

## APPENDIX K

### UNF RADIATION GENERATING DEVICE SAFETY PROCEDURES

#### Policy and Purpose

This policy provides administrative control over the use of radiation generating devices and is designed to ensure that such devices are operated in a safe manner and are in compliance with the appropriate state or federal regulations or guidelines promulgated by recognized governing committees.

#### Definitions

ALARA – As low as reasonably achievable

Controlled Area – A specified area in which exposure of personnel to radiation or radioactive material is controlled and which is under the supervision of a person who has knowledge of the appropriate radiation protection practices, including pertinent regulations, and who has responsibility for applying them. 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

Enclosed beam – All possible x-ray beam paths are fully contained in a chamber, coupled chambers, or other beam-path-confinement devices to prevent any part of the body from intercepting the beam during normal operations. Normal access to the beam path, such as a sample chamber door, shall be interlocked with the high voltage of the x-ray tube or the shutter for the beam to be considered “enclosed”. An open-beam device placed in an interlocked enclosure is considered an “enclosed beam” unless there are provisions for routine bypassing of the interlocks.

Fail-Safe – A design feature built into the system or its components that causes the system to return to a safe condition if a key component malfunctions in its most likely failure mode(s).

Incidental radiation generating device – A device that emits or produces x-rays during normal operation, and the radiation is an unwanted by-product of the device’s intended purpose. Examples of such devices include scanning electron microscopes, electron pulse generators, and electron beam welders.

Installation Enclosure – That portion of an x-ray installation which clearly defines the transition from a non-controlled area to a controlled area, and provides such shielding as may be required to limit the dose rate in the non-controlled area during normal operation.

Intentional radiation generating device – A device in which particles undergo acceleration in a vacuum to produce x-rays for a particular application. Examples are

medical devices, flash x-ray systems, x-ray diffraction and fluorescence analysis equipment, laser irradiators, and accelerators.

Interlock – A device that precludes access to an area of radiation hazard by either preventing entry or by automatically shutting down the radiation generating device.

Non-controlled area – Any area to which access is not controlled for purposes of radiation protection.

Open beam - An x-ray beam that is not fully contained within a chamber, coupled chambers, or other beam-path-confinement devices (e.g., shutters), or where there are no physical barriers between an individual and the radiation beam.

Primary beam – Radiation generated from an evacuated x-ray tube that has not been diffracted.

Secondary beam – Radiation that has been diffracted from a primary beam or is generated by fluorescence.

Radiation area – Any area accessible to personnel in which there exists radiation at such levels that the whole body, head and trunk, active blood-forming organs, gonads, or lenses of the eyes could receive in any one hour a dose in excess of 5 mrem, or in any 5 consecutive days a dose in excess of 100 mrems, but shall not exceed 5 rem in a year.

Radiation Generating Device (RGD) – A device that generates ionizing radiation either incidentally or intentionally

## Responsibilities

The Principal Investigator (PI) shall notify the Radiation Safety Officer (RSO) of the intended purchase of radiation generating devices. The PI shall notify the RSO of any changes in operational status (operative, inoperative), location or orientation of equipment. The PI is responsible for instructing users in proper safe operating procedures for the equipment.

The individual user (equipment operator) shall observe all safety precautions and operating procedures while using the radiation generating device and shall inform the PI or the RSO of any apparent safety problems associated with the use of such equipment.

The RSO has jurisdiction over all aspects of and has the authority to suspend any operation that constitutes a radiation health hazard to the equipment operators or general public.

The office of Environmental Health & Safety (EH&S) will conduct surveys of all radiation generating devices at the following intervals:

Upon equipment installation,

Following any change in equipment arrangement,  
Following any change in operating parameters,  
Following any maintenance requiring the disassembly or removal of local component,  
When visual inspection reveals abnormal conditions,  
During maintenance or alignment if primary beam is present,  
When area monitoring devices show an increase in exposure, and  
Annually

EH&S requires that training shall be provided in the following areas:

Identification of radiation hazards associated with the use of the equipment,  
Significance of the various radiation warning and safety devices incorporated into the equipment, or the reasons they have not been installed on certain pieces of equipment and the extra precautions required in such cases,  
The operation, calibration and limitation of radiation survey instruments, proper survey techniques,  
Characteristics of x-ray radiation,  
Units of radiation dose,  
Methods of controlling radiation dose, such as time, distance and shielding,  
Symptoms of acute localized exposures,  
Proper procedures for reporting actual or suspected exposure, and  
Applicable state regulations

#### Area Requirements

Radiation levels - The local components of an analytical x-ray system shall be located and arranged and shall include sufficient shielding or have access control such that no radiation levels exist in any area surrounding the local component group which could result in a dose to an individual present therein in excess of the dose limits given in 64E-5.312, (dose limits for individual members of the public from the registered operation does not exceed 0.1 rem (1 millisievert) in a year, exclusive of the dose contribution from background radiation). For systems utilizing x-ray tubes these levels shall be met at any specified tube rating.

#### Procedures

All radiation generating devices per F.A.C 64E-5 shall be registered with the State of Florida Department of Health, Bureau of Radiation Control, Radiation Machine Program. Registration for each piece of equipment will be coordinated through EH&S and a copy of each registration will be maintained in the PI's file.

Prior to the installation of diagnostic x-radiation producing equipment, EH&S shall be contacted to ensure that adequate shielding is present to protect adjacent areas.

Before any radiation generating device is placed in use, EH&S shall be notified so that the device may be surveyed to determine any safety hazards from its use. If after normal use of the device, the operator suspects a radiation hazard may exist, a radiation survey by EH&S shall be requested and performed prior to continued operation.

A copy of the equipments normal operating and safety procedures shall be forwarded to the RSO and a copy will be maintained in the PI's file.

Access to the Radiation Equipment shall be limited to authorized personnel. Entryways shall remain locked when lab personnel are not present.

No individual shall be allowed to operate radiation generating devices unless that person has received the proper training and can demonstrate knowledge and competence in the safe use of the equipment; the purpose and or necessity of each safety device; and radiation safety procedures.

A copy of the written operating and safety procedures shall be in close proximity to the radiation generating device. Operators of each unit shall be aware of the location of the procedures.

Under no circumstance will any unit capable of producing x-rays be operated with any interlock or safety device by-passed without the written authorization of the RSO. The interlock bypass key(s) shall be removed and retained by the RSO, unless an authorized bypass operation is in process. If a by-pass becomes necessary, the PI shall submit a written request to the RSO (e-mail request/authorization is acceptable). The request shall include the date, duration, and reason for the by-pass, how access to the lab will be controlled, and the personnel involved in the procedure. When a safety device or interlock has been bypassed, a readily discernible sign bearing the words "SAFETY DEVICE NOT WORKING" or words having a similar intent, shall be placed on the radiation source housing.

Interlocks shall be tested at least on the same frequency as that specified for the radiological safety survey.

If an interlock malfunctions, it shall be repaired before the equipment may be operated.

Equipment must be operated in accordance with the written operating and safety procedures provided for each unit. Requests to deviate from the operating and safety procedures shall be directed in writing to the RSO for approval. Such requests shall outline the procedure to be changed and the necessity for the change.

The RSO may apply additional safety requirements as it is deemed necessary to protect the health of operators and/or the general public.

In the event of an electronic product accident, the equipment will be shut down according to standard procedures unless it is necessary to use the Emergency Shut Down Button, or

disconnect switch. This should minimize exposures to bystanders. The RSO should then be contacted for additional instructions.

Emergency procedures shall be posted beside or on each x-ray unit. These shall include the PI, RSO and UPD contact numbers for notification reporting of a radiation emergency.