



X-RAY SAFETY MANUAL

ENVIRONMENTAL HEALTH & SAFETY
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I. ADMINISTRATION

The use of all x-ray producing equipment on FAU's campuses falls under the jurisdiction of the RSO (Radiation Safety Officer) and the RSC (Radiation Safety Committee). All x-ray producing equipment must be registered with the RSO and the Florida Department of Health, Bureau of Radiation Control (BRC). The use of analytical x-ray equipment is regulated by Florida Administrative Code 64E-5.701-5.704. All purchases and/or transfers of x-ray producing equipment must receive prior approval from the RSO and RSC.

II. TRAINING

All users of x-ray producing devices are required to participate in FAU Radiation Safety Training for x-ray Users. New users must enroll in the required initial training course. Sessions are offered on an as needed basis. Please contact the RSO to register for the training. All users are also required to complete annual refresher training which is available in a web-based format. If you have received training at another institution before coming to FAU this training must be documented with the RSO.

III. SECURITY

All x-ray producing equipment will be operated only by trained faculty, staff, or students. No x-ray producing equipment will be left operating unattended without prior approval from the RSO. If approved to do so by the RSO, the laboratory entrance/exit doors must be locked while the machine is operating. All x-ray producing equipment will be secured when not in use in such a manner that it cannot be used by untrained, unauthorized workers or members of the public, either knowingly or unknowingly. This must be done by either removing keys necessary to operate the equipment or locking the room in which the equipment is located. All x-ray use laboratories and x-ray equipment must be labeled with appropriate warning signs to alert others as to the possible dangers associated with use of the device.

IV. RADIATION PROTECTION PROGRAM

A. ALARA

It is this university's intent to operate all x-ray producing equipment in such a manner as to keep doses, to workers and members of the public, **As Low As Reasonably Achievable.**

B. POSTINGS

The **FAU Radiation Protection Program for the Safe Use of x-ray Producing Equipment** (Appendix A) must be posted near each x-ray device. This protection plan should be known, understood, and followed by each individual operating an x-ray producing device. The **Notice to Employees and Worker's Compensation Procedures** information (in Appendix B) must also be posted next to each x-ray producing device.

All x-ray equipment should be labeled as outlined in FAC 64E-5.701 (4) and summarized as follows:

- 1) **“CAUTION-HIGH INTENSITY X-RAY BEAM”** or similar wording, on the x-ray source housing
- 2) **“CAUTION RADIATION- THIS EQUIPMENT PRODUCES RADIATION WHEN ENERGIZED”** or similar wording near any switch that energizes an x-ray tube if the radiation source is an x-ray tube.
- 3) An easily visible, fail-safe warning light labeled with the words **“X-RAY ON”** or similar wording located near any switch that energizes an x-ray tube. This warning light should be illuminated only when the tube is energized.

C. RADIATION PROTECTION PROCEDURES

- 1) Understand and apply the three cardinal principles of radiation protection and control: **time, distance, and shielding**.
- 2) Avoid exposure to the primary beam.
- 3) Avoid holding the patient or object to be imaged.
- 4) Always wear a personal dosimetry device.
- 5) Analyze the hazards of each job in advance.
- 6) Provide safeguards against foreseeable accidents.
- 7) Use protective devices and planned emergency procedures when accidents happen.

D. GUIDELINES FOR USING RADIATION-PRODUCING MACHINES

- 1) Before working with any radiation-producing machine, adequately trained personnel must be familiar with the work that is to be done and the safety precautions to be taken.
- 2) Written operating instructions and safety procedures must be available to personnel before operating the machines.
- 3) Visitors in areas where radiation-producing machines are used must be supervised by the equipment operator.
- 4) Radiation-producing machines must not be left unattended while operating unless the operator has received prior approval to do so by the RSO. If approved, the laboratory entrance/exit doors must be locked while the machine is operating.
- 5) Structural shielding requirements for any new installation, or an existing one in which changes are to be made, must be reviewed by the RSO before the machine is to be used.
- 6) If the safe use of the radiation-producing machine depends on the mechanical set-up of the unit or on technique factors, then these restrictions must be rigidly followed.
- 7) Shutter mechanisms and interlocks must not be tampered with or defeated under any circumstances.
- 8) All warning lights must be "fail safe".
- 9) A manually reset cumulative timing device must be used which will either indicate elapsed time or turn off the machine when the total exposure reaches a certain previously determined limit.
- 10) All radiation-producing equipment must be properly maintained. Attempts to "fix" equipment should only be made by properly trained technical staff.
- 11) All x-ray machines must be registered with the State of Florida BRC and maintained on inventory with the RSO.
- 12) Instrumentation which contains a radioactive calibration source must be maintained on inventory with the RSO.

E. COMMENTS FOR USERS OF X-RAY DIFFRACTION UNITS

X-ray diffraction units are designed for routine analytical work and, in theory, do not present a radiation hazard to the user if simple precautions are observed. However, they make use of extremely high-intensity primary beams. Although the primary beam may have a diameter on the order of a centimeter, it can produce a severe and permanent local injury from only momentary irradiations of the body. The primary beam intensities can range from 50 to 400,000 R/minute depending upon the scatter distance from the x-ray source.

The greatest risk of acute accidental exposure occurs during sample manipulation by the primary beam. Exposure rates of 10,000 R/sec can exist at the tube housing port. Skin reddening can occur after an exposure of only 0.3 seconds, and in 1 second, severe and permanent injury could occur. The fingers are the parts of the body most likely to receive these high exposures.

Modern x-ray diffraction units incorporate shielding and safety features to prevent both acute and local accidental exposures and chronic long-term exposures. Operators must be fully aware of the protective devices incorporated into their machines and the possibilities for failure or malfunction of the safety devices. Operators may be assigned a personal radiation monitoring dosimeter to record their exposure when operating x-ray diffraction units if they have the potential of receiving 10% of the maximum annual occupational dose limit.

X-ray diffraction units must be surveyed by The State of Florida BRC at least once per year. The RSO must also survey each unit at least once per year and whenever the equipment is relocated or modified. The RSO is also responsible for the following:

- All of the posting requirements listed in part B of this section apply to x-ray diffraction units.
- All analytical x-ray equipment must be registered with the Environmental Health and Safety Office.
- Shutters should be used that cannot remain open unless a collimator is in position. Shutter interlocks should be used to cut off the beam when samples are changed.
- No repair, cleaning work on shutters and shielding materials, or non-routine work that could result in exposure to the primary beam will be allowed unless it has been positively ascertained that the x-ray tube has been completely de-energized.
- Everyone working with analytical x-ray equipment must receive prior approval from the RSO and the RSC and pass the Radiation Safety Training Course for x-ray Users.

F. COMMENTS FOR USERS OF DIAGNOSTIC X-RAY UNITS

Workers using diagnostic x-ray devices (C-arms, dental, medical, etc.) must be sure to wear the appropriate personal protective equipment (PPE) when operating the device. All diagnostic x-ray units must be surveyed by The State of Florida BRC at least once per year. The RSO must also survey each unit at least once per year and whenever the equipment is relocated or modified. The RSO will evaluate the hazards associated with the device and establish protection guidelines for safe use of the device. Appropriate PPE recommendations will be made for each type of device and may include the following: safety glasses, radiation dosimeter, lead aprons, etc. If you are assigned a personal radiation dosimeter, you must wear it at all times when operating the x-ray device. Dosimeters will be assigned to individuals with the potential to receive 10% of the maximum annual occupational dose limit. If you are unsure of what PPE to wear when operating your x-ray device contact the RSO.

The following guidelines must be followed by all diagnostic x-ray operators to ensure maximum protection for both the operator and the patient:

- A licensed Medical Doctor or Doctor of Veterinary Medicine will specifically and individually order all exposures.
- Humans must not be exposed for training, demonstration, or other non-healing art purposes. Except for Student Health Services, Florida Atlantic University is not licensed for exposure of humans.
- Appropriate measures must be used to keep patient exposure at a minimum, while still obtaining the necessary diagnostic information.
- The operators must stand behind the protective barrier at the controls (if applicable) and wear personal dosimeters (if assigned) during the exposure.
- Only individuals required for the radiographic procedure are to be in the room during the exposure.
- Access to the x-ray room should be secured during the exposure.
- Everyone working with diagnostic x-ray equipment must receive prior approval from the RSO and the RSC and pass the Radiation Safety Training Course for x-ray Users.

Appendix A

FAU Radiation Protection Program for the Safe Use of x-ray Producing Equipment
(Based on the pre-approved Radiation Protection Program
for Industrial/Educational Registrants)

Note: Radiation Protection Programs are used to minimize unnecessary exposure to employees and the general public and help prevent either group from exceeding their legal limits on exposure to radiation. This program has been developed by the Bureau of Radiation Control to assist registrants in meeting 64E-5.303, Florida Administrative Code. If this program is used, it does not need to be submitted for review.

The signature below attests this registrant has evaluated the following provisions and agrees they accurately describe the conditions present. All staff members involved in making radiographic exposures will be made aware of these provisions and held accountable for them.

1. The machine will be used according to manufacturer instructions and will not be modified.
2. The manufacturer's operating, maintenance and safety procedures are available and followed.
3. The Principle Investigator responsible for the device will inform the RSO of the following:
 - Emergencies involving the use of the x-ray device
 - Changes in Use Protocol
 - Relocation of x-ray device
 - Changes to personnel authorized to operate x-ray device
4. The radiation protection program will be re-evaluated annually and when changes occur that could affect dose.
5. All radiation protection program(s) will be kept on file until the registration is terminated.
6. Wayne Landowski, RSO is responsible for radiation protection.

_____	JR	_____
Principle Investigator Responsible for X-ray Device		BRC Registration Number

Location of X-ray Device (Building /Room)		

Signature of Person Responsible for Above Program		Date

Appendix B



FLORIDA DEPARTMENT OF HEALTH



NOTICE TO EMPLOYEES

STANDARDS FOR PROTECTION AGAINST RADIATION; NOTICES, INSTRUCTIONS AND REPORTS TO WORKERS; INSPECTIONS

POSTING REQUIREMENT

THIS NOTICE MUST BE POSTED IN PLACES THAT PERMIT EMPLOYEES IN A RESTRICTED AREA TO SEE A COPY ON THE WAY TO OR FROM THEIR PLACE OF EMPLOYMENT.

The Department of Health has established standards for protection against radiation hazards in Chapter 64E-5, Florida Administrative Code.

YOUR EMPLOYER IS REQUIRED TO:

- Post or provide you a copy of the Department of Health rules and operating procedures that apply to your work and explain them to you.
- Apply the rules to work involving radiation sources.
- Post or provide you any Notice of Violation involving radiological working conditions, proposed civil penalties, and orders.

YOU ARE REQUIRED TO:

- Become familiar with the rules and the operating procedures that apply to your work.
- Observe the requirements to protect yourself and your co-workers.

WHAT IS IN THESE RULES:

- Limits on exposure to radiation and radioactive material in restricted and unrestricted areas
- Actions to take after accidental exposure
- Personnel monitoring, surveys, and equipment
- Caution signs, labels, and safety interlocks
- Exposure records and reports
- Options for workers about Department of Health inspections
- Related matters

REPORTS ON RADIATION EXPOSURE

Your employer must give you a written report if you receive an exposure above the limits in the rules or in the license. The maximum limits for exposure to employees are in Part III of the rules. However, your employer should keep your radiation exposure as low as reasonably achievable.

If you work where personnel monitoring is required:

- Your employer must give you a written annual report of your radiation exposures.
- Your employer must give you a written report of your radiation exposures when you terminate employment.

INSPECTIONS

Representatives of the Department of Health inspect all licensed and registered activities. Any worker or worker representative who believes that there is a violation of Chapter 404, Florida Statutes; Chapter 64E-5, Florida Administrative Code; or the terms of the employer's license or registration can request an inspection by contacting the Bureau of Radiation Control, Bin C21, 4052 Bald Cypress Way, Tallahassee, FL 32399-1741 (850) 245-4266. The request must state specific reasons for the inspection. During inspections, Department of Health inspectors can confer privately with workers and any worker can bring to the attention of the inspectors any past or present condition that they believe contributed to or caused any violation.

Copies of Chapter 64E-5, F.A.C., the license or registration, operating procedures, any notice of violation about working conditions, penalty orders issued, and responses can be examined at:

Environmental Health and Safety, 777 Glades Rd,
CO Bldg #69, Boca Raton, FL 33431, phone 561-
297-3129, fax 561-297-2210, ehs@fau.edu,
www.fau.edu/ehs.