MC7 Enclosure
Hazard Awareness Training
Handout

[PDMC7001/CR/01]

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Overview

This document is intended to inform you of the potential hazards in the MC7 enclosure, with a focus on the NOvA Test Beam setup in the MC7b enclosure. This hazard awareness training is required for all individuals who intend to enter the MC7 enclosure except those escorted by qualified personnel. It is valid for a period of one year. Please read the entire document and **take the on-line test ORcomplete the Signature Page and Training Record at the end of this handout**. This document should be viewed *after* taking FTBF Hazard Awareness Training (PDFTBF01/CB/01) which contains additional information about MC7 that is not included here.

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Figure 1. Photo 1 (left): MCenter (NOvA) Control Room door (left), MC7 key tree (center) and entrance gate (right); Photo 2 (middle): Outside walkway; Photo 3 (right): MC7a upstream entrance.

1. Introduction

MC7 is a beamline enclosure managed by the Particle Physics Division and is part of the Fermilab Test Beam Facility (FTBF) within the Meson Detector Building (MDB) West (Fig. 7). The upstream and downstream sections of MC7, separated by a firewall, are referred to as MC7a and MC7b respectively. The NOvA Test Beam experimental hardware is installed in the MC7b enclosure (Fig. 6). The NOvA Test Beam program is designed to test a scaled down version of the NOvA detectors with a tertiary beam from the MCenter beamline. In addition to the NOvA test detector, the MC7b enclosure includes a target and collimator assembly to generate a tertiary beam, a dipole magnet, shielding and collimation to direct and control the tertiary beam and beamline detectors to characterize the beam particles incident on the test detector.

Note: MC7a and MC7b, as used in this document, do not directly correspond to MC7-1 and MC7-2 used in interlock system documentation. MC7b is the area of the MC7 enclosure north of the firewall, constructed in CY2018; MC7a is the portion of the MC7 enclosure south of the firewall. MC7-2 is the area of the MC7 enclosure north of the interlocked sector gate that is located immediately adjacent to the Jolly Green Giant magnet; MC7-1 is the portion of the MC7 enclosure south of the sector gate.

2. MC7 Enclosure Access Control

Typically, access to MC7 is through the entrance gate at the upstream (south) end on the west side. No key is required during open access periods. For controlled access, access key sets are to be checked out from the remote key tree (Photo 1) at the MC7 entrance gate by calling the Main Control Room (MCR). Each set includes a pair of keys: one for opening the gate near the key tree and another for the interlocked doors. Every entrant is to have their own individual access key set during a controlled access. There is a narrow passage outside between two parts of the building that may have falling ice overhead and ice on the ground during the winter (Photo 2). In addition to the entrance door to MC7 (Photo 3), there is an interlocked gate within the MC7 enclosure (Photo 4) upstream of MC7b. Access to MC7b for NOvA is normally through a door in the firewall (Photo 5).

The temperature and humidity in the MC7b enclosure must be tightly controlled to avoid damage to detector components. In addition, the liquid scintillator in the NOvA detector poses a fire hazard. All three doors leading to the MC7b enclosure as well as the roll-up door at the downstream end are to be kept closed. The roll-up door also leads to a fenced-off section with radiation shielding outside classified as a High Radiation Area.

Figure 2. Photo 4 (left): Internal gate within MC7; Photo 5 (middle): MC7b entrance at firewall; Photo 6 (right): East side of the MC7b enclosure.

On your way into the MC7b enclosure, watch your step and use the railing on the right. Stay on the west (left) side whenever possible. There is less clearance between components, more trip hazards and overhead cables and hoses on the east (right) side (Photo 6).

2.1. MC7 Enclosure Access Requirements

Two Person Rule

Except when mandated otherwise by local procedures or FESHM (Fermilab Environment, Safety and Health Manual), the two person rule is recommended but not required for access to the MC7 enclosure. If you will be working alone, notify the NOvA Test Beam Coordinator and arrange for someone to check on you.

Hazard Awareness Training

All personnel working in or making a controlled access to the MC7 enclosure must read the MC7 Enclosure Hazard Awareness Training Handout (this document) and take the on-line test associated with Particle Physics Division Course PDFTBF02/CB/01.

Radiological Control Requirements

General Employee Radiation Training (GERT) [FN000241/CR/00] is required for unescorted access to FTBF (including the MC7 enclosure) which is posted as a Controlled Area and a Radioactive Material Area. Dosimetry is not required while the MC7 enclosure is in open access. In addition to this training, Fermilab Controlled Access [FN000311/CR/01] and Radiological Worker (Classroom [FN000470/CR/01] and Practical Factors [FN000471/OJ/01]) training as well as radiation dosimetry are required for controlled access to the MC7 enclosure. All controlled accesses to the MC7 enclosure are governed by a Radiation Work Permit (RWP). The active RWP is available at the key tree and must be reviewed and signed every time a key is obtained before accessing the enclosure. The RWP contains information on the radiological training, PPE, and dosimetry required for access.

3. MC7 Enclosure Hazards and Controls

3.1. Ionizing Radiation

When beam is transported through the MCenter beamline, ionizing radiation is a significant hazard. All material in the beam path must be surveyed for activation before being removed from the enclosure. Beam delivery at high-intensity could produce activated materials resulting in residual dose rates in the enclosure after beam operations. Residual activation hazards will be handled operationally as in all other secondary beam enclosures. The RWP for the enclosure will detail the controls necessary for controlled access.

3.2. Electrical Hazards

Some NOvA Test Beam components utilize potentially dangerous high voltages and currents. In addition, certain electrical devices and components may retain their charge after their power has been removed. The high current bus conductors powering the spectrometer magnet run overhead along the upstream half of the MC7b enclosure under the cable tray on the east side and turn down and go through the floor in the middle of the enclosure. They are insulated by PVC piping marked with red stripes on the outside (Photo 7). Although the voltage is low, damage to the insulation exposing the conductor inside can lead to a significant hazard. Several detectors within the MC7b enclosure use high voltage (low current) power supplies. High voltage cables should not be connected or disconnected while the power supply is on.

Figure 3. Photo 7 (left): High current bus, fire alarm on the east side; Photo 8 (right): Magnet-on warning light and exclusion zone.

3.3. Magnetic Field Hazards

NOvA Test Beam has a 1.8 Tesla (18,000 Gauss) spectrometer dipole magnet, often referred to as the M1 Magnet. During controlled access, the magnet is permitted to remain energized. However, with current in the magnet, the DC magnetic field could be hazardous to those working close by with hand tools or other objects susceptible to magnetic forces. The magnetic field could also be a hazard to those with cardiac pacemakers or other medical implants. There is a red flashing light on the west side of the magnet body to indicate the magnet power supply is on (Photo 8). The light is visible from near the west door to MC7b. Pause at that door on your way in to check the light -- if it is flashing, turn around and leave the enclosure unless you know that the magnet power supply is supposed to be on.

A personnel exclusion zone is maintained around the magnet. There is a non-magnetic barrier permanently installed at the boundary of the exclusion zone at chest level to prevent people from accidentally reaching into the high field region (Photo 8). **No access to the exclusion zone is allowed** without an approved written Job Hazard Analysis even if the magnet power supply is off and locked out. The only activity that can be performed near the magnet (without a written JHA) when it is energized is visual inspection from outside the exclusion zone. A pre-operational survey ("sweep") of the area around the magnet is done to ensure all ferrous materials have been removed prior to energizing the magnet.

3.4. Oxygen Deficiency Hazard (ODH)

All of MC7 is classified as an ODH Class 0 area. Some sections of beam pipe may include He gas and the NOvA Cherenkov detector in MC7b is filled with CO2. The amounts are too small to create an oxygen deficiency hazard. If you notice a gas leak, leave the enclosure and notify the NOvA Test Beam Coordinator. An ODH alarm (whooping sound and strobe light) is installed near the upstream entrance (Photo 9) due to another experiment with a liquid argon based detector (LArIAT). In the event of an ODH alarm, leave the enclosure using the nearest exit.

3.5. Flammables

The NOvA wire chambers in MC7b (and similar LArIAT chambers in MC7a) utilize a flammable gas mixture (Photo 10). If you notice a gas leak, leave the enclosure and notify the NOvA Test Beam Coordinator.

The NOvA test detector contains a large volume of combustible liquid scintillator (mostly mineral oil) inside sealed hollow PVC extrusions. There is a secondary containment underneath the detector (photo 10) with enough capacity to hold all the liquid scintillator in the event of a leak. You should not step directly onto this containment or place anything on it as any tears, holes or damage to the structural integrity means no secondary containment. (A mat is provided in the area on the north end of the detector where it is necessary to walk into the containment in order to reach the exit door.) If you notice a leak, leave the enclosure and notify the NOvA Test Beam Coordinator.

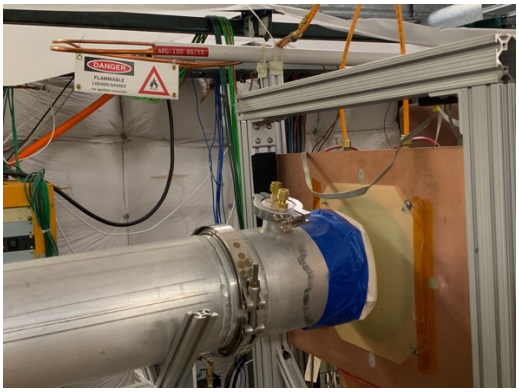


Figure 4. Photo 9 (left): ODH alarm at upstream (MC7a) entrance; Photo 10 (right): NOvA wire chamber with overhead gas lines.

3.6. Chemicals

Exposure to the liquid scintillator in the NOvA detector may lead to serious health complications, so avoid contact and leave the area immediately if there is a leak. Notify the NOvA Test Beam Coordinator after

leaving the area. If a large leak is noticed (multiple gallons), call the Emergency Operator at x3131 to summon the Fire Department.

Figure 5. Photo 11 (left): Secondary containment tub; Photo 12 (right): MTAP and stairs.

3.7. Mechanical

Moveable Top Access Platform (MTAP)

This platform (Photo 11) was built to enable safe access to the top of the NOvA detector for liquid scintillator filling and electronic instrumentation installation and maintenance. Portable stairs are used for access to the platform. All 4 wheels of the MTAP are normally locked and each wheel is also blocked by a pair of chocks. The portable stairs are also locked in place with the wheels off the floor. Do not unlock or move the stairs or the platform. Access to the platform is blocked by a locked gate at the top of the stairs. The key to the the platform access gate is kept in a key box in the MCenter Control Room next to the list of users who are allowed access to the platform. Anyone who needs to work on the platform must read and sign the MTAP procedures and JHA to be added to the list. The two person rule applies to any work done on the platform. No more than two people can be on the platform at any time and only one person at a time can use the stairs.

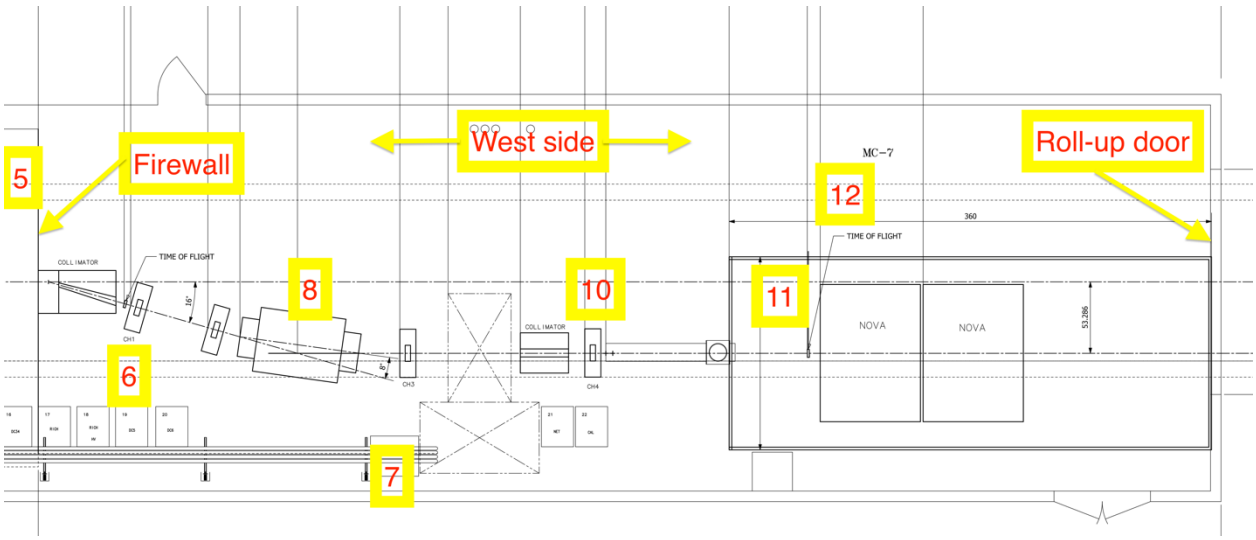


Figure 6. MC7b enclosure -- numbered locations refer to the photos in previous figures.

4. Emergencies

Call ext. 3131 from a safe location in the event of an emergency, such as personnel requiring medical treatment for any reason. Stay on the phone until the emergency operator indicates that s/he has all 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. An Automated External Defibrillator (AED) is located just outside the doors to the MTest Control Room.

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 not 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 (eg., 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.

4.1. Fire Alarm

The MC7 enclosure has a fire alarm system (Photo 7). If the fire alarm goes off in the enclosure, leave the area via the nearest exit and go to the designated assembly point, which is across the street from the west side of the building. Fire extinguishers should be used by trained personnel only.

4.2. Sitewide Emergency Warning System (SEWS)

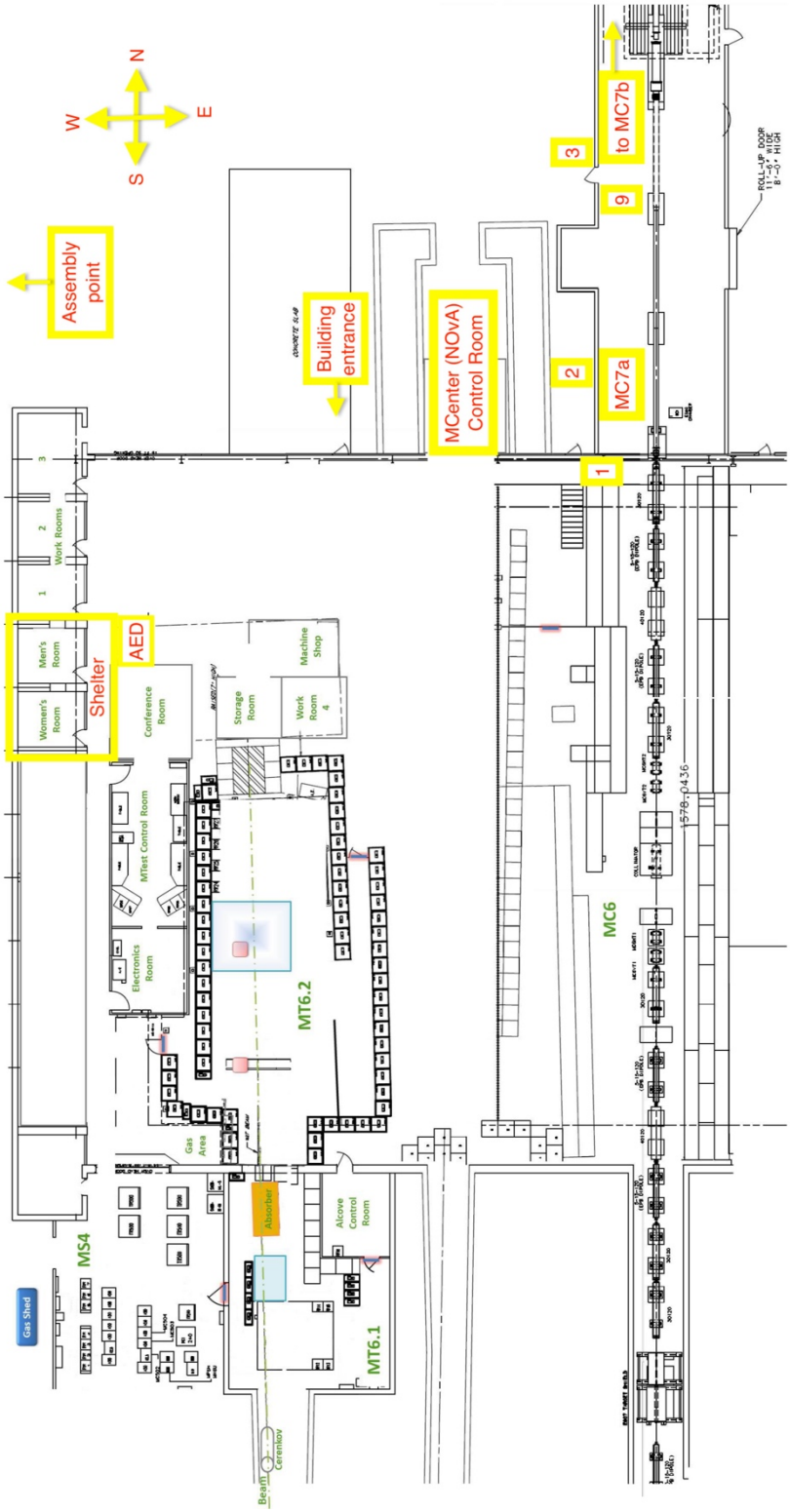
This is a verbal communication system broadcast throughout all areas of the laboratory. It is used to notify personnel when hazardous conditions exist and what protective actions to take. It is very important that you respond to its warning tones and messages and that you follow the transmitted instructions. If the nature of the message indicates severe weather, promptly go to the designated shelter for your area. The designated shelter areas for FTBF are the bathrooms on the west side of the Meson Detector building.

5. Contacts

A copy of the following list with phone numbers can be found in the MCenter Control Room.

- Fermilab Emergency Operator/Fire Department x3131
- NOvA Test Beam Coordinator Alex Sousa
- Experiment Liaison Officer Carrie McGivern
- Main Control Room x3721
- FTBF Coordinator Mandy Rominsky
- FTBF Deputy Manager JJ Schmidt
- ES&H Particle Physics DSO Raymond Lewis
- ES&H Neutrino DSO Angela Aparicio
- MC7 Building Manager Steve Huey

Fig 7. MDB West -- numbered locations refer to the photos in previous figures.



Signature Page and Training Record

"I have read the **MC7 Enclosure Hazard Awareness Training [PDMC7001/CR/01] Handout** and understand the hazards present within the facility. Also, I agree to follow all of the listed work rules and emergency procedures."

Print your name: _____Fermilab ID#: _____

Division/Section/Affiliation: _____Department/Group: _____

Fermilab Phone #: _____ Mail Station: _____

Email address: _____

Your signature: _____

Today's Date: _____

If you have not completed this training online, please complete this form and return it to:

Raymond Lewis or Katie Swanson, MS 355

----------FOR ADMINISTRATIVE USE ONLY----------

Course: **MC7 Enclosure Hazard Awareness Training [PDMC7001/CR/01]**

Authorization: _____

(Must be signed by ESH&Q personnel)