SC-XRD Safety Overview

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Overview

The Rigaku XtaLAB Mini II SC-XRD is housed in the Department of Chemistry and Physics, Apodaca Building Room 314.

The instrument is meant to be used to support classroom/laboratory activities and for research purposes. All individuals, whether faculty or student, should obtain X-ray safety training from Matt Burleson, Instrumentation Specialist, prior to use. All users are required to document that they have received proper training! Likewise, all users are required to sign in using the log sheet in this binder.

Access to the SC-XRD must be restricted according to state law. This is done with password protection on the computer. Users should not share the password with anyone and should log out when they've completed their run. Additionally, individuals who have not had training should never enter the room containing the instrument(s).

The SC-XRD is fully shielded and does not require any personnel monitoring. Since the instrument is fully shielded, radiation surveys will be completed per NC Regulations for Protection Against Radiation, Section 0.804. They will be performed:

- Within 30 days of initial operation
- Prior to use following any change in the initial arrangement, including the number or type of local components in the system; and
- Prior to use following any maintenance requiring the disassembly or removal of a local component in the system that could affect the radiation exposure of personnel.

Testing of interlocks, shutters, and warming lights will be tested annually and documented.

A Ludlum 14C Survey Meter and detector are available for the surveys.

The North Carolina Radiation Protection guidelines are available via a shortcut on the SC-XRD computer desktop.

Additional information can be found in the binder dedicated to the instrument.

Personnel Requirements

No one will be permitted to operate or maintain analytical X-ray equipment unless the person has received instruction in:

- Identification of possible radiation hazards and the biological effects associated with equipment use.
- Significance of the various radiation and safety devices incorporated into the equipment.
- Proper training in equipment operation.
- Proper procedures for reporting actual or suspected exposure.

Hazards of X-ray Radiation

- X-rays are energetic radiation that can ionize matter.
- Ionizing radiation deposits energy, thereby causing chemical changes in cellular matter and thus biological changes.
- The changes to living cells include cell transformations, non-repairable cellular damage, cell death, and damage to genetic material.
- The extent and type of injury depends on the energy (wavelength) of the radiation and the intensity (amount) of radiation.
- The extent and type of injury also depends on the distance from the source. (Inverse square law -- intensity decreases with the square of distance.)
- Intensity from a scattered beam is much less than that from a direct beam.
- X-rays are invisible and impossible to see! The strongest intensity is in the path of the direct beam.

XtaLAB Mini II Safety Features

- The apparatus is equipped with a circuit breaker that will turn off in the event of a ground fault.
- The instrument is entirely contained within a metal enclosure, except for the computer.
- The enclosure door can only be opened by pressing the "Door Lock" button. This will halt the production of X-rays.
- The system has a key insertion slot labeled "HV Enable" on the front panel. When the key is turned clockwise X-rays will/can be generated. When the key is turned counter-clockwise X-ray generation will halt. **This key should never leave the room. Notify emergency contacts immediately if the key is missing.**
- The top of the instrument contains X-ray indicator lights that glow when the X-ray source is on.
- The X-ray tube runs at fixed settings of 50 kV and 12 mA.
    - If the tube voltage does not reach -10% of the set value, the X-rays are turned off by the low-voltage limiter (LVL) being actuated.
    - If the voltage rises above 10% of the set tube value (standard setting), the X-rays are turned by the over current limiter (TCL) being actuated. **The tube-current limiter is set according to the rated load of the X-ray tube.**
    - The overload limiter (OLL) actuates to turn off the X-ray system within approximate +10% of the set value of the OLL is equal to less than 1 kW. **The OLL value is set according to the rated load applied to the X-ray tube.**
    - If a broken filament wire is detected, or the output of the tube-current op-amp is +10V or more, the broken filament wire and limiter (FILOPEN) is actuated to turn off the X-rays.
    - If the tube voltage (at standard setting) is +10% more than the set value, the over voltage limiter (HVL) actuates to turn off the X-rays. The thermostat temperature error will actuate to turn off the X-rays when the high voltage inverter cooling heat sink is overheated. Both of these are within the high-frequency power-supply error (PSFLT).
    - If there is a ±2 kV deviation for kV, or a ±2 mA deviation, the output deviation error (Feedback err) actuates to turn off the X-rays.
- Do not tamper with the interlocks or other safety devices!
- In the event of an emergency, the large, round, red pushbutton on the front of the instrument will turn it off immediately. Likewise, the "HV Enable" key may be turned counter-clockwise. Lastly, the instrument can be unplugged in the event of an emergency.
- Changing of the X-ray tube should only be done under the direct supervision of a person trained in the procedure.
    - Handle the tube carefully
    - Run water for 30 minutes to cool it down and prevent burns.
    - The tube windows are made of beryllium. Beryllium is ***toxic***! If you touch it with your hands wash immediate with warm soapy water. Beryllium is also fragile -- do not touch it!
- The X-ray tube requires constant cooling when on and for 30 minutes after it has been shut off. Use the water chiller for this purpose.
- A CW error will display if water flow is insufficient to cool the X-ray source.
- Do not move, open, modify, or otherwise tamper with the equipment unless accompanied by trained personnel. (Moving the equipment requires a change to the Notice of Registration!)

Emergency Procedures

If you believe radiation is leaking from the cabinet or you hear otherwise unexplained warning signals, you may ***press the red, round pushbutton*** on the front of the instrument, turn the "HV Enable" key counter-clockwise or unplug the instrument to immediately cut power and shut off the X-rays.

If you execute an emergency stop, immediately notify one of the emergency contacts below and explain the reason for the stop (start at the top of the list and work your way down until you contact someone).

Emergency Contacts

Contact	Role	Office	Email	Phone
Matt Burleson	**Instrumentation Specialist, XRD Authorized User**	**AP 346**	**mburleson@wcu.edu**	**828-227-2239**
Wes Bintz	Research Operations Manager, Arts & Sciences	AP 221	wwbintz@wcu.edu	828-227-2270
Jamie Wallen	Department Head, CHPH	AP 112	jamiewallen@wcu.edu	828-227-3667
Jon Maddy	Director, Safety and Risk Management	-	jmaddy@wcu.edu	828-227-7442
Amanda Lytle	Lab Safety Officer, Safety and Risk Management	-	alafferty@wcu.edu	828-227-3645
Campus Police	**Non-emergency**/after hours contact	-	-	828-227-730
Campus Dispatch	Fire/Medical/Police Emergency Response	-	-	828-227-8911
NC Radiation Protection Section	State Emergency Center	-	-	800-858-0368