BAMRR MRI Safety Week 2025

Day 2: Quench Button, Electrical Isolation and Emergency Stop buttons

⚠ Important: The material provided only applies to traditional superconducting magnets—not permanent or resistive ones

What is a Quench?

In traditional superconducting MRI scanners, a ‘quench’ is the sudden loss of superconductivity in the magnet coils, whereby the coils become resistive, generating heat and rapidly vaporising the liquid helium (and liquid nitrogen if present) into a large amount of cold gas. This gas should escape safely through the quench pipe and is usually seen as a white vapour plume outside the building.

A quench is typically accompanied by a ‘hissing sound’ followed by a loud bang as the burst disc ruptures.

What are the Risks?

If the quench pipe fails (due to design or maintenance issues), large volumes of extremely cold helium gas may enter the magnet room .

Helium expands massively (1 litre becomes over 700 litres of gas), resulting in a pressure increase within the magnet room, making an inward opening RF door difficult to open.

As the gas is lighter than air, it forms a white cloud at ceiling level, displacing oxygen.

This creates serious hazards for both patients and staff and could result in:

- **Asphyxia**
- **Frostbite**
- **Hypothermia**

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Emergency Actions:

Immediate evacuation of staff and patients is essential, taking care not to touch any icy surfaces.

- **Escape Hatch**: All inward opening RF doors should have an escape hatch or ‘cat flap’ for pressure equalization and emergency exit.
- **RF Window:** If people are trapped, an emergency hammer can be used to break the RF window between the magnet room and control room, releasing the pressure. A suitable tool is required for cutting through the wire mesh found between two panes of glass.
- **Emergency Air Extract System:** This should trigger automatically during a quench, but staff should know how to manually activate it in case of malfunction. Do you know where your switch is?

Styles differ between **mobile** and **static** units.

The buttons should be clearly labelled….

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Why does a Quench Occur?:

A Quench can occur:

Spontaneously:
Due to technical failure, long-term power loss, ramping up/down or cold head servicing

Initiated manually:
By pressing the quench button in response to an emergency. For example, a fire in the magnet room or a person being pinned to the magnet following a projectile incident

Quench Buttons:

Each MRI unit should have two quench buttons:

- One in the control room
- One inside the magnet room

As there is no universal design, quench buttons vary by scanner manufacturer.
Ensure you are familiar with the quench buttons for each scanner you work on.

Don't confuse with Electrical Power Off Buttons or Emergency table stop buttons:

Electrical isolation/mains power off buttons are often mistaken for quench buttons due to their similar designs

- Know the difference.
- Powering down the scanner electrically does not quench the magnet…..

Examples of these buttons are shown and discussed in the following slide.

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Quench button
or emergency run down unit
(ERDU)

Located normally in control room and magnet room.

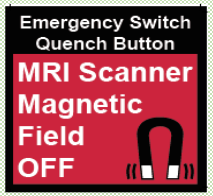
Will shut down the magnetic field in about 20-30 seconds.

Should be clearly labelled.

Siemens

GE

Philips



Emergency power or

Electrical isolation button

Located normally in control room, technical room and magnet room.

Turns off the electrical power supply to the system in cases of fire or flood etc but does not remove the magnetic field.

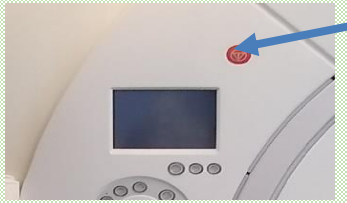
Should be clearly labelled.

Emergency
Table stop

Can be located on intercom, keyboard, scanner table and both sides of the front panel of the magnet.

Stops the motorised movement of the table. For some manufacturers it will stop the RF, gradient power supply.

It does not remove the magnetic field



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Checking for a Quench:

To check if a quench has occurred:

- On some scanners helium levels can be seen on the console
- Others require checking via a magnet monitor in the technical room

Know your system:

- Do you know how to check the helium level and what might cause it to drop?
- How much helium does your system need to be able to scan safely and what should the pressure reading be?

According to the SCoR/BAMRR guidance:

Helium levels should be checked and recorded regularly, following manufacturer recommendations.

Modern 'Helium-Light' Systems:

Finally, there are now some newer MRI systems which contain much lower volumes of helium ('Helium free').

- They do not require an external quench pipe
- The emergency quench button releases a relatively small amount of helium into the magnet room.

Nevertheless, safe working procedures and staff training remain essential.

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Key Takeaways:

- A quench is a serious safety event. Know how to respond.
- Evacuate immediately if helium is released into the magnet room.
- Understand the location and function of quench, electrical power off and emergency stop buttons.
- Know how to check your scanner's helium levels and manually activate the air extraction system if necessary.
- Be familiar with escape mechanisms and safety features.
- If in doubt, never be afraid to ask ☺…..
- Try to be

BAMRR are also [illegible] direct you to what BIR and ISMRT and SCoR have produced for MR Safety Week

https://bir.org.uk/get-involved/special-interest-groups/bir-magnetic-resonance.aspx

https://www.ismrm.org/mr-safety-links/mr-safety-week-2025/

https://www.sor.org/

Materials from MR Safety Week from previous years are available for members on the BAMRR website https://www.bamrr.org/safety/