

SOP 101: Hardware Emergencies

1 Summary

This document establishes procedures for hardware emergencies at the Notre Dame Human Neuroimaging Center (ND-HNC). They are intended to coordinate a planned response of:

1. Moving to safety,
2. Initiating emergency response,
3. Coordinating with others in the building,
4. Protecting responders from the magnetic field, and
5. Protecting equipment.

For dual responders, the Lead protects the participant and then equipment while the Helper initiates the emergency response.

2 Scope

These policies apply to all investigators, research assistants, and ND-HNC staff who enter Zones 3 & 4 (B15, B17, B17a; Form RO03).

3 Definitions

- **Control Room:** B17; The main room of the MRI suite that contains the computer displays and keyboards that control the MRI scanner. The Control Room is accessed from B15 that is controlled by an Electronic Lock.
- **Electronic Lock:** All doors at the ND-HNC are controlled by electronic locks. The electronic lock system recognizes the owner's Irish1Card, logs the time of the attempted entry, and unlocks the door if the owner has been granted access.
- **Equipment Room:** B18; The room containing hardware for MRI operations.
- **Helper:** Second person in Zones 3 and 4 who assists in emergency responses, typically Level 2-3.
- **Lead:** Primary person in Zones 3 and 4 responsible for the Visitor's safety, in charge during emergency responses. Level 4 operator or MRI Technologist.

- **Magnet Room:** B17A; The room within the MRI suite that contains the MRI scanner. It is accessed from within the MRI Control room (B17) through a doorway that is controlled by an Electronic Lock.
- **Visitor:** An individual who has not taken the ND-HNC MRI Safety Course but has a legitimate reason for entering the MRI suites. Research participants and their legal guardians are Visitors. Other Visitors may include: individuals providing/receiving a tour of the VFPC and ND-HNC, faculty and staff who have not received MRI Safety Course, and research assistants.

4 Notes

1. Emergency response and maintenance personnel **CANNOT** enter the Magnet Room unless they have been screened and all metal objects have been removed.
2. Emergency response personnel can **ONLY** enter Zone 3 without completing an MRI Safety screener if the door to the Magnet Room has been locked by key.
3. Fire extinguishers in the MRI suite are **NOT** MRI compatible, and cannot be brought into the Magnet Room.

5 Policies & Procedures

In the sections below, several scenarios are depicted regarding hardware emergencies.

5.1 Gas: the Magnet Room is filling with gas and/or vapor.

A magnet quench results in the rapid boil-off of cryogenics that maintain the superconductivity of the main field coils. Once in progress a quench cannot be stopped, do not attempt any interventions and stay out of the Magnet Room. While the resulting gases are engineered to exhaust safely through ceiling-mounted vent pipes, a venting system failure will cause these gases to accumulate in the room. Although the cryogenics are non-toxic and non-explosive, they present a critical safety risk by displacing oxygen, creating a severe danger of fatal asphyxiation.

Single Responder

1. If a Visitor is in the scanner, remove them immediately. If the Visitor is injured, follow injury procedures (SOP 102.5.1 or SOP 102.5.2).
 - 1.1 Stay low to the floor below the gas. The room will be cold, water vapor may make visibility in the room poor. A change in pressure may make it difficult to open the Magnet Room door.

2. Close and lock the Magnet Room door.
3. Follow SOP 302.5.2 'Fire or Gas Leak' procedures:
 - 3.1 Pull the nearest fire alarm (Fig. 7).
 - 3.2 Gather in the designated Safe Meeting Spot: Northwest corner of parking lot (Fig. 8).
 - 3.3 Call 911 to notify the South Bend Fire Department (SBFD) and say: "We have gas in the MRI Center at Veldman Family Psychology Clinic, 501 North Hill Street".
 - 3.4 If you are unable to evacuate, draw attention by yelling out.
4. Call any MRI staff; MRI staff call Richard Vega (Siemens Engineer).
5. Prepare to receive and escort SBFD.
6. Record issue in ND-HNC Form LG01: Hardware Issues.

Dual Responders

1. Lead
 - 1.1 If a Visitor is in the scanner, remove them immediately. If the Visitor is injured, follow injury procedures (SOP 102.5.1 or SOP 102.5.2).
 - 1.2 Close and lock the Magnet Room door.
 - 1.3 Proceed to the designated Safe Meeting Spot: Northwest corner of parking lot (Fig. 8).
 - 1.4 Call any MRI staff; MRI staff call Richard Vega (Siemens Engineer).
 - 1.5 Prepare to receive and escort SBFD.
 - 1.6 Record issue in ND-HNC Form LG01: Hardware Issues.
2. Helper
 - 2.1 If a Visitor is in the scanner, assist with their removal.
 - 2.2 Pull the nearest fire alarm (Fig. 7).
 - 2.3 Gather in the designated Safe Meeting Spot: Northwest corner of parking lot (Fig. 8).
 - 2.4 Call 911 to notify the South Bend Fire Department (SBFD) and say "We have a possible gas leak in the MRI Center at Veldman Family Psychology Clinic, 501 North Hill Street".
 - 2.5 Assist in receiving, escorting SBFD.

5.2 Fire or Smoke: present in Magnet or Control Room.

Electrical disruption may spark combustible materials, resulting in fire or smoking. The Magnet Room is equipped with a built-in fire suppression system which should trigger automatically, and both the Magnet Room and Control Room are equipped with fire detectors. The fire extinguisher located in B15 **IS** MR compatible.

Single Responder

1. Press the Emergency Power Off (EPO) button (Fig. 1, C; Fig. 2, C).
2. If a Visitor is in the scanner, remove them immediately. If the Visitor is injured, follow injury procedures (SOP 102.5.5.1 or SOP 102.5.5.2).
3. Call 911 to notify the South Bend Fire Department (SBFD) and say: “We have [fire, smoke] in the MRI Center at Veldman Family Psychology Clinic, 501 North Hill Street”.
4. For small fires, use the MR-compatible fire extinguisher located in B15 (Figs. 3, 4) to combat the fire only if:
 - 4.1 The Fire Department has been notified.
 - 4.2 The fire is not spreading to other areas.
 - 4.3 An escape route is available.
 - 4.4 The fire extinguisher is in working condition.
 - 4.5 You are trained to use the fire extinguisher.
5. Initiate Fire Evacuation (SOP 302.5.2): pull fire alarm (Fig. 5) and evacuate building. If possible, lock the door to the Magnet Room before leaving Zone 3.
6. Call any MRI staff; MRI staff call Richard Vega (Siemens Engineer).
7. Prepare to receive and escort SBFD.
8. Record issue in ND-HNC Form LG01: Hardware Issues.

Dual Responders

1. Lead
 - 1.1 Press the Emergency Power Off (EPO) button (Fig. 1, C; Fig. 2, C).
 - 1.2 If a Visitor is in the scanner, remove them immediately. If the Visitor is injured, follow injury procedures (SOP 102.5.5.1 or SOP 102.5.5.2).

- 1.3 For small fires, use the MR-compatible fire extinguisher located in B15 (Figs. 3, 4) to combat the fire only if:
 - 1.3.1 The Fire Department has been notified.
 - 1.3.2 The fire is not spreading to other areas.
 - 1.3.3 An escape route is available.
 - 1.3.4 The fire extinguisher is in working condition.
 - 1.3.5 You are trained to use the fire extinguisher.
- 1.4 Follow Fire Evacuation procedures. If possible, lock the door to the Magnet Room before leaving Zone 3.
- 1.5 Call any MRI staff; MRI staff call Richard Vega (Siemens Engineer).
- 1.6 Prepare to receive and escort SBFD.
- 1.7 Record issue in ND-HNC Form LG01: Hardware Issues.

2. Helper

- 2.1 Call 911 to notify the South Bend Fire Department (SBFD) and say: “We have [fire, smoke] in the MRI Center at Veldman Family Psychology Clinic, 501 North Hill Street”.
- 2.2 Initiate Fire Evacuation (SOP 302.5.2): pull fire alarm (Fig. 5) and evacuate building.
- 2.3 Assist in receiving, escorting SBFD.

5.3 Water: present in Magnet or Control Room.

Plumbing failure or severe storms may result in flooding and electrical disruption.

1. Press the Emergency Power Off (EPO) button (Fig. 1, C; Fig. 2, C).
2. If a Visitor is in the scanner, remove them immediately. If the Visitor is injured, follow injury procedures (SOP 102.5.1 or SOP 102.5.2).
3. Close and lock the Magnet Room door.
4. Move to Zone 2.
5. Call Utilities & Maintenance (after hours: Notre Dame Police) and say: “We have flooding in the MRI Center at Veldman Family Psychology Clinic, 501 North Hill Street”.
6. Call Veldman Reception and say “We have flooding in the MRI Suite and have called Utilities & Maintenance.”

7. Call any MRI staff; MRI staff call Richard Vega (Siemens Engineer).
8. Prepare to receive and escort Maintenance or Police.
9. Record issue in ND-HNC Form LG01: Hardware Issues.

5.4 O2 Sensor: Alarm sounds.

A magnetic quench or smoke in the Magnet Room may trigger the oxygen sensor (Fig 1, B; Fig. 6).

1. Follow the relevant Gas (SOP 101.5.1) or Fire, Smoke (SOP 101.5.2) protocol.

5.5 Metal: an object is attracted to the magnet, a Visitor is NOT in the bore.

Any ferrous material introduced into the Magnet Room will become attracted to the bore. Objects may range in size from the very small (metallic shavings, paper clips) to the intermediate (tools, watch, phone) and the large (chair, fire extinguisher). The very small items will disrupt signal, compromising data quality, while the larger items pose a risk to the magnet itself.

1. Do not attempt to remove the object.
2. Call any MRI staff; MRI staff call Richard Vega (Siemens Engineer).
3. Record issue in ND-HNC Form LG01: Hardware Issues.
4. Record compliance issue in ND-HNC Form LG04: Compliance.

5.6 Metal: an object is attracted to the magnet, an UNAFFECTED Visitor is in the bore.

When a research assistant or MRI personnel enter the Magnet Room during the course of research, perhaps to calibrate the eye tracker or reattach psychophysiologic recording devices, there is a risk that they will introduce a ferrous object into the field.

1. Remove the Visitor from the Magnet Room.
2. Follow procedures in SOP 101.5.5.

5.7 Pump: you do not hear coolant circulating, or UPS alarms.

The liquid helium of the magnet is kept cool by circulating cryogenics, and the pumping system for these cryogenics can be heard in rooms B15, B17a, and B18. If the pumps are inoperative for a long enough period, the magnet may lose superconductivity and quench.

For short-term power disruption, the pumps are connected to a Universal Power Supply (UPS) which provide a reserve of power and sound an alarm that they have activated. Longer-term power disruption (>4 hours) requires a transfer of power from the building (and UPS) to the backup generator.

1. To transfer power from building supply to the generator:
 - 1.1 Navigate to MRI Equipment room (B18).
 - 1.2 Identify pump power switch (Fig. 9).
 - 1.3 Avert eyes, move switch from Normal ON to OFF. Wait a moment.
 - 1.4 Move switch from OFF to GENERATOR.
2. Call any MRI staff. MRI staff call:
 - 2.1 Christine Schmidt (Haskris); Haskris monitors the cooling system and should contact MRI staff for any issues.
 - 2.2 Richard Vega (Siemens Engineer).
3. Record issue in ND-HNC Form LG01: Hardware Issues.

5.8 Access: you are locked out of the Control or Magnet Room.

The Control Room door is controlled by an Electronic Lock and will not open unless an authorized Irish1Card is presented. The Magnet Room door is electronically sealed. In the case of power failure, a key can open each door.

1. Door to Magnet Room (B17a) does not release: press the emergency release button (Figs. 2, D); twist button clockwise to reset lock.
2. Door to Control Room (B17) does not open: ensure you have proper access by contacting Allison Collins (Building Management).
3. Record issue in ND-HNC Form LG01: Hardware Issues.

6 Figures



Figure 1: Magnet Room button wall. **A** Quench. **B** Oxygen sensor, alarm. **C** Emergency Power Off.



Figure 2: Control Room button wall. **A** Haskris Coolant Sounder. **B** Fire System Board. **C** Emergency Power Off. **D** Magnet Door release. **E** Unknown (potentially electric power off). **F** Thermostat. **G** Light switch.



Figure 3: Zone 3 (B15) fire extinguisher location (red arrow).



Figure 4: Zone 3 (B15) MR-compatible fire extinguisher.



Figure 5: Lower level fire alarm, south door (red arrow).



Figure 6: Control Room oxygen sensor (left) and psychophysiologic equipment (right).

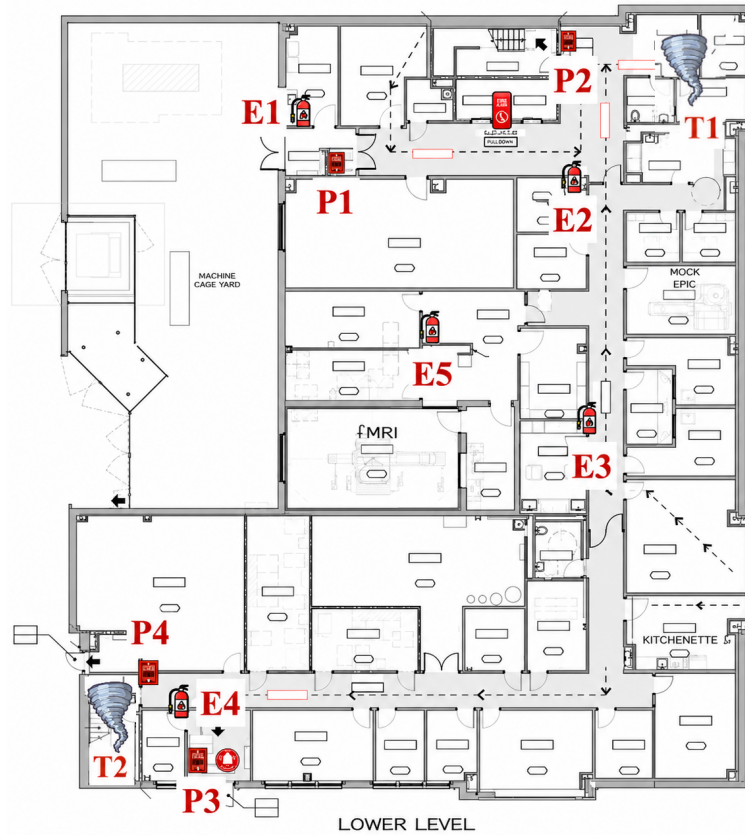


Figure 7: ND-HNC location of fire extinguishers (E1-5), alarm pulls (P1-4), and tornado shelters (T1-2). Crossed extinguisher indicates extinguisher does not exist in location.

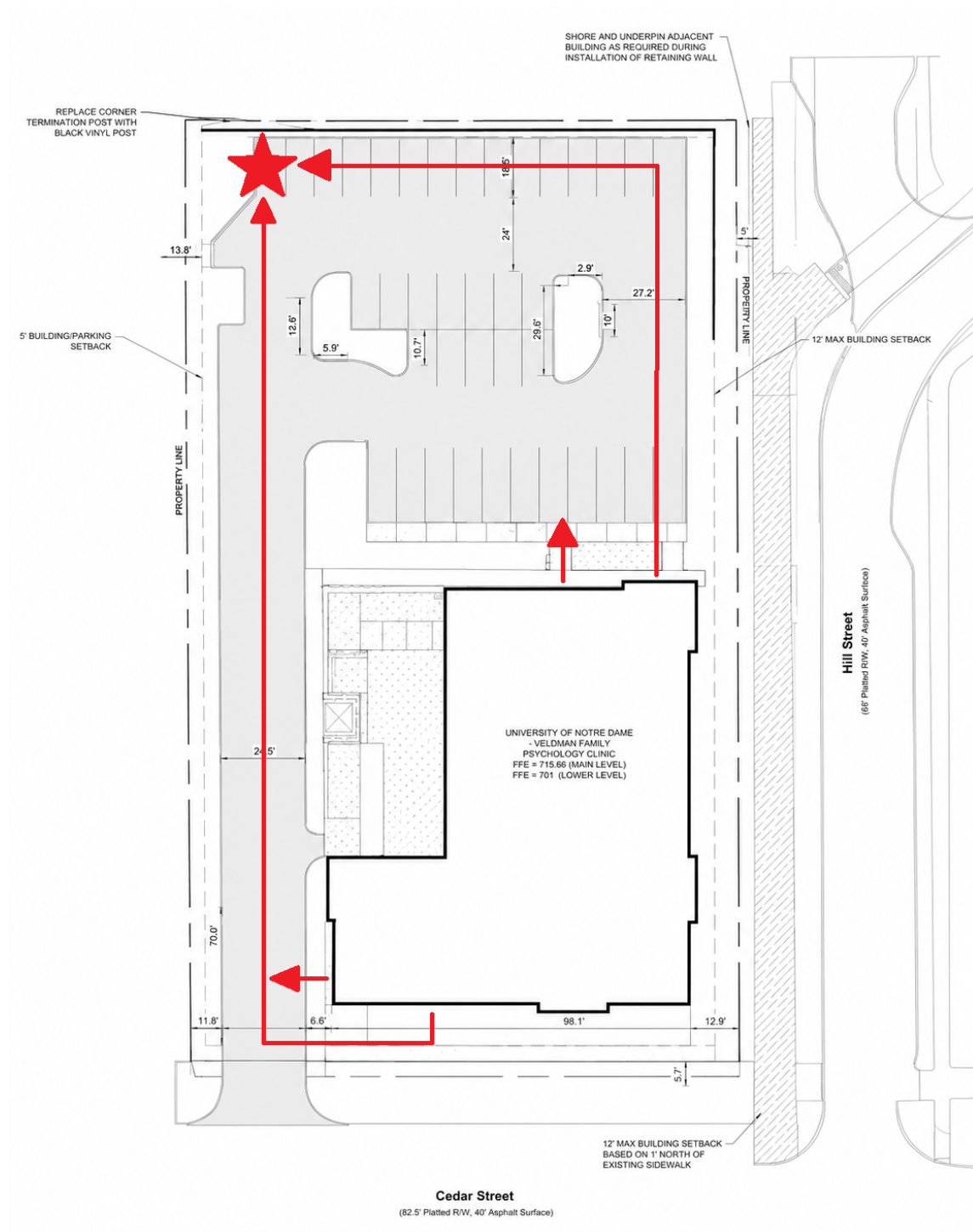


Figure 8: VFPC rendezvous location.



Figure 9: Cooling pump power switch.