mu2e Fire Protection/ Life Safety Assessment

Prepared for

Fermi National Accelerator Laboratory

P.O. Box 500
Batavia, IL 60510

Prepared by

Aon Fire Protection Engineering

Aon FPE Project No. 1812010-001

May 28, 2013

Aon Fire Protection Engineering Corporation
1000 Milwaukee Avenue, 5th Floor | Glenview, IL 60025
t +1.847.953.7700 | **f** +1.847.953.7793 | aonfpe.com

I. Introduction

This report outlines fire protection and life safety recommendations for the new Fermilab mu2e conventional facilities. The fire protection and life safety recommendations contained in this report are based on our review and analysis of the following documents:

- Conceptual design drawings for the Mu2E Conventional Facilities dated March 25, 2013,
- *2009 International Building Code* (IBC),
- *2009 International Fire Code* (IFC),
- NFPA 101 – 2009 Edition*, the Life Safety Code* (LSC).

The recommendations made as a result of this analysis are listed in Section IX of this Report.

The Fermilab Antiproton Source and proposed elements of the Muon Campus Program play an essential role in the beam delivery scheme for Mu2e. No enclosure currently exists in the vicinity of the antiproton source that would be suitable to house the Mu2e experiment so a new detector hall facility is required. The Conventional Construction sub-project includes the management, planning, design, and construction of new structures, buildings and utilities, as well as modifications to existing structures as required to house and support operation of Mu2e. The Conventional Construction builds upon and extends the proposed facilities provided in the Muon Campus projects.

The Conventional Construction scope includes the elements of work normally included in conventional construction such as earthwork, utilities, structural concrete, structural steel, architectural cladding, finishes, roofing, plumbing, process piping, HVAC, fire protection, fire detection, lighting and electrical. The civil portion of the Mu2e Conventional Construction will consist of the work required to extend the utilities to the project site, excavation associated with the below grade cast-in-place concrete enclosures, creation of a shielding berm and site restoration.

Design activities have been packaged into two distinct functional packages:

A. <u>Detector Service Building and Detector Enclosure</u>

The Detector Building will house the Mu2e detector including the Production Solenoid, Transport Solenoid and Detector Solenoid and will provide space for support functions. The Detector Enclosure adjoins to the existing Muon Campus M4 Beamline Enclosure for the final routing of the proton beamline.

B. <u>Antiproton Upgrades</u>

In order to accommodate the increased beam power required for Mu2e the Antiproton Rings require upgrading. The Mu2e Accelerator sub-project has the responsibility to assess and provide the criteria for the conventional facilities

portion of the required upgrade. The Antiproton Rings Service Buildings will be fenced and posted to restrict access during beam operations. Additional electrical power and HVAC is specific areas are required for the new RF systems and beamline power supplies located in the AP Service Buildings and enclosure.

As currently indicated on the conceptual design drawings, no floor level of any below grade areas will exceed 30 feet below the level of exit discharge.

II. Occupancy Classification

The *2009 International Building Code* (IBC) would classify the Mu2e facilities as Use Group F-2 (Low Hazard Factory Industrial) occupancies. NFPA 101 – 2009 Edition, the *Life Safety Code* (LSC), would classify the facilities as Industrial Occupancies.

The Detector Hall and Beam Transport Enclosure would also be classified as *Underground Buildings* by IBC Section 405 and LSC Section 3.3.254.11.

III. Building Height and Area

Conceptual design drawings indicate that the Detector Support Building will be one-story (32'-6") in height and have an area of approximately 12,180 sq. ft.

IV. Building Construction

The building construction type is not indicated on the design drawings. Based on the proposed height and area, the Detector Support Building may be constructed of Type IIB construction in accordance with IBC Table 601.

All underground portions of the facility should be constructed of Type I construction as required by IBC Section 405.2.

V. Means of Egress

A. Exits

All floor levels are required to have a minimum of two exits per IBC Section 1021.2. The conceptual design drawings show three (3) exits from the Detector Hall and two (2) exits from the Detector Support Building. Sufficient exit capacity appears to be provided.

B. Smokeproof Enclosures

There are no requirements for smokeproof enclosures.

C. Travel Distance

The maximum travel distance to an exit should not exceed 300 feet in accordance with IBC Table 1016.1 for a Use Group F-2 occupancy. Travel distances to exits as depicted on the conceptual design drawings are within this limitation.

D. Common Path of Travel

The maximum common path of travel distance should not exceed 75 feet in accordance with IBC Section 1014.3 for a Use Group F-2 occupancy. The common path of travel distances as depicted on the conceptual design drawings appear to be within this limitation.

E. Dead End Corridors

The maximum dead end corridor distance should not exceed 20 feet in non-sprinklered facilities or 50 feet in fully sprinklered facilities in accordance with IBC Section 1018.4.

F. Corridor and Aisle Widths

All corridors and aisles should be a minimum of 44 inches wide in accordance with IBC Section 1018.2. Aisles used solely for access to and utilization of electrical, mechanical, or plumbing systems or equipment may be reduced to a minimum of 24 inches.

VI. Smoke Control

There are no requirements for smoke control.

VII. Fire Protection Systems

A. Automatic Fire Sprinkler System

An automatic fire sprinkler system is required by LSC Section 11.7.3.4 for all below grade areas of the facility.

B. Fire Standpipe System

There are no requirements for a fire standpipe system.

C. Fire Alarm System

A fire alarm system is required for this facility by LSC Section 40.3.4.1.

VIII. Emergency and Standby Power Systems

A. Means of egress illumination and exit signs are required to be connected to an emergency power source to provide power for duration of at least 90 minutes (IBC Sections 1006.3 & 1011.5.3).

B. Standby power systems are not required.

IX. Recommendations

Based on our review of the project documents and the applicable codes, Aon Fire Protection Engineering has the following recommendations for the mu2e facilities. Our recommendations are segregated by facility. It should be understood that these recommendations are based on a preliminary design and are subject to change as the design progresses. It should also be understood that these recommendations are based on floor levels for all below grade areas not exceeding 30 feet below the level of exit discharge.

DETECTOR HALL

A. Construction: The facility should be of Type IB construction as defined by Section 602 of the 2009 IBC.

B. Means of Egress:

1. At least two separate exits to the surface should be provided. The maximum travel distance to an exit should not exceed 300 feet.

2. Exit stairways should be enclosed by 2 hr. fire rated construction.

3. The common path of travel should not exceed 100 feet in areas protected by an automatic fire sprinkler system, or 50 feet in areas not protected by an automatic fire sprinkler system.

4. Emergency lighting should be provided for all means of egress in accordance with the IBC and NFPA 101.

C. Automatic Fire Sprinkler System:

1. An automatic fire sprinkler system should be provided throughout the Detector Hall, except for any room or space where the application of water could constitute a serous radiation related issue as determined by Fermilab and the Authority Having Jurisdiction. The fire sprinkler system may be either wet-pipe, dry-pipe, or preaction type.

2. For any area(s) not provided with fire sprinkler system protection, documentation should be submitted to the Department of Energy substantiating the reason(s) why fire sprinkler system protection is not provided. Line type heat detection and air sampling smoke detection systems should be provided for any areas not provided with fire sprinkler system protection.

D. Fire Detection and Alarm System:

1. An addressable fire detection and alarm system should be provided for the Detector Hall. The system should consist of:

   a. Manual pull stations located at the entrances to exit stairways.

b. Air sampling smoke detection (or spot type smoke detectors) and linear heat detection in any areas not provided with fire sprinkler system protection.

c. Duct type smoke detectors on the supply and return sides of all air handling units having a capacity greater than 2000 cfm, and in ducts penetrating a 2 hr. fire/smoke barriers.

d. Sprinkler system waterflow detectors and valve supervisory switches.

e. Combination horn/strobe devices located throughout the facility.

f. An addressable fire alarm control panel with a standby power supply.

E. Emergency Power and Standby Power Systems:

1. Emergency power should be provided for the following systems such that the transition time from the instant of failure of normal power to an alternate power source does not exceed 10 seconds:

   a. Fire detection and alarm system.
   b. Exit sign illumination.
   c. Lighting throughout the Detector Hall.
   d. Elevator car lighting.

2. Standby power should be provided for the following systems such that the transition time from the instant of failure of normal power to an alternate power source does not exceed 60 seconds:

   a. All lighting for rooms containing HVAC equipment.
   b. All ventilation systems.

3. The alternate power supply should be capable of providing power for a minimum of 1½ hours for emergency power systems and 4 hours for standby power systems. The fire detection and alarm system should be provided with battery back-up sufficient to power the system for 24 hours in stand-by mode, followed by 15 minutes of alarm mode.

F. Miscellaneous:

1. The quantities of flammable and combustible liquids stored and/or used shall not exceed the quantities permitted by Table 4.1.3.1(c) of NFPA 520.

2. All wall and ceiling finishes, along with movable partitions, should be Class A with a flame spread rating not to exceed 25 and a smoke development rating not to exceed 450.

3. Insulated cables and wiring not installed in metal conduits and raceways should meet IEEE Standard 1202 for flame propagation, where possible. All fire alarm system wiring should be installed in metal conduit.

4. On-site self-contained breathing apparatus should be provided in the quantities and locations as directed by Fermilab-Environmental, Safety & Health.

5. Portable fire extinguishers should be provided throughout the facility in accordance with NFPA 10, *Standard for Portable Fire Extinguishers, and as directed by the Fermilab Fire Department*.

DETECTOR SUPPORT BUILDING

A. Construction: The facility should be of Type IIB construction as defined by Section 602 of the 2009 IBC.

B. Compartmentation: Rooms containing equipment for standby or emergency power should be enclosed by 2 hr. fire rated construction.

C. Means of Egress:

1. At least two exits should be provided. The maximum travel distance to an exit should not exceed 300 feet.

2. The common path of travel should not exceed 100 feet.

3. Dead end corridors should not exceed 50 feet in length.

4. Emergency lighting should be provided for all means of egress in accordance with the IBC and NFPA 101.

D. Automatic Fire Sprinkler System:

1. An automatic fire sprinkler system should be provided throughout the Detector Support Building. The fire sprinkler system may be either the wet-pipe, dry-pipe, or preaction type.

E. Fire Detection and Alarm System:

1. An addressable fire detection and alarm system should be provided for the Detector Support Building. The system should consist of:

   a. Manual pull stations located at all exits.

   b. Duct type smoke detectors on the supply and return sides of all air handling units having a capacity greater than 2000 cfm, and in ducts penetrating a 2 hr. fire/smoke barriers.

c. Sprinkler system waterflow detectors and valve supervisory switches.

d. Combination horn/strobe devices located throughout the facility.

e. An addressable fire alarm control panel with a standby power supply.

F. Emergency Power and Standby Power Systems:

1. Emergency power should be provided for the following systems such that the transition time from the instant of failure of normal power to an alternate power source does not exceed 10 seconds:

   a. Fire detection and alarm system.
   b. Exit sign illumination.
   c. Elevator car lighting.
   d. Means of egress lighting.

2. Standby power should be provided for lighting of any rooms containing HVAC equipment for below grade areas. Standby power should be provided such that the transition time from the instant of failure of normal power to an alternate power source does not exceed 60 seconds.

3. The alternate power supply should be capable of providing power for a minimum of 1½ hours for emergency power systems and 4 hours for standby power systems. The fire detection and alarm system should be provided with battery back-up sufficient to power the system for 24 hours in stand-by mode, followed by 15 minutes of alarm mode.

G. Miscellaneous:

1. Portable fire extinguishers should be provided throughout the facility in accordance with NFPA 10, *Standard for Portable Fire Extinguishers, and as directed by the Fermilab Fire Department*.

2. Any outdoor liquid filled transformers should be separated from the Detector Support Building by distance in accordance with FM Global Data Sheet 5-4, *Transformers*.

Prepared By:

Rick Glenn, P.E.
Project Manager