

**STANDARD OPERATING PROCEDURE:**  
**GENERAL SAFETY GUIDELINES**

**1. INTRODUCTION**

- 1.1 Research involving Magnetic Resonance Imaging (MRI) at high magnetic field strengths presents unique hazards to individuals working within and around the MRI system. The potential for serious personal injury is present due to the sheer size and strength of the static magnetic field along with the immense flexibility of the research system and associated peripheral hardware.
- 1.2 The static magnetic field in the 9.4T MRI Facility is always present. It is important that all those entering the facility be aware of the presence of the field, as it cannot be detected by our person in any way, i.e. magnetic fields cannot be felt, seen, or smelt.
- 1.3 There exist dangerous and potentially lethal levels of electricity in the 9.4T MRI system. As such, it is important that all individuals working around the MRI system be aware of the dangers and safety issues concerning electricity. Current carrying cables, connections and junction points in the vicinity of the main magnetic field are particularly susceptible to damage due to the extreme Lorentz forces created through the normal operation of the system. Periodically, the effects of prolonged mechanical fatigue will result in breakage causing electrical arcing, sparking and high heat levels before the system can shut down. There is therefore a high potential for personal injury and the possibility of a fire being ignited.
- 1.4 During certain types of MRI data collection, there exists high and therefore potentially dangerous acoustic sound pressure levels (SPL). All those entering the facility must be made aware of this risk and instructed as to the proper precautionary measures to be taken. Any research personnel present in the magnet room during an MRI experiment must wear appropriate hearing protection as outlined below.
- 1.5 As a result of the potential for serious injury, access to the 9.4T MRI Facility is restricted, and requires permission. See SOP#100-01 "Facility Access" and SOP#105-01 "Visitor Approval".
- 1.6 Working within and around the high field MRI requires in depth training on safety and Standard Operating Procedures, and documented proof of other necessary training. See SOP#200-01 "Safety and Training of Personnel".
- 1.7 It is imperative that all personnel who are within and around the 9.4T MRI Facility always keep in mind the potential safety risks and act in accordance with the guidelines set out in the Standard Operating Procedures.

**2. SAFETY ISSUES – MEDICAL DEVICES INCOMPATIBLE WITH MAGNET**

- 2.1 There are medical devices, implants and objects that are incompatible with the MR environment. Anyone with any of the following should indicate so before entering the 9.4T MRI Facility and may not enter the magnet room unless the object can be safely removed:

- 2.1.1 Aneurysm clip(s)
- 2.1.2 Implanted cardioverter defibrillator (ICD)
- 2.1.3 Electronic implant or device
- 2.1.4 Magnetically-activated implant or device
- 2.1.5 Neurostimulation system
- 2.1.6 Spinal cord stimulator
- 2.1.7 Cochlear implant or implanted hearing aid
- 2.1.8 Insulin or infusion pump
- 2.1.9 Implanted drug infusion device
- 2.1.10 Any type of prosthesis or implant
- 2.1.11 Artificial or prosthetic limb
- 2.1.12 Any metallic fragment or foreign body
- 2.1.13 Any external or internal metallic object
- 2.1.14 Hearing aid

### 3. SAFETY ISSUES – DUE TO HIGH STATIC MAGNETIC FIELD STRENGTHS

- 3.1 High static magnetic field strengths are present in the 9.4T MRI Facility. These strong magnetic fields pose potential risks to those working or touring in the environment. Medical safety is very important; everyone entering the environment must be aware of the potential dangers. A red and white checkerboard line surrounds the magnet. The magnetic field at this line is approximately 25 Gauss.
  
- 3.2 There are specific medical devices, implants and objects that are incompatible with the MR environment. Anyone with any of these, as listed above, should indicate so before entering the facility and may not enter the magnet room unless the object can be safely removed.
  
- 3.3 All metallic objects have the potential to become projectiles in the MR environment, as they may contain ferrous components. As a result, objects entering the magnet room are restricted.
  - 3.3.1 The operator is responsible to screen all objects entering the magnet room for ferrous components.
  - 3.3.2 All objects, not already in the magnet room, should not be brought into the magnet room unless they are necessary for the successful execution of the experiment and have been tested using a permanent magnet in the control room, or have been viewed and permitted for entry by one of the Facility Director, Manager or Head Technician.
  - 3.3.3 There are several metals that are non-ferrous. These metals include titanium, copper, gold, silver, aluminium, brass and lead. It is extremely important to note that all metal objects must be tested or permitted for entry by one of the Facility Director, Manager or Head Technician even if they are thought to have no ferrous components.
  
- 3.4 It is mandatory to remove all personal metallic objects from your person before entering the magnet room of the 9.4T MRI Facility. This includes the following list of articles:
  - 3.4.1 Hearing aids
  - 3.4.2 Pager
  - 3.4.3 Cell phone
  - 3.4.4 Keys
  - 3.4.5 Eyeglasses
  - 3.4.6 Hair pins
  - 3.4.7 Barrettes
  - 3.4.8 Jewellery (including body piercing jewellery)
  - 3.4.9 Watch

- 3.4.10 Safety pins
- 3.4.11 Paperclips
- 3.4.12 Credit cards
- 3.4.13 Bank cards
- 3.4.14 Magnetic strip cards
- 3.4.15 Coins
- 3.4.16 Pens
- 3.4.17 Pocket knife
- 3.4.18 Nail clipper
- 3.4.19 Steel-toed boots/shoes
- 3.4.20 Tools

3.5 Any metallic object with ferrous components will fly toward the magnet and could potentially cause serious injury to anyone near the magnet, and damage to the MRI system. All operators must be first responders trained in Emergency First Aid, including first aid for impaled objects.

3.6 It is extremely important that no large metal objects be brought into or near the magnet room at any time. All large metal objects must not enter the magnet room unless specifically directed by the Director, Manager or Head Technician. A large metal object with ferrous properties, if placed too near the magnet, will fly towards the magnet with great force potentially causing serious injury to anyone near the magnet and damage to the MRI system.

3.6.1 If someone is pinned to the magnet, trapped or potentially in a life-threatening situation as the result of a large ferrous object coming too near the magnet, the operator, or if the operator is pinned, one of the experimental support personnel, must follow SOP#325-01 “Emergency Quench” and apply first responder principles.

#### 4. **SAFETY ISSUES – DUE TO HARDWARE**

4.1 There exist dangerous and potentially lethal levels of electricity in the 9.4T MRI system. As such, it is important that all individuals working around the MRI system be aware of the dangers and safety issues concerning electricity. There is a risk of electric shock from extremely high voltages, possibly causing severe injury or death, and damage to the MRI system. Only trained personnel should set up hardware in the magnet room and plug in or change the placement of any cables.

4.1.1 If someone is electrocuted in the 9.4T MRI Facility and is not responding, not breathing and has no pulse, the operator or, if the operator was electrocuted one of the experimental support personnel, must apply first responder principles. If the incident occurs in the magnet room, remember that the paramedics/fire rescue are not to bring anything metallic into the magnet room.

4.1.2 Notify the Facility Manager or Director, and Robarts Security (x34041), immediately following the incident. The facility staff must then file an appropriate Robarts incident report of the situation.

4.2 Current carrying cables, connections and junction points in the vicinity of the main magnetic field are particularly susceptible to damage due to the extreme Lorentz forces created through the normal operation of the system. Periodically, the effects of prolonged mechanical fatigue will result in breakage causing electrical arcing, sparking and high heat levels before the system can shut down. There is therefore a high potential for personal injury and the possibility of a fire being ignited.

- 4.2.1 In the case of a fire, the operator, must follow the procedure outlined in SOP#330-01 "Emergency Fire Procedure". The operator must keep his/her own safety in mind when evacuating the magnet room. After all parties are safe, it is appropriate to seek to minimize damage to the system.
- 4.2.2 Use a fire extinguisher only if you can do so safely. Do not attempt to extinguish a fire by yourself – have someone stand by for backup. Do not use fire hoses. If the fire cannot be contained using the non-magnetic fire extinguisher, the operator must call the fire department via RRI security at x34041 and follow the procedure outlined in SOP#325-01 "Emergency Quench Procedure". The fire department cannot enter the facility if the magnet is at field.
- 4.3 During certain types of MRI data collection, there exist high and therefore potentially dangerous acoustic sound pressure levels (SPL). It is mandatory for everyone who will be present in the magnet room during the scan session to wear hearing protection in the form of earplugs provided by the 9.4T MRI Facility.

## 5. SAFETY ISSUES – DUE TO ANIMALS

- 5.1 The 9.4T MRI Facility, excluding the Tech office and the control room, is considered a Level 2 Biohazard Facility as outlined by Health Canada's "Laboratory Safety Guidelines, 2<sup>nd</sup> edition". However, not all work conducted is Level 2. As such, consult each individual Animal Use Protocol to determine the appropriate Personal Protective Equipment required.
- 5.2 Research involving animals presents unique hazards related to naturally occurring pathogenic organisms which may be transmitted from the animals and infect the people working with and caring for these animals. Similarly, humans may transmit diseases to animals.
- 5.3 Because it is possible for diseases to be transmitted from animals to humans, any individual at particular risk of such an infection should be identified before the risks are encountered. In particular, individuals who are immune compromised (e.g., HIV infection, anti-rejections drugs or steroids, chemotherapy drugs, pregnancy, etc.) should be made aware of the potential risks involved prior to entering the 9.4T MRI Facility.
- 5.4 Personnel who have not been trained to handle animals should not do so. Animals can be very unpredictable and proper training is mandatory. Gloves must be worn when handling animals and animal related items. Hands must be washed upon removal of gloves and again prior to leaving the facility. A lab coat, scrubs, or other protective clothing should be worn when working with animals. All bites require immediate first aid treatment. See SOP#400-01 "Animal Exposure and Health Issues" for the procedure to follow in the event of an animal bite.

## 6. GENERAL RESPONSIBILITIES OF THE OPERATOR DURING AN EMERGENCY

- 6.1 The operator should take the following steps when faced with an emergency:
  - 6.1.1 If appropriate, apply first responder principles to the injured party.
  - 6.1.2 Call Robarts Security (x34041). Tell them the location and nature of the emergency. If appropriate, Robarts Security will contact the emergency services personnel.
  - 6.1.3 Attempt to keep all unnecessary personnel out of the Facility.

ROBARTS RESEARCH INSTITUTE  
CENTRE FOR FUNCTIONAL AND METABOLIC MAPPING  
9.4T MRI FACILITY

SOP #205-01

**STANDARD OPERATING PROCEDURE:**  
**GENERAL SAFETY GUIDELINES**

*SOP Approval Signatures*

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Dr. Robert Bartha, Facility Director

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Date

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Dr. Greg Dekaban, RRI Biosafety Officer

\_\_\_\_\_  
Date

\_\_\_\_\_  
Ron Noseworthy, RRI Occupational Health & Safety Officer

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Date