Western Carolina University | Safety and Risk Management

Radiation Safety Program

Radiation Producing Equipment

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The Radiation Protection Program is intended to ensure that all activities and operations involving the use of radiation producing equipment are performed in such a way as to protect the campus community from exposure to unnecessary radiation. This program addresses all provisions required by the North Carolina Regulations for Protection Against Radiation (10A NCAC 15). The regulations are available online on the NC Radiation Protection Section website.

The basis of this program is to maintain all radiation exposures As Low As Reasonably Achievable (ALARA). This practice is defined as making every reasonable effort to maintain exposures to radiation as far below the regulatory dose limits as is possible. Everyone involved with the use of radiation producing equipment is required to be familiar with the provisions of this manual and a current copy must be readily available to all interested individuals.

Three types of radiation producing equipment are covered in this manual:

- **Analytical** instruments including x-ray diffraction (XRD), x-ray fluorescence (XRF), spectroscopy, particle size analysis and components utilizing x-rays to determine elemental composition or to examine the microstructure of materials.
- **Cabinet Radiography** machines producing radiographs in an enclosed, interlocked cabinet, such that the radiation machine will not operate unless all openings are securely closed.
- **Medical X-Ray** machines for the examination of human beings.

Section 1: Authorized User Specific Radiation Safety Plan

This manual addresses the provisions applicable to the use of radiation producing equipment; however, each authorized user of a registered piece of equipment is required to document a Specific Radiation Safety Plan (Appendix A) for their area. The customizable safety plan must be reviewed and updated as necessary by the authorized user.

An Authorized User (AU) will normally be the Principal Investigator of a research project or faculty/staff member responsible for the program in which the radiation producing equipment is used.

Section 2: Responsibilities

Western Carolina University is committed to providing a safe and healthful environment for all persons associated with the institution, including employees, students, visitors, and the community. Cooperation of all parties involved is necessary to ensure that the University conducts research and teaching laboratories safely and in compliance with local, state, and federal regulations.

Safety and Risk Management Office (SRM)

SRM has the administrative responsibility for the University's Radiation Safety program. The staff provide a wide range of radiation protection services such as personnel monitoring, waste disposal, laboratory surveys, record keeping required by the State, and consultation on the safe use of radiation sources.

Radiation Safety Officer (RSO)

- Establish, maintain, and annually update the Radiation Safety Program (RSP).
- Provide advice and assistance on radiological safety matters.
- Monitor procurement, use, storage, and disposal of radioactive materials and equipment.
- Conduct regular inspections of the laboratories to assess compliance with the RSP and other applicable policy manuals.
- Keep current with regulatory requirements concerning radiation safety and protection from the State of North Carolina and U.S. Nuclear Regulatory Commission (NRC).
- Assist with licensing and inspections by regulatory agencies.

Authorized User (AU)

The Authorized User will normally be the faculty member responsible for a course or research study with laboratory or field exercises in which the radiation producing equipment is used. It is the Authorized User's responsibility to ensure that all users of the equipment under his/her authorization are trained in safe operation, are familiar with the Radiation Safety Program, and comply with University policies and applicable regulations.

Equipment Users

- Read, understand, and follow the Radiation Safety Program and all specific radiation safety documents for the equipment.
- Participate in training that demonstrates all safety issues including possible radiation hazards and biological effects associated with the instrument.
- Follow the proper operating procedures for the equipment.
- Agree to document that training has been completed.
- Record their usage time in the equipment log book.
- Agree not to bypass any safety device.
- Inform the Authorized User and your direct supervisor of injury or any radiation exposure immediately.

Section 3: Purchasing Radiation Producing Equipment

The Safety and Risk Management Office is responsible for reviewing purchase requisitions of radiation-producing equipment to ensure proper installation and regulatory requirements are maintained. Anyone intending to purchase an X-Ray producing device, must submit the Notification to Purchase Radiation Producing Equipment (available in Appendix E) to the Safety and Risk Management Office to initiate the process.

The Safety Office will review the type of equipment, noting the location where the equipment is to be installed, and determine if shielding or other special requirements will be necessary. To expedite the review, a brief description of how the equipment will be used and any special safety precautions or operation procedures should be included.

Section 4: Registration of X-Ray Equipment

All radiation producing equipment is required to be registered with the North Carolina Department of Health and Human Services, Radiation Protection Section. Contact the Safety and Risk Management Office to initiate the registration process at 828-227-7443.

Authorized Users are required to submit updates when any change renders the information contained in the Notice of Registration (NOR) no longer accurate. Any of the following changes must be reported to the Safety and Risk Management Office:

- Relocation of equipment
- Change in equipment ownership or billing contact information
- New installation or change to X-ray component
- Change in status of the equipment (not in use, surplus, or donated)

X-Ray Equipment Inventory

The Safety Office will maintain an inventory of radiation producing instruments and those containing sealed sources or foils, such as liquid scintillation counters and gas chromatographs. The Safety Office must be notified if the location or status of the instrument changes. The Safety Office will ensure that the radiation source in these instruments is removed prior to transferring them as surplus property.

Section 5: Radiation Protection Principles

Radiation Health Effects

X-ray radiation has sufficient energy to affect atoms in living cells and thereby can cause damage to genetic material (DNA) upon exposure. Body cells are extremely efficient at repairing damage, but if damage is not repaired correctly, a cell may die or eventually become cancerous.

Exposure to high levels of radiation over a short time can cause acute health effects such as skin burns and radiation sickness. Symptoms of radiation damage can occur quickly when an individual receives a dose in excess of 50 rem in a short period of time.

Chronic exposure results from a lower radiation dose over an extended period of time and the effects, if any, appear after several years. If effects do occur, it is due to cellular changes over time rather than direct contact with the radiation source.

Radiation Dose

The body may be irradiated in two general ways; externally from radioactive material or radiation sources, or internally from radioactive material deposited in the body.

Internal exposure results from the absorption, ingestion, or inhalation of radioactive material. This material can be incorporated in the body in several ways:

- Breathing radioactive gases, vapors, or dust.
- Consuming radioactive material transferred from contaminated hands, tobacco products, food, or drink.

- Entering through a wound.
- Absorption through the skin.

External doses can be the result of exposure to gamma, x-ray, or high-energy beta emitters. Low energy beta and alpha emitters lack the energy needed to penetrate the outer layer of skin and subsequently present less of an external hazard and are of more concern when ingested. The radiation dose an individual receives depends on the following factors:

Exposure*:* The "strength" (activity, mrem/hr, etc.) of the radiation source. By reducing the amount of radioactive material used or lowering the settings on a radiation-producing machine, dose can be reduced.

Time*:* The total dose received from an external source is dependent on the amount of time actually exposed to the source. Therefore, any time that is spent near a source should be controlled and used effectively.

Distance: By increasing the distance between the source of exposure and an individual, the dose received can be significantly reduced. When an individual doubles his/her distance from a gamma source, for example, the dose rate at the further distance will drop to one-fourth of the level at the closer distance.

Shielding: When radiation sources are being used, absorbing material or shields can be incorporated to reduce exposure levels. The specific shielding material and thickness is dependent on the amount and type of radiation involved.

The fundamental objectives of radiation protection measures are to limit exposure from external radiation to levels that are as low as reasonably achievable (ALARA) and always within the established dose limits. Use procedures and engineering controls based upon sound radiation protection principles to achieve ALARA by:

- Decreasing time of radiation exposure
- Increasing distance from radiation exposure
- Increasing shielding from radiation exposure

Radiation Dose Limits

The permissible upper bounds of radiation dose are termed dose limits. Dose limits represent an acceptable level of potential risk and do not represent a level that will necessarily be unsafe if exceeded.

Occupational Annual Dose Limits for Adults:

- 5 rems (0.05 Sv) Total effective dose equivalent to whole body (TEDE)
- 15 rems (0.15 Sv) Eye dose equivalent to lens of the eye
- 50 rems (0.5 Sv) Shallow dose equivalent to the skin or any extremity (SDE)

*Note: The annual exposure is cumulative and must include data from all radiation exposure sources. If an employee works at multiple sites, then all exposures are combined for the annual sum.

Annual Dose Limit for Minors:

The annual dose limit for a minor is 10% of the adult dose

- 0.5 rems (0.05 Sv) Total effective dose equivalent to whole body (TEDE)
- 1.5 rems (0.15 Sv) Eye dose equivalent to lens of the eye
- 5 rems (0.5 Sv) Shallow dose equivalent to the skin or any extremity (SDE)

Dose limit to embryo/fetus:

The dose to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, is 0.5 rem.

Dose limit for individual members of the public:

The total effective dose equivalent from a registered operation is 0.1 rem in a year. The dose in any unrestricted area from external sources of radiation is 0.002 rem per hour.

All individuals who, during employment, are likely to receive in a year an occupational dose in excess of 100 millirem (mR) shall be:

- Instructed about storage, transfer, or use of radiation in restricted areas.
- Instructed in health protection problems associated with exposure to radiation.
- Instructed in precautions or procedures to minimize exposure.
- Instructed in purposes and functions of all protective devices employed, such as lead drapes, safety interlocks, etc.
- Instructed in the appropriate response to warnings made in the event of any unusual occurrence or malfunction that may involve exposure to radiation.

Exceeding Dose Limits

An individual will be notified if the action level of 100 mrem is exceeded in a monitoring year. The data reported will include:

- estimated dose
- individual's name
- employee ID#
- cause of elevated exposure
- corrective actions taken

The following X-ray incidents are required to be reported to the Radiation Protection Section in addition to the affected employee. Reporting is initiated by the Safety and Risk Management Office if the following occur:

1. A written report of the following X-ray over-exposure is required within 30 days of the occurrence:
    - Employee exceeded the occupational dose limit for adults
    - Employee exceeded the occupational dose limit for a minor

- Employee exceeded the dose limit for an embryo/fetus of a declared pregnant worker
- Dose limits have been exceeded for an individual member of the public

2. An immediate written report (within 24 hours) is required for a loss of X-ray equipment or an X-ray incident that results in an exposure at or above the limits listed below:
   - Total effective dose equivalent of 25 rems
   - Eye dose equivalent of 75 rems
   - Shallow-dose equivalent to skin or extremity of 250 rads

Medical Reporting Limits

In addition to the dose limit reporting requirements discussed above, the NC Radiation Protection Section would like to collect reports of erroneous X-ray exposures on patients from diagnostic exams. This reporting is voluntary but the information could be beneficial in identifying safety issues. The following patient exposures may be reported voluntarily:

- Unintended dose to the skin of 200 rads
- Unintended dose 5 times ordinary protocol and exceeds 50 rads to an organ or 5 rads total effective dose
- Expose wrong patient or wrong site and exceeds 50 rads to an organ or 5 rads total effective dose
- Any equipment of personnel error that causes a dose in excess of 5 rads total effective dose

Any patient or operator death caused by malfunctioning medical equipment must be reported to the FDA and to the manufacturer of the equipment. Malfunctioning equipment causing serious injury must be reported to the manufacturer of the equipment.

Personnel Monitoring

Personnel monitoring devices (whole body dosimeters, extremity dosimeters, pocket dosimeters, etc.) are used to measure an individual's radiation exposure to gamma, energetic beta, and x-ray sources. The standard monitoring device is issued as a clip-on badge or ring badge bearing the individual assignee's name, date of the monitoring period and a unique identification number. The dosimeters are provided, processed and reported through a commercial service company that meets current requirements by the National Voluntary Laboratory Accreditation Program (NVLAP).

Monitoring Requirements

Radiation protection regulations require that appropriate personnel monitoring equipment be provided to individuals who:

1. Are likely to receive a radiation dose in one year from sources external to the body, in excess of 10 percent of:
   a) 5 rems, total effective dose equivalent, to the whole body;
   b) 15 rems, eye dose equivalent, to the lens of the eyes;
   c) 50 rems, shallow dose equivalent, to the skin or to each of the extremities.

2. Are less than 18 years of age and are likely to receive a radiation dose in any calendar year in excess of 10 percent of;
    a) 0.5 rems to the whole body;
    b) 1.5 rems to the lens of the eyes;
    c) 5 rems to the skin or to each of the extremities.
3. Have declared a pregnancy or planned pregnancy;
4. Enter a High or Very High Radiation Area (exposure to greater than 100 millirems in any one hour);
5. Operate open-beam analytical x-ray equipment that is not equipped with a safety device.

Monitoring Protocol

- Work in radiation restricted area under such conditions that an occupational radiation dose more than 10 percent of the specified calendar year limits may occur.
- Prior radiation dose histories from all past employers for the monitoring year must be available and used to monitor annual dose.
- The badges can only be used by the assigned person and must be stored in a radiation free area. The control badge should not be stored in the same area as the X-ray equipment.
- Dosimeters will be exchanged on a quarterly basis.
- All personnel occupational radiation dose records shall be maintained by the Safety Office.
- It shall be the responsibility of each individual dosimeter recipient to wear and use the dosimeter properly.
- Authorized Users are responsible for assuring their radiation workers are wearing badges appropriately and that badges are returned on time for reading.

Use of Personnel Monitoring Devices

A. Whole-Body Dosimeter

The whole-body dosimeter (or other device) is to be worn on the body where it will most likely approximate the radiation exposure to the head and torso of the wearer. A dosimeter assigned for whole body monitoring is not to be used to monitor the extremities (hands, forearms, feet, ankles). Separate badges must be assigned for extremity monitoring. Generally, whole body dosimeters are to be worn between the waist and the neck. When a protective apron is worn, the badge is to be worn at the collar, outside the apron.

B. Ring or Wrist Dosimeter

Ring or wrist personnel monitoring equipment will be used for:

- Individuals operating an open beam radiation generating device not equipped with a safety device; and
- Individuals maintaining devices if the maintenance procedures require the presence of a primary x-ray beam when any local component in the devise is disassembled or removed.
- Ring dosimeters should be worn on the hand most likely to be exposed, that is, the hand closest to the source of radiation.

Personnel Monitoring Reports

Occupational radiation dose reports are sent to each radiation employee group representative. The report(s) must be posted or otherwise provided such that each group member may learn of his/her own dose record. Routine monitoring periods are quarterly. Each report will include the name, monitoring period date, dose (millirems) for the immediate past period, current calendar quarter, calendar year and the lifetime dose for each member of the group. The monitoring reports shall be sent to the Safety Office quarterly.

Radiation Survey Requirements

Radiation surveys of all Radiation Producing Equipment shall be performed:

a) Within 30 days after initial operation of the device;
b) Prior to use following any change in the initial arrangement, including the number or type of local components in the system; and
c) Prior to use following any maintenance requiring the disassembly or removal of a local component in the system that could affect the radiation exposure to personnel.

Radiation surveys shall be performed with a radiation survey instrument calibrated according to manufacturer's recommended frequency, or at least annually when frequency is not recommended, and capable of the following:

a) Measuring the radiation energies of the system surveyed;
b) Confirming that the radiation limits are met;

Annual Testing Requirements

1. Safety devices including interlocks, shutters, and warning lights shall be tested once annually for proper operation. Records of testing shall be retained by the Authorized User and the Safety Office for at least three years.
2. Radiation surveys should be conducted annually. The action level for x-ray leakage is 0.5mR/hr at a distance of 5cm from the instrument.

Section 6: Safety Guidelines for Use of Radiation Producing Equipment

The following guidelines should be implemented to achieve occupational doses ALARA:

- Everyone intending to operate any radiation producing machine must be trained in its use by an individual experienced and competent with the system.
- Everyone working with a radiation producing machine should know exactly what work is to be done and which applicable safety precautions should be used.
- Written operating and safety procedures must be available to personnel before operating this type of machine.
- Visitors and students in the area should be supervised by the equipment operator.
- Radiation producing machines must not be left unattended in an operational mode.

- Structural shielding requirements for any new installation, or any modifications to an existing unit or room, must be approved by the Radiation Safety Officer before the machine is used.
- Under no circumstances shall shutter mechanisms or interlocks be defeated or in any way modified.
- Portable devices must never be pointed towards the user or anyone else. Keep hands, feet, and other body parts away from the beam path.
- All warning lights should be "fail safe" (specific regulations require "fail safe" features).
- A manually reset cumulative timing device should be used to indicate elapsed time and to turn off the machine when the total exposure reaches the planned amount.
- Individuals operating the unit must be instructed in the appropriate response to warnings in the event of any unusual occurrence or malfunction that may involve exposure to radiation.
- Special care is needed when working with x-ray diffraction units. Exposure rates in the primary beam can be more than 500,000 rems per minute at the x-ray tube (NIH, 1972). Follow the specific procedures for training, operation and emergency response that have been developed for these devices.
- Some machines such as analytical x-ray devices, irradiators and accelerators have individual safety programs. The detailed operating and emergency procedures must be posted and followed.
- Proper maintenance on all radiation producing equipment is essential. Only properly trained technical staff should perform all repairs to these instruments. Service personnel must be licensed or registered by the North Carolina Radiation Protection Section.
- Radiation surveys shall be conducted annually. The action level for x-ray leakage is 0.5mR/hr at a distance of 5cm from the instrument.
- Equipment control measures must be in place to prevent unauthorized access to the room and equipment, such as locked key access and password protection for software.
- All access doors shall remain locked at all times when unoccupied.

Section 7: Healing Arts of Medicine

The North Carolina Radiation Protection Section (NC RPS) enforces radiation rules that require radiation machines meet specific requirements, procedures are followed, and records maintained. The intent of these written procedures is to minimize radiation exposure of x-ray personnel and patients without sacrificing diagnostic quality. You are required to know the procedures outlined below and be able to demonstrate that you can use them. After reading the procedures and demonstrating that you can use the machines safely and correctly, you must sign and date the Record for Instruction of Individuals in Operating Safety Procedure in Appendix B.

The rules also require that each x-ray facility be registered with the state. This notification must be available to personnel and state inspectors. All operators of x-ray machines are responsible for following the radiation safety procedures. The Radiation Safety Officer (RSO) has the responsibility and authority for overseeing matters relating to radiation protection. The RSO also confirms all training and serves as the contact person with the state. Employees should submit all radiation questions or concerns about radiation to the RSO (Safety and Risk Management Office).

A. Make sure that all x-ray examinations have been ordered by an attending physician. The authorized operator must maintain a log of each exam ordered with the practitioner's signature.

B. Personnel Monitoring
   1. Always wear the personnel monitoring badge when you are working and make sure it is the badge assigned to you.
   2. Wear the badge on your collar. When you wear a lead apron, the badge shall be outside the apron.
   3. When not in use, store badges in a low-radiation designated area. The control badge shall also be stored in a radiation free area, not in the same location as the radiation equipment.
   4. Badges shall be exchanged on a quarterly basis.
   5. If you suspect there has been an excessive exposure or a radiation incident, immediately notify the Radiation Safety Officer. The RSO will then notify the Radiation Protection Section.
   6. Try to keep your personal radiation exposure as low as you can. Be aware of where you are standing and how long you stay in the radiation area. Do not enter or remain in a radiation area unless it is necessary.

C. The general requirements for radiation safety and your rights and obligations as a radiation worker are found in the regulations, section .1600. The specific sections that most impact your facility are Rules .0603, .0604, .0605, .0606, .0608, and .0609. These rules pertain to requirements for radiography, fluoroscopy and therapy. You need to review these rules. The regulations are available online on the NC Radiation Protection Section website.

D. The x-ray equipment in this facility was installed following the manufacturer's specifications. Do not alter, tamper with, or remove any of the filters or collimators, or in any way cause needless radiation exposure.

E. Operation of X-Ray Equipment
   1. The x-ray room where the machine is operated is a restricted area. The area is designated by a "Caution Radiation Area" sign on the door.
   2. Do not allow anyone in the room with the patient during an x-ray examination. If other persons are needed for the examination, they must have badges and protective devices. They must follow safe radiation procedures and shall keep out of the direct x-ray beam.
   3. Stay in the control booth, if available, or behind the protective barrier, during each exposure.
   4. Always maintain visual and audio contact with the patient.
   5. Restrict the x-ray beam to the area of clinical interest. The beam size must not be larger than the image receptor. Use the collimation method described in the operation manual to restrict the beam.
   6. Align the x-ray beam with the film by using the light localizer and the centering device.
   7. Use a centimeter measuring device for each patient to determine the thickness of the body area to be x-rayed. Using these measurements, check the technique chart to determine proper settings of mAs, mA, time, and kVp.

8. Structural shielding requirements for any new installation, or any modifications to an existing unit or room, must be approved by the Radiation Safety Officer before the machine is used.
9. Under no circumstances shall shutter mechanisms or interlocks be defeated or in any way modified.
10. All warning lights should be "fail safe" (specific regulations require "fail safe" features).
11. A manually reset cumulative timing device should be used to indicate elapsed time and to turn off the machine when the total exposure reaches the planned amount.
12. Proper maintenance on all radiation producing equipment is essential. Only properly trained certified technical staff should perform all repairs to these instruments. Service personnel must be licensed or registered by the North Carolina Radiation Protection Section.

F. Exposure Procedures and Protective Equipment
1. Remove any unnecessary staff or other persons from the room during x-ray examination.
2. All staff in a radiographic room during x-ray exposures must stand behind a protective barrier or use protective aprons or whole body protective barriers of not less than 0.25mm of lead equivalent. All staff working in fluoroscopy must wear a lead apron. Aprons of varying sizes should be available to fit comfortably.
3. Personnel who are required to wear lead aprons or other similar radiation protection devices should visually inspect these devices prior to each use for obvious signs of damage such as tears, creases, or sagging of the lead.
4. If you must be in the room during x-ray examinations, keep your body out of the beam, wear the protective lead apron, and wear your badge at your collar outside of the apron.
5. The protective equipment (apron) is stored in the x-ray room. Check the lead apron for holes, cracks, or tears. If a defect is found, notify the RSO. The lead apron must be cared for properly, never crumple, roll, or fold the apron and always store it on a hanger or by lying flat. Inspect the aprons before each use and document inspection annually using the Lead PPE Inspection Log (provided in Appendix C).
6. Place barriers between the beam and any other person who must stay in the room during an x-ray examination.
7. Use mechanical holding devices when a patient must be held for x-ray examination.
8. If a patient must be held by another person, make sure the holder is wearing the appropriate protective lead garments that have been properly positioned. Human holders must be provided with adequate protection, 0.5mm lead when standing in the primary beam and 0.25mm for scatter radiation.
9. Always use gonadal shielding for the patient, of not less than 0.25mm lead equivalent. Exceptions occur only when gonadal shielding will interfere with the diagnostic procedure.

G. Fluoroscopic Procedures (if applicable)
1. Do not perform fluoroscopy without the immediate supervision of a physician properly trained in fluoroscopic procedures.
2. Set the appropriate exposure factors using the technique chart.

3. Wear full trunk aprons of 0.25 millimeter or more lead equivalent. You must wear the whole-body monitoring badge at the collar, outside the apron.
4. Make sure the protective devices are in place.
5. For mobile fluoroscopy that is in general use, the 30-centimeter spacer assembly must be in place.
6. Reset the 5-minute cumulative timing device before each fluoroscopic procedure.

H. Mobile or Portable Machines Procedures (if applicable)
1. Stand behind a protective shield or at least 6 feet from the patient and well away from the useful beam. If you do not use a protective shield, wear a full trunk lead apron of 0.25 millimeter or more of lead equivalent.
2. Remove others from the area and for anyone remaining who cannot be removed, use protective barriers of 0.25 millimeter or more lead equivalent material and/or position at least 6 feet from the tube head and the nearest edge of the image receptor.

Section 8: Voluntary Declared Pregnancy

It is the responsibility of the employee to inform the employer in writing if they choose to declare the pregnancy. The declaration should include the individual's name, estimated due date, and date of declaration. A Voluntary Declaration of Pregnancy form is provided in Appendix D.

The employee will be counseled for exposure history, options for fetal monitoring, and reassignment of duties to reduce exposure if applicable.

The dose to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, is 0.5 rem.

Section 9: Emergency Procedures

IF YOU ARE EXPOSED TO THE DIRECT X-RAY BEAM, OR SUSPECT AN EXPOSURE, IMMEDIATELY FOLLOW THESE STEPS:

1. Shut off the x-ray beam. Ensure that all users are familiar with the shut-off procedure for the beam before they begin operating the unit.
2. Remain calm. Call the contacts below until (1) medical advice is obtained and (2) the incident is reported. A list of Emergency Contact Numbers is provided in Appendix F and should be posted in a visible area of your work space.

- Safety and Risk Management Office: 828-227-7443 (M-F 8am-5pm)
- Campus Emergency Dispatch: 828-227-8911
- Off Campus Emergency Dispatch: 911

Section 10: Annual Inspections of X-Ray Equipment

As required by state and federal law, the Safety and Risk Management Office will conduct inspections to determine individual compliance with WCU's Radiation Safety Program (RSP) and other relevant safety policies.

The following items will be addressed during the annual inspection of the equipment:

- Notice of Registration (NOR) is available and has the correct information listed.
- Record of x-ray equipment installation and survey reports are available.
- Current State Regulations are available in electronic or print format. The NC regulations are available online at the Radiation Protection Section website.

Applicable sections of the regulations include:

10A NCAC 15 [.0100]; [.0200]; [.1000]; [.1100] and [.1600] and in addition:

[.0600] for Medical X-ray in the Healing Arts and [.0800] for Non-Human Use of Radiation Generating Devices

- Current Notice to Employees sign is posted in the area. The agency form "Notice to Employees" contains information to employees regarding employer's responsibility, worker's responsibility, reports on radiation exposure history, inspections, and any other information that the agency may include. The Notice to Employees should be posted nearby the X-ray device.
- Current copy of WCU's Radiation Safety Program is available.
- Appendix A (Authorized User Specific Radiation Safety Plan) is reviewed annually and updated with current information (Authorized User must document annual review).
- Manufacturer's operating procedures are available.
- Compliant Signs and Labels: The symbols shall use the colors magenta or purple or black on yellow background. The radiation symbol is the standard three-bladed design.
- "Caution X-Ray Equipment" signs are posted at the entry to each use area.
- "Caution Radiation – This equipment produces radiation when energized" located near any switch that energizes an x-ray tube.
- Warning lights are labeled "X-Ray ON" to indicate when energized and are visible from all access areas.
- Security control measures are in place to prevent unauthorized access to the equipment.
- Training for the safe operation of the equipment and emergency procedures is documented for all users. A training log is provided in Appendix B Record for Instruction of Individuals in Operating Safety Procedure.
- User entries are logged. Analytical users can enter date/time in a log book. Medical x-rays are logged with the order from a physician with time of exposure for each patient.
- Annual testing for proper operation of safety devices (interlocks/shutters/warning lights) is documented.
- Personnel monitoring and quarterly exposure records are available (if applicable).

- Lead PPE inspections are documented at least annually. A Lead PPE Inspection Log is provided in Appendix C.

Medical X-Ray Inspections

In addition to the inspection items listed above, the following items will be included for Medical X-Ray units:

- Installation report (FDA 2579 Form) is available.
- Copy of Shielding Design and Letter of Acknowledgement available.
- Radiation area survey results are available.
- Fluoroscopic outputs posted in clear view (if applicable).
- Notification records available if annual occupational dose exceed 100 mrem.
- Safety plan posted in clear view. Recommended bullet points to include wearing lead apron, monitoring badge, clear the room, close the door, etc.
- Documentation of medical order for x-ray usage. Medical x-rays are logged with the standing order from a physician with practitioner's signature and time of exposure for each.

Inspection checklists and other resources are available at http://www.ncradiation.net. The NC Radiation Protection Section website is an excellent tool to assist you in preparation for an inspection or with registering equipment.

Section 11: Radiation Safety Program Review

The Safety and Risk Management Office will conduct an annual review of the program and ensure that any updates are available to each individual who operates the x-ray equipment. The Annual Review and amendments will be documented in Appendix G.

Appendix A: Authorized User Specific Radiation Safety Plan

Authorized User (AU): This is the person designated as most responsible for ensuring that students, faculty, and staff using the radiation producing equipment are trained in safe operation and comply with the Radiation Safety Program and applicable regulations.

Authorized User Information:

Name:		Email Contact:	
Office:		Phone:	
Department:			
Supervisor:		Supervisor Email:	

Select the type of equipment and specify the model, manufacturer, and serial number:

	Type	Model	Manufacturer	Serial Number
	Medical X-Ray			
	Analytical X-Ray			
	Cabinet X-Ray			

Registration Information:

Notice of Registration Number (NOR):	
NOR Effective Date:	
Equipment Installation Date:	
Equipment Location:	
Billing Address:	

Any individual who wishes to use the equipment must:

1. Participate in training that demonstrates all safety issues including possible radiation hazards and biological effects associated with the instrument.
2. Receive training in proper operating procedures for the equipment.
3. Agree to document that training has been completed.
4. Agree to record their usage time in the equipment log book.
5. Agree to operate the instrument only in the manner specified in the operations manual.
6. Agree not to bypass any safety device.

Personnel Monitoring Required: _____ Yes (explain below) _____ No

_____

Written safety precautions and operating procedures for the equipment are available: ____ Yes ____ No

Annual Review: _____ (AU signature) Date: _____
The Authorized User must document annually that the information above is current.

Appendix B: Record for Instruction of Individuals in Operating Safety Procedure

I have read the Radiation Protection Program and operating safety procedures and have been trained in the safe operation of the x-ray equipment.

X-Ray Instrument Model: _____

Instructor Name (Print)	Instructor Signature	Name of Trainee (Print)	Signature of Trainee	Date (MM/DD/YR)

Appendix C: Lead PPE Inspection Log

Inspect lead personal protective equipment annually. Lead aprons must be stored on a hanger or lying flat (not wrinkled). Contact Safety and Risk Management to dispose of failed lead PPE.

Type of Lead PPE	Lead PPE Identification #	No tears, perforations, or thinning	Fastening device intact	Inspected By	Inspection Date (MM/DD/YR)

Appendix D: Voluntary Declaration of Pregnancy

I, _____, WCU ID# _____, hereby certify and voluntarily declare that I am pregnant or planning to become pregnant. I wish to participate in the fetal dose monitoring program.

The following information is provided in support of this declaration:

Date of Declaration: _____

Estimated Pregnancy Due Date: _____

Estimated Conception Date: _____

Signature of Declared Radiation Employee _____ Date: _____

Signature of Radiation Safety Officer: _____ Date: _____

Appendix E: Notification to Purchase Radiation Producing Equipment

WCU Notification to Purchase Radiation Producing Equipment

Instructions: Fill in the information and email the form to the Safety and Risk Management Office or send via intercampus mail to Facilities Management: Safety Office

Purchaser (Person responsible for monitoring the equipment onsite):

_____

Department: _____

Office Location: _____ Phone Number: _____ Email: _____

Type of Radiation Producing Equipment: _____

Manufacturer & Model of Equipment: _____

Location where equipment will be stored: _____

Location where equipment will be used (if portable): _____

Provide a brief description of how the equipment will be used and any special safety precautions or operation procedures needed.

Approved by Department Head: _____ Date: _____
(Signature)

Approved by Safety and Risk Management:

RSO Signature _____ Date: _____

Appendix F: Emergency Contacts

In the event of an emergency affecting campus, the Campus Emergencies webpage is the official source for WCU emergency related information.

Emergency Telephone Numbers

	Normal Business Hours (8-5)	**Evenings/Weekends**
EMERGENCY Fire/Police/Medical	828-227-8911 or 911	828-227-8911 or 911
University Police Department NON-EMERGENCY	828-227-7301	828-227-7301
Safety and Risk Management	828-227-7443	828-227-7443
Chemical Spill	828-227-7443	828-227-7443
Biological Spill	828-227-7443	828-227-7443
Radiation Exposure	828-227-7443	828-227-7443
Workers' Compensation	828-227-7443	828-227-7443
NC Poison Control Center	1-800-84 TOXIN (1-800-848-6946)	1-800-84 TOXIN (1-800-848-6946)
N.C. Radiation Protection Section	919-814-2250	800-858-0368 Emergency after hours
Work Management Centers		
Facilities Management	828-227-7442	828-227-7224
WCU Health Services	828-227-7640	828-227-8911 EMS

Appendix G: Annual Review Radiation Safety Program

Date	Updated By	Amendments
July 22, 2019	Sharon Tighe	Initial Radiation Protection Program developed.
July 23, 2020	Sharon Tighe	Section 5: Added health problems associated with exposure to radiation. Section 7: Healing Arts of Medicine. Added medical reporting procedures and Appendix C: Lead PPE Inspection Log. General formatting updates.
January 7, 2022	Amanda Lytle	Minor formatting updates