

Standard Operating Procedure

Magnetic Resonance Imaging Safety Procedures at PERFORM

PC-SOP-IM-003-v04

Revision History

Version	Reason for Revision	Date
04	Minor changes to reflect current practices New SOP format <ul style="list-style-type: none"> • Removed table of contents • Revised definition table • Removed appendices to become independent form or document 	10-Dec-2019

I. Overview

1.1 Background

Work involving magnetic resonance at high magnetic field strengths presents unique hazards to both research participants and individuals working within and around the MRI equipment. There is a potential for serious personal injury.

1.2 Purpose

This Standard Operating Procedure (SOP) outlines the requirements for the safe access and operation of the MRI scanner in order to minimize the risk of an adverse incident. It also describes the procedures to respond to emergency situations.

1.3 Scope

This SOP applies to all PERFORM users working with or around the MRI, including but not limited to PERFORM researchers, staff, university auxiliary staff, students, research participants and authorized visitors.

2. Definition of Terms

Magnetic Field	A force field created by a magnet or as a consequence of movement of electric charges
Medical Device	Includes internal/external electronic devices, metallic implants, surgical clips, prostheses, and hearing aids
Quench	Refers to the loss of liquid nitrogen or helium cooling of superconducting coils in magnets present in MRI equipment with total loss of magnetic field
Radiofrequency Field (RF)	An electromagnetic field oscillating, in the case of MRI studies, in the range of 30 KHz and 300 GHz
Technologist	An authorized and qualified user with specialized training on a given equipment; normally carrying a certification.

3. Responsibility

All users are responsible for:

- Following all applicable safety rules and practices.
- Reporting all potential hazards, unsafe conditions or safety issues to the Associate Director, Bio Imaging or delegate.
- Using and wearing personal protective equipment.
- Attending all applicable training courses.

3.1 Associate Director, Bio Imaging (or delegate)

The Associate Director, Bio Imaging or delegate, has overall responsibility for safety and general training of all users.

3.2 Principal investigator/Project lead

The principal investigator/project lead is responsible for ensuring his/her team members and all users in her/his team have completed the proper training to be able to conduct activities in a safe manner.

3.3 Relevant documents

- VPS-54 Magnetic Field Safety Policy
- VPS-40 Environmental Health and Safety Policy
- VPS-42 Policy on Injury/Incident Reporting and Investigation
- VPS-45 Policy on First Aid and Medical Emergencies

Note: This SOP defers to Concordia policies at all times

4. Procedure

No one is to access the magnet room outside of normal working hours without prior authorization

The following procedures must be adhered to when around the magnetic resonance equipment:

4.1 Procedures

- 4.1.1 All users entering the MRI facility must be aware that the static magnetic fields of the superconducting magnets are always present and are not detected by human senses.
- 4.1.2 Access to magnets must be restricted to authorized, knowledgeable staff. Authorization is provided by the Supervisor, MRI and Ultrasound once all SOP's have been signed off and the Bio Imaging safety orientation has been done.
- 4.1.3 Those authorized to work within and around high field magnetic resonance equipment must have completed appropriate safety training and must comply with all approved SOPs.
- 4.1.4 Any individual entering the MRI scanner area will need to have completed the MRI [Safety Screening form](#) and be authorized by the MRI technologist or delegate before accessing the scanner room. The signature for regular users is required on an annual basis or when they have experienced physical changes, surgery, health problems or implants.

4.2 MRI Technologist

- 4.2.1 All MRI technologists will be trained as evidenced by signed documentation and will be accredited by federal/provincial associations for MR technologist.
- 4.2.2 All participants to be scanned in the MRI have to complete the MRI [participant Safety Screening form](#) and have to be approved to be scanned by the PERFORM MRI technologist for each imaging session.
- 4.2.3 The MRI technologist must be present at all times and will verbally monitor the participant throughout the procedure.
- 4.2.4 The MRI technologist has the authority to stop procedures when they are deemed unsafe.
- 4.2.5 MRI technologist scanning human research participants must have current CPR training.

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4.3 Participant Safety

- 4.3.1 Researchers using the MRI system for human studies must have an ethics approved protocol prior to scanning human research participants.
- 4.3.2 Individuals who are or may be pregnant are not allowed to remain in the MRI scanning room while the RF system is operating.
- 4.3.3 Research participants in MRI studies must be screened for safety risks prior to entering the magnetic field.
- 4.3.4 Implanted devices and other objects within or on research participants or other individuals intending on entering the magnetic environment must be investigated by manufacturer label and documented as safe in the MRI environment prior to the individual or research participant entering the scanner magnet room.
- 4.3.5 Research participants must be evaluated for medical status that would indicate a safety risk and or prevent a successful MRI study.

4.4 Spill or Leakage

Accidental spill or leakage into the magnet or control room of the MRI must be reported to the Associate Director, Bio Imaging or designate and followed by aborting any scan in progress. The decision to quench or initiate the run down procedure of the magnetic resonance equipment (Magnet Stop button) can only be made by the PERFORM Administration or MRI Technologist.

4.5 Fire, Smoke or Odor in the MRI suite

*****White fire extinguisher only to be used in the MRI Suite.**

- 4.5.1 In the event of a suspected or real fire of the MRI scanner, fixed equipment or walls of the magnet room, follow these steps:
 - 4.5.1.1 Stop scan. Turn off the electrical supply (Emergency stop button on the gantry or the wall). Activate the fire alarm. Ensure your safety and that of any participant in the magnet room. Evacuate the magnet room.
 - 4.5.1.2 Move to a safe location and communicate with Security (514-848)-3717 or go directly to their office at the main entrance of the PERFORM Centre.
 - 4.5.1.3 Respond to any injury and notify security, EHS, and the department manager or designate.

4.5.2 In the event that a piece of equipment starts to smoke or smell of fire in the MRI suite and can be removed safely, follow these steps:

- 4.5.2.1 Ensure your safety and that of any participant and evacuate the magnet room and everyone towards the back end of the Bio Imaging suite.
- 4.5.2.2 Move the item from the MRI suite to the adjacent tiled bathroom or hallway and close the MRI door. Leave yourself an evacuation route.
- 4.5.2.3 Contain the fire using a fire extinguisher (Bio Imaging Hallway or fire blanket (Hot lab I.140)).
- 4.5.2.4 If the fire can't be contained close the door, evacuate and activate the fire alarm.

4.6 Victim Pinned to MRI

The following steps must be taken **only if** an individual is pinned to the magnet, trapped or in a potentially life-threatening or injury-inducing situation by a non-removable ferromagnetic object or if fire fighters need to access the room. The decision to shut down the magnetic resonance equipment (Magnet Stop button) can only be made by the PERFORM Administration or MRI Technologist taking into consideration seriousness of situation and time factor in taking the decision of the quench process.

- 4.6.1 Alert Security by dialing 3717.
- 4.6.2 If the victim is otherwise unharmed and the situation is stable contact GE to assist in a controlled shutdown of the magnet.
- 4.6.3 If the victim's wellbeing is at stake or the situation is not under control, be prepared to evacuate the victim from the MRI room. Depress the red Magnet Stop 'kill switch' button in the magnet room (GE system). An audio alarm will sound with warning lights. The result is a rapid reduction of the magnetic field, a "quench", within 2 minutes. There is a boil-off of helium accompanied by loud crackling and hissing sounds. Evacuate everyone from the magnet room as there is potential for it to fill with helium, replacing oxygen and causing asphyxiation.
- 4.6.4 Treat any injuries in a well-ventilated area away from the MRI room.

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4.7 Medical Emergency

- 4.7.1 An individual or research participant who becomes ill or injured must be removed from the magnetic environment immediately by the researcher or technologist.
- 4.7.2 Extract the person from magnet room on the magnetic resonance imaging bed, the MRI safe stretcher or the MRI safe wheelchair.
- 4.7.3 Close the magnet room door.
- 4.7.4 If emergency response is required, call Security by dialing 3717 and follow procedures.
- 4.7.5 The incident report form must be completed.
- 4.7.6 Notify EHS within 24 hours or, in case of a serious medical situation, as soon as possible.

4.8 Radiofrequency (RF) Field

- 4.8.1 Only properly trained individuals should operate devices and monitoring equipment in the magnetic environment.
- 4.8.2 Only electrically conductive equipment, accessories and materials that have been thoroughly tested and determined to be safe for MRI procedures are allowed.
- 4.8.3 Manufacturer recommendation for safe use of all devices must be followed.
- 4.8.4 All non-essential electrically conductive materials must be removed from MRI bore, including unsafe RF coils, cables and wires prior to scanning.

4.9 Acoustic Noise

- 4.9.1 Any researcher or individual who remains in the scanning room during data acquisition must wear hearing protection.
- 4.9.2 Research participants must be supplied with hearing protection, either foam earplugs or an MRI-compatible headset system.
- 4.9.3 The intercom and auditory stimulus equipment must be adjusted to not exceed safe dB level for the research participant.
- 4.9.4 Noise should be less than 85dB

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4.10 Infection Control

- 4.10.1 The scanning room table and any other surfaces that have come in contact with research participants must be cleaned and the cotton linens/table paper changed before placing another research participant on the scanning table.
- 4.10.2 Gloves must be removed and disposed of properly before touching common areas such as scanner key board, log books, light switches, counter surface and other objects.
- 4.10.3 Surfaces touched with gloves must be cleaned properly before leaving the area.
- 4.10.4 All biohazard material must be disposed of according to [EHS Biohazard Waste Disposal Guidelines](#).

4.11 Safety Screening

- 4.11.1 MRI safe equipment is developed for specific magnetic field strengths and MRI system configurations. Equipment that may operate safely within a magnet room is not necessarily safe to operate in another even if the magnets are of the same static field strength. Routine inspection and maintenance of equipment must be performed and any problem must be reported to the Supervisor, MRI & Ultrasound.
- 4.11.2 Anyone with a medical or non-medical device installed in his/her body must discuss it with the MRI technologist.
- 4.11.3 All metallic objects have the potential to become projectiles in the magnetic resonance environment if they contain ferromagnetic elements. Therefore, the MR Technologist or User is responsible for screening all objects brought into the magnet room for ferromagnetic properties.
- 4.11.4 It is mandatory to remove all personal metallic objects before entering the magnet room. These include but are not limited to
 - Hearing aides
 - Pagers, cell phones or any communication device
 - Keys
 - Hairpins, barrettes, clips
 - Jewelry
 - Watches

- Safety pins, paperclips
- Credit/debit cards, magnetic chip cards
- Pens
- Pocket knives, nail clippers
- Steel toed safety footwear
- Tools
- Eyeglasses
- Cosmetics

4.11.5 Any incident causing injury to an individual or research participant must be reported to the Associate Director, Bio Imaging or delegate as well as Environmental Health and Safety. In case of an accident or injury when the PI is not present, the technologist or user must report to PI. Follow the link below for the EHS Injury/Near-Miss Report form:

<http://www.concordia.ca/campus-life/safety/injury.html>