

# MRI LABORATORY SAFETY MANUAL

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## GENERAL INFORMATION

### *Risks associated with the MRI lab:*

Used properly, the magnetic resonance imaging equipment contained within the MRI lab is quite safe, however, it poses serious risks to the unwary. Users of the lab should be completely familiar with this manual and with the procedures for protecting others from hazards. To minimize risks to subjects and other members of the research team, **only personnel who have successfully completed the full ALBMC safety certification process are allowed access to the MR scan rooms, control rooms or equipment rooms.** Observers who have not been safety trained are **not permitted** to enter the MRI suites without special prior arrangements.

The main hazards in the lab are:

- The “projectile effect” when heavy, sharp, or dangerous objects are hurled into the instrument. Even seemingly innocuous objects, such as hand tools, can be *lethal*.
- Pacemaker damage. Certain cardiac pacemakers can be damaged by exposure to magnetic fields, causing direct hazards to subjects. Under no circumstances should persons with pacemakers enter the MRI suites at ALBMC.
- As in many laboratories, the MRI lab contains wiring and circuitry that operate at dangerous voltages. Under no circumstances should users touch any exposed wiring, or any exposed terminals in the equipment cabinets.
- Grossly improper scanner operation could result in excessive heating of the subject due to RF energy being deposited. This is easily avoided by operating the equipment according to the guidelines contained in the user manuals and set by the individual instructors.
- Suffocation: in extreme cases, the imaging magnet may release large volumes of helium gas that can rapidly force all air out of the scan room. Normally, the helium gas would be vented through the roof. However, there is a small but significant risk that the venting system could fail.

### *Safe Areas*

There are no areas in the MR suites that can be considered completely safe. The control rooms (Rooms 120 and 121), scanner rooms (Rooms 121A and 125) and equipment rooms (Rooms 121B and 125B) all have risks associated with magnetic fields and/or electrical equipment. ALBMC safety certification is required for personnel to enter any of these areas.

### *Reduction of Risks*

The chief risk exposure in the lab is to entering personnel who are unfamiliar with the equipment and its hazards. Personnel working in the facility must be constantly vigilant of who is entering the console or scan room areas. Especially in emergency situations, you must ensure that no one without proper training enters either of the scanner rooms, and even then, that they have adequately checked themselves for possible hazards such as projectiles.

Many objects in the scanner control rooms and equipment rooms are **NOT MR compatible** and may become projectiles in the MR scanner rooms. You must never move any object from these rooms into the MR scanner rooms unless you are absolutely certain that the object is MR safe.

Similarly, some objects in the MR scanner rooms may only be safe when kept at a distance from the MR scanner. **Only personnel explicitly authorized to do so should move objects in the scanner room that are labeled “Not MR safe”.** Only objects that are not ferromagnetic should be labeled with a “MR safe” label and this safe label should not be in red or orange. Unlabeled objects should be assumed **NOT** safe to move unless they are clearly non-metallic.

#### *Tours and Training Exercises*

As interesting as the equipment is, please resist the temptation to show visitors the scanner “up close,” as this introduces the unnecessary risk of unwittingly exposing people to potential hazards. Tours or training exercises that would involve having non-safety trained personnel present in the scanners, control rooms or equipment rooms must be authorized in advance by John Mazziotta or Roger Woods and must be performed in compliance with any special requirements included as part of that authorization.

#### *Reporting of safety incidents or near-incidents*

All incidents or near-incidents must be reported to John Mazziotta and Roger Woods as soon as possible and no more than 24 hours after the incident. Contact information is available at the end of this manual. When appropriate, such events must also be reported to the UCLA IRB.

Information in this manual that you believe to be incorrect or out-of-date should be reported to Roger Woods.

In any emergency, try to step through the following guidelines methodically and carefully. Review the safety features, policies and procedures in this manual regularly to assure that you do not need to take unfamiliar actions in a panic situation.

A printed copy of this safety manual is available in both the Trio and Sonata control rooms. You should familiarize yourself with its location.

## METAL SCREENING

Anyone preparing to enter an MR scanner room must complete a metal screening form, and this form must be reviewed before access to the scanner room is granted. Separate forms are available for research subjects and for all other individuals (e.g., family members of research subjects, facilities personnel requiring on-time supervised access, etc). Individuals who are safety certified at the ALBMC are not required to personally complete a formal written metal screening form about themselves but are responsible for verifying that they are personally safe to enter the scanner room.

If there are any doubts regarding the metal screening responses, **do not allow the individual to enter the scanner room**. The fact that the individual has been scanned in an MR scanner previously (even at the ALBMC) is **never** a sufficient basis upon which to conclude that the subject can enter the scanner room safely, since risks vary according to magnetic field strength. Dental fillings and orthodontic braces do not constitute significant risks (though the latter may produce unacceptable artifacts) and do not preclude scanning. Subjects with tattoos or permanent eyeliner should be advised of the small risk of local redness or irritation and asked to report any discomfort immediately. Scanning should be stopped immediately if such discomfort develops. These small risks may be further reduced by applying a damp cloth to the area during scanning.

Some implanted metal devices have been established as safe for MR scanning. A recent copy of Sherlock's book cataloguing implanted medical devices is available in the MR suite and up-to-date information is always available on the website <http://www.mrisafety.com>. If, in reviewing these resources, you believe that it is possible to safely scan your subject, you should contact Roger Woods or Jeff Alger to request authorization to scan the subject. Even if you are certain that the implanted metal does not constitute a risk, **do not allow the individual into the scanner room unless you have obtained explicit authorization to do so**. Qualified individuals (e.g., neuroradiologists or neurosurgeons) may request blanket authorization to assume responsibility for such authorizations for their own research protocols.

Before entering the scanner room, subjects and staff must remove all objects from their person that might constitute a risk in the MR environment. It is the investigator's responsibility to assure that this has been done. Subjects should be asked to turn pockets inside out to demonstrate that no potentially hazardous objects have been overlooked. Alternatively, subjects may be asked to change into hospital gowns that are available in the scanner suite. Silver, gold and platinum jewelry is not ferromagnetic. Nonetheless, subjects should remove jewelry before going in the scanner since these metals can still conduct electricity and therefore pose a risk for burns in the presence of time-varying magnetic fields. Jewelry that forms large loops is particularly hazardous.

Ferromagnetic screening wands, specifically designed for screening subjects prior to MR examinations, are available in both scanner control rooms as an additional screen for metal hazards. These should only be used **after** all of the conventional screening methods described above, not as a substitute for them. They should never be used to screen a subject who has not already been deemed safe for MR scanning since they do contain weak magnets that could

potentially disrupt pacemakers or cause injurious movement of small metallic fragments in the eye. The wands need to be held one inch or less from the body to be fully effective and should not be rubbed directly over the eyes. For sensitive areas, subjects can place their own hands over the area and be screened through their hands. The ferromagnetic screening wands are **NOT** MR compatible and should never be taken into the scanner rooms.

### **EAR PLUGS AND HEADPHONES**

Anyone in the scanner room while the scanner is in operation must be provided with and must use hearing protection in the form of earplugs and/or headphones to avoid hearing injury from the acoustic noise generated by the scanner. According to the Trio documentation, hearing protection for subjects should provide a single number rating (SNR) of 10 dB or greater. The Sonata documentation does not specify an SNR value, but indicates that earplugs or a headset should be used.

### **MEDICAL CRASH CART**

A medical crash cart is kept locked in the alcove near the back exit to the building just adjacent to the MRI suite. **The crash cart and associated equipment is not MR safe and should NEVER be brought into an MR scan room.** A subject in need of resuscitation must be removed from the scan room using the MR compatible gurney before crash cart equipment and supplies can be safely used.

### **MEDICAL GASES**

Both scan rooms are equipped with compressed air and suction from tubes that hang from the ceiling. **Medical oxygen is not available in the scan room.** An oxygen tank is located on the crash cart and tubing is located in the crash cart drawers. **The oxygen tank is NOT MR compatible.**

### **ECG, PULSE AND RESPIRATORY MONITORING**

The scanner is equipped with leads and devices that can be used for ECG, pulse or respiratory monitoring. These are primarily intended for acquisition of gated scan images, but can also be used for monitoring purposes. Only specially designed electrodes can be safely used for monitoring and must be used in strict accordance with the manufacturer's guidelines. If you need to perform physiologic monitoring, you must first obtain special training on the proper use of the monitoring equipment.

Note that the magnetic field alters the contours of the electrocardiogram.

If a patient requires the use of a defibrillator (defibrillation should NEVER be performed in the scanner room), monitoring electrodes applied for use in the scanner should be removed first to avoid electrical burns.

## **MR COMPATIBLE GURNEY**

An MR compatible gurney is available in the MR suite. The gurney is a vital piece of safety equipment and **should not be removed from the MR suite under any circumstances** other than for evacuation of a non-ambulatory person from the building in the event of a fire or earthquake. The MR compatible gurney should not be taken to the hospital to pick up or deliver a patient. Such patients should be brought to the ALBMC using standard transport equipment and transferred to the MR compatible gurney in the ALBMC. An MR compatible wheelchair is also available and no other gurney or wheelchair should ever be brought into either of the scanner rooms. The MR compatible gurney should be stored in the Trio (3 Tesla) scanner room when not in use. The MR compatible wheelchair may be stored in the Trio (3 Tesla) scanner room or in the equipment room for the Sonata (1.5 Tesla) scanner.

The MR compatible gurney has a weight limit of 400 pounds, so no subject (even if ambulatory) weighing more than 400 pounds should enter the scanner room. For a 200 pound person, a minimum of two people are typically required to transfer a person on or off the gurney. For any non-ambulatory subject or any ambulatory subject at significant risk for a medical emergency, staff sufficient to transfer the patient onto the gurney must be present in the MR suite at all times when the subject is in the scanner room.

### **Procedure for transferring subjects between scanner and gurney**

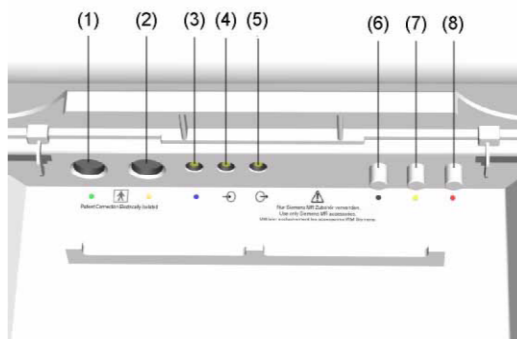
1. Make sure that the gurney is free of magnetic objects (oxygen bottles, IV poles, etc.) before bringing it into the scan room.
2. If possible, make advance preparations by making sure that the subject is lying on a sheet.
3. Move the scanner bed out of the gantry and adjust its height to match the gurney's.
4. Lower one gurney side rail and position this side of the gurney next to the scanner bed.
5. Lock all four wheels of the gurney.
6. With at least one person on each side of the subject, slip the edge of the white slide board under the side of the patient that corresponds to the direction in which the subject will be moved. If necessary, lower the other gurney side rail in preparation for transfer.
7. Slide the subject across the slide board. The person standing next to the gurney should use his or her weight to hold the gurney firmly against the scanner bed during the transfer.

8. Once the subject is well situated on the bed or gurney, remove the slide board from beneath the subject from whichever side is most convenient.
9. Put up the gurney side rails if appropriate and unlock the gurney wheels.
10. Visually inspect to verify that nothing is physically caught before moving the gurney away from the scan bed.

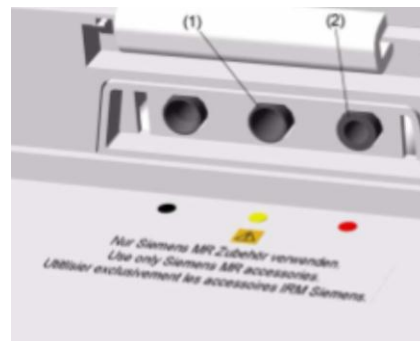
## SUBJECT SQUEEZE BULB

### Siemens Squeeze Ball

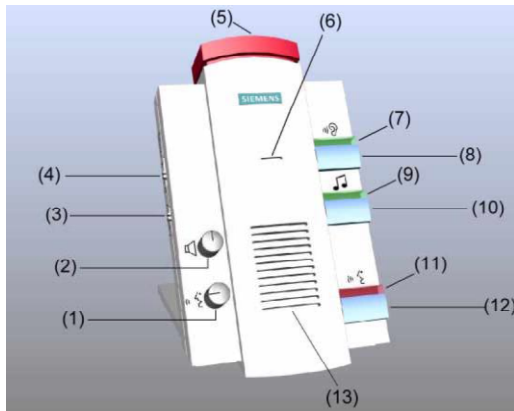
The scanners are equipped with a squeeze bulb that allows the subject to set off an audible alarm to attract the operator's attention. The squeeze bulb should be made available to subjects unless some alternative method of constant monitoring (e.g., another person in the scanner room) is in effect. Use of the squeeze bulb or some comparable form of continuous subject monitoring is mandatory if you are operating the scanner in "Level 1" mode, which has an increased risk of magnetostimulation or subject heating due to RF energy deposition or if you are scanning a subject who has a tattoo or permanent eyeliner. The squeeze bulb plugs into the red connector at the foot of the bed. You can verify that the squeeze bulb is connected by noting that the squeeze bulb LED lights up when you press the talk button on the intercom. If the subject squeezes the squeeze bulb, a continuous audible alarm is emitted via the intercom and the intercom squeeze bulb LED lights up.



Sonata squeeze bulb connector at the foot of the bed is labeled "(8)" and the hose connector is red.



Trio squeeze bulb connector at the foot of the bed is labeled "(2)" and the hose connector is red.



The squeeze bulb LED is labeled “(11)”, the talk button is labeled “(12)”. The “STOP” button is labeled “(5)”.

### **Resonance Technology Squeeze Ball**

The Resonance Technology squeeze ball is connected to the Res Tech headphones in the Trio scanner ONLY. It is the circular button, at the junction of the headphone cables, that lays on the chest/abdomen. This squeeze ball may be used instead of the Siemens squeeze ball if you are using the Res Tech headphones and intercom.

### **Responding to a squeeze bulb alarm**

- 1) If a scan is ongoing, press the “Stop” button on the console using the mouse. Alternatively, you may press the “STOP” button on the Siemens intercom twice to stop the scan immediately. *This is especially important if you are scanning in “Level 1” mode rather than standard mode since the subject may have triggered the squeeze ball in response to magnetostimulation or excessive heating.*
- 2) Press the appropriate intercom talk button (Siemens or Res Tech depending on which squeeze ball you are using) to stop the audible alarm.
- 3) While holding down on the intercom talk button, speak to the subject to determine why the squeeze bulb was pressed. *Make sure that the volume is turned up so that you can hear the subject’s response.*
- 4) If necessary, enter the room to further investigate and/or correct the problem.



## **POLICY REGARDING DOOR SECURITY**

Fingerprint keypad access doors to the Trio suite and the Sonata scan room should never be left open when the rooms are not in use. The non-keypad doors to the scanner rooms should also be kept closed when the rooms are not in use.

## **POLICY REGARDING ACCURATE ENTRY OF SUBJECT HEIGHT, WEIGHT, AGE AND SEX**

The scanners require that the subject's height, weight, age and sex be entered before scanning. Accurate information must be provided to ensure that FDA limits for energy deposition are not exceeded. Weights should be correct to within five pounds. Incorrect information should **never** be entered in an effort to get the scanner to conduct a study that it otherwise would not perform because FDA limits would be exceeded.

## **POLICY REGARDING TEMPERATURE CONTROL**

In regulating energy deposition in the subject's body in accordance with FDA guidelines, the scanners assume that the ambient temperature in the room does not exceed 72° and that the relative humidity does not exceed 60%. Consequently, the thermostat should never be set for a room temperature higher than 72°. Blankets are available for subject comfort if needed. Please note that only cotton, linen or paper should be used for bed covering or blankets since radiofrequency energy may cause heating of synthetic sheets or blankets.

## **POLICIES REGARDING PREGNANCY**

Although there is no evidence that participation in an MR study by a pregnant woman would be harmful to her fetus, current guidelines for the use of MRI in clinical settings recommend that MRI studies be delayed until after the pregnancy when possible. Consequently, it is laboratory policy that:

- 1) Pregnant women may not undergo MR studies unless the study itself is specifically designed to investigate pregnancy with IRB approval.
- 2) Except for members of the research team, women who are pregnant (including a pregnant parent or spouse of a research subject) are not allowed into the scanner room at any time.
- 3) Pregnant members of the research team are allowed in the scanner room (e.g., for positioning a subject), but are not to remain in the scanner room while the scanner is in operation.

It is not laboratory policy to require pregnancy testing for research subjects.

## **POLICY REGARDING OBESE OR LARGE SUBJECTS**

Subjects weighing more than 400 pounds should not be scanned. This is the weight limit for the MR compatible gurney that might be needed to transfer the patient off the table during an emergency. The Trio 3.0 Tesla scanner bed is designed to support weights up to 440 pounds. The Sonata 1.5 Tesla scanner documentation does not specify a maximum weight. Even subjects weighing substantially less than 400 pounds should never be allowed to sit at the distal end of either of the scanner beds, since they are not designed to support the full weight of a large subject applied at full mechanical advantage.

To avoid burns or peripheral nerve stimulation, a minimum distance of 5 mm should be maintained between the subject's body and the wall of the scanner tunnel. MR pads or cotton sheets available in the MR scan rooms can be used to assure this distance is maintained.

## **POLICY REGARDING CHILDREN**

Children may only enter the scan rooms as participants in an IRB approved research study of children. Children not involved in the research study (e.g, the child or sibling or a research subject) may not enter the scan room and may only be present in the control room if under direct adult supervision. Equipment room doors must be kept closed whenever children are present.

All safety precautions applicable to adult subjects are applicable and if anything, more important in children. Careful metal screening, accurate entry of age, sex and weight, and use of "Standard Mode" scanning options whenever possible are important steps in minimizing risks to this population.

## **POLICIES REGARDING PATIENT POPULATIONS**

Although located near the UCLA Medical Center, the ALBMC is not a part of the UCLA Hospital or clinics. The hospital does not provide any emergency services for patients undergoing studies in the ALBMC. For example, in the event of a medical emergency, you must call 911, not the hospital operator, and LA County paramedics will respond, not the hospital code team. To reduce the likelihood of adverse outcome in the event of a medical emergency, the following policies apply to all patient studies:

- 1) All hospital inpatients undergoing studies in the ALBMC must be accompanied by a physician or nurse familiar with the patient's medical condition. The only exception to this policy pertains to patients who are admitted to the CRC (clinical research center) as a result of participation in a research study and who would otherwise not be hospitalized.
- 2) All patients (inpatients or outpatients) at significant risk of a life threatening medical event (e.g., cardiac arrest, respiratory arrest, generalized or complex partial seizure) must be accompanied by a physician familiar with the patient's medical condition and qualified to treat the life threatening condition.

- 3) Staffing adequate to assure the patient's safety in the event of an emergency must be present at all times. For example, if the patient is obese and not ambulatory, sufficient personnel to transfer the patient onto a gurney in the event of a fire or medical emergency must remain with the patient throughout the study. If the patient is confused, staffing sufficient to assure that the patient does not get up and fall from the exam table during the examination must be present.
- 4) Solo scanning of patients at significant risk of a life threatening medical event on nights or weekends is not acceptable. At least two people (not including the patient or the patient's friends and family) must be present for any research study involving patients at significant risk of a life threatening medical event.
- 5) Careful attention must be given to metal screening of patients with impaired cognitive abilities

## PERFORMING AN EMERGENCY MAGNET QUENCH

Users of the ALBMC facility should only quench the magnet in the event that the magnetic field itself poses an **immediate risk to life or major property**. Two such circumstances are:

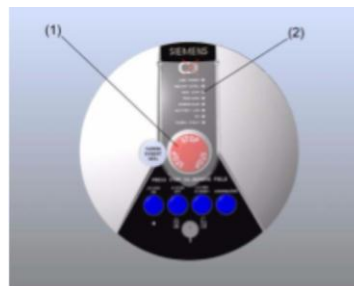
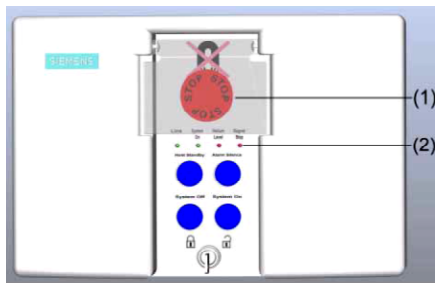
- 1) A metal object is lodged in the scanner in a way that poses an immediate serious threat to a person (e.g., the person is pinned to the magnet by a metal object that is causing internal injuries).
- 2) Fire personnel determine that there is ***no other alternative*** to entering the room with axes or other heavy gear when fighting a fire.

If the absence of a major emergency, facility users should never quench the magnet by themselves, even if they are convinced that a magnet quench will ultimately be necessary (e.g., if a large object has been drawn into the magnet, but poses no immediate risk to a person).

### Quench Procedure

1. Locate and press the **QUENCH BUTTON** in the control room or scanner room. The magnetic field will fall to a safe level within 20 seconds.

In the control rooms, quench buttons are located on the top portion of the Siemens wall mounted control boxes located just to the right of the window. The Sonata control room quench button is covered by a plexiglass cover with a label that says “Quench Button For Emergency Use Only”. The Trio control room quench button is covered by a tamper evident plastic cover. In each control room, the quench button itself has the word “STOP” printed three times around its perimeter. Lift the plexiglass cover and press the button.



Sonata (left) and Trio (right) control room quench buttons are the buttons labeled “(1)”



Sonata (left) and Trio (right) scan room quench button plexiglass covers

In the scanner rooms, quench buttons are mounted on the south wall, which is immediately to your left when you are standing at the foot of the scanner bed looking towards the scanner. The scanner room quench buttons are mounted at a height of almost six feet. The scanner room quench buttons are covered with a plexiglass cover that has a yellow background with a red “X” a black “0” and the words “Emergency use only” printed in red. The button itself has the word “STOP” printed three times around its perimeter. Lift the plexiglass plastic cover and press the button.

2. When the magnet is quenched, the helium in the scanner boils off. Although the helium should vent out of the room to the rooftop, **you should make sure the door to the scanner room is wide open before quenching the magnet**. If possible, you should remove yourself and the subject from the scanner room before quenching the magnet to minimize the chance of asphyxiation in the event that the helium is improperly vented.
3. If emergency medical assistance is needed, dial 911 (not 8-911) and request medical assistance as detailed elsewhere in this manual.
4. The helium vent ducts become dangerously cold during a quench. Do not touch them.
5. Immediately notify an ALBMC staff member that you have quenched the magnet.
6. At best, it will be many hours before the scanner can be returned to service. If uninjured, your research subject should be sent home.

## PERFORMING AN EMERGENCY ELECTRICAL SHUTDOWN

The following events should prompt an emergency electrical shutdown:

1. You see smoke or fire coming from the scanner, equipment room or console.
2. Flooding has carried or is threatening to carry water into electrical equipment

**Electrical shutdowns do not turn off the magnetic field—the magnet is always on unless the magnet has been quenched.**

### Emergency Electrical Shutdown Procedure

1. Locate and press one of the large red electrical shutdown buttons in the scanner room or control room. **Make sure that it is the electrical shutdown button, not the quench button.** The electrical shutdown buttons are all uncovered, and there is no writing on the button itself. Buttons are located as follows:

Trio (3T) Control Room: Next to the Siemens control box located to the right of the window

Trio (3 T) Scanner Room: On the wall immediately to your left when you enter the room

Sonata (1.5 T) Control Room: On the wall that is opposite the doorway.

Sonata (1.5 T) Scanner Room: On the wall immediately to your right when you enter the room



The emergency electrical shutdown button is red with no writing on the button

2. Electrical shutdown immediately stops all power to the scanner, the scanner equipment and the console computers. It does not turn off the lights. Also, power to the stimulation equipment will not be interrupted, so be aware that electrical or fire hazards may still be present.
3. In the case of fire or medical emergency, call 911 (not 8-911)

4. Remove your subject from the scanner room. The electric brakes on the scanner bed will have been released automatically, so simply pull the bed out of the gantry manually using the handle at the foot of the bed.
5. Notify ALBMC staff that you have performed an Emergency Electrical shutdown.
6. Circumstances that justify an emergency electrical shutdown do not typically justify quenching the magnet. Do not quench the magnet unless there is a specific reason to do so (possible reasons for quenching the magnet are discussed elsewhere in this manual).
7. If uninjured, send your subject home. It will take at least a couple of hours to restore the scanner to operational status.

## PERFORMING A ROUTINE ELECTRICAL SHUTDOWN

You should initiate a routine electrical shutdown if you believe that a situation is developing that might predispose the equipment to electrical damage or that might soon warrant an emergency electrical shutdown. **Electrical shutdowns do not turn off the magnetic field—the magnet is always on unless the magnet is quenched.** A routine electrical shutdown requires 3-5 minutes to complete. **If an emergency electrical shutdown becomes warranted at any time, you should follow the emergency electrical shutdown procedure described elsewhere in this manual,** even if you have already initiated a routine electrical shutdown. Situations that would warrant a routine electrical shutdown include:

1. Receiving notice that an electrical outage in the building is likely
2. Development of a minor water leak that is not expected to flood electrical equipment before a routine shutdown can be completed
3. Alarms sounding indicating that the magnet has quenched or that helium is unacceptably low (a routine warning message on the console that the helium needs to be refilled and instructing you to call service is not an alarm and does not warrant an electrical shutdown).
4. Error messages from the scanner console indicating that correction of a problem requires rebooting the equipment.
5. Failure of the scanner bed to respond to its controls

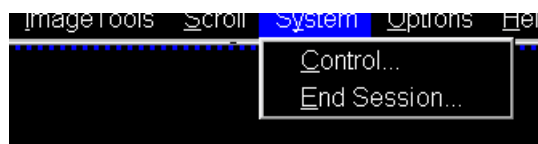
Per the manufacturer’s updated recommendations, a routine electrical shutdown should NOT be routinely performed at the end of the day. The scanner should be left in operational status.

### Routine Electrical Shutdown Procedure

1. Click the System tab at the top of the screen:

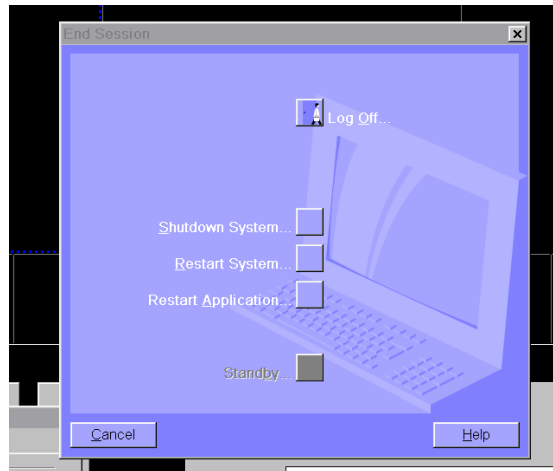


2. Click on “End Session”:

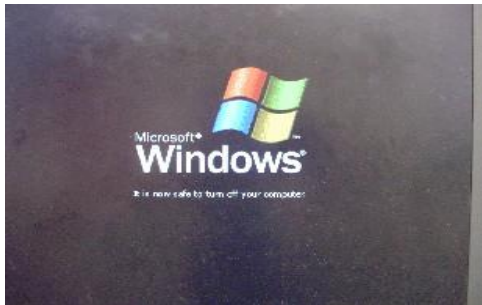




3. Click “Shutdown System”.



4. In the confirmation dialog box that appears, click “Yes”
5. It will take approximately 5-10 minutes before you see “It is now safe to turn off your computer” (picture a.) on the MR computer screen. You must then press the blue “system off” button on the Siemens scanner control box (picture b.) located on the wall next to the MR Scanner window.



When it is appropriate to restore power, press the blue “power on” button located on the Siemens control box next to the control room window. The system will need approximately 20 minutes to reinitialize. To avoid subsequent problems, make sure that the bed is completely out of the gantry at its home position and that the top head coil is attached and plugged in before restoring power.

## HANDLING MEDICAL EMERGENCIES

The following procedures are designed on the assumption that a physician or nurse is not immediately available in the MR laboratory at the time of the emergency. If a physician or nurse is present, the medical recommendations may be adjusted as deemed medically appropriate for the subject's condition. However, all non-medical aspects of these guidelines, **particularly those related to removing the person from the magnet or scanner room, must be followed** to avoid unnecessary injury to the subject or personnel.

1. If (**and only if**) the medical emergency involves the subject being pinned to the magnet by a metal object held in place by the magnetic field, quench the magnet following the procedure described elsewhere in this manual.
2. Call 911 (Not 8-911). Describe the event. Advise the person taking the report that the building is a secure building and that you will provide access via the back door, which is the entry closest to you. Give the location as:

**AHMANSON-LOVELACE BRAIN MAPPING CENTER  
660 Charles Young Drive South**

**Room 121 (3 Tesla MRI scanner)**

**(310) 825-6627**

**OR**

**Room 125 (1.5 Tesla MRI scanner)**

**(310) 825-9217**

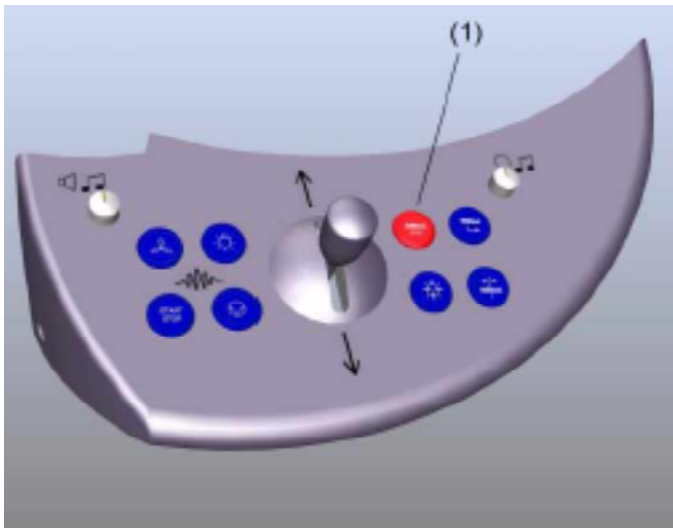
3. Open the back door of the building so that emergency personnel will be able to enter when they arrive.
4. If the emergency involves a subject in the magnet:

A. *Press the "STOP" button on the top of the intercom twice to abort the scan and*



The "STOP" button is labeled "(1)"

*to allow the scanner bed to be moved manually, alternatively, in the scanner room, press the "STOP" button on the scanner control panel.*



**Table Stop button**

The table stop button is labeled “(1)”

B. *Pull the bed completely out of the scanner bore. **The scanner bed cannot be detached from the scanner.***

C. Remove the subject from the scanner room.

1) *Get the MR compatible gurney and slide board (stored in the Trio 3T scanner room—Room 121A). **Only an MR compatible gurney or wheelchair should be used in the scanners. Never bring a standard gurney or wheelchair into the scanner room.***

2) *Lock the gurney wheels and stabilize the gurney against the scanner bed using your own body*

3) *Transfer the subject onto the gurney using the slide board to reduce friction—at least two people (one on each side) are required to safely transfer a 200 pound subject. The gurney can support up to 400 pounds.*

4) *Set the slide board aside*

5) *Put up the side rails and unlock the gurney wheels*

6) *Wheel the gurney from the scanner room into the hallway*

7) *For medical emergencies, the crash cart is kept chained in the hallway alcove near the building back door. **Never bring the crash cart into the scanner room—it is metal and may become a potentially lethal projectile.***

***Under no circumstances should a code team or emergency personnel untrained in MR safety enter the scan room. Always remove the subject from the instrument first!***

5. Provide medical assistance in accordance with your training and experience while awaiting arrival of the paramedics. Consider the following options:

A. Initiate CPR if the person is pulseless or not breathing

B. Use the crash cart to provide Advanced Cardiac Life Support measures if you have the appropriate training to do so

C. Provide oxygen from the green canister (**NOT MR compatible**) attached to the side of the crash cart. Tubing is available in the crash cart drawers.

D. Contact one of the licensed physicians with offices in the ALBMC to help with medical care. Specific contact information is provided elsewhere in this manual.

## HANDLING FIRE EMERGENCIES

1. In case of fire, call 911 (not 8-911). Give the location as:

**AHMANSON-LOVELACE BRAIN MAPPING CENTER  
660 Charles Young Drive South**

**Room 121 (3 Tesla MRI scanner)**

**(310) 825-6627**

**OR**

**Room 125 (1.5 Tesla MRI scanner)**

**(310) 825-9217**

2. If smoke or fire is coming from the scanner, equipment room or console, perform an emergency electrical shutdown as described elsewhere in this manual.
3. If you are scanning and smoke or fire is NOT coming from the scanner, equipment room or console, stop the scan and release the bed by tapping the red “STOP” button on top of the intercom twice. If time permits, initiate a routine electrical shutdown by selecting “End” from the “System” menu at the far right at the console.



The “STOP” button is labeled “(1)”

4. If you determine that it is necessary or appropriate to attempt to extinguish a fire in the scanner room yourself (e.g., if your subject is on fire), use one of the blue and white MR compatible fire extinguishers in the MR suite. **NEVER BRING A STANDARD RED FIRE EXTINGUISHER FROM ELSEWHERE IN THE BUILDING INTO THE SCANNER ROOM.**
5. Remove the subject from the scanner and escort the subject out of the building.
6. Do not return to the building until advised by fire personnel that it is safe to do so.
7. Contact ALBMC personnel to advise them that there was a fire in the building.

## **HANDLING NON-FIRE FACILITIES EMERGENCIES**

- Unscheduled Power Shutdowns
  - Earthquakes
  - Magnet Quench (catastrophic boil-off of helium)
  - Water Leaks
  - Foreign Metal Objects in the Magnet
- 
1. Perform a routine electrical shutdown, or if circumstances such as a rapid flooding threaten to reach the equipment before a routine shutdown could be completed, perform an emergency electrical shutdown. Both shutdown procedures are described elsewhere in this manual.
  2. Remove the subject from the scanner
  3. If appropriate, evacuate the building and do not return until advised that it is safe to do so.
  4. Notify an ALBMC staff member of the emergency.

## HANDLING AUDIBLE ALARMS

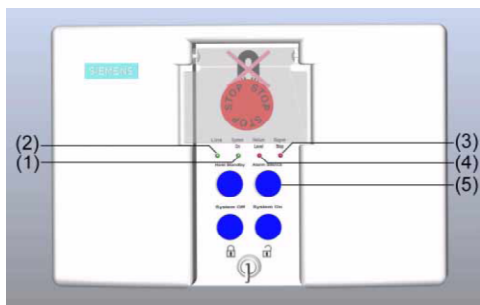
You should never scan while an audible scanner-related alarm is sounding. If you cannot identify and correct the underlying problem, your study should be discontinued. If an audible alarm is sounding, investigate the following possibilities:

1) The alarm might be the building fire alarm. This extremely loud alarm is audible throughout the building, is associated with flashing lights in the hallways, and would be difficult to mistake for a scanner related alarm. Even if you suspect that the fire alarm has been triggered accidentally, you **MUST** do the following:

- A. If you are scanning, press the “STOP” button on top of the intercom twice.
- B. Go into the scanner room and pull the bed out of the gantry using the handle at the foot of the bed.
- C. Assist the subject off the bed (if appropriate, use the MR compatible wheelchair or gurney).
- D. Accompany the subject out of the building via the nearest accessible exit.
- E. Do not reenter the building until told that it is safe to do so by fire personnel.

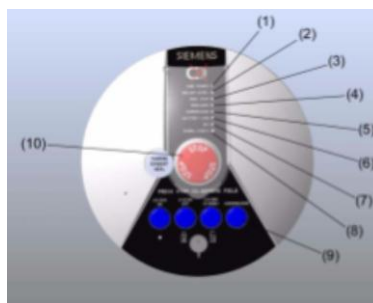
2) The alarm might have been triggered by someone squeezing the squeeze bulb. Look to see if the squeeze bulb LED on the intercom is lit. If it is, see the separate section regarding the squeeze bulb. You will be able to continue your study if this is the source of the alarm.

3) The helium level might be low or the magnet might have quenched spontaneously due to an earthquake or as a result of someone pressing the quench button. Check the Siemens control box located in the control room immediately to the right of the window. If the magnet stop LED is lit, the magnet has quenched. If the helium level LED is lit, the helium level is low. On the Trio, other LEDs indicate power problems, compressor problems, battery problems and communications errors. You can press the alarm silencer to stop the audible alarm, but **do not scan**. Notify ALBMC staff of the problem and send your subject home.



Sonata

The magnet stop LED is labeled “(3)”  
The helium level LED is labeled “(4)”  
The alarm silencer is labeled “(5)”



Trio

The magnet stop LED is labeled “(3)”  
The helium level LED is labeled “(2)”  
The alarm silenced (acknowledge) button is labeled “(9)”

4) The alarm might be a building related alarm. Check the annunciator panel in the hallway near the building exit for an LED indicating the source of the problem. If the LED’s indicate a

problem that is outside the MR suite, you will generally be able to continue your study. Facilities should automatically be notified of alarms appearing on this board.

5) The alarm be might related to the Oxygen Sensors.

PureAire Aircheck O2 Systems oxygen sensors are located in the Trio and Sonata control rooms. In the unlikely event of helium venting into the scanner room, these sensors will generate a low oxygen alarm. A normal oxygen level is 20.8-20.9%.

**Low Oxygen Level Alarm - STOP SCANNING IMMEDIATELY**

The oxygen monitors will emit an audible alarm if the oxygen level drops to 19.5%. An LED will light up on the front panel, and the display will alert you to the oxygen level AND/OR the error message. If the alarm sounds and the display indicates a low oxygen level, immediately check on your subject, open the door to the scanner room and remove the subject from the scanner room in the safest manner possible (i.e. MR safe gurney or MR safe wheelchair if needed). If your subject needs medical attention, call 911. Please alert BMC staff immediately if there is a decrease in oxygen in the scanner room.

**Other Errors - IT IS SAFE TO SCAN IF THE OXYGEN LEVELS ARE NORMAL**

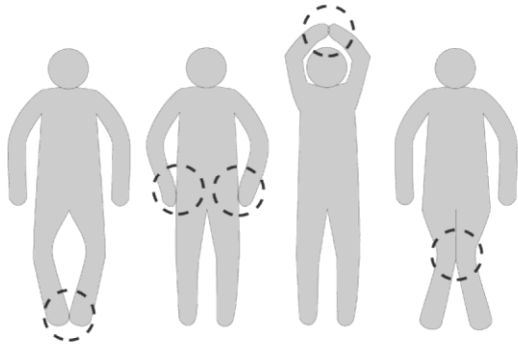
If a voltage or surge problem occurs, it is possible that the device will alarm, that the LED light will come on AND/OR that an error message will be displayed, despite normal oxygen levels in the room. In this case, verify that your subject is fine and ALWAYS verify that the oxygen level is normal (20.8-20.9%) before resuming scanning. If the error is non-oxygen related, please contact BMC MRI staff by email to let them know the details of the problem.



## HANDLING SUBJECT TINGLING OR MUSCLE TWITCHES

Tingling or muscle twitches are potential physiologic effects of time varying magnetic fields. Such effects are particularly likely to occur with echo-planar imaging in fMRI studies. To minimize the likelihood of such magnetostimulation, operate the scanner in “Standard Mode”. In this mode, only 1% of subjects should experience such effects. However, the scanner may refuse to scan certain subjects with certain pulse sequences in “Standard Mode”. If you operate in “Level 1” operating mode, up to 50% of subjects may experience magnetostimulation with certain pulse sequences.

Complaints of tingling or muscle twitches should prompt rescreening for any metal objects that might have been previously overlooked and verification that subject positioning does not form potential loops. For echo planar imaging, selecting a phase encoding direction that is anterior-posterior (when this is an option) should reduce the likelihood of magnetostimulation. Note that the sensory input associated with magnetostimulation will pose an unwanted confound in fMRI studies.



Subject positioning loops that predispose to magnetostimulation or burns

## **HANDLING PERSPIRATION AND INCREASED PULSE AND SUBJECTS WITH CONDITIONS ASSOCIATED WITH IMPAIRED THERMAL REGULATION**

Perspiration and an increased pulse rate may result from energy deposition in the body during scanning. Energy deposition in the body is carefully regulated by the scanner in accordance with FDA guidelines. If your subject develops these symptoms, you should verify that the subject's age, height and weight were entered correctly when registering the patient, since these parameters may influence the calculated energy deposition. You should also verify that the room temperature does not exceed 72° and the humidity does not exceed 60% since the calculated energy deposition limits assume that they do not. The Trio will measure the temperature and may refuse to scan certain sequences if the temperature exceeds 71.6°. For subjects who have medical conditions such as fever, diabetes, pregnancy, or cardiovascular disease that can impair thermal regulation, you should operate the scanner in "Standard Mode" if possible, since energy deposition is not a concern in this mode. Children or elderly subjects are also at increased risk of overheating. If you do scan subjects with conditions associated with impaired thermal regulation in "Level 1" mode, you should be attentive to signs or symptoms of overheating and stop the scan if overheating is suspected. "Level 1" mode should be avoided if possible in subjects who are unable to communicate reliably (e.g., children, sedated subjects, stroke patients). Adjusting the fan in the scanner may be helpful in reducing the likelihood of overheating in subjects.

## **HANDLING DOOR FAILURES**

Switches on both sides of the scanner room doors operate the pneumatic devices that assure that the doors are appropriately sealed against radiofrequency leaks. **Both switches must be in the up position for the door to seal.** You should not scan if the doors do not properly seal since your data will potentially be contaminated. It is possible in the event of a door malfunction that you might be unable to open the door, and if you are inside the scanner room, you might find yourself trapped. You should never close the scanner door from the inside if no one is on the outside to provide assistance should this occur. If you do find yourself trapped in the Sonata (1.5 T) scanner, you may be able to open the back door leading to the equipment room where you can either unplug the compressor for the pneumatic seals or possibly exit via the small crawl door located on the opposite wall. Similar options are **not** available in the Trio (3.0 T) scanner room. If no other means of timely escape is available, it may be necessary to forcefully disconnect the tubing that operates the pneumatic seal or to break the glass between the scanner room and corresponding control room.

## HANDLING UNEXPECTED ABNORMAL LOOKING SCANS

If you encounter a scan that does not look normal to you, do not panic. If you are not a radiologist or neurologist qualified to interpret the scan, the abnormality may be benign or even a normal variant. To allow the potential problem to be appropriately addressed by qualified personnel:

1. Make sure that you acquire a whole brain structural study that can be reviewed.
2. Make sure that you have valid contact information for the subject.
3. If possible, contact ALBMC medical staff so that the study can be reviewed immediately. Contact information is provided on the last page of this manual. **Any abnormalities that you believe to constitute a medical emergency must be brought immediately to the attention of ALBMC medical staff, even if arrangements are already underway to provide appropriate medical care.**
4. If ALBMC staff are not available for immediate review, bring the suspected abnormality to ALBMC medical staff attention at the earliest opportunity.
5. Advise the subject that the study will be reviewed by qualified personnel and make sure that the subject knows how to contact you to follow up if this review is not completed immediately.
6. You may continue your study as planned unless you are certain that the subject is disqualified from your study by the abnormal finding or unless the subject prefers that the study be discontinued.
7. Review your IRB protocol and/or contact the study principal investigator to make sure that you follow any protocol defined procedures for dealing with possible abnormalities.

## **LASER LIGHT LOCALIZER HAZARDS**

On both the 1.5 Tesla Sonata and the 3.0 Tesla Trio scanner, a laser is available for landmarking the patient's position in the scanner. Subjects should be instructed to keep their eyes closed while the laser light is turned on to avoid eye injury. If the laser light appears as a spot rather than as crosshairs, it should be turned off immediately, and you should notify one of the designated ALBMC staff that it is in need of repair.

## **MRI PHANTOM LEAK HAZARDS**

The MR phantoms used to calibrate the scanners are sealed and should not show any evidence of leakage. The contents of some of the phantoms is potentially hazardous. If a phantom develops a leak, protective clothing (gloves, labcoat, goggles and, if the contents have become aerosolized, a face mask) should be worn while cleaning the leak. The contents should be disposed of as hazardous materials (i.e., not simply poured down the drain).

## **ECHOPLANAR (fMRI) IMAGING HAZARDS**

Echoplanar imaging, used in fMRI, utilizes rapidly changing gradients and is associated with higher voltages than many other MR imaging modalities. The risk of magnetostimulation is increased with echoplanar imaging. The risk of magnetostimulation can be reduced by choosing a phase-encoding direction that is oriented anterior-posterior when this is an option.