MuCool Test Area Hazard Awareness Training Handout
Version 2.0
February 16, 2011

Overview

This document is intended to inform you of some of the common hazards encountered in the MuCool Test Area (MTA) enclosure. This hazard awareness training is required for all personnel who intend to access or work in the MTA enclosure. It is valid for a period of two years. Please read the entire document and take the on-line test associated with Accelerator Division Course AD000008/CR/01 or return the signature sheet available in the Main Control Room.

Introduction

The MuCool Test Area (MTA, aka Muon Test Area) has been designed to test MuCool RF accelerating cavities at the highest possible gradients in large magnetic fields and to accept 400 MeV protons from the end of the Linac accelerator at a rate of ~1.6×10^{13} protons/pulse. The MTA supports two modes of beam operation: beam emittance measurements and beam to muon cooling experiments.

Experimental Hall Access Control

The door at the top of the stairs leading to the experimental hall and the door from the labyrinth hallway to the lower exterior pit area are to be kept closed during all operational modes and during access periods. Access keys are to be checked out from the Main Control Room (MCR). Every entrant is to have their own individual access key.

Experimental Hall Access Requirements

Two Person Rule

The two person rule is required for all accesses to the experimental enclosure.

Hazard Awareness Training

All personnel accessing the hall, except those individuals on approved tours, must read the MuCool Test Area Hazard Awareness Training Handout (this document) and take the on-line test associated with Accelerator Division Course AD000008/CR/01 (or return the signature sheet available in the Main Control Room) to indicate that they have read and understood the information presented herein.

Radiological Control Requirements

Radiation Worker training is required for personnel accessing the experimental hall. All accesses to the experimental hall are governed by a Radiation Work Permit (RWP). The active RWP for the hall is available in the MCR and must be reviewed, in conjunction with obtaining an access key, before accessing the hall. The RWP contains information on the radiological training, PPE, and dosimetry required for access. A frisker and wallflower are located in the entrance alcove.

Clean Room Conditions

For the MTA equipment to operate correctly and to support maintaining the portable clean room located in the hall in good condition, every effort needs to be taken to ensure the cleanliness of the experimental hall. Everyone accessing the hall is to wear shoe covers to minimize the tracking of foreign materials into the hall. Note that shoe covers can create a hazard for the wearer due to less than normal traction and loose fit, so for activities where shoe covers could pose a hazard, such as climbing ladders, the shoe covers should be removed inside the hall before beginning the activity. Shoe covers are located in a shelving unit located in the grade-level entrance alcove. As an alternative to shoe covers, an individual may procure a pair of shoes or boots for wearing exclusively in the hall and store that footwear in the shelving unit. Shoe covers and other PPE must not be stored, discarded, or otherwise left in the entry hallways.

Experimental Hall Hazards and Controls

Ionizing Radiation Sources

When beam is transported through the MTA Beamline, ionizing radiation is a significant radiation hazard. In order to protect workers and the general public, the enclosures and beam pipes are surrounded either by sufficient amounts of shielding (earth, concrete or iron), and/or networks of interlocked detectors to keep any prompt radiation within acceptable levels.

Beam delivery at high-intensity will produce activated materials which will result in residual dose rates in the hall after beam operations. Residual activation hazards will be handled

operationally as in all other primary beam enclosures. The RWP for the hall will detail the controls necessary for access.

The high electric field gradient RF cavities under test in the enclosure have the potential to generate x-rays due to electrons hitting the interior walls of the cavity. As such, the enclosure safety system interlocks remove the possibility of RF power to the enclosure under all access conditions. This is done by opening the modulator charging power supply 480 VAC contactor and inhibiting the low level RF for the 805 MHz system, and opening the klystron power supply 480 VAC contactor and inhibiting the Low Level Pulse Enable for the 201 MHz system.

Electrical Hazards

Many MTA components utilize potentially dangerous high voltages and currents. In addition, certain electrical devices and components may retain their charge after their voltage source has been removed. All personnel working on or near potentially energized components must have LOTO Level II training and must lockout, tagout, and verify that the equipment energy sources have been deenergized before beginning work.

Magnetic Field Hazards

The MTA has a 5 Tesla (50,000 Gauss) superconducting solenoid. During controlled access, the solenoid is permitted to remain energized. In addition, when the solenoid power supply is de-energized, the current in the magnet decays for another two hours. 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 inside the enclosure to indicate when current is present in the solenoid (see Photo 1).

Photo 1: Magnet-On Warning Light

When the magnetic field is present, persons with metallic implants (excluding dental fillings), metallic prosthesis, medical electronic devices, or active sickle cell anemia shall be prohibited from the experimental area unless formally permitted by the Fermilab Occupational Medicine Director. In addition, the area inside of the experimental enclosure where the magnetic field can exceed 300 G is demarcated with warning signs. To further assist in identifying the 300 gauss demarcation line around the magnet, a removable non-magnetic barrier will be put in place around the downstream end of the magnet when the magnet is energized. The only activities that can be performed within the >300 gauss region *when the magnet is energized* are visual

inspections and installation and/or removal of photographic films. Any other work within this region with the magnet on requires a written Hazard Analysis reviewed by the MTA Review Committee and the approval of the Accelerator Division Head. Personnel involved with approved activities in the >300 gauss region should minimize the time spent inside of the >300 gauss region; in no case should any part of an individual's body be exposed to greater than 20,000 G. In addition, any ferrous equipment or material to be installed within the >300 Gauss region must receive an engineering review to ensure the adequacy of the anchorage of the equipment or material and have the approval of the MTA Review Committee prior to installation. A pre-operational survey of the area around the magnet is done to ensure all ferrous materials have been removed prior to energizing the magnet. It should be noted that above 300 G, the probability increases that magnetic data storage media, such as the type found on credit cards, will be compromised by exposure to the magnetic field.

Cryogenic Systems

There are areas within the MTA where cryogens such as liquid helium, nitrogen, or hydrogen are routinely used. A leak of these liquids can cause local zones of oxygen deficiency. In addition, there may be areas where acute physical hazards, associated with handling of cryogenic liquids, such as burns to the skin, are present. When working with cryogenic liquids, appropriate personal protective equipment (PPE), such as gloves, protective eyewear, or face shields must be worn.

Oxygen Deficiency Hazard (ODH)

Under normal conditions, the MTA is classified an ODH Class 0 area due to the continually running ventilation fan. In the event of a ventilation fan failure, an amber warning light and siren sounds warning occupants to exit the enclosure (see Photo 2).

Photo 2: Vent Fan Failure Alarm

In addition, the enclosure has an ODH monitoring system consisting of a red strobe light and whooper horn (see Photo 3). In the event of an ODH alarm, all occupants are to exit the enclosure.

Photo 3: ODH Alarm

Flammable Gas

Various experiments utilize flammable gasses, typically hydrogen. When these are present in the enclosure, the upstairs entry door is posted with a flammable gas warning sign and a flammable gas detection system is utilized to detect flammable gas leaks. Before entry through the lower level enclosure door, verify the flammable gas monitor to the left of the door reads less than 3. A reading of 3 corresponds to 3% of the Lower Explosive Limit (LEL) for hydrogen in air. When flammable gasses are in use, no ignition sources are allowed within 15 feet of the flammable gasses. For example, no lighters, torches, pagers, cell phones (unless classified as intrinsically safe), etc. In the event of a flammable gas leak, a blue warning light and audible alarm sounds, warning occupants to exit the enclosure (see Photo 4).

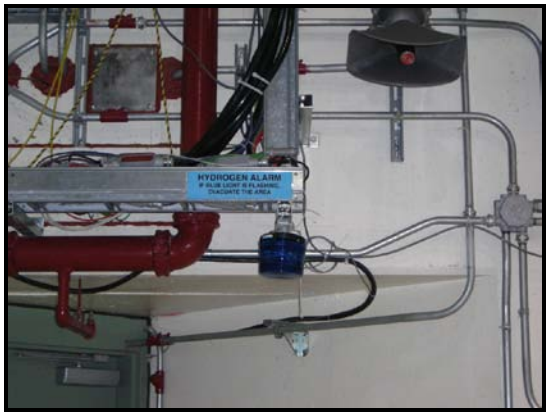

Photo 4: Flammable Gas (Hydrogen) Alarm

Chemical

The types and quantities of chemicals to be used are generally similar to those routinely in use throughout the laboratory. The LBL Single Cell 805 MHz cavity and the larger LBL 201 MHz cavity both use beryllium vacuum windows. Working with beryllium components requires specialized training from the AD ESH Department.

Fire

The experimental hall is provided with an automatic sprinkler system and a fire alarm system. If a fire alarm sounds (see Photo 5) in the experimental hall while personnel are in access, the personnel shall evacuate the hall and assemble in the parking lot outside of the MuCool Service Building. The evacuated personnel shall wait for the arrival of the Fire Department and report any information they have on the situation to the Incident Commander.

Photo 5: Fire Alarm

Mechanical

At various times, some experimental chambers will utilize high pressure gasses in the enclosure that may become hazardous if handled improperly. All gas cylinders must be properly regulated while in use and capped while in storage. They also must be secured at all times from falling.

An aerial lift is located in the hall. Only personnel trained on the use of the lift by a knowledgeable person may operate the lift. Hard hats may be needed by users of the lift and by those working on the floor underneath the lift.

Emergencies

Call ext. 3131 in the event of an emergency situation from the phone in the upstairs refrigerator building or phone in the Booster West Gallery. Stay on the phone until the emergency operator indicates that she/he has all the necessary information.