings are above background contact EHS immediately (518-956-7229)
11. Dispose of all dry ice (if any) correctly.

Appendix C

Radioactive Material Laboratory Safety Rules

1. This laboratory, Room _____, is only authorized for use of the following radioisotopes: _____, _____, _____, _____, _____.

2. Work must follow the procedures adopted by the Principal Investigator (PI) as submitted to the Radiation Safety Officer.

3. Lab personnel should not work with radioisotopes unless they have attended an initial radiation safety training session and received hands-on training by the PI or his/her designee.

4. Laboratory coats, gloves, and safety glasses must be worn when working with radioisotopes.

5. Do not eat, drink, smoke, chew gum, or apply cosmetics in the laboratory.

6. Do not store food or beverages in the laboratory.

7. Do not pipette *anything* by mouth.

8. Wash hands after handling any radioactive material and before doing anything else.

9. Before leaving, clean up the work area and dispose of waste into appropriately segregated waste containers.

10. Perform a post-experiment survey of yourself and your work area.

11. Provide for the security of all radioactive materials, including stock vials and waste containers. Challenge unauthorized persons entering the laboratory.

12. Report all accidents (spills, injuries) to Security (518-437-8600).

Questions on these rules should be referred to your laboratory supervisor or to the CNSE Environmental Health & Safety Department at 518-956-7229.