X-Ray Radiation Safety Management Program

References:
1.) Oklahoma Administrative Code (OAC) Title 252 Department of Environmental Quality (DEQ), Chapter 410 Radiation Management (OAC 252:410).
3.) TU X-ray permit # XR-114.

Introduction:
The radiation safety officer (RSO) is Scott A. Holmstrom, Ph.D. Each X-ray machine is used under the combined supervision of the RSO and the person responsible for the X-ray machine’s safety as identified on DEQ registration form 410-13-2. The person responsible for the X-ray machine’s safety will, hereafter in this document, be referred to as the machine’s “primary user.”

X-ray machines shall be used in accordance with the manufacturer’s instruction and recommendations. Owner's manuals must be accessible to all users and must contain safety procedures.

Acquisition, transfer, sale, or assemblage of an X-ray machine must have prior approval of the RSO. If an outside company is to be contracted for use of an X-ray system on campus, the RSO must be notified in advance.

No person shall operate an X-ray machine until that individual has received radiation safety training and been trained to use the machine in a safe and competent manner. The RSO and the primary user are responsible for making sure that each X-ray operator is properly trained and competent.

Training:
In-person training by both the RSO and the primary user is required to become an authorized user for a particular X-ray machine. The RSO will provide initial radiation safety training in:

- The basics of electromagnetic radiation theory including how it’s produced and how it’s described using wavelength, frequency, and energy.
- Propagation, reflection, refraction, transmission, scattering, and absorption of electromagnetic radiation and how each depends on frequency/energy. This shall include the definitions of ionizing radiation, non-ionizing radiation, X-rays, and gamma rays.
- The known effects of ionizing radiation on human tissue and the difference between chronic and acute exposure.
Following the radiation safety training, authorized user status may be granted only after the primary user for each machine provides initial training in:

- Proper operating and emergency procedures.
- The warnings indicators, safety devices, and interlocks associated with the machine.

Refresher training is required for each X-ray operator annually. Refresher training shall consist of a review of the proper operating procedures and any changes to the radiation management plan. Refresher training is to be conducted by the primary user.

Records of radiation safety training will be maintained for at least three years.

**Supplemental use and safety requirements:**

If an automated, non-portable X-ray system is being used while unattended, access to software/hardware control shall be password protected and the door to the room containing the X-ray machine shall be locked and have appropriate signage. An experiment that automatically completes shall be set to shut off the X-ray tube upon completion.

When not in use, the primary user shall store the operation key in a secure place that is only accessible by qualified X-ray operators.

Portable X-ray producing devices may only be used at temporary jobsites with the permission of the primary user or RSO.

**Safety devices and interlocks:**

For cabinet systems, safety device or interlocks may not be bypassed except by a permitted third party and with prior approval by the RSO.

For handheld systems, the proximity safety device may be disabled for small samples with the approval of the primary user or the RSO.

If there is a malfunction in the X-ray machine, it must be shut down immediately. Repairs may only be made by an appropriately trained party and with the approval of the RSO.

**X-ray machine, posting, and labeling requirements:**

Each room containing X-ray equipment shall be posted with a sign bearing the radiation symbol and words “Caution – X-ray Equipment,” or words having similar intent.

Each X-ray machine shall have a warning light labeled “X-ray On,” or with words and/or symbols having similar intent, that lights up only when the X-ray tube is on.

Each X-ray machine shall be labeled with a sign bearing the radiation symbol and words “Caution Radiation – This Equipment Produces Radiation When Energized,” or words having similar intent, near the switch that energizes the tube.

Each X-ray tube housing that is visible and accessible without the use of tools, shall have a label "Caution – High Intensity X-ray Beam,” or words having similar intent.
Dosimetry:

Personal dosimeters are required for all authorized users. These dosimeters must be evaluated at least quarterly by a laboratory approved through the National Voluntary Laboratory Accreditation Program (NVLAP). If a personal dosimeter is lost, stolen, or damaged, the authorized user will notify the primary user immediately.

The primary user will review the dosimetry records quarterly for elevated levels of radiation exposure. If elevated levels are reported, the primary user will notify the RSO.

Any maintenance involving the removal, assembly, rearrangement, and/or realignment of the X-ray components will require a ring badge to be worn and may only be performed with the prior approval of the RSO.

During use of portable X-ray producing devices, users must wear a wrist or ring dosimeter.

If an X-ray operator is pregnant, she may voluntarily declare the pregnancy by notifying the RSO in writing and provide an estimated date of conception. The RSO will work to ensure compliance with 10 CFR 20.1208.

Reporting Overexposures:

If an overexposure of radiation is suspected, the authorized user or primary user will notify the RSO immediately and the incident will be investigated. If the user feels that the investigation was not handled properly, he/she may contact Oklahoma DEQ (http://www.deq.state.ok.us)

If the radiation is proved to cause or threatens to cause a person to receive:

- a dose exceeding 5 rems, or
- a lens dose exceeding 15 rems, or
- a shallow dose to the skin or extremities exceeding 50 rems,

the RSO will notify DEQ within 24 hours of the discovery of the incident. A report will be submitted to the DEQ within 30 days containing the following information:

- estimates of each individual's dose,
- levels of radiation involved,
- cause of the elevated exposures and dose rates, and
- corrective steps taken or planned to ensure against recurrence.

Area surveys:

Survey meters will be calibrated annually or whenever there is a service/repair performed on the survey instrument excluding battery replacement.

Area surveys shall be performed:

- when an X-ray system is installed,
• every 12 months after installation,
• following any changes in the initial arrangement of the X-ray components, and
• following maintenance requiring removal or disassembly of the X-ray components of the system.

Each area survey record will include the following information:

• the date the survey was performed,
• who performed the survey,
• manufacturer, make, model, and serial number of the X-ray machine,
• the kV and mA settings during the survey,
• the make, model, serial number, and calibration date of the survey instrument,
• the background reading, and
• a diagram of the X-ray instrument with survey locations and results.

Review of the program:

This X-Ray Radiation Safety Management Program will be reviewed annually for program content and implementation by the Radiation Safety Committee.

Registration updates:

If a new X-ray machine is acquired or an X-ray machine is sold, transferred, or disposed of, an updated registration form “Registration of Industrial and Analytical X-Ray Machines” shall be submitted to DEQ within 30 days.

If an X-ray machine is transferred, DEQ shall be notified within 15 days after the transfer in writing with the following information: (i) the name and address of the transferee, (ii) the manufacturer, model and serial number of each transferred machine, and (iii) the transfer date.