BAMRR MRI Safety Week 2025

Day 4: Chiller, HVAC and Compressor Alarms:

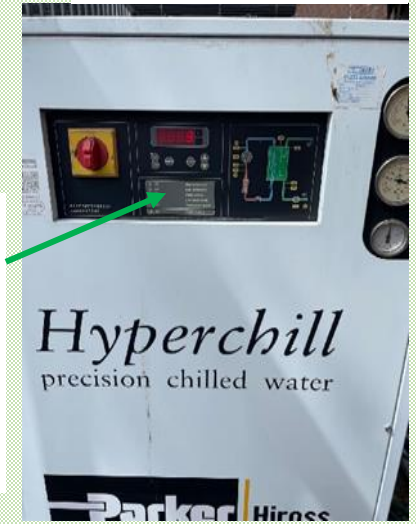
What does the chiller do?

- There is a lot of heat generated by the components of the magnet, especially the gradients and they are cooled by water.
- This cold water is generated by **chillers**, which are located outside (usually in a secured external plant area and may be on a roof). Some units have one chiller and some have a secondary back up. Mobile MRI unit chillers are usually at the rear of the trailer.

How does the chiller work ?

- MRI chillers work by circulating a coolant, typically water or a water-glycol mixture, through a closed-loop system that absorbs heat from the MRI system and transfers it to an external cooling source.
- The chilled water pathway (supply and return) operates at a specific flow rate and temperature and will alarm if it is out with this range. Do you know what these values are?
- It is important chillers are maintained and serviced regularly and local systems are in place with your estates team, so they prioritise their response to MRI alarms, as the compressor that circulates the helium around the magnet windings is also water cooled and if it goes off for an extended time period, it could result in a magnet quench.

This is an example of a chiller unit. Other types exist.



Are there any red lights on the panel indicating a fault?
Do you know who to contact?

Know your system:

- Do you know where your chillers are located? Familiarise yourself with your systems.
- Do you have a display panel in your control room that indicates the flow rate and temperature of the chilled water and any error alarms?

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Heating, Ventilation and Air Conditioning (HVAC):

MRI chillers also help to manage the overall climate in the MRI department, by supporting the HVAC
The MRI environment must be kept at a stable temperature and humidity level to:

- Ensure the safety and comfort of both patients and staff.
- Protect the equipment from thermal stress and condensation.

According to the MHRA guidelines and the joint SCoR & BAMRR document:

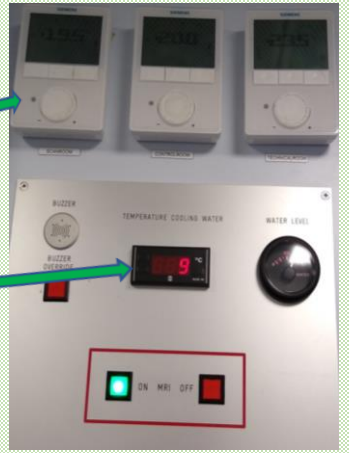
'Temperature and humidity levels should be monitored and kept within specific limits to help protect patients from heat stress and RF burns'. Also 'MR operators should be aware of the acceptable limits of humidity and ambient temperature for each scanner, ensuring that a good airflow is passing through the MR scanner while patients are in situ and the bore fan is working'. 'Air conditioning in the magnet is often helpful in providing patient comfort and loss of the air conditioning system could affect patient safety'.
Finally, 'Panels should be labelled accordingly'.

Temperature and Humidity:

Approximate temperature of the magnet room is usually between 16-22 degrees
Approximate temperature of the technical room is usually between 15-30 degrees
Approximate relative humidity of magnet room is 30-60%
Approximate relative humidity of the technical room is 30-75 %

Magnet room, control room and technical cupboard temperature. Are they within the range for your mobile scanner?

Chilled water temperature. Is this within the range for your mobile scanner?



- Check your system specifications and follow your local guidance.
- Do you have a display panel in your control room wall in your department or in the mobile MRI unit?
- Do you know your system specifications and who to contact if they are out with these or there is an alarm?

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Example Display panel:

O_2 analyser digital display

Sticker indicating the last time the O_2 sensor was serviced

Low O2 audible alarm – if this is alarming has there been a quench or is the sensor overdue for service?

Mute button for O_2 alarm

This light indicates the oxygen monitor has detected a drop in the oxygen level in the magnet room. Why is this?

Chilled water temperature.
Is this within the range for your scanner?

This light indicates there is a fault with the chilled water temperature and the external chillers need to be checked

This light indicates the technical room temperature is out with range- has the AC gone off?

Emergency extract fan over-ride switch.
Turned to test/run when:
- Initial acceptance testing performed during site handover by estates/air conditioning installer before sign off.
- The MR engineer is doing a helium fill
- If the emergency extract fan does not automatically activate during a magnet quench, it can be manually turned on as a safety back- up process

This light indicates the emergency extract fan is running.
Why is this?
Has there been a quench and it's been activated?

Emergency extract fan fault light.
If this is illuminated, the emergency extract fan is not working.
Recommend stop scanning until checked by estates or your agreed contractor and deemed fully functional

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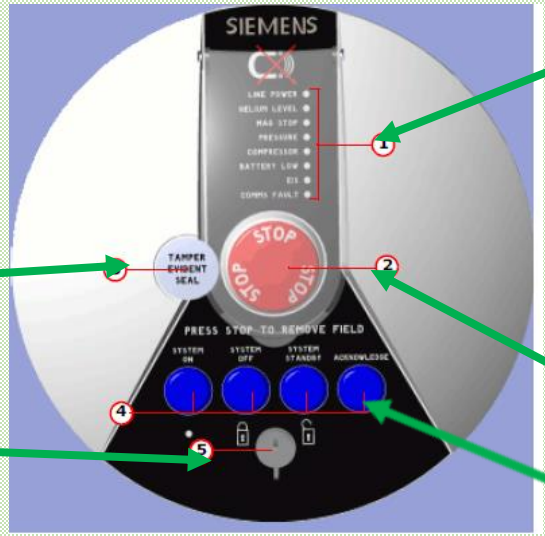
Example Alarm Box:

It is important to check the LED and alarm status.



1) Status and error lights
The 'Line Power' and 'Compressor' LEDs should both be green. If the 'compressor' LED is red, there is a fault with the compressor or if the 'line power' LED is red, there is a power problem with the system.
Any other illuminated LED indicates a fault with that component.

3) Tamper proof seal for quench button

2) Quench button or ERDU button

5) Power switch locking key button

4) System power on/off switches and alarm acknowledge. The acknowledge button silences the alarming from status and power section.

For this Siemens system, only the 'Line' LED should be illuminated green, unless the system is on.

If 'Helium Level' or 'Magnet Stop' are illuminated, then there is a fault.

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Cold Head:

- Check that cold head is still operating in the magnet room (the normal chirping like a bird noise).
- If not, then check the compressor for any faults

Compressor:

- The compressor continuously draws low-pressure helium from the magnet system's helium low pressure (return) line.
- It compresses, cools and cleans the gas, then delivers it through the system's helium high pressure (supply) line to the cold head on the top of the magnet.
- It requires a power and chilled water supply to work.
- Any faults with the compressor require appropriately trained engineers.

Other vendors and systems exist- these are examples
Please familiarise yourself with your system ☺
Always follow your local rules, policies and procedures for reporting and dealing with all faults and alarms.
Although most modern scanners are remotely monitored by the magnet vendors; please ensure you are aware of the customer contact number in case you need to report an error or alarm.
Some HVAC alarms are routed through hospital estates BMS (building management system), so a process for appropriate responses is required.

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Key Takeaways:

- MRI units (whether it be a departmental, static or mobile scanner) will have a chiller and HVAC system
- Ensure you are familiar with the location of your chiller, all alarm panels, the compressor and what the normal values on all the displays should be .
- Know what to do if there are alarms and who to report any issues to. Follow your local policies and procedures.
- Remember different designs exist
- Ensure this critical equipment is serviced and maintained.
- If in doubt, never be afraid to ask, or phone a friend  and try to be 

BAMRR are also pleased to 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.orgmr-safety-links/mr-safety-week-2025//

https://www.sor.org/

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