***STANDARD OPERATING PROCEDURE – E006***

**Nuclear Magnetic Resonance (NMR) spectroscopy**

1. **Objectives**

The objective of this document is to establish standard operating procedures for the nuclear magnetic resonance (NMR) spectroscopy, 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 the nuclear magnetic resonance (NMR) spectroscopy, 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.
* Disposable nitrile gloves to prevent direct contact with hazardous materials.
* Cryogenic gloves for handling ultra-low-temperature materials.
* Safety glasses or goggles to protect against splashes or flying debris.

 If the user has long hair, it should be tied back. Remove all metallic decorations and devices, such as rings, bracelets, necklaces, piercings, earphone and hearing aids before approaching the NMR machine to avoid interference with the magnetic field and prevent injury.

Laboratory workers with pre-existing conditions, including but not limited to allergies, immunocompromised states, chemical sensitivities, or those who are pregnant or planning pregnancies should notify their supervisors and medical specialists. Should any concerns be expressed by these workers, their job duties and activities should be reviewed.

1. **Potential Hazards**

The nuclear magnetic resonance (NMR) spectroscopy poses various hazards that must be managed to maintain a safe working environment. These include:

* **Strong Magnetic Field:** Risk of injury or interference with medical devices (e.g., pacemakers, hearing aids, or orthopedic implants) due to the strong magnetic field generated by the NMR magnet. Personnel with such implants must not work with the NMR machine and must stay outside the 5-gauss line.
* **Struck-by Hazard:** Risk of injury from ferromagnetic objects (e.g., tools, keys, or pens) being rapidly attracted to the NMR magnet.
* **Cryogenic Burns:** Risk of burns or frostbite from exposure to liquid helium or liquid nitrogen used to cool the NMR magnet.
* **Asphyxiation:** Risk of suffocation due to oxygen displacement in confined spaces if large volumes of helium or liquid nitrogen escape during maintenance or refilling.
* **Sharps Hazard:** Risk of cuts or punctures from handling narrow and fragile NMR sample tubes.
* **Chemical Exposure:** Risk of exposure to toxic or hazardous chemicals used in sample preparation if not handled properly.
* **Electrical Hazards:** Risk of electrical shock, short circuits, or fires due to malfunctioning equipment or improper use of the NMR spectrometer.
1. **Procedures**
2. Preparation
* Apart from heart pacemakers and metallic implants that should not be taken near the NMR, **magnetic tape and magnetic strip credit cards SHOULD NOT** be brought to the vicinity of the NMR magnet.
* All users should have undergone training before using the NMR machine.
* Review the protocols to familiarize yourself with the specific NMR method and sample requirements.
* Prepare samples in appropriate NMR sample tubes, ensuring they are clean and correctly labelled.
* Before running the samples, inspect the NMR instrument for any visible signs of damage or malfunction.
* Radioactive samples or other samples considered dangerous should not be allowed near the NMR machine.
* Identify the magnetic influence zone and clearly mark the zone.
1. Setup
* Ensure all PPE is worn before operating the NMR.
* Carefully load the NMR sample tube into the sample compartment, making sure it is secure.
* Confirm that the area around the NMR is clear of ferromagnetic materials.
1. Operation
* Ensure nobody is inside the magnetic influence zone.
* Power on the NMR spectrometer and follow the software prompts for initialization.
* Set the appropriate parameters for the experiment, including pulse sequences and temperature.
* Start the NMR machine and monitor the process for any irregularities.
1. Post-Run Procedures
* After the run is complete, carefully remove the sample from the instrument.
* Clean the area around the NMR and dispose of any waste materials according to lab protocols.
* Review and analyze the NMR spectra generated, documenting all findings.
1. **Incident Reporting**
* Promptly notify the Principal Investigator (PI) and/or the departmental safety officer (DSO) of any accidents, spills, or equipment malfunctions
* For serious incidents, contact the Security Unit immediately by calling the 24-hour hotline on **2358 8999**.
1. **References**
* Kwan, A. (2016). *SOP\_SMB021: Using Nuclear magnetic resonance (NMR) spectroscopy.* Risk Assessment. The University of Sydney.
* Coleman, N. & Kerr, P. (2014). *SOP SMB021.2 (PK NC 0314): Nuclear magnetic resonance (NMR) spectroscopy.* The University of Sydney.
* Health, Safety and Environment Office, The Hong Kong University of Science and Technology (2023). *Section P:* *Non-Ionizing Radiation Safety*. Retrieved on June 30, 2025, from https://hseo.hkust.edu.hk/sm\_10