

DEPARTMENT OF CHEMISTRY, PHYSICS AND GEOLOGY RADIATION SAFETY PLAN

The requirements and procedures outlined in this plan are provided in addition to the requirements outlined in the University's Radiation safety Plan.

RESPONSIBILITIES

Chair of the Department

Has ultimate responsibility for the radiation safety program in the Chemistry Department. The chair must ensure that an effective radiation program is in place and supported by everyone in the department.

Department Radiation Safety Coordinator

The Department Radiation Safety Coordinator (DRSC) will have the following responsibilities:

- Assist the University Radiation Safety Officer (RSO) with implementation of the University's Radiation Safety Program within the academic department.
- Develop and implement a departmental radiation safety plan which incorporates the equipment manufacturer's standard operating and safety procedures.
- Verify that the manufacturer's standard operating and safety procedures are posted near the x-ray equipment and available to all designated users.
- Verify that all x-ray equipment users have completed radiation safety training appropriate to their level of responsibility, as well as other department-specified safety training, and maintain department training records.
- Conduct periodic laboratory inspections to verify compliance with the department radiation safety plan.
- Conduct equipment and area surveys, including testing of equipment safety devices, as dictated by the departmental radiation safety plan. Maintain records of all surveys and tests.
- Schedule the required annual calibration of all survey equipment with the RSO.
- Respond to accident and emergency situations.

Principal Users

A principal user will be a faculty member who has been approved by the Department Chair to independently possess and use analytical x-ray equipment with direct responsibility for the equipment and any individual user thereof. Principal users will be responsible for:

- Satisfactory completion of Radiation Safety Training
- Confirming that each individual user working in the laboratory has completed radiation safety and laboratory safety training as specified by the department and reporting training information to the DRSC.
- Providing individual users with initial and annual refresher in-laboratory training which includes equipment-specific operating and safety procedures, and verification of the user's competence through personal observation.

- Ensuring that equipment-specific standard operating and safety procedures are posted near the equipment and providing a copy of the procedures to all individual users under their direction.
- Ensuring that all x-ray equipment under their control is registered with the RSO and notifying the RSO of any changes to registered equipment or personnel authorized to use it.
- Notifying the RSO of plans to procure additional x-ray equipment prior to initiating the purchase.
- Responding to incidents and emergencies in the x-ray diffraction laboratory and reporting incidents to the DRSC.

Individual Users- Faculty/Staff Members and Students

An individual user will work with analytical x-ray equipment under the supervision of a principal user, but is capable of doing independent work or research. An individual user has the following responsibilities:

- To satisfactorily complete all required laboratory and radiation safety training.
- To follow equipment-specific standard operating and safety procedures.
- To observe the radiation safety rules for analytical x-ray equipment as presented in this manual.
- To immediately notify the principal user, the DRSC, or the RSO of any defects or deficiencies in radiation protective devices and procedures.
- To utilize appropriate protective equipment and personnel monitoring devices, should they be issued.
- To know what to do in the event of a radiation emergency.
- To perform all work with radiation in a manner that will keep exposures as low as reasonably achievable (ALARA).

Student User

A student user works with analytical x-ray equipment only as part of a classroom requirement approved by the Department Chair. Student users must be under the **direct** (in-the-room) supervision of a principal user at all times. Student users are not allowed to perform independent work using the analytical x-ray equipment.

University Radiation Safety Officer

Oversees the University's Radiation Safety Program as outlined in the University's Radiation Plan.

SAFETY REQUIREMENTS

Labeling

The x-ray diffraction laboratory, Sims 306, must be posted with a sign bearing the radiation symbol and a warning such as "CAUTION- X-RAY EQUIPMENT".

A label must be placed near the switch which energizes the x-ray tube indicating to the user that the instrument produces radiation when energized, such as "Caution- Radiation. This Equipment Produces Radiation when Energized".

A label must be placed on the X-ray source housing with wording such as "Caution-High Intensity X-Ray Beam".

Warning Lights

An easily visible warning light that is illuminated only when the tube is energized must be located near the switch that energizes an X-ray tube.

Safety Devices

Interlocks are put in place to prevent access and exposure to the primary beam. The Rigaku MiniFlex system is fully interlocked so that the x-rays will turn off if a cover is removed. When opening the door of the MiniFlex in order to mount or dismount a sample, a shutter is closed to block the x-rays and protect the user from any radiation exposure. Once the door is closed, the shutter will open.

Users must not disable, alter, modify or bypass any safety interlocks associated with X-ray equipment. Bypassing or manipulating the interlocks presents the potential for dangerous exposure.

Safety interlocks shall not be used to de-activate the X-ray beam except in an emergency or during testing of the interlock system.

Unused ports shall be secure in a manner which will prevent accidental opening. Open beam unit shall have a shutter over the port which cannot be opened unless a collimator or coupling has been connected.

Each port is equipped with a shutter that cannot be opened unless a collimator or a coupling device has been connected to the port.

Radiation Surveys

A radiation survey meter must be available to user and stored in x-ray diffraction laboratory. The survey instrument shall be kept clean, batteries shall be checked periodically and the instrument calibrated at intervals not to exceed one (1) year.

Radiation surveys shall be performed and documented in the instrument usage log book:

- 1) Upon installation of the equipment and at least once every six months thereafter to monitor leakage radiation.
- 2) Following any change in the initial arrangement, number, or type of local components.
- 3) Following any maintenance which requires the disassembly or removal of a local component.
- 4) During the performance of maintenance and alignment procedures which requires the presence of a primary beam and the disassembly or removal of a local component.
- 5) When a visual inspection of the local components reveals an abnormality.

Users of the x-ray diffractometer must perform **daily radiation surveys**. The survey should include monitoring for stray radiation in the immediate vicinity. The results of the daily radiation survey will be recorded in the instrument usage log book.

When conducting a **daily radiation survey**,

- The survey meter should be set as ??????
- The radiation level around the immediate vicinity of the instrument with the instrument door closed must be compared to the background radiation. The background radiation level outside the room (in the hallway) will serve as the standard. Thus, when conducting a radiation survey, survey the immediate vicinity around the instrument with the instrument door closed and compare the maximum reading to the maximum background reading outside the room in the hallway. Record the maximum reading of both locations in the instrument usage log book.
- If the maximum radiation level around the instrument is within \pm ?? cpm of the maximum background reading, the instrument is safe to use.
- If the maximum radiation level around the instrument is outside this range, the instrument is not safe to use. Immediately report these levels to Pam Jaco, Maria Gelabert, Cliff Calloway or Kathie Snyder.

Repairs

No operation involving removal of covers, shielding materials or tube housings or modifications to shutters, collimators or beam stops can be performed without ascertaining that the tube is off and will remain off until safe conditions have been restored. The main switch, rather than interlocks, must be used for routine shutdown in preparation for repairs.

Safety Device Tests

Tests of all safety devices such as interlocks, shutters and warning lights and a radiation exposure survey will be conducted for the Rigaku MiniFlex 600 XRD system by a principle user. Records of all tests will be maintained in the instrument usage log book kept in Sims 306. Tests will be conducted:

- annually
- upon installation of the instrument
- after any major changes in equipment configuration
- after any maintenance to the instrument
- when visual inspection of the local components in the system reveals an abnormal condition

A hand held radiation monitoring instrument is available to all users. The survey meter will remain in Sims 306.

X-Ray Radiation Safety-General Precautions

The Rigaku MiniFlex 600 XRD system is a closed system. Under normal operation, exposure to scattered radiation from the instrument is extremely low.

No personnel dosimeter is required for routine operations.

The Rigaku MiniFlex system is fully interlocked so that the x-rays will turn off if a cover is removed. When opening the door of the MiniFlex in order to mount or dismount a sample, a shutter is closed to block the x-rays and protect the user from any radiation exposure. Once the door is closed, the shutter will open.

User should always verify that the beam shutter is closed before reaching into primary beam.

GENERAL REQUIREMENTS FOR USING THE DIFFRACTOMETER

All users must be trained before using the diffractometer and adhere to all training requirements. See TRAINING REQUIREMENTS below.

All personnel involved in the installation, maintenance, repair or use of the Rigaku MiniFlex system must be registered with the Radiation Safety Office.

The first user of the day must perform a radiation survey using the hand held radiation monitoring instrument. The results of this daily pre-operational check must be recorded in the instrument usage log book.

An instrument usage log book must be maintained. The log book must be located by the instrument and every user must log their usage of the instrument.

CLASSIFICATIONS OF USERS

Principal User- A principal user is a faculty or staff member who has been approved by the Department Chair to independently possess and use analytical x-ray equipment with direct responsibility for the equipment and training of individual users and/or student users.

Individual User – An individual user may be an employee (faculty or staff) or student who works with analytical x-ray equipment under the supervision of a principal user, but is capable of doing independent work or research.

Student User - A student user works with analytical x-ray equipment only as part of a classroom requirement approved by the Department Chair. Student users must be under the **direct** (in-the-room) supervision of a principal user at all times. Student users are not allowed to perform independent work using the analytical x-ray equipment.

TRAINING REQUIREMENTS

No person is permitted to operate the x-ray diffractometer unless such person has received instruction and demonstrated competence in radiation safety and proper instrument use.

Principle Users and the Department Radiation Safety Coordinator

The Department Radiation Safety Coordinator and principle users of the instrument must be trained by the University Office of Environmental Health and Safety in general radiation safety before using the instrument. This training, offered in various formats, will cover the following topics and include a written examination:

- General properties of ionizing radiation
- Principles of radiation detection
- Radiation hazards associated with the use of the equipment
- Biological effects of ionizing radiation
- Procedures to minimize exposure
- Radiation safety regulations for the equipment
- Emergency procedures
- Proper operating procedures for the equipment
- Purposes and functions of equipment radiation warning and safety devices
- Winthrop University's Radiation Safety Program

Training of all principal users must be recorded in the training log book located in Sims 306 and reported to the Department Radiation Safety Coordinator who will maintain records of all trained principle users. All training and reporting of training must be completed before using the instrument.

The Department Radiation Safety Coordinator will maintain records of all trained principle users and will provide such information to the University Radiation Safety

Officer. Training of all principle users will be recorded in the faculty/staff training log book located in Sims 306 with an additional copy (hard copy or digital copy) of all records located in Sims 109B.

The vendor will train at least two principle users in the use of the instrument which will include detailed instructions on the operations, hazards and radiation warning devices of the instrument. Any faculty or staff member who needs training on the use of the instrument can be trained by a principle user.

In summary, before a principle user can use the x-ray diffractometer,

- the principle user must complete radiation safety administered by the University's Office of Environmental Health and Safety;
- Be trained by in the use of the instrument by a principle user who is already trained;
- Complete and pass the radiation safety quiz with an 80%.

Individual Users- Faculty/Staff Members

Principal users will determine the extent of training necessary for individual users under their control, based on the intended use of the equipment and the anticipated degree of supervision. At a minimum, individual users must receive training in:

- Radiation hazards associated with the use of the equipment
- Biological effects of ionizing radiation
- Procedures to minimize exposure
- Emergency procedures
- Standard operating procedures for the equipment
- Purposes and functions of the radiation warning and safety devices

Individual users who will be monitoring analytical x-ray equipment should also read the appropriate sections in Section 5 of this manual. Competence should be demonstrated by passing a written examination administered by either the principal user or the DRSC. A ***Training Acknowledgment Form*** must be completed, signed by the individual user and the trainer, and kept on file in Sims 306. A copy must be submitted to the DRSC.

Individual Users- Students

Before a student can use the x-ray diffractometer, the student must:

- attend chemical safety training before working in the x-ray diffraction lab;
- take and pass the general safety training quiz with a 100%;
- receive training in basic radiation safety as indicated above; See **Training Individual Users-Faculty/Staff**
- take and pass the radiation safety training quiz with an 80%;
- receive training from a trained principle user before using the instrument;

- the principle user must observe the student using the instrument and the student must demonstrate competence in radiation safety principles before being allowed to use the instrument.

A *Training Acknowledgment Form* must be completed, signed by the individual user and the trainer, and kept on file in Sims 306. A copy must be submitted to the DRSC.

Students cannot perform the daily pre-operational checks without the assistance of a principal user.

Students are not allowed to use the x-ray diffractometer outside the hours of 8:00 am and 6:00 pm unless there is a principal user present in the room.

Students using x-ray equipment as part of a classroom requirement under the **direct** supervision (in the room) of a principal user are not required to take the radiation safety test.

Training of all students must be recorded in the training log book located in Sims 306. Additionally, research mentors must also maintain training records.

LAB ACCESS

Visitors are not permitted in the lab unless prior approval is obtained from the Chair of the Department and must be accompanied by a principal user.

Custodial personnel will not enter Sims 306. Trash cans will be placed outside the door in the hallway for trash removal.

SURVEY METER MAINTENANCE

Instrument maintenance consists of keeping the instrument clean and periodically checking the batteries and the calibration. The Model 3 instrument may be cleaned with a damp cloth (using only water as the wetting agent). Do not immerse instrument in any liquid.

Never store the meter over 30 days without removing the batteries.

Recalibration must be accomplished annually and after maintenance or adjustments have been performed on the meter. Recalibration is not normally required following instrument cleaning, battery replacement, or detector cable replacement.

The survey meter will be sent to Ludlum Measurements (or a similar capable company) at least once a year for recalibration.

RADIOLOGICAL EMERGENCY PROCEDURES **306 Sims Science Building**

- 1) Turn the x-ray equipment off, if possible, and have the person remain in the area until an authorized individual arrives. Do not stay in the room if the equipment is on.
- 2) Remove an unconscious victim from the room as quickly as possible if the equipment cannot be immediately turned off.
- 3) Call the Radiation Safety Officer (RSO), **Mitzi Stewart - 803-242-9545**.
- 4) Notify at least one person from the Chemistry Department line of authority below:
 - **Kathie Snyder**, Radiation Safety Coordinator – **803-323-4947**
 - **Pam Jaco**, Sims 306 Principal User – **803-323-4931**
 - **Pat Owens**, Department Chair – **803-323-4925**
- 5) Call **Campus Police** at **803-323-3333** to initiate emergency medical response if needed. *Individuals exposed to x-rays are not radioactive and cannot harm others. No precautions for radiation are needed when handling victims.*

South Carolina Bureau of Radiologic Health

Normal Work Hours: (803) 545-4400

After Hours, Weekends, Holidays: (803) 690-8286 (pager)