Extraordinary Events, MR

Action Plan in connection with extraordinary events at the magnetic resonance scanner

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A. You enter the MRI room and notice that equipment/object is stuck to the magnet. No obvious risk of personal injury.

A.1 The equipment can be removed manually.

1. If it's a smaller object, staff must make a decision based on the current situation. Subsequently, check all relevant equipment (with the help of medical technicians) to ensure it functions as expected.

A.2 The equipment cannot be removed manually.

1. Contact Support and Service at tel. 010-103 60 00 and inform them of the urgent situation. When equipment is stuck to the magnet, it is both time-saving and more economical to perform a controlled ramp-down instead of a Quench. DO NOT Quench the system without first contacting Support and Service at tel. 010-103 60 00.

B. You enter the MRI room and notice that equipment/object is stuck to the magnet. High risk of serious personal injury.

B.1 Person is in immediate danger.

Emergency stop magnetic field

May only be used in case of acute danger. It is a very costly and time-consuming process to activate the magnetic field again.

1. **Turn off the magnet with the "Emergency Stop Magnetic Field" (Quench button).**
2. Stay calm and evacuate the patient. Attend to the person as needed.
3. Contact Support and Service at tel. 010-103 60 00 and inform them of the emergency so that actions can be taken immediately (within less than 30 minutes) and system operation can be restored.

   COMMENTS (PHILIPS): During the ramp-down, the system will emit a loud sound caused by rapidly releasing extremely cold helium gas through the exhaust line. This

loud sound confirms that the magnet has "quenched" and the magnetic field has dropped below 10 mT. This process takes less than 20 seconds. When a magnet is quenched, the MRI scan fails, for example, with a message that the MRI resonance frequency cannot be found. You can check if the magnet is off by holding a magnetic coin firmly near the magnet (e.g., a five-krona). Take necessary measures if the magnet's ventilation system is not functioning correctly and if helium gas is leaking into the examination room.

C. Oxygen alarm is sounding.

C.1 Nothing obvious has happened at the MRI.

1. In case of an unexplained low oxygen level alarm, ensure that staff and patients evacuate the MRI room and close the door. Immediately contact Support and Service at tel. 010-103 60 00 and inform them of the emergency.
2. Optionally contact MTA/Gasverkstaden US (tel. 010-103 2261) to perform a control measurement of the oxygen level in the MRI room. In doubtful cases, this can determine if the alarm is due to too low oxygen levels (<18%) in the MRI room or if the oxygen detector needs replacement.

C.2 The MRI is evidently leaking helium (e.g., gas clouds).

1. Ensure that staff and patients evacuate the MRI room and close the door.
2. Contact Support and Service at tel. 010-103 60 00 immediately and inform them of the emergency.

   COMMENTS: It is the hospital's responsibility to take emergency measures in the event of a quenching of the magnet, especially if the magnet's ventilation system is not functioning and helium gas is leaking into the examination room.

   If the ventilation system is not working (e.g., if it is blocked), and the magnetic field is turned off, a high concentration of helium gas can build up in the examination room, forming clouds of cold mist. If possible, evacuate the patient and staff immediately from the examination room.

   Do not turn off the air conditioning or air circulation in the examination room if helium has leaked out (this is an automatic procedure triggered by fire alarms). Maintain air circulation and ventilation.

D. Fire/burn. Regardless of whether the fire alarm has been triggered or not.

If possible in case of fire: *Rescue - Alarm - Extinguish.*

Fire service personnel should *not* take any actions in the MRI room or the adjacent room without MR safety-trained personnel from the Radiology Department present to oversee the actions. Therefore, the fire service does not have access to the MRI room (Zone IV) or the adjacent room (Zone III) unless MR safety-trained personnel can monitor the actions being

carried out. However, the fire service has tools to gain access to the MRI room, so communication is crucial during rescue operations.

Firefighting in the MRI room must not begin without first turning off the magnetic field, if MR-safe fire extinguishers are not sufficient.

D.1 Fire has occurred in adjacent rooms outside the MRI unit.

1. Rescue.
2. Alarm, call 112.
3. Optionally turn off the power supply to the MRI using the "Emergency Stop Power Supply" (red button).

4. Extinguish the fire if possible. Use only fire extinguishers approved for electrical (carbon dioxide or powder) or chemical fires (foam, powder, or carbon dioxide). Using water (also applies to foam extinguishing in equipment over about 1000 V) can cause serious or fatal injuries in case of a fire in electrical equipment.

D.2 Fire has occurred in the technical room.

1. Turn off the power supply to the MRI using the "Emergency Stop Power Supply" (red button).
2. Rescue if possible.
3. Alarm, call 112.

4. Extinguish the fire if possible. Use only fire extinguishers approved for electrical (carbon dioxide or powder) or chemical fires (foam, powder, or carbon dioxide). Using water (also applies to foam extinguishing in equipment over about 1000 V) can cause serious or fatal injuries in case of a fire in electrical equipment.

D.3 Fire has occurred in the MRI room.

1. In case of a fire in the examination room: Press the "Emergency Stop Power Supply" button to turn off the power supply to the MRI.

2. Rescue.
3. Alarm, call 112.
4. Extinguish the fire if possible. Use only fire extinguishers approved for use in the MRI room (Zone IV) and those approved for electrical (carbon dioxide or powder) or chemical fires (foam, powder, or carbon dioxide). Using water (also applies to foam extinguishing in equipment over about 1000 V) can cause serious or fatal injuries in case of a fire in electrical equipment.
5. If a person is still in the MRI room, the rescue leader, in consultation with MR safety-trained radiology personnel, will determine when a smoke diving operation can be initiated.

   COMMENTS: Only use fire extinguishers designed for electrical or chemical fires. The use of water or other liquids can cause serious or fatal injuries. MR-safe (completely non-magnetic) fire extinguishers for a field strength of 3.0 T are available and must be used if the magnetic field is on. Be careful not to mix MR-safe extinguishers with those that are not.

   SIEMENS: In case of smoke development, the system is automatically shut off with the help of a built-in smoke sensor.

E. Leakage of liquid has occurred in the magnet.

E.1 Leakage of (significant volume of) body fluid in the magnet.

1. Turn off the power supply to the MRI by pressing the "Emergency Stop Power Supply" button.

2. Sanitize appropriately. Immediately wipe up spilled fluids, or collect after absorption in absorbent material 'InstaZorb' or small absorbent pads that can absorb about 1 L

per pad. Never let water or other liquids penetrate the system. Sanitation equipment, if needed, is available in the technical rooms of the respective MRI units.

COMMENTS: Liquids can cause electrical shorts or corrosion. If you suspect that liquid has entered the system's enclosures, contact your local service representative. Never clean electrical parts with a damp or wet cloth unless the system or the specific system parts are turned off. Use appropriate protective equipment and precautions when wiping up blood or residual contrast agent. Blood and contrast agent can be infectious. Wipe up spilled fluids immediately. Never let water or other liquids penetrate the system. Immediately contact Support and Service at tel. 010-103 60 00 if liquid enters the system. It is important that all parts of the system, as well as all coils and accessories, are completely dry before starting an examination.

Fluids from phantoms must be collected and must not be emptied into drains. They must be handled as hazardous waste.

E.2 Leakage of (significant volume of) fluid/electrolyte from phantom or equipment.

1. Turn off the power supply to the MRI by pressing the "Emergency Stop Power Supply" button.
2. Sanitize appropriately. Immediately wipe up spilled fluids, or collect after absorption in absorbent material 'InstaZorb' or small absorbent pads that can absorb about 1 L per pad. Never let water or other liquids penetrate the system. Sanitation equipment, if needed, is available in the technical rooms of the respective MRI units.

   COMMENTS: Liquids can cause electrical shorts or corrosion. If you suspect that liquid has entered the system's enclosures, contact Support and Service at tel. 010-103 60 00. Never clean electrical parts, such as the UIM and connections, with a damp or wet cloth unless the system or the specific system parts are turned off. It is important that all parts of the system, as well as all coils and accessories, are completely dry before starting an examination.

   Fluids from phantoms must be collected and must not be emptied into drains. They must be handled as hazardous waste.

F. The MRI has quenched spontaneously or due to improper handling.

F.1 No personnel present at the event.

1. Always report an immediate quenching of the magnet to Support and Service at tel. 010-103 60 00 so that appropriate measures can be taken. Failure to do this quickly enough may result in a costly and time-consuming defrosting of the magnet or permanent magnet damage.
2. Attempt to maintain air circulation and ventilation if helium has leaked.

F.2 Personnel present at the event.

1. Always report an immediate quenching of the magnet to Support and Service at tel. 010-103 60 00 so that appropriate measures can be taken. Failure to do this quickly enough may result in a costly and time-consuming defrosting of the magnet or permanent magnet damage.
2. Do not turn off the air conditioning or air circulation in the examination room if helium has leaked out; instead, maintain air circulation and ventilation.

G. Patient or subject experiences acute illness or claustrophobia and needs/wants to exit the magnet immediately.

1. Remove the patient as quickly as possible from the magnet; see below for the manual routine.

   PHILIPS: Press the emergency button on the UIM unit if you urgently need to stop and release the table. The table can then be manually moved out of the magnet. After an emergency stop, use the reset button to restore the examination table. Normal operation will then be activated again.

   GE: Turn (or, depending on the model, 'press') the handle at the foot end and manually pull the table out.

   SIEMENS: Pull the handle at the side of the foot end (release the table completely) and manually pull out the table.

2. Treat the patient **outside the MRI room**. Electronic emergency equipment or other metal emergency equipment must not be brought into the examination room. Do not call the emergency team until the patient is out of the MRI room.

Contact Information etc.

- Philips Service Center (tel. 0200-81 00 10)
- GE Service Center (tel. 020-120 14 36)
- Siemens Helpdesk (tel. 020-22 50 22)
- MTA/Gasverkstaden US (tel. 010-103 22 61)

Temporary deactivation of sounding oxygen alarm. This may only be done for well-founded reasons by MRI responsible personnel:

GE: After checking the oxygen level in the MRI room, the oxygen monitor may be turned off using a switch in the technical room. The switch is located to the right inside the cabinet labeled PDB for each system.

Note that the alarm function is also turned off. This may only be done for well-founded reasons by MRI responsible personnel. Subsequently, promptly address any deviations. Also, inform all users of this action.

PHILIPS: *Comment Ingenia 3 T (MR3):* Use hearing protection. According to SICK, pressing the Accept button should be sufficient to turn off the audible alarm.

However, I (PL) have not been able to get this to work. Instead, you need to open the alarm unit (Monicon Technologies) by loosening (star) screws on the unit. Open the hatch and then locate the CAL button. Pressing it will turn off the alarm signal. Note, however, that the alarm function is also turned off. An alternative is to disconnect the fuse related to the oxygen alarm (in the Philips 3 T technical room / MR3: 601-445-41-19-17 Gr 16). This may only be done for well-founded reasons by MRI responsible personnel. Subsequently, promptly address any deviations. Also, inform all users of this action.