***STANDARD OPERATING PROCEDURE – R003***

**Using an X-ray generator**

1. **Objectives**

The objective of this document is to establish standard operating procedures for using an X-ray generator, ensuring the safety of laboratory personnel by mitigating potential risks associated with hazardous materials and injuries. Additionally, this SOP aims to enhance the efficiency of experimental workflows.

1. **Personal Protective Equipment**

To ensure safety of using an X-ray generator, appropriate personal protective equipment (PPE) must be worn. This includes:

* Long pants and closed-toe shoes to protect against spills and splashes.
* A long-sleeved, buttoned lab coat to minimize skin exposure.
* Safety glasses or goggles to protect against splashes or flying debris.
* A personal dosimeter must be worn by personnel working with X-ray.
* Disposable nitrile gloves to prevent direct contact with hazardous materials.
* Insulated gloves for handling high-voltage components, if maintenance is required.
* If the user has long hair, it should be tied back.

1. **Potential Hazards**

Using an X-ray generator poses various hazards that must be managed to maintain a safe working environment. These include:

* **Radiation Hazards:** Direct, prolonged exposure to X-rays can cause severe burns, DNA damage, and increased cancer risk. Scattered or leaked radiation from misaligned equipment or improper shielding.
* **Electrical Hazards:** Electrocution risk due to high-voltage components (e.g., X-ray tube, power supply). Faulty wiring or improper grounding may lead to electrical fires.
* **Mechanical Hazards:** Pinch/crush injuries from moving parts (e.g., sample stages, shutters). Vacuum-related hazards (implosion risk if equipment is compromised).
* **Bypassing Safety Circuits:** Tampering with interlocks or safety systems is prohibited unless during authorized maintenance.
* **Chemical hazards:** Hazardous chemicalscould be present from any materials that are used in conjunction with the X-ray generator. Safety data sheets (SDS) from all chemicals must be read and understood prior to the start of an experiment.

1. **Training / Licenses**

Ensure all personnel have received proper training on their hazards and safe handling techniques. All users that will use X-ray must complete the relevant training and undergo medical surveillance and register as a radiation worker prior to start of work.

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Ensure the licenses for the apparatus, users and workers remain valid.

1. **Procedures**
2. Pre-Operation Checks

* The risk assessment for X-rays should be read and understood by all users prior to the use of the X-ray generator.
* Inspect the X-ray generator for any visible damage or irregularities. If the equipment does not appear to work as expected, stop all work immediately. Arrange for the equipment to be checked and repaired (if necessary).
* Ensure that all safety equipment, including emergency shut-off switches, is functional.
* Check the area is free from unnecessary personnel and that warning signs are posted.

1. Setting up the X-Ray generator

* Follow the manufacturer’s instructions to configure the X-ray generator.
* Ensure that all connections are secure, and that the generator is properly calibrated.
* Verify that the power supply and cooling systems are properly connected.

1. Operation of the X-Ray Generator

* Wear all the required PPE before starting the generator.
* Turn on the X-ray generator according to the manufacturer’s guidelines.
* Use the generator in accordance with established protocols, ensuring that all safety interlocks are engaged.

1. Post-Operation Procedures

* Turn off the X-ray generator and allow it to cool down as per manufacturer specifications.
* Conduct a thorough inspection of the equipment to ensure it is in good working condition for future use.
* Clean the workspace and ensure that all equipment is powered off and stored properly.

1. **Incident Report**

* Notify the Principal Investigator (PI) or departmental safety officer (DSO) immediately of any accidents, spills, or equipment malfunctions.
* For serious incidents, contact the Security Unit right away by calling the 24-hour hotline on **2358 8999**.

1. **References**

* Guss, M. & Coleman, N. (2014). *SOP SMB038.2 (MG NC 0314): Using an X-ray generator.* The University of Sydney*.*
* Safety and Environmental Protection Manual *- Chapter 10: Radiation Safety | Health, Safety and Environment Office - the Hong Kong University of Science and Technology*