

## ANALYTICAL X-RAY EQUIPMENT

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This Safe Operating Procedure (SOP) summarizes regulatory and UNL policy requirements to possess and operate analytical x-ray equipment. This SOP will include hand-held x-ray systems (e.g., NOMAD Pro Veterinary unit and the NITON XRF Analyzer). Analytical x-ray equipment consisting of electron microscopes or x-ray photo-spectrometers are excluded from the requirements of this SOP except those discussed under the STATE REGISTRATION section.

### DEFINITIONS

Useful regulatory definitions from Nebraska Title 180, Control of Radiation that apply to the use of analytical x-ray equipment are provided below.

**Analytical x-ray equipment** means equipment used for x-ray diffraction or fluorescence analysis.

**Analytical x-ray system** means a group of components utilizing x-rays to determine elemental composition or examine the microstructure of materials.

**Fail-safe characteristics** means a design feature which causes beam port shutters to close or otherwise prevents emergence of the primary beam upon failure of safety or warning device.

**Local components** means part of an analytical x-ray system, including areas that are struck by x-rays such as radiation source housings, port and shutter assemblies, collimators, sample holders, cameras, goniometers, detectors and shielding; but do not include power supplies, transformers, amplifiers, readout devices, and control panels.

**Normal operating procedures** means step-by-step instructions necessary to accomplish the analysis. These procedures shall include sample insertion and manipulation, equipment alignment, routine maintenance by the registrant, and data recording procedures that are related to radiation safety.

**Open-beam configuration** means an analytical x-ray system configured such that an individual could accidentally place some part of his/her body in the primary beam path during normal operation.

**Primary beam** means radiation that passes through an aperture of the source housing by a direct path from the x-ray tube or a radioactive source located in the radiation housing.

### AUTHORIZATION TO POSSESS OR OPERATE ANALYTICAL X-RAY EQUIPMENT

Operation of analytical x-ray equipment must be performed under the supervision of an individual that has been approved by the UNL Radiation Safety Committee (RSC). The

approved individual or Authorized User (AU) must be a faculty or staff member knowledgeable in the operation of analytical x-ray equipment. To become an AU:

- Complete EHS Radiation Safety training for x-ray users.
- Complete vendor-provided equipment training for hand-held x-ray systems.
- Complete an Authorization Application. Obtain an Authorization Application by contacting the Radiation Safety Office. Authorization applications require Department Head concurrence.
- Complete and submit normal operation procedures to the Radiation Safety Office.
- Commission the analytical x-ray equipment and operating location through inspection by the Radiation Safety Office.
- Obtain approval from the UNL RSC.

The use of analytical x-ray equipment in an open beam configuration such as a hand-held x-ray system will require additional procedures and fail-safe characteristics beyond the scope of this SOP. Contact the UNL Radiation Safety Office for additional information.

## **STATE REGISTRATION**

All analytical x-ray equipment must be registered with the Nebraska Department of Health and Human Services, Office of Radiological Health within 30 days of receipt, change in location or disposal. The Radiation Safety Office maintains this registration. The AU shall promptly notify the Radiation Safety Office of any such changes. The receipt of new equipment will require a commissioning inspection by the Radiation Safety Office.

## **TRAINING**

As previously discussed, AUs must complete EHS Radiation Safety training for X-ray users and complete annual Radiation Safety refresher training.

Radiation Workers (RW) are individuals that are approved to use analytical x-ray equipment under the supervision of the AU. RWs must complete the following training:

- EHS Radiation Safety Training for X-ray users.
- Training on normal operating procedures (discussed later in this SOP) for the specific equipment to be used.
- Annual Radiation Safety refresher training.
- Additional vendor-provided equipment training may be required by the RSO.

Training on normal operating procedures is provided by the AU or a designated RW who has completed all training requirements and is knowledgeable in the operation of the equipment. Training on normal operation procedures must be completed in a timely manner following the EHS provided training. Dosimetry, as discussed later in this SOP,

is not issued until all training is completed (not required for training on normal operation procedures). Documentation upon completion of training must be provided to the Radiation Safety Office.

## **RADIATION SURVEYS AND INSPECTIONS**

At a minimum, Radiation Safety Office staff will inspect analytical x-ray equipment annually to evaluate compliance with regulatory requirements. These routine inspections will be scheduled with the AU. X-ray operation by the AU or RW will be required during the inspection.

Additional radiation surveys are required by regulation under certain circumstances. If any of the circumstances listed below occur, it is the responsibility of the AU to promptly notify the Radiation Safety Office to schedule a radiation survey.

- Upon installation of new equipment or removal of the equipment from a “lockout” configuration.
- Following any change in the initial arrangement, number or type of local components in the system.
- Following any maintenance requiring the disassembly or removal of a local component in the system.
- Any time a visual inspection of the local components in the system reveals an abnormal condition.

## **NORMAL OPERATING PROCEDURES**

Written step-by-step instructions necessary to accomplish the analysis are required for each analytical x-ray device and must be available to all RWs. These procedures must provide instruction for sample insertion and manipulation, equipment alignment, routine maintenance, and any data recording procedures that are related to radiation safety.

The AU is responsible to ensure no individual operates the analytical x-ray equipment in any manner other than that prescribed in the normal operating procedures.

Any procedure, maintenance or alignment that requires access to the primary x-ray beam with any local component of the system disassembled or removed requires prior approval by the UNL Radiation Safety Office.

## **DOSIMETRY**

All approved operators of analytical x-ray equipment will be issued dosimetry consisting of a torso badge and finger ring badge. Detailed instructions for the proper use of dosimetry is provided in the EHS SOP, ***Dosimetry Program***. Students participating in laboratory courses, which include infrequent use of analytical x-ray equipment, will not be issued dosimetry. Dosimetry is sent to the appropriate department for distribution to

the AU and their RWs. Dosimetry for new RWs will be sent following successful completion of all previously discussed training requirements.

Analytical x-ray equipment shall not be operated without properly worn dosimetry. If dosimetry is lost, the Radiation Safety Office shall be promptly notified and replacement dosimetry will be issued. Dosimetry is exchanged regularly on a quarterly basis (monthly for fetal dosimeters). It is the responsibility of the AU to ensure dosimetry is returned to the Radiation Safety Office in a timely manner for processing.

## **REPORTING OF SUSPECTED BEAM EXPOSURE**

Exposure to the primary x-ray beam is unlikely if the requirements of this SOP and normal operating procedures are strictly followed. If you suspect that a part of your body has been exposed to the primary x-ray beam, report the suspected exposure immediately to your AU and the Radiation Safety Office at (402) 472-4925 to initiate an exposure investigation.