

MC-1 Building Hazard Awareness Training Handout

[PDMC1002/CB/01]

Version 2.1

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Overview

The upgrades to and maintenance and operation of the Muon g-2 experiment present many potential hazards. This document is intended to inform you of the potential hazards you may encounter in the MC-1 Building and the proper precautions to take to prevent unsafe situations. Please read the entire document and complete the [online quiz](#). This hazard awareness training is mandatory for all personnel who routinely enter or work at MC-1. It is valid for one year.

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1. Introduction

This training document outlines the hazards specific to the MC-1 building. For the purpose of this document, the Muon g-2 High-Bay refers to the room with the storage ring and overhead crane, accessible only through the Controlled Access labyrinth doors or through the roll-up door.

Access to the Muon g-2 Experiment High-Bay is restricted to authorized personnel that have completed additional training and are in compliance with additional written Hazard Analyses (HA). Before entering the g-2 Experiment High-Bay, you MUST check the status screen above the key tree for the daily hazards. If you may be creating any hazards with your work, inform the Run Coordinator so that this information can be included on the screen.

If you find a situation in which you need advice, training, review or a decision in regards to safety or safe operations, you should first go to your immediate supervisor or the Run Coordinator. If you and your supervisor or the Run Coordinator conclude that the matter goes beyond your own group, that you need assistance in resolving it, or that you need to arrange for safety training, you should contact the [PPD Division Safety Officer \(DSO\)](#). In all cases, if a Run Coordinator cannot be reached, then the Operations Manager may be contacted as a backup. In the event of an emergency, you should call ext. 3131 from any Fermilab telephone.

Environmental Safety, Health & Quality (ESH&Q) materials referenced in this document can be consulted for guidance on ESH&Q issues. These materials can be found on-line at this URL: <http://esh.fnal.gov/xms/>

1.1. Programs for Controlling Hazards

The programs for controlling the hazards that may be found within the facilities generally have three parts: (1) reviews to minimize hazards of new systems; (2) personnel training; and (3) documented operating and safety procedures or guidelines to follow. In addition, work activities performed by Fermilab employees or visitors shall be reviewed via a Hazard Analysis (HA) before work is started (see Fermilab Environmental, Safety and Health Manual (FESHM) 2060 Work Planning and Hazard Analysis). Reviews to minimize hazards in the design, construction, and operation of new systems are conducted by specific review committees or Environmental, Safety, Health, and Quality (ESH&Q) personnel. If you are involved in an operation that you feel should be reviewed, contact your supervisor or the facility coordinator/spokesperson. Training courses are conducted by supervisors, the Particle Physics Division (PPD) Division Safety Officer (DSO), or the Fermilab ESH&Q Section, depending on the specific need. Written procedures and job hazard analyses are usually developed by those doing the work and their supervisors, in consultation with ESH&Q personnel when necessary.

In addition to following the safety protocols at the laboratory, it is essential to recognize precursors that can lead to an unsafe work environment. These commonly include:

- Time pressure to complete the work, or working excessive hours
- Lack of planning, supervision, or clearly-defined roles
- Not having written JHAs and procedures
- Poor housekeeping and disorganized/cluttered work spaces
- Failure to pause work and re-evaluate when work does not proceed as planned

1.2. Housekeeping, Occupancy, and Storage

MC-1 was not designed to contain office space, high-occupancy meetings, or non-essential equipment storage. The daily 8:30 toolbox meeting is the only meeting to be held in the control room. Outside of the toolbox meeting, the control room is only to be staffed by the experiment shifters, the operations shifter, the Run Coordinator on-call, the Operations Manager, and systems experts performing system commissioning, tests, or maintenance. Over occupancy of MC-1 and particularly the control room complicate work planning and work execution and distract shifters potentially leading to an unsafe environment.

All tools and equipment are to be stored in cabinets or shelves. Only equipment essential to immediate operations are to be stored in MC-1. Long term storage of non-essential items should be stored in the warehouse or other locations designated by the Particle Physics Division. The limited space in MC-1 quickly turns into an unsafe environment when equipment is stored on the floor or loose on tables.

2. Magnetic Field Hazards

Magnetic fields may be present due to experimental operations at the facility. The primary hazard associated with static magnetic fields is difficulty handling ferromagnetic items. There is a rotational force causing objects to align with field lines. In addition, there can be a translational force that pulls objects toward the source of a magnetic field. Magnetic fields can also interact with implanted metallic or electronic devices, and there can be direct interactions with biological systems.

Specific Magnetic Field Hazards at the MC-1 Facility:

The Muon g-2 magnet can produce fields up to 1.45 Tesla. A chirp alarm goes off for 20 seconds when the Brucker main magnet power supply is turned on. This is accompanied by a flashing red light indicating when the magnet power supply is active.

To protect personnel, and the magnet itself, **access to the Experiment High-Bay is restricted to authorized personnel who have completed additional training.** Contact the Run Coordinator if you believe you may need this additional training.

Loose ferromagnetic materials can present a serious hazard when the Muon g-2 magnet is on. The introduction of such materials into the Experiment High-Bay should be minimized.

3. Hazardous Energy

Many components utilize potentially dangerous high voltages and/or currents. In addition, certain electrical devices/components may retain significant electric charge after their high-voltage sources are removed. These sources of energy can cause electric shock to personnel if work on these devices is carried out improperly. All personnel are required to have [Electrical Safety Orientation \[FN000387\] Training](#), which is a brief orientation to the Fermilab Lockout/Tagout (LOTO) program and NFPA-70E for unqualified workers.

People performing service or maintenance work on or near equipment that could cause them injury if it were to become energized must lockout and tagout that equipment's energy source(s) and must have current [Fermilab LOTO Level 2 \[FN000212\] Training](#). Only LOTO Level 2 trained personnel are authorized to work on equipment that could become hazardous to them if that equipment were unexpectedly energized. LOTO requires the use of a designated red lock and a DANGER tag to isolate the hazardous stored energy source (e.g., electricity, gravity, springs). Additional information about LOTO can be found in FESHM 2100 Fermilab Energy Control Program (Lockout/Tagout).

NOTE: The term "configuration control" applies to the lockout and tagging of equipment to control the state or operation of equipment or systems where individuals are not actively engaged in servicing or maintenance. Improper removal of these locks and/or tags may lead to accidental injury of personnel or the public, damage to equipment, disruption of normal process, or degradation of system performance. The application of "configuration control" locks should be implemented with a (non-red) padlock and a tag (such as Warning, Caution, or Notice) other than one that says Danger-Do Not Operate. Configuration

control locks and/or tags are applied by persons or groups authorized by line management, and are typically removed by the same person or group who applied the devices. (See the Appendix of [FESHM Chapter 2100](#) for further details and examples of Configuration Control.)

4. Chemical Hazards

Small amounts of chemical materials, such as epoxies and solvents, are used or stored in certain areas. If handled incorrectly, some of these materials may become harmful. As a general practice, the use of combustibles should be limited. All hazardous (e.g., flammable, corrosive, reactive, or toxic) materials that are not in use must be stored in specially designated cabinets. Flammable liquids, such as ethanol, must be stored in a Flammable Liquids Cabinet. Figure 2 shows an example of a Flammable Cabinet. Rags or Kim Wipes used in the application or cleanup of such solvents must be collected disposed of in flammable rag containers and must be emptied every night.

Safety Data Sheets (SDSs) containing information on all of these and other materials within the facility can be found online at http://www-esh.fnal.gov/pls/ip/msds_search.html. Additional information regarding chemical hazard communication is outlined in FESHM 4110 Hazard Communication.

Contact [ESH&Q](#) waste personnel for information about proper disposal of hazardous or unknown chemicals.



Figure 1. Example of a Flammable Cabinet.

5. Environmental Hazards

An accidental release of some materials (e.g., oil, gasoline, diesel fuel) from equipment could become harmful if it is not promptly contained. Such a release can be considered harmful if it can cause adverse effects to people or the environment. If you know or suspect that such a release has occurred or will occur, call ext. 3131 to report a spill emergency. Designated personnel are trained to execute procedures designed to minimize the spread of accidentally released materials. In addition, the following materials are prohibited from disposal in trash cans and dumpsters:

- all hazardous (e.g., flammable, corrosive, reactive, toxic) materials
- degreasing agents (e.g., Freon)
- uncured epoxy
- ethylene glycol (“anti-freeze”)
- fluorescent light bulbs
- oils
- paints
- pesticides
- radioactive material, radiation signs and labels
- scrap metal
- NiCad, lead/acid, and lithium batteries
- any free liquids (regardless of chemical nature)

Contact [ESH&Q](#) waste personnel for information regarding the proper disposal of such items. Whenever possible, please recycle rather than throw away materials that are no longer of use.

Specific Environmental Hazards at the MC-1 Facility:

Contact a [Waste Generator](#) or [ESH&Q waste personnel](#) for assistance with waste determination and disposal requirements.

6. Hazards Associated with Operating Machinery

6.1. Cranes and Forklifts

Improper use of certain equipment, such as cranes and forklifts, can endanger people working in the area as well as material being moved. People operating cranes and forklifts must complete operator training and renew this training every three years. Operators must clear personnel from the area of the lift and warn others of approaching loads. All personnel are prohibited from the area near or under any suspended load. Personnel conducting or in the vicinity of overhead lifts or lifts that have the potential to contact the head must wear hard hats and safety shoes. Procedures for crane use can be found in FESHM 10100 Overhead Cranes and Hoists and FESHM 10140 Mobile Cranes.

Specific Hazards Associated with Cranes and Forklifts at the MC-1 Facility:

When the overhead crane is in use to load/unload materials from the loading dock, no one shall be under the loading dock. Crane operators are responsible for clearing personnel from the area of the lift.

7. Hazards Associated with Working at Heights

There are unusual places throughout the facility from which people or things have the potential to fall. These include ladders, scaffolds, personnel (aerial and scissor) lifts, etc. The physical condition of ladders and scaffolds should always be inspected prior to their use and must be used in accordance with all posted instructions and/or safety precautions. Personnel lifts are available in some areas for workers trained in their use. Work from elevated platforms that have no railings requires [Fall Protection Orientation \[FN000304\] Training](#), the use of a body harness and lanyard, and a written rescue plan in the hazard analysis. Hard hats must be worn whenever someone is working above you or during overhead rigging activities.

It is common for work to be conducted at elevations above floor level. When working with ladders, a number of rules apply:

- Always use the appropriate ladder for the job. Avoid reaching or leaning from a ladder to complete a task.
- When ladders are not in use, they must be stored in a secure location that will not cause an obstruction to walkways or workspaces.
- The physical condition of ladders and scaffolds should always be inspected prior to use and must be used in accordance with any posted instructions and/or safety precautions.

Specific Hazards Associated with Working at Heights at the MC-1 Facility:

Hard hats are required whenever working in an area where others are working nearby from an elevated position, such as when lifts are in use close to your location. Fall protection is required when working from aerial lifts. If your work requires the use of a ladder or to be above the level of a guardrail (i.e. unloading a semi-trailer on the loading dock while standing on the bed of the trailer), a fall protection assessment must be conducted.

Any ladder use on the surface or platform levels (such as the Cryo Platform) where the ladder is placed within a ladder-height distance from any guardrail must be used with fall protection.

Access to the scaffolding above the emergency staircase is highly restricted. The scaffolding must be inspected by a trained scaffolding inspector, and anyone accessing it must complete a written Hazard Analysis.

8. Hazards Associated with Compressed Gas and Pressure Vessels

Many facilities contain systems and operations that utilize compressed gases and pressure vessels that may become hazardous if ruptured or handled improperly. All gas cylinders must be properly regulated while used and capped while stored. They also must remain protected from falling down at all times, for example by securing them to a storage rack or other solid object. Only trained personnel, with current [Fermilab Compressed Gas Training \[FN000213\]](#), should handle compressed gasses. Additional requirements and procedures regarding compressed gas systems and pressure vessels can be found in the FESHM 5000 series.

Specific Compressed Gas and Pressure Vessel Hazards at the MC-1 Facility:

Compressed gas cylinders are not allowed in the center on the muon g-2 storage ring when the magnet is on unless they are chained to a permanent fixture. Bottle carts on wheels are insufficient for storage during magnet operations.

9. Hazards Associated with Sustained High Noise Levels

Extended exposure to certain areas where high noise levels are common can cause hearing damage to people without proper hearing protection. These areas are posted accordingly and have the appropriate hearing protection available. Additional information on hearing conservation can be found in FESHM 4140 Hearing Conservation. Electric and pneumatic tools can be sources of high noise levels.

Some tools and equipment may generate high noise levels. Signs that the noise level is hazardous include if you are unable to hear a person talking (without shouting) standing 3 feet from you. If you believe the noise levels are excessive, contact the [ESH&Q Industrial Hygiene Group](#), who can review the work and noise levels to determine if engineering controls or personal protective equipment is required.

10. Cryogenic Hazards

There may be areas within the facility where cryogenics such as liquid nitrogen or helium may be routinely present. A leak of these materials can cause local zones of oxygen deficiency. In addition, there may be areas where acute physical hazards associated with handling cryogenic materials, such as burns to the eyes and skin, are present. When cryogenic materials are handled, appropriate PPE, such as gloves and protective eyewear with side shields, must be worn. Additional information regarding the controls and procedures required of cryogenic and ODH areas are contained in FESHM 5032 Cryogenic System Review and FESHM 4240 Oxygen Deficiency Hazards (ODH) (Work Smart Standard).

Specific Cryogenic Hazards at the MC-1 Facility:

Anyone who may handle large (160 liter) dewars must complete [Large Portable Liquefied Gas Dewar Handling \[FN000475\] Training](#), and use a special lifting fixture available from the Area Coordinator.

The Experimental High-Bay of MC-1 is an ODH-0 area. This means there is no special ODH training required to enter the area, but all personnel must exit the high-bay if the whooping and strobe alarms go off. Anyone needing

to remove the gas barriers in the penetrations to the Experiment high-bay in the Computer room, or the Power supply room must contact the DSO and have a JHA.

The Refrigeration room is an ODH-1 area. This area can only be entered by ODH-qualified personnel. While rescue air-packs are not required in the Refrigeration room, portable/personal oxygen monitors must be worn by all personnel in the room at all times.

11. Confined Spaces and Limited Access Areas

Confined spaces are locations in which hazards, such as poor illumination, difficult emergency escape and ODH, can be intensified. A written permit and [Fermilab Confined-Spaces \[FN000003\] Training](#) is required for access to any confined space. Additional policies and procedures regarding access to confined spaces can be found FESHM 4230 Confined Spaces.

Specific Confined Spaces and Limited Access Areas at the MC-1 Facility:

The sump pit in the experimental high-bay, the building's elevator pit, and the pit in the refrigeration room are all considered confined spaces. Do not enter unless you have a completed entry permit. Contact [ESH&Q Confined Space personnel](#) for entry permit approval.

12. Radiation Hazards

This facility may contain areas where radiation hazards can be found. Radiation fields can also be found near activated objects and radioactive sources. The ALARA (As Low As Reasonably Achievable) concept is used to keep doses to radiation workers at a minimum. Certain training and dosimetry requirements are also put in place to help keep doses ALARA. See below for specific requirements.

Specific Radiation Hazards at the MC-1 Facility:

Operation of the kicker and quad systems can result in sparking in the storage ring vacuum that can create x-ray radiation. To ensure compliance with radiological requirements, all personnel entering the High Bay (with the exception of authorized tours on the catwalk area) must have current [Radiological Worker – Classroom \[FN000470\]](#) and [Radiological Worker – Practical Factors \[FN000471\]](#) Training and must wear their assigned dosimetry. JHAs or procedures covering kicker and quad operations must address the need, if any, for temporary shielding of the SRV. The area RSO must be consulted with respect to the temporary shielding requirements.

If work needs to be performed with a radioactive source, [Radiological Worker – Classroom \[FN000470\]](#), [Radiological Worker – Practical Factors \[FN000471\]](#), and [Radioactive Source \[FN000048\]](#) Training is required. If work needs to be performed during a controlled access, [Radiological Worker – Classroom \[FN000470\]](#), [Radiological Worker – Practical Factors \[FN000471\]](#), and [Controlled Access \[FN000311\]](#) Training is required.

Radiation dosimetry badges are not required in this facility outside of the High Bay. However, they are required when entering the High Bay, when performing a controlled access, when working with a radioactive source, and/or when entering posted Radiation Areas. Temporary badges are available from the Communications Center (on the Ground Floor of Wilson Hall, ext. 4251). Badges are not transferable and may not be shared. Permanently-assigned badges are located on badge racks in the facility. Quarterly radiation dose reports can be obtained through your local RSO. Dosimetry badges must remain on Fermilab site.

Only personnel who have current [Radiological Worker – Classroom \[FN000470\]](#), [Radiological Worker – Practical Factors \[FN000471\]](#), and [Radioactive Source Training \[FN000048\]](#) can sign out radioactive sources from the

designated “source monitor”. The names of the source monitors for Muon g-2 are posted on the radioactive source storage box.

13. Emergencies

Call ext. 3131 in the event of an emergency situation, such as personnel requiring medical treatment for any reason. Stay on the phone until the emergency operator indicates that s/he has all of the necessary information, including your name, location and nature of the emergency. Do not attempt to bandage another person or clean any bodily fluids from another person's injury.

When evacuating any area, proceed to the designated assembly point and wait there until the 'all clear' signal is given. If you must leave and can't wait for the 'all clear', tell your supervisor or an Emergency Warden. Rescue attempts will be made by the Fire Department if someone is unaccounted-for and believed to be in an unsafe area (e.g., burning structure, oxygen deficient area). If you notice that a fellow worker is missing during an emergency, immediately report this to an Emergency Warden, the Incident Commander (Fire Dept.) or the Fire Chief.

13.1. Fire Alarm

The fire alarm is a steady alarm that may be accompanied by a flashing strobe light. It means that smoke or fire has been detected in the area.

Specific Procedures for a Fire Alarm at the MC-1 Facility:

Exit via the closest exit door; gather at the emergency assembly area, located in the MC-1 Parking lot (see Figure 3).

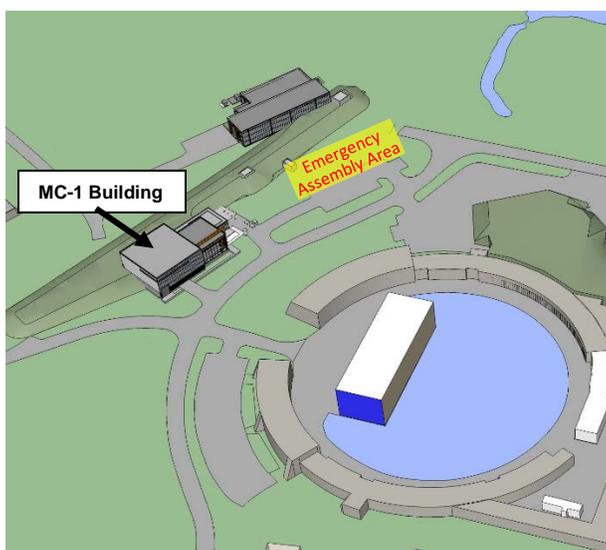


Figure 2. Aerial view of MC-1 Building with Emergency Assembly Area location indicated.

13.2. ODH Alarm

The ODH alarm is a whooper alarm that indicates an oxygen deficiency hazard (ODH). There is an ODH alarm for the g-2 experiment High-Bay and a separate ODH alarm for the refrigerator building

Specific Procedures for an ODH Alarm at the MC-1 Facility:

- Leave the area in alarm immediately and call the Accelerator Division Main Control Room (MCR) from a telephone outside the area to report the alarm. Do not stop at a telephone in the enclosure to call and report the warning.
- Coordinate with emergency responders when they arrive. If you suspect someone remains inside the area in alarm, inform the emergency responders.

Note that only the area in alarm – the High-Bay or refrigerator room - needs to be evacuated. The other areas of the MC-1 building are separated by barriers from the High-Bay and refrigerator room and are not provided with ODH alarm systems.

13.3. Radiation/Electrical Safety System Interlock System Alarm

If you find yourself in the g-2 Experiment High-Bay and hear a loud whooping sound or verbal warning message, you must always treat these audible warnings as real and follow the instructions below. The warning sound can be generated as a result of several scenarios:

- An electrical permit is about to be issued.
- Interlocks are being tested.
- A search and secure of an adjacent enclosure is taking place.
- Oxygen levels have dropped below 19.5 percent (as discussed in 13.2 above).

If you hear a warning sound or message, take immediate action:

- Go immediately to the nearest exit and open the door or gate without using the controlled access procedure, which will drop the enclosure interlocks.
- Leave the enclosure immediately and call the MCR from a telephone outside the enclosure to report what happened. Do not stop at a telephone in the enclosure to call and report the warning.

13.4. Sitewide Emergency Warning System (SEWS)

This is a verbal communication system broadcast throughout all areas of the laboratory. It is used to notify personnel when hazardous conditions exist (such as inclement weather) and what protective actions to take. It is very important that you respond to its warning tones and messages and that you follow the transmitted instructions. If the nature of the message indicates severe weather, promptly go to the designated shelter for your area.

Specific Procedures for a SEWS Message at the MC-1 Facility:

The designated shelter area for the building is the Power Supply Room. Remain in the shelter until given directions, via the safety alert system, that it is safe to exit.

14. Miscellaneous

The following describes some additional general hazards and work rules which exist within the facilities:

- Smoking at facilities is permitted only outdoors and at least 15 ft. from the nearest indoor entrance. Smoking is prohibited within 25 feet of the outdoor flammable gas system and storage area on the east side of the building.
- All new visitors working at Fermilab must register with the Users' Office (Wilson Hall Mezzanine, ext. 3111) upon their arrival.
- It is always preferred that people not work alone. When this is impractical, workers should at least insure that another person, such as their supervisor, is aware of when and where they are working, and they

should make arrangements to periodically check-in with that person. This is especially important for work during off-hours. Also note that for some types of jobs, explicit "two-person rule" requirements may exist.

- **Nothing** must be attached to or suspended from overhead sprinkler pipes.
- Since janitorial personnel do not service some areas within the facilities, you must clean up after yourself.
- Appropriate PPE must be worn to protect against hazards.
 - Consult the written hazard analysis, your supervisor, the MC-1 Coordinator (or designee), or PPD DSO if unsure what PPE is necessary.
- Keep the roll up door closed as much as possible to prevent stressing the Heating, Ventilation and Air Conditioning (HVAC) system.
- Note that there is a video camera in the g-2 High-Bay that records and broadcasts all movement within in the High-Bay.