

CCN Safety Manual



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Update Log

Last Updated By:	Date:
Jared Gilbert	Nov. 2019
Jared Gilbert	Nov. 2020
Jared Gilbert	Oct. 2021
Jared Gilbert & Melodie Yen	Aug. 2022

REMEMBER: THE MAGNET IS ALWAYS ON

Safety Training & Certification

Overview: Safety certification is a multistep process that is required in order to begin to shadow and participate in scanning at CCN.

NOTE: Individuals not certified **CANNOT** participate in scans without first going through the certification process. Please contact CCN staff if you would like to discuss a temporary exemption or setup a tour for uncertified users.

Procedure: Certification instructions can be found on the CCN Scheduling website under the **Safety** drop-down



Please note that this information is slightly outdated and pertained to the CCLE Safety course. New instructions regarding enrollment in the BruinLearn course will be uploaded soon. Please speak to your lab about current certification instructions.

MR Safety Markings

Overview: International safety regulations designate devices and equipment into three categories:



MR Safe



MR Safe



MR Conditional



MR Unsafe

1. **MR Safe:** Items that pose no known hazards resulting from exposure to any MR Environment
2. **MR Conditional:** Items with demonstrated safety in the MR environment within defined conditions
3. **MR Unsafe:** Items which poses unacceptable risks to the patient, medical staff or other persons within the MR environment

Static Magnetic Field

Overview: The scanner at CCN is a Siemens Prisma with a magnet strength of 3 Tesla, which can pose a real danger to subjects and users if the correct safety procedures are not adhered to. As already stated, the magnet is **ALWAYS ON**.

Safety Concerns:

1. Attractive Force – The potential hazard of the projectile effect of ferromagnetic material in a strong magnetic field is a **serious** concern in MR units, and fatalities have occurred due to heavy projectiles such as oxygen canisters entering the MR environment. No equipment should be taken into the magnet room unless it has been checked with the MR Tech.

Note on Screening: Small personal items can act as projectiles as well. Belt buckles, keys, glasses etc. can also cause serious harm if brought into the magnet environment. This is why screening is so important! If something ferrous is accidentally brought into the magnet room, **DO NOT** attempt to remove yourself. Contact Jared Gilbert and Robert Welsh and/or if unavailable, Siemens Uptime.

2. Torque – As well as the attractive force, ferromagnetic objects will also experience a torque that will try to align that object along the magnetic field lines. Torque is shape dependent and proportional to the field strength.
3. Interaction with medical devices – Any ferromagnetic component within an implantable medical device may experience both an attractive force, and/or a torque force.

Gradient Field and Stimulation

Overview: The Prisma scanner is equipped with a time-varying gradient magnetic field in the x-, y-, and z-directions. These time-varying gradient fields produce safety concerns of their own.

Safety Concerns:

1. Peripheral Nerve and Muscle Stimulation – Induced currents from the time varying gradient magnetic fields are able to produce the effect of stimulation of nerve and muscle cells. The extent will depend on the pulse shape and repetition rate.
2. Implant Interaction – Time varying gradient magnetic fields can interact with implants and may result in device heating and vibration.

Specific Absorption Rate

Overview: The radiofrequency (RF) fields are used to generate signal in the MR system. Although RF is generally harmless, such induced fields, commonly referred to as RF “pulses”, can create safety concerns based on duration and participant information.

Safety Concerns:

1. Heat Stress – Induced currents will lead to power dissipation within the body’s tissues, which leads to accumulation of energy and a rise in body temperature. The ambient temperature, airflow, clothing, and humidity all play a factor in the rate of heat dissipation. Heat stress is a particular concern for persons suffering from severe hypertension, or those on diuretics, vasodilators or beta-blockers, that may compromise their ability to thermoregulate. Such individuals should be monitored.
2. Burns – The RF field will induce currents in conductive materials and can raise their temperature significantly. Examples include contact with metal on clothing, coils, coil leads, ECG leads etc... Careful placement and positioning should be a top priority when using peripheral equipment with metallic parts. Participants should also be warned not to cross their limbs or position their arms and legs in such a way as to create a conductive current loop.

Acoustic Noise

Overview: The production of acoustic noise is a characteristic of the rapidly changing gradient fields.

Safety Concerns: Alternating current flow produces forces exerted on the gradient coils which generate sound waves. The level of acoustic noise can reach uncomfortable and even dangerous levels depending on sequence, patient positioning, and patient sensitivity. Earplugs should be worn at all times without exception.

Emergency Buttons



Overview: The MR System has designated buttons for various safety related incidents. It is paramount that certified users understand the use cases for each, so they are applied properly.

1. **Magnet Quench (top two buttons):** The MRI is a superconducting magnet and needs a temperature close to absolute zero in order to function properly. This is made possible via cryogen in the form of

liquid helium. When that cryogen is released, the magnetic field drops to zero very quickly.

NOTE: THE QUENCH BUTTON IS FOR EMERGENCY SITUATIONS ONLY

- AN INDIVIDUAL IS TRAPPED BETWEEN THE MAGNET AND A VERY HEAVY OBJECT AND IS IN CRITICAL CONDITION
 - AN INDIVIDUAL REQUIRES IMMEDIATE MEDICAL ATTENTION AND MOVING THEM OUTSIDE OF THE MAGNET ENVIRONMENT IS IMPOSSIBLE
 - THERE IS A MASSIVE FIRE OR DISASTER IN THE MR SUITE AND EMERGENCY PERSONNEL NEED TO ENTER THE MAGNET ENVIRONMENT WITH METAL EQUIPMENT BEFORE THE SUIT OR BUILDING IS COMPROMISED
2. **Electrical Shut-off (bottom left button):** The Electrical Shut-off button will turn off power feeding scanner components such as the console, tower, gradient cabinets etc... Note **the magnet will remain ON!** The electrical shutoff should be used in the following types of situations:
- There are signs an electrical fire has started/might start
 - There is a natural disaster, such as a flood or earthquake which may damage the electronics
 - There are sparks or smoke emitting from the console tower or any electrical components inside the scanner room or the equipment room
3. **Table Stop (bottom right button):** The table stop button halts the table from moving at whatever point along its path into or out of the bore, and is utilized in a few narrow cases:
- Wires, cables, or other equipment are caught in the track of the scanner bed, and the bed should be stopped to decrease damage done to the equipment or the bed has jammed and the electronic controls or not responding
 - A person's body part (finger, hand, hair etc...) has been trapped between the table and the wall of the bore or the track of the bed
 - **Note:** The Table Stop can be found in two places
 - On each side of the patient bed
 - On the upper right-hand side of the intercom

Table Release Button

Overview: After the Table Stop button has been pressed for any of the reasons listed in the above section, the table must then be released and reset.

Procedure:

1. On the right side of the patient table towards the foot end there is a grey lever, pull towards you
2. You can now manually pull the table out of the bore
3. Once you have dealt with the situation at hand, the bed must be reset
4. Make sure the bed is all the way out of the bore, and follow instructions on the LED screen to reset the table bed position
5. This involves pressing the 'up' and 'down' table buttons at the top and bottom of the table control panel simultaneously
6. The LED screen should now read that the bed is in the HOME position

Quench Ventilation Failure



Overview: In the rare case of a magnet quench, the MR system is outfitted with a ventilation system for the rapid boiloff of liquid helium into helium gas. In the rare case the ventilation system fails, there are two window breakers available, one on either side of the window. The first is located underneath the alarm box, to the right of the window. The second is located in the scanner room, to the left of the patch panel, down towards the floor. Although very unlikely to begin with, this use case highlights why it is important to depressurize/open the door to the scanner room as soon as the quench is pressed (or before).

Note: These tools are ferrous, do not use them for any reason other than their intended purpose.

Common and Adverse Reactions

Overview: Although MR is a safe, non-invasive imaging method free from radiation, there are typical mild reactions that participants may experience from exposure to the static and time-varying magnetic fields, as well as the RF system.

Common Reactions: No need to report to CCN

1. *Mild headaches* which resolve quickly
2. *Slight dizziness* without the feeling of nausea or fear of fainting
3. *Muscle twitches* most often associated with participants crossing their arms or legs

Adverse Reactions: Please report reaction to CCN, and talk with your PI about contacting IRB if necessary

1. Skin burns
2. Fainting
3. Vomiting
4. Heavy perspiration or heat exhaustion
5. Injury from metallic objects or projectiles

Emergency Squeeze Ball

Overview: The emergency squeeze ball is in place in order for participants to alert users of a problem while a sequence is running (i.e. while the scanner is making lots of noise!). If your participant squeezes the ball, click on the scan stop button on the computer, and immediately communicate with your participant in order to identify the reason.

MR Alarm System

Overview: The alarm box (or quench box as it is also referred to) is located in the control room on the right side of the window. An audible alarm is directed through this box in order to alert the users and technicians of issues with the MR system. If unfamiliar with why the alarm is going off, please stop your scan and immediately contact CCN personnel.

- There is an “Audio Alarm Off” button located on the box to the right of the key, press this to turn the sound of the alarm off (does not clear the alarm but stops the audio):



NOTE: ALARM IS NOT RELATED TO THE MAGNET QUENCH – PAY ATTENTION TO POP UP ON CONSOLE SCREEN FOR INFO

Fire Alarm in Building

Overview: If there is a fire alarm in the building, stop your scan and leave the center. If the fire is near the scanner or equipment room, press the electrical shut off button and call CCN personnel.

Consenting and Subject Privacy

Overview: Subject privacy and confidentiality is important to uphold. Please always fill out consenting and medical screening documents in private. Use the testing room when available (please book in advance).

CCN Staff and Contacts

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