

**INSTRUCTIONS AND PROCEDURES
FOR USE OF THE
RADIATION FACILITIES
IN THE
UNM NUCLEAR ENGINEERING LABORATORY**

Nuclear Engineering Department
University of New Mexico
Albuquerque, New Mexico

Department Chair: _____

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INTRODUCTION

These instructions present procedures that shall be applied in the use of byproduct materials and radiation sources in the Nuclear Engineering Laboratory. They are intended to ensure the safety of personnel and are consistent with the provisions under which NRC and UNM Permits have been issued to the Nuclear Engineering Laboratory, University of New Mexico, Albuquerque, New Mexico.

These instructions will be reviewed periodically to ensure that the information contained herein is current.

RADIATION SAFETY INSTRUCTION #1 - Assignments

Purpose: The purpose of this instruction is to describe categories of personnel associated with the Nuclear Engineering Laboratory.

Chair, Nuclear Engineering Department

Provides final policy decisions on all phases of operation and use of Nuclear Engineering Laboratory Facilities.

He/She is advised on matters concerning personnel health and safety by the UNM Radiation Safety Office and/or the UNM Radiation Control Committee.

UNM Radiation Safety Officer

UNM Radiation Safety Officer or designate, represents the Radiation Control Committee in matters concerning the Radiation safety aspects of laboratory operation.

He/She is available for advice and assistance on Radiation safety problems.

Certified Worker Without Supervision (WOS) and Certified Supervisor of Use (SOU)

Members of the faculty, staff, and Nuclear Engineering students who have been certified by the Nuclear Engineering Laboratory Radiation Permit Holder. A current letter of certification will be maintained in the Nuclear Engineering Department files. The certification letter will show that the individual has passed the appropriate exam. A list of certified WOS and SOU personnel will be posted in the NE Lab by the phone near the east door.

The UNM Radiation Control Committee (RCC) has established three categories or levels in which individuals are approved for working with radioactive materials and/or radiation producing machines:

“WDS Level” - may work with radiation sources only With Direct Supervision by an approved Supervisor Of Use.

“WOS Level” - may work with radiation sources WithOut Supervision. To work independently in the NE Lab, individuals in this category must complete the Radiation Safety Course or an approved alternate course (such as NE 230), or provide documentation or demonstration of having completed the equivalent training and education. To be certified, these individuals must pass the NE WOS exam and maintain qualifications by passing the UNM Safety Training every year.

“SOU Level” - - Supervisors Of Use are Permit Holders or other qualified individuals whose level of training and experience in radiation safety is sufficient to allow them to escort individuals in the NE Lab and supervise those using radioactive materials. To be certified as a SOU, the NE Lab Permit Holder must review and approve the applicant’s qualifications as submitted in the T&E Forms. These individuals must also pass the NE SOU exam and maintain qualifications by passing the UNM Safety Training every year.

RADIATION SAFETY INSTRUCTION #2 - Responsibilities

Purpose: The purpose of this instruction is to describe individual responsibilities by title.

Individual or WDS – Individuals who have any contact with radioactive materials are responsible for:

- a. Keeping their own exposures to radiation and also those of others as low as reasonably achievable (ALARA).
- b. Using the prescribed monitoring equipment in the radiation laboratory.

- c. Using gloves, hoods, and protective clothing when necessary.
- d. Using proper techniques and tools in operations involving radioactive materials.
- e. Observing the recommended procedures in regard to eating and smoking in the laboratory.
- f. Reporting injuries and ingestion or inhalation promptly to a Supervisor of Use.

Worker Without Supervision (WOS) – Individuals who are certified to work without supervision have the following responsibilities in addition to those described for a WDS:

- a. Following the requirements for using radioactive sources as detailed in these procedures and in the UNM Radiation Safety Manual.
- b. Being responsible for security in those accessing the NE Lab, i.e., not admitting anyone to the laboratory unless a certified SOU is present and provides permission for access.
- c. Understanding and following the requirements of 10CFR20 in providing personnel protection against radiation.

Supervisor of Use (SOU) – Supervisors of Use are responsible for ensuring that the above individual responsibilities are discharged by those under their control. Individuals who are certified as supervisors of use have the following responsibilities in addition to those described for a WOS:

- a. Instructing those students / workers for whom they are responsible in the use of safe techniques and in the application of approved radiation safety practices.
- b. Directing the packaging of contaminated waste and the decontamination of anything for which they are responsible.
- c. Furnishing information to the Radiation Safety Office concerning individuals and activities in their classes when such information is requested.

- d. Notifying the Radiation Safety Office whenever changes in operational procedures, new techniques, alteration in physical plant, or new operations that might lead to personnel exposures are anticipated.
- e. Cooperating with the Radiation Safety Office personnel and Licensing Agency Inspectors during inspections.
- f. Assisting in leak testing of the sources, when this assistance is requested by Radiation Safety Office personnel.
- g. Keeping a record of exposures for each person in the radiation laboratory.
- h. Personally supervising the use of the sealed sources.
- i. Being present in the Nuclear Engineering Laboratory when the sources are being moved or used in unshielded and unsecured locations.

Chair, Nuclear Engineering Department – The Department Chair is directly responsible for the overall radiation protection program, including assistance to individuals and radiation supervisors in discharging their duties, and for:

- a. Maintaining personnel monitoring equipment.
- b. Directing a continuous program of hazard evaluation and hazard elimination.
- c. Enforcing disciplinary action when violation of these instructions is detected.
- d. Complying with all aspects of the license issued to the University of New Mexico by the Nuclear Regulatory Commission and by the State of New Mexico Environment Department.

RADIATION SAFETY INSTRUCTION #3 - Training

Purpose: The purpose of this instruction is to outline training required for Workers with Direct Supervision (WDS), Workers without Supervision (WOS), and Supervisors of Use (SOU) in the Nuclear Engineering Laboratory.

All Individuals: All individuals permitted in the laboratory will have read the NE Lab Procedures and demonstrated understanding thereof. Under the personal supervision of a Supervisor of Use, students must demonstrate competence to use sealed sources, related handling tools, and radiation survey instruments which will be employed in class or work assignments.

All Workers without Supervision and Supervisors of Use will be proficient in all subjects listed below. A passing score on the appropriate examination is required to demonstrate proficiency. See Appendix A for the descriptions of the examinations.

Subjects for training of WOS and SoU (covered in NE 230 and NE 323L or acquired by self study):

- A. Characteristics and Types of Ionizing Radiation
- B. Definitions, Terms, and Units associated with Ionizing Radiation
- C. Biological Hazards associated with ionizing radiation
- D. Calculations of Half-life, Activity, and Exposure
- E. Fundamentals of radiation safety (Time, Distance, Shielding, Half-Value Layers)
- F. Radiation detection instrumentation to be used
- G. Regulations
 - 1. Federal Register, Title 10, Parts 20, 30 and 31 and all amendments
 - 2. State of New Mexico (NMAC, Title 20, Chapter 3, Part 4 – hereafter referred to as NMAC Part 4)
 - 3. Nuclear Engineering Laboratory Radiation Safety Instructions
 - 4. UNM Manual on Radiation Safety.
- H. Emergency Procedures
- I. Duties and Responsibilities associated with Title

RADIATION SAFETY INSTRUCTION #4 - NE Lab Access

Purpose: The purpose of this instruction is to identify requirements for NE Lab Access and individual responsibilities for security.

1. The Nuclear Engineering Laboratory is a restricted area and all entrances to the facility must be secured at all times.
2. Only those personnel certified by the NE Lab Permit Holder and the NE Facility Supervisor are allowed unescorted access in the NE Lab. Certified Personnel must be either one of the following:
 - a. Supervisors of Use (SOU))
 - b. Workers without Supervision (WOS).
3. All non-certified personnel must be accompanied by a Supervisor of Use (SOU).
4. All WDS and WOS are responsible for security in those accessing the NE Lab, i.e., not admitting anyone to the laboratory unless a certified SOU is present and provides permission for access.
5. Only a Supervisor of Use (SOU) shall have access to the source storage room 077 in the NE Laboratory.

RADIATION SAFETY INSTRUCTION #5 - NE Lab Areas Under Separate Permit

Purpose: The purpose of this instruction is to describe the interface between the NE Lab Permit and portions of the NE Lab under separate permit.

1. There may be portions of the Nuclear Engineering Laboratory dedicated to research that are under a separate Permit Holder. Those areas are not covered by these procedures with the exception of Instruction #4 on Lab Access. There shall be a separate set of Radiation Procedures and Instructions specific to each area, permit, and application.

2. If radioactive materials need to be transferred through the NE Laboratory to or from a separate permit area, this transfer shall be done by personnel from the Radiation Safety Office.
3. Regardless of Permit Holder, all personnel with unescorted access to the NE Lab must be certified as either Workers without Supervision (WOS) or Supervisors of Use (SOU)

RADIATION SAFETY INSTRUCTION #6 – Emergency Procedures

Purpose: The purpose of this instruction is to establish procedures that will be followed in the event of an emergency in the Nuclear Engineering Laboratory.

1. An Emergency would be:
 - a. Those situations that require immediate notification of the UNM Police (Call 911 from campus phone or (505) 277-2241 from outside phone). These include:
 - i. Fire within the Nuclear Engineering Laboratory Building lasting more than 10 minutes.
 - ii. Bomb threat or civil disturbance directed toward the UNM Nuclear Engineering Laboratory.
 - b. Those situations that involve abnormal levels of radiation, rupture of a source, or loss of a source.
2. A copy of these procedures will be posted in a conspicuous location in the laboratory with the following information.
 - c. Chair, NE Dept. _____
Office Room _____ Building _____
Office Telephone _____
Cell Phone or Home Phone _____
 - d. NE Lab Permit Holder _____ Office Room _____
_____ Building _____
Office Telephone _____
Cell Phone or Home Phone _____
 - e. NE Lab Supervisor _____
Office Room _____ Building _____
Office Telephone _____
Cell Phone or Home Phone _____
 - f. Radiation Safety Officer _____
Office Room _____ Building _____
Office Telephone _____
Cell Phone or Home Phone _____

3. FIRE: In case of fire, notify campus police at 7-2241 or 911 from a UNM phone or (505) 277-2241 from a cell phone. If safe, immediately return all radioactive sources to their storage container or source room. If this is not accomplished, the Radiation Safety Officer shall be notified. To prevent the spread of contamination:
 - a. Make sure all outside doors to the NE Lab are closed.
 - b. Turn on emergency exhaust fans with the switches located by the East Door of the NE Lab.
 - c. Prevent the entrance of unauthorized persons.
4. SUSPECTED OVEREXPOSURE: In case of a suspected overexposure or an abnormal level of radioactivity in the NE Lab, all radioactive sources shall be immediately returned to their storage container and the container locked. The Supervisor of Use shall be immediately notified. Any area with an abnormal level of radioactivity shall be evacuated. If an overexposure has occurred, the Radiation Safety Office and the NE Lab Permit Holder shall be notified.
5. RUPTURE OF SOURCE: In the event of the rupture of an encapsulated source, a Supervisor of Use and the Radiation Safety Office shall be notified immediately. The immediate area will be evacuated at once. All personnel involved in the accident shall assemble in and shall remain in an adjacent area until released by the Radiation Safety Officer or designated representative.
6. LOST SOURCE: In the event of a lost source, the NE Lab Permit Holder and the Radiation Safety Office shall be notified immediately and a search initiated.
7. SPILLS: You should only clean up a spill of hazardous material if it is less than one liter volume or 30 cm diameter and:
 - a. You have the training and proper equipment
 - b. You can clean up the spill without endangering yourself If the spill involves large quantities of material, then:
 - c. Evacuate the area and control access to the spill location
 - d. Assist injured or contaminated personnel
 - e. Call Radiation Safety (505-272-5500) or 911 to report the spill
 - f. Notify a Supervisor of Use

RADIATION SAFETY INSTRUCTION #7 – Standards and References

Purpose: The purpose of this instruction is to list the materials that may be used as standards and references for calculations to obtain or maintain safe working conditions.

1. Standards: The following shall be used as a basis for calculations to obtain or maintain safe working conditions within the meaning of these instructions.
 - a. Federal Register, Title 10, Part 20, "Standards For Protection Against Radiation."
 - b. Federal Register, Title 10, Part 30, "Licensing of Byproduct Material."
 - c. Federal Register, Title 10, Part 31, "Radiation Safety Requirements for Radiographic Operations."
 - d. State of New Mexico, NMAC Part 4
2. References: The following may also be used but will not be considered in whole or in part as a portion of these instructions unless specifically so stated.
 - a. NCRP - Reports

RADIATION SAFETY INSTRUCTION #8 – Maximum Permissible Dose

Purpose: The purpose of this instruction is to provide a monitoring limit for personnel dose that being exceeded requires management action.

1. The exposure of persons to radiation shall always be kept as low as reasonably achievable (ALARA).
2. The exposure of members of the Nuclear Engineering faculty and students shall not exceed the following limit: 0.1 Rem/Quarter or 100 mrem/Quarter.
3. Exceptions to this limit must be documented in writing and signed by the Radiation Safety Officer and will be in compliance with paragraph 10 CFR 20.101 (b) Federal Register as amended and the State of New Mexico NMAC Part 4.
4. Violations of this limit must be documented in writing and signed by the Radiation Safety. Remedial actions should be identified and implemented by the NE Lab Permit Holder to minimize the occurrence of such violations.
5. Students under 18 years of age are not permitted in the laboratory when sources other than check sources are in use without the approval of the Radiation Control Committee.
6. Reports of exposures recorded by radiation badges are maintained by the UNM Radiation Safety Office.
7. Exposure reports for each quarter are kept in the NE Lab by the Lab Supervisor.

RADIATION SAFETY INSTRUCTION #9 – Radiation Monitoring

Purpose: The purpose of this instruction is to provide a description of monitoring equipment, surveys, and security required to ensure personnel protection.

1. Personnel monitoring equipment shall be required for each individual in the Nuclear Engineering Laboratory when a source is being used. The following monitoring devices shall be used as required by the Radiation Supervisor in charge:
 - a. Personnel Badge, for x-ray, beta, gamma, and neutron sensitive, 0-30K mrem.
2. A radiation badge will be issued to each individual on the faculty and staff using the laboratory and to each student enrolled in laboratory classes or performing research. A record will be maintained showing the person to whom the badge was issued and the indicated dose from the official report of the firm providing the badge service. The service utilized will be one approved by the NRC and the NM Environment Department.
3. Portable radiation survey equipment must be available in the Nuclear Engineering Laboratory when sources are being used. The following equipment is available for use provided the equipment is within a current calibration period.
 - a. Fast and Thermal Neutrons Monitors
 - b. Beta - Gamma Survey Meters
 - c. Meters capable of identifying Alpha contamination

4. Gamma sensitive Radiation Area Monitoring equipment is also found in the Nuclear Engineering Laboratory at various locations.
5. The radiation laboratory will be conspicuously posted with the following signs or labels as applicable:

Caution

Radiation Area

OR

Caution

Radioactive Materials

All radiation and high radiation areas will be posted unless a Radiation Supervisor is in attendance.

6. Each time a source (with activity greater than 1 milliCurie) is removed from its container, the 2.5 mr/hr line will be conspicuously posted with the following sign or label unless the user is continuously present to advise other persons of the radiation levels :

Caution

Radiation Area

RADIATION SAFETY INSTRUCTION #10 - Storage

Purpose: The purpose of this instruction is to provide a description of locations and requirements for storage of radioactive materials.

1. When not in use, all radioactive material will be stored in locked storage containers and/or in the locked source storage room 077 of the Nuclear Engineering Laboratory.
2. The storage containers and sources will be stored in the source storage room or in an area in the Laboratory that is not readily accessible to the curious.
3. *At a minimum, the container should be marked with the contents. For those containing sources with activities greater than 1 milliCurie, the containers will be marked with the following information:*

This container contains _____

Surface Intensity _____ mr/hr

Tolerance Distance (2.5 mr/hr) _____ inches

Radium-Beryllium Source

Half-life 1620 years

Radiation: Neutrons, Spectrum 1 - 10 Mev

Gamma, Spectrum < 0.9 Mev

1. A radium-beryllium source of nominal 10 mCi strength was received with the AGN-201 M reactor.

The source is normally stored in its original shipping container and located in the source storage room.

RADIATION SAFETY INSTRUCTION #12 – Use of Sources

Purpose: The purpose of this instruction is to provide a description of requirements for using radioactive sources in the Nuclear Engineering Laboratory.

1. Purpose: The purpose of this instruction is to provide a description of requirements for using radioactive sources in the Nuclear Engineering Laboratory.
2. The sources will not be removed from their place of storage or from the storage container except by or under the supervision of a Supervisor of Use.
3. The sources will not be removed from the storage container until the necessary shielding has been put in place for the experiment to be performed.
4. A source will be out of its storage container only during the time that the source is required to make measurement.
5. The sources listed in Radiation Safety Instruction #11 (i.e., > 10 mCi activity) will be removed from the storage container with handling tools and at no time will these sources be handled with the bare hands.
6. Students performing calculations or other paper work will be instructed to do this type of work at a distance consistent with the hazard involved. The only time that close proximity to the source will be allowed will be the time that is necessary to record data.
7. Any time a source (includes calibration and check sources) is used an entry will be made in the "Source Checkout Form", shown on the next page. Note that an entry is required at the start and end of use. A Supervisor of Use should check out the source and later, indicate that the source is returned to storage by initialing in the "Secured - Supv Initials" column.

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RADIATION SAFETY INSTRUCTION #13 - Calibration

Purpose: The purpose of this instruction is to provide a description of requirements for using calibrating Radiation Monitoring Equipment for use in the Nuclear Engineering Laboratory.

1. All radiation monitoring instruments will be calibrated as required.
2. Each time an instrument is repaired, its current calibration is void and a new calibration is required.
3. Records of calibration are maintained by the Radiation Safety Office.
4. All instruments will have affixed a sticker (provided by the Radiation Safety Office) with the following information:

CALIBRATE BY _____ DATE _____ DUE FOR CAL

RADIATION SAFETY INSTRUCTION #14 – Leak Testing

Purpose: The purpose of this instruction is to establish procedures for the leak testing of sealed sources.

1. Leak testing of sealed sources is performed by the Radiation Safety Office Personnel in accordance with the License and State of New Mexico regulations.

RADIATION SAFETY INSTRUCTION #15 - Receipt and Shipping of Radioactive Materials

Purpose: The purpose of this instruction is to establish procedures for the ordering and receipt to the Nuclear Engineering Laboratory or for the shipment of radioactive material from the Nuclear Engineering Laboratory.

1. Radiation Safety maintains a list of approved radioactive material vendors and suppliers. The vendors are required to maintain a current copy of the UNM Radioactive Materials License. If you are ordering from a new supplier, please contact the RSO and provide the name, address, contact number, and email address for the record.
2. All purchases of Radioactive Materials must be done with the prior approval of the Radiation Safety Office. This includes ALL activities, even those labeled as “exempt quantity”. The physical address where the Radioactive Material Packages must be delivered is the Radiation Safety Laboratory located at:
 - i. UNM Radiation Safety Receiving
 - ii. Reginald Heber Fitz Hall
 - iii. 2425 Camino de Salud (BLDG 211), Room B89
 - iv. Albuquerque, NM 87131
3. When an order needs to be placed, first check the activity limits of the Radiation Permit to make sure the activity being requested is within the ordering and possession limits. If the item exceeds the current permit limits, a written request to change the limits must be submitted to the Radiation Safety Office for RCC approval.
4. Specific Instructions for ordering Radioactive Materials are provided in the UNM Radiation Safety Manual.
5. Outgoing radioactive material shipments must go through the Radiation Safety Office. Records of each shipment to an outside entity must be maintained. It is the responsibility of the Radiation Safety Office to assure that shipments are packaged and labeled in accordance with regulations, and that the consignee is licensed to receive the shipment.

A valid copy of the radioactive materials license for the consignee must be in hand and approved before shipping.

RADIATION SAFETY INSTRUCTION #16 – Acceptance of Packages into NE Lab

Purpose: The purpose of this instruction is to establish procedures for the safe acceptance of packages (e.g., equipment) into the Nuclear Engineering Laboratory.

Often delivery personnel will attempt to deliver packages to the NE Lab that are intended for the NE Department Office or for other departments. Check the delivery papers to ensure that the package is specifically for the NE Lab. If the package is for the NE Lab then:

1. All packages from delivery agencies that are brought into the NE Lab must be held in the North area by the double doors (Lab Holding Area) until their contents are checked and verified against purchase documents.
2. No package shall be moved from the Lab Holding Area into other parts of the Lab until its contents have been verified.
3. If in doubt as to the contents of a container, hold it in the Lab Holding Area and contact either the Facilities Manager or the Permit Holder associated with the delivered package, or the NE Lab Supervisor.
4. If a package contains unknown materials that may be radioactive, contact Radiation Safety at (505) 925-0743 or (505) 272-4607.

All backpacks, briefcases, etc. are subject to inspection if brought into the Nuclear Engineering Lab.

RADIATION SAFETY INSTRUCTION #17 - Disposal

Purpose: The purpose of this instruction is to establish procedures for the safe and proper disposal of radioactive sources and contaminated materials.

1. The Supervisors of Use will assure that all surplus radioactive sources are properly packaged for transmittal to the UNM Radiation Safety Office. The NE Lab Permit Holder shall make arrangements with the Radiation Safety Office for pickup and disposal.
2. The Supervisors of Use will assure that all radioactive waste material is properly packaged for transmittal to the UNM Radiation Safety Office. The NE Lab Permit Holder shall make arrangements with the Radiation Safety Office for pickup and disposal.
3. All solid waste will be properly labeled, identified, and packaged in an approved container provided by Radiation Safety Office.
4. Disposal of liquid wastes must be coordinated with the Radiation Safety Office.
5. Liquid waste collected in the underground holding tank will be analyzed prior to determining the method of disposal.

RADIATION SAFETY INSTRUCTION #18 – Hazardous Material Handling and Awareness

Purpose: The purpose of this instruction is to establish procedures for handling hazardous material in the laboratory which may be used for radiation shielding.

1. The Supervisors of Use will identify potentially hazardous areas or materials that may contain Cadmium or Lead contamination.
2. The Supervisors of Use will provide necessary Personal Protective Equipment (PPE) including but not limited to gloves and Tyveks.
3. Hazardous Materials should be stored when not in use, in a location that is labeled as “Hazardous Materials” and in a manner that would prevent accidental contamination.
4. Lead should be wrapped in tape to limit contamination.
5. The Supervisors of Use are responsible for providing decontamination procedures and materials should contamination occur.

APPENDIX A – EXAMINATIONS FOR WOS AND SOU

Purpose: The purpose of this appendix is to describe the test formats and requirements for demonstrating proficiency appropriate to a given job title: Workers without Supervision (WOS), and Supervisors of Use (SOU).

NE Lab Exam Questions for WOS

The exam consists of two sections: Part I covering A through F, and Part II covering G through I. Note Parts A through I are as identified in Instruction #3. As part of the qualification as a Worker without Direct Supervision (WOS), personnel must take both parts of the exam and score 80% or above on each part. If the score is less than 80%, then personnel can retake that Part of the exam (waiting at least two weeks to allow scoring of the previous exam and creation of a retake exam).

Part I will be worth 40 points and consist of 25 questions as follows:

A – 5 questions worth 1 point each

B – 4 questions worth 2 points each

C – 4 questions worth 2 points each D – 3 questions worth 2 points each

E – 4 questions worth 2 points each

F – 5 questions worth 1 point each

A passing score on Part I is 32 points

Part II will be worth 60 points and consist of 20 questions as follows:

G – 7 questions worth 3 points each

H – 6 questions worth 3 points each

I – 7 questions worth 3 points each

A passing score on Part II is 48 points

NE Lab Exam Questions for SOU

The exam consists of one section with two parts: Part A covering duties and responsibilities of a SOU while working in an area of the NE Lab under a permit holder, and Part B covering duties and responsibilities of a SOU in terms of NE Lab security and access. As part of the qualification as a Supervisor of Use (SOU), personnel must take both parts of the exam and score 80% or above on each part. If the score is less than 80%, then personnel can retake that Part of the exam (waiting at least two weeks to allow scoring of the previous exam and creation of a retake exam).

Part A will be worth 20 points and consist of 10 questions, each worth 2 points. A passing score on Part A is 16 points.

Part B will be worth 20 points and consist of 10 questions, each worth 2 points. A passing score on Part B is 16 points.