



Module 8
GENERAL RULES for
Radiation Producing Machines

Awareness

- Types of X-ray units on campus,
- Nature of X-rays,
- Hazards,
- Radiation protection,
- Regulations
 - State and University

Types of Radiation Producing Machines

- Analytical:
 - X-ray diffraction (XRD),
 - X-ray fluorescence (XRF),
 - MicroCT (μ CT).
- Medical:
 - Radiographic (general medical X-ray),
 - Computed tomography (CT),
 - Dual x-ray absorptiometry (DEXA),
 - Fluoroscopic (continuous output of medical X-ray).

Analytical

- X-ray diffraction (XRD).
- X-rays produced are enclosed inside the unit by shielded doors.
- Under no circumstances should the shielded doors be opened during X-ray production.
- Interlocks will shutdown the XRD in case of accidental opening of the shielded doors.



Analytical

- X-ray fluorescence (XRF).
- This is a handheld X-ray unit.
- Used to analyze rocks and soil.
- Sample must be in contact with the XRF.
- Under no circumstances shall the XRF be pointed at an individual.
- Proximity sensors are used to prevent accidental firing of the XRF.
- Individuals using XRF's are required to complete manufacturer training and provide proof of training to the Radiation Safety Office.



Analytical

- MicroCT (μ CT).
- X-rays produced are enclosed inside the unit by shielded doors.
- Under no circumstances should the shielded doors be opened during X-ray production.
- Interlocks will shutdown the XRD in case of accidental opening of the shielded doors.



Medical

- General radiographic X-ray unit.
- X-rays produced are not enclosed in the unit. This is an open beam unit.
- This unit must be placed in an approved shielded room.
- The operator must stand behind a shielded control booth. Under no circumstances can the operator be exposed to the primary beam.



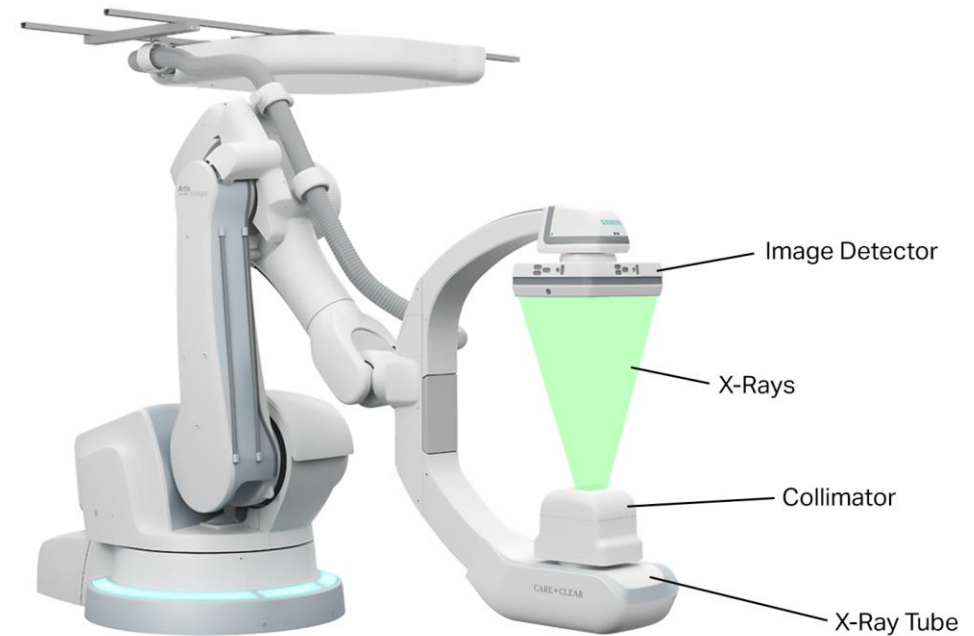
Medical

- Computed tomography (CT).
- X-rays produced are not enclosed in the unit. This is an open beam unit.
- This unit must be placed in an approved shielded room.
- The operator must stand behind a shielded control booth (usually a separate room). Under no circumstances can the operator be exposed to the primary beam.



Medical

- Fluoroscopy.
- X-rays produced are not enclosed in the unit. This is an open beam unit.
- Operator must wear a leaded apron during operation of the unit.



Nature of X-rays

- X-rays are a form of ionizing radiation in the electromagnetic spectrum.
- They are produced when electrons being accelerated using a high voltage power supply are slowed down by interacting with a metal target such as tungsten or copper.
- When the electrons strike the metal target, X-rays are produced through a process called Bremsstrahlung.
- The maximum X-ray energy is usually equal to the maximum voltage produced on the X-ray tube.

Nature of X-rays

- The energy and number of X-rays produced by the X-ray tube is proportional to the operating potential voltage (kVp) and current (mA).
- The higher the kVp, the more energetic X-rays are produced.
- The higher the mA, the greater number of X-rays are produced.
- All X-ray units have a designated maximum kVp and mA associated with them.

Hazards

- X-rays can travel great distances and penetrate many materials.
- X-rays can cause radiation burns if any part of the body is in the direct path of the beam.
- Shielding is used to attenuate X-rays.
 - Lead (most often used),
 - Concrete.

Radiation Protection

- All users of X-ray equipment on campus must have a personal dosimetry badge.
- For users of XRF units, a ring badge is also required.
- For users of fluoroscopy or C-arm units, three badges are required, that is, a collar, waist and ring. Users must also wear a leaded apron.
- Personal dosimetry badges do not protect against radiation, so time, distance and shielding must be used to protect oneself from X-rays.

Radiation Protection

- Never remove shielding or covers for an X-ray unit without prior permission from the Radiation Safety Office.
- Never place any body parts in the primary beam.
- Never use your hands to hold a sample.
- Never bypass the interlocks for any X-ray unit. Especially the ones that have shielded doors.
- Never use an X-ray unit that has technical or mechanical problems.

Radiation Protection

- Control the access to X-ray units during use to avoid any unintentional exposures.
- Never allow individuals who are not trained in radiation safety or do not have a radiation badge to operate an X-ray unit.
- You must know the operating/safety procedures for the X-ray unit you are going to use.
- Always operate the X-ray unit at the specific kVp and mA approved by the Radiation Safety Office on your radiation use application.

Regulations

- All personnel who are going to use X-ray units at LSU must review the radiation safety modules and take the radiation safety exam.
- Never move an X-ray unit from its location that is listed in the radiation user application without the approval from the Radiation safety Office.
- You must follow the procedures for use of the X-ray unit that was submitted on the radiation use application. Any deviations must be approved by the Radiation Safety Office.
- You must be familiar with the standard operating procedures associated with your X-ray unit.

Regulations

- The room where the X-unit is stored and used must be approved by the Radiation Safety Office.
- A DRC-6 (registration certificate with the State of Louisiana) must be present on or next to the X-ray unit.
- The console must have a sign containing the statement “Caution Radiation – This equipment produces radiation when energized”.
- There must be warning lights with the statement “X-ray On” located on or near the console/unit and is illuminated only when the unit is energized.
- SOP’s must always be available to operating personnel.

Regulations

- Whenever the X-ray tube or interlock is serviced, an inspection is required by the Radiation Safety Office.
- All installations/service of X-ray units must be performed by a licensed service provider approved by the Louisiana Department of Environmental Quality (LDEQ). Please contact the Radiation Safety Office for a list of approved service providers.
- All X-ray units on the LSU Campus, except for electron microscopy, are required to be registered with the LDEQ. The Radiation Safety Office is responsible for these registrations, and they must go through the office.
- Shielding evaluations also require the approval of the LDEQ.