Technical Division Facilities

Section V - Chapter 6

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Table of Contents

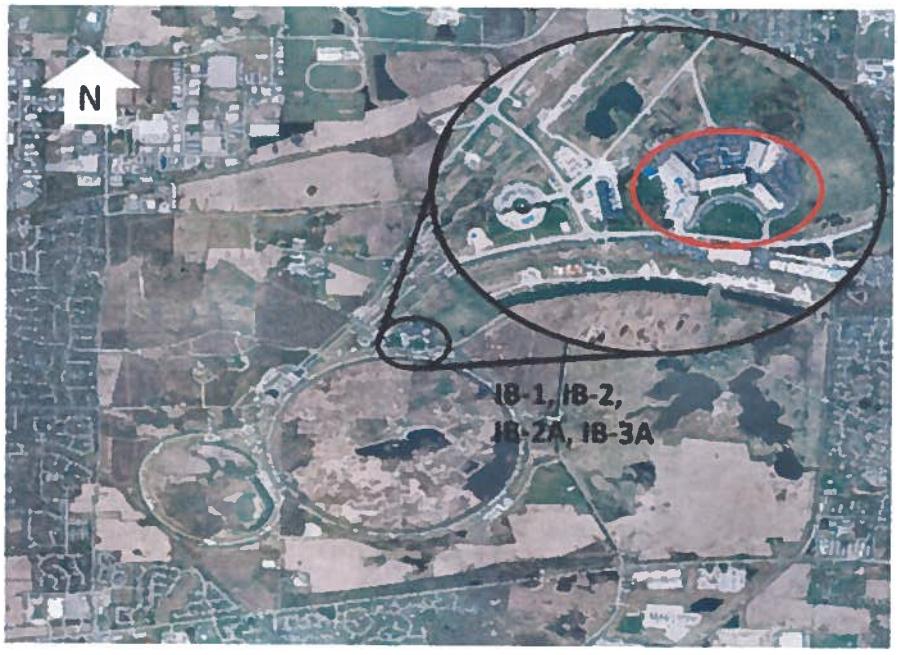
V-6 Technical Division Facilities

V – 6.1 Locations of Technical Division Facilities on Fermi National Accelerator (Fermilab) Site

The Technical Division (TD) is the landlord of and conducts its operations within the following buildings:

- Industrial Building 1 (IB-1), a Fermilab testing facility
- Industrial Building 2 (IB-2), a production facility (magnet factory)
- Industrial Building 2A (IB-2A), north end, radioactive materials work area
- Industrial Building 3A (IB-3A), houses a Class 4 laser cutter
- Magnet Storage Building (MSB)
- Tagged Photon Lab (TPL), a former target building now used for storage
- Lab 4, Village Machine Shop

The maps below show the locations of the TD facilities on the Fermilab site.



Technical Division Industrial Complex

Tagged Photon Lab & Magnet Storage Building

Village Machine Shop

V – 6.2 Inventory of Hazards

The following table lists the identified hazards found in each of the TD facilities. All hazards with an * have been discussed in Section I Chapters 1-10 of this document and are therefore not covered in detail in this section.

Industrial Building 1

Radiation Activated materials (e.g. magnets) X-rays and thermal neutrons (VTS 1, 2, 3)	**Kinetic Energy** Hand-held power tools* Pumps and motors* Rotating machining equipment (tech shop) *
Toxic Materials Hexavalent chromium (welding fume) *	**Potential Energy** Compressed gases* Vacuum / pressure vessels* Vacuum / pressure piping* Vacuum pumps*
Flammable & Combustible Materials Cables* Flammable Liquids (small quantities) *	**Electrical Energy** High voltage exposure (power supplies & buss)* Creation of magnetic fields*
Cryogenic Materials Helium Nitrogen	**High Noise (> 85 dBA)** None

Industrial Building 2

Radiation Activated materials (e.g. magnets) Radioactive waste materials	**Kinetic Energy** Power tools* Motors (powered equipment)*
Toxic Materials Lead shielding * Lead-based paint * Welding fume * Lead-based solder (tin-lead) *	**Potential Energy** Compressed gases*
Flammable & Combustible Materials Cables* Flammable Liquids *	**Electrical Energy** High voltage exposure *
Cryogenic Materials Nitrogen	**High Noise (>85 dBA)** Grinding * Grit blast booth *

Industrial Building 2A (North End)

Radiation Activated materials (e.g. magnets) Radioactive waste materials	**Kinetic Energy** Power tools *
Toxic Materials Lead (shielding, paint) *	**Potential Energy** None
Flammable & Combustible Materials Flammable Liquids *	**Electrical Energy** None
Cryogenic Materials None	**High Noise (>85 dBA)** Grinding *

Industrial Building 3A

Radiation Class 4 cutting laser*	**Kinetic Energy** None
Toxic Materials Solder (tin-lead) *	**Potential Energy** Compressed gases* Pressure vessels* Vacuum pumps*
Flammable & Combustible Materials Cables* Flammable Liquids *	**Electrical Energy** High voltage exposure * Creation of magnetic fields *
Cryogenic Materials Helium * Nitrogen *	**High Noise (>85 dBA)** None

Magnet Storage Building

Radiation Activated magnets and associated components	**Kinetic Energy** None
Toxic Materials Lead shielding *	**Potential Energy** Pressure vessel (outside) *
Flammable & Combustible Materials None	**Electrical Energy** None
Cryogenic Materials Nitrogen *	**Noise (>85 dBA)** None

Tagged Photon Lab

Radiation Activated magnets and associated components	**Kinetic Energy** None
Toxic Materials Lead shielding *	**Potential Energy** None
Flammable & Combustible Materials Cables (abandoned) *	**Electrical Energy** None
Cryogenic Material None	**Noise (>85 dBA)** None

Lab 4 Village Machine Shop

Radiation Activated materials Radioactive waste (metal chips)	**Kinetic Energy** Rotating machining equipment *
Toxic Materials Lead (shielding) *	**Potential Energy** None
Flammable & Combustible Materials Flammable Liquids *	**Electrical Energy** None
Cryogenic Materials None	**Noise (>85 dBA)** None

V – 6.3 Introduction

This Section V, Chapter 6 of the Fermi National Accelerator Laboratory (Fermilab) Safety Assessment Document (SAD) covers the operations of the various TD facilities and material storage areas.

V – 6.3.1 Purpose of TD Facilities

IB-1

IB-1 houses the activities of the Test and Instrumentation (T&I) Department of the Technical Division. The department's main activities are to:

(1) Manage, operate, maintain, and develop the Technical Division's Magnet Test Facility (MTF) and Vertical Cavity Test Facility (VCTF), both located within the Industrial Building 1 (IB-1), sharing infrastructure and services;

(2) Support users of these test facilities to conduct tests and acquire measurements of both R&D and production conventional and superconducting magnets and superconducting radio frequency (SRF) cavities; and

(3) Develop advanced instrumentation and provide instrumentation fabrication services to test facilities and Technical Division projects.

IB-2

IB-2 houses the activities of the Magnet Systems Department of the Technical Division, and is sometimes called the magnet factory. Activities in this building include the assembly of magnets and associated magnet components for Fermilab and other labs in the United States and around the world, and the repair of magnets and associated magnet components at Fermilab.

IB-2A (North End)

The north end of IB-2A houses the operations of the Magnet Systems Department of the Technical Division and is used for work on radioactive magnets when there is a desire to isolate activities that may produce dusts and fumes, thereby keeping IB-2 free from surface

contamination. This area is also used to house Class 2 magnets for short periods of time, and if necessary, work on Class 2 magnets to limit exposures from these items to as few individuals as possible.

IB-3A

IB-3A houses a Class 4 laser cutting table that is operated by personnel from the Magnet Systems Department of the Technical Division. The laser is used mainly to cut thin strips and other shapes from Kapton (a polymide film) and similar materials, which are then used in magnets being assembled for R&D purposes in IB-3. The other operations in IB-3A are not associated with the Class 4 laser, and are general industrial operations that are covered in SAD chapters 1 - 10.

MSB

As the name implies, the Magnet Storage Building is used strictly to store magnets and associated components for possible use when an item needs to be replaced in the accelerator complex for some reason. Many of the items that were housed in the building were for use in the Tevatron, and a large number of those have since been removed to the Railhead since they are no longer needed. Components, of which some are Class 1 with an occasional Class 2, do remain for use in the Main Injector.

TPL

The Tagged Photon Lab is a former target building that has been repurposed as a storage area for all manner of items associated with activities at Fermilab. Among the items included in the building are a number of Class 1 materials and a few Class 2 materials.

VMS

The Lab 4 Village Machine Shop is the main machine shop at Fermilab and performs typical machining operations, and occasionally machines low level (Class 1) radioactive materials.

V – 6.3.2 Description of the Various TD Facilities

IB-1

IB-1 is a two story metal building located in the industrial complex that houses offices and test areas in the high bay portion of the building. The VCTF for testing SRF cavities consists of Vertical Test Stands (VTS), #1, #2 and #3. There are three test stands for testing conventional magnets, Stands A, B, and C. There are five test stands for testing superconducting magnets, Stands 2, 3, 4, 6, and the Vertical Magnet Test Facility (VMTF). There is also a Calibration Magnet Facility with a 2 Tesla Solenoid Magnet operated at 320 Amperes.

There are three control rooms in the IB-1 building: the MTF control room, the VCTF control room, and the cryogenic systems control room (common to both MTF and VCTF). Materials are

moved within the building with a number of overhead cranes rated at 25 tons, 10 tons (2), 4 tons, 2 tons and a hoist rated at 300 pounds.

Conventional safety hazards that may exist due to the presence of the test infrastructure equipment or test activities include the following, and are covered in SAD Chapters 1 -10:

- Electrical Hazards - high Electric currents and voltages (120 VAC, 480 VAC, DC power systems up to 30,000A, Hi-pot equipment, magnet voltage taps up to 1,000 Volts), and high power (500W) RF amplifiers.
- High Magnetic Fields
- Mechanical Hazards
  - High pressure cryogenic fluids (e.g., during a superconducting magnet quench)
  - High pressure room temperature gases
  - Motion of heavy objects via the building cranes
  - Rotating machinery
- Cryogenic Hazards - Exposure to low temperatures (Liquid Nitrogen, Liquid Helium)
- Oxygen Deficiency Hazard (ODH) is primarily due to the presence of helium and nitrogen, and affect the mezzanine on the northeast section of the building and all areas within 3 feet of the production floor ceiling during refrigerator operation

Radiation hazards consist of the following and are addressed Section V – 6.4.1:

- Ionizing radiation (x-rays generated during SRF cavity testing)
- Non-ionizing radiation (RF fields)
- Low level radioactive objects (activated magnets)

Certain experiments may introduce additional hazards into the building (e.g., high power lasers).

The IB-1 production floor is classified as a Controlled Area and a Radioactive Materials Area. Access to IB-1 is restricted to personnel who have received, at a minimum, General Employee Radiation Training (GERT). Non-trained personnel may enter the production floor area provided they are escorted by personnel who have received GERT or Radiological Worker training. Specific assignments may require further training and certification as deemed necessary by the supervisor or Division Safety Officer (DSO). The Controlled Area determination is based on potential exposure rates when areas of IB-1 are utilized as Radioactive Materials Areas and also due to the presence of the VCTF which has the potential for producing ionizing radiation during operation.

No radioactive source or material with activity rated above Class 1 is allowed in IB-1 without written permission from the Division Head.

During operation, the VCTF has the capability of producing ionizing radiation (X-rays). The shielding of the VCTF has been designed to maintain the Controlled Area status of IB-1. During high power operation of the VCTF, access is restricted by a chain barricade surrounding the VCTF and the Radiological Work Permit (RWP). Only authorized personnel (i.e., those with VCTF Operator training, ODH, Lockout/Tagout (LOTO), and Radiological Worker training, and who in addition have read and signed the VCTF RWP are permitted entry into the restricted area.

The VCTF also incorporates a system of interlocks to prevent personnel exposure to ionizing and non-ionizing (RF) radiation. The interlock system is designed to de-energize the RF systems of the VCTF in the event of a failure or breach of an interlock. This interlock system is maintained by the Accelerator Division ES&H Department Interlocks Group. No work is performed on the VCTF interlock system by T&I Department personnel. Normal operation of the VCTF (cavity testing) is restricted to authorized VCTF operators who have received LOTO, Oxygen Deficiency Hazard (ODH), Radiological Worker, and VCTF Operations training and are on the list of operators authorized by the T&I Department Head.

IB-2

IB-2 is a two story metal building located in the industrial complex that houses offices and production areas. The production and repair activities within IB-2 take place in the high bay area of the building, and on the first floor of the newer addition commonly referred to as the wrapping room. Low level radioactive hazards (Class 1) may be present in the form of activated magnets and associated components, and some of the activities that repair these items may product low level radioactive waste. There is an epoxy room off to the side of the high bay area where nitrogen is used in the epoxy mixing vessels. This room has an alarms system and is classified as ODH 0 due to the active ventilation in the room. The ventilation also reduces any vapors that may be generated during epoxy mixing. Two overhead cranes rated at 15 tons and 25 tons are used to move materials into and out of the high bay area of the building, and within the high bay area.

IB-2A

IB-2A is a small metal building located in the parking lot to the north of the Industrial Center Building. The north end of the building is classified as a Controlled Area and Radioactive Materials Area. Low level radioactive materials (Class 1) may be present in the form of activated magnets and associated components, and some of the activities that repair these items may produce low level radioactive waste. The north end of the building is segregated from the south end, where a tech shop is located, by a wall that seals the north end from the south end. Activities that are considered "dirtier", i.e. producing more fume, dust, or small particles than usual, are performed in IB-2A to prevent contamination of IB-2. Class 2 magnets may be housed in IB-2A as well until they are ready to be worked on, thus reducing exposure to personnel in IB-2 for As Low As Reasonably Achievable (ALARA) purposes. Materials are moved within IB-2A using one of two 1 ton hoists.

IB-3A

IB-3A, a two story metal building, is the newest building in the industrial complex. It consists of lab space on the first floor and office space on the second floor. The Class 4 laser, which is used to cut thin plastic type material such as Kapton, is located in the center area of the first floor. The laser complies with Fermilab Environmental Safety and Health Manual[1] (FESHM) Chapter 4260 *Lasers*, by using shielding to prevent exposure to reflective beam, and the shielding is interlocked to prevent operation of the laser without the shielding in place.

MSB

MSB is a large open metal building located at Site 50, and is classified as a Controlled Area and Radioactive Materials Area. It is used strictly for storing low level radioactive objects, such as activated magnets and associated components. The building is not occupied, except when personnel are adding to or removing items from the building. A 15 ton overhead crane is used to move materials into and out of the building. A nitrogen dewar on the exterior provides a nitrogen bleed through some of the magnets. The building is classified as ODH 0.

TPL

TPL is a one story metal building above ground with a former target area below grade, and is classified as a Controlled Area and Radioactive Materials Area. TPL is used strictly for storing low level radioactive objects, such as activated magnets and associated components. An occasional Class 2 magnet may be stored in the building as well but is shielded from personnel with lead blankets, lead plates on casters, or other magnets by its placement in the building. The building is not occupied, except when personnel are adding to or removing items from the building. A 10 ton overhead crane is used to move items into and out of the building.

VMS

The Village Machine Shop is located in what is known as Lab 1, a metal pole building located in the Village. The building houses typical machining operations, some of which at times may be on low level radioactive materials. All work on radioactive materials is performed under a RWP no matter how low the level of radiation. For ALARA purposes radioactive items are not allowed to be delivered to VMS until a machinist is available to perform the required task. Equipment and floor areas are thoroughly cleaned and surveyed upon completion of a radioactive job. Two overhead cranes rated at 2 tons and 5 tons are used to move materials at VMS.

V – 6.4 Safety Assessment

The unique hazards of each TD facility are analyzed in this section.

V – 6.4.1 Radiological Hazards

A number of different types of materials located in the Technical Division Facilities may present radiological hazards. The Technical Division implements the Fermilab management controls that govern radiological material use, storage, transportation, and disposal. This section identifies the types of radiological materials, radio-activated material, radioactive and hazardous waste, and their respective safety controls.

The applicable Fermilab safety controls that are implemented within the Technical Division are in the form of prescribed procedures and protective measures and include the following guidance documents: FESHM, Fermilab Radiological Control Manual[2] (FRCM), Fermilab Site Security Plan, and Low-Level Waste Certification Program.

V – 6.4.1.1 Prompt Radiation

The TD facilities listed in this SAD chapter are not physically connected to the accelerator complex; therefore there is no prompt radiation hazard.

V – 6.4.1.2 Residual Activation

Since no TD facility is physically connected to the accelerator complex, there is no residual activation produced at any TD facility listed in this SAD chapter. Activated materials are brought to several of the facilities as described above: IB-1, IB-2, IB-2A, MSB, TPL, and Lab 4 (Village Machine Shop). As outlined in policy TD-6060, Control of Radioactive Materials Class 2 and Higher into Technical Division Buildings, no radioactive material above Fermilab radioactive material Class 1 may be brought into a TD building without prior approval from the Division Head. Any work within a TD facility is performed according to approved procedures, including requisite safety precautions that include consideration of radiation protection, and an approved Radiological Work Permit (RWP). As part of the RWP, the work area is cordoned off when a Class 2 magnet is worked on in IB-2, and when any radioactive item no matter the level is worked on in the VMS. Radiological hazards are not directly associated with accelerator operations and are managed in accordance with the requirements of the FRCM Chapter 4, *Radioactive Materials*, that implement Title 10 of the Code of Regulations Part 835, *Occupational Radiation Protection* (10 CFR 835).

V – 6.4.1.3 Ionizing Radiation (X-rays, Neutrons)

X-ray and neutron radiation may be generated at the VCTF VTS 1, 2 and 3 in IB-1 by field-emitted electrons traveling in the cavity RF fields and impacting the cavity inner surface and other materials in the cryostat. Each VTS pit has radiation shielding that is designed to maintain an integrated dose rate of < 5 mrem/hour in the immediate vicinity of the VTS pit, and a dose rate of < 0.25 mrem/hour in all other working areas of IB-1. The shielding consists of a movable lid constructed of steel and concrete, and the steel lined concrete walls of the pit. Because the shielding lid is movable, there is an interlock system to ensure that it is in the correct position over the VTS pit when the cavity is powered. In addition, three Fox radiation detectors are strategically positioned on the outside of the shield and integrated with the interlock system. Any elevated radiation level detected by one of the Foxes will trigger a shutdown of the RF power.

In addition to an extensive array of procedures[3] that have been written for the operation of the VTS, a RWP has been written for its operation as well. It requires that each authorized VTS operator wear a dosimetry badge when it is operating.

V – 6.4.1.4 Non-ionizing Radiation (Radiofrequencies)

Radiofrequencies are generated at each VTS (1, 2 and 3) by a 208 V 20A single phase RF amplifier with a maximum power output of 500 W. The shielding described in Section V – 6.4.1.3 will protect personnel in the vicinity of each VTS from RF exposure in addition to the ionizing radiation exposure.

6.4.1.5 Radioactive Waste

Minimal radioactive waste is generated in the following TD facilities: IB-2, IB-2A and Lab 4. The radioactive waste generated in IB-2 and IB-2A results from repair work on activated magnets and associated components. The radioactive waste generated in Lab 4 results from machining operations on activated materials. All radioactive wastes are disposed in accordance with FRCM Chapter 4, *Radioactive Materials*, Part 4, *Radioactive Waste Management* requirements.

V – 6.5 Assessment of Potential Credited Controls

V – 6.5.1 Passive Controls

There are no passive credited controls that qualify for inclusion in the Accelerator Safety Envelope (ASE). All hazards are managed in accordance with FESHM including FRCM.

V – 6.5.2 Active Controls

There are no active controls that qualify for inclusion in the ASE. All hazards are managed in accordance with FESHM including FRCM.

V – 6.5.3 Administrative Controls

Administrative control of the TD facilities in this chapter begins with ensuring that all work is performed according to procedures approved by the appropriate Department Head or according to policy approved by the Technical Division Head. There are no administrative controls that qualify for inclusion in the ASE. All hazards as outlined in this chapter are managed in accordance with FESHM, including FRCM.

V – 6.6 Summary & Conclusion

Specific hazards associated with operations within certain TD facilities are identified and assessed in this chapter of the Fermilab Safety Assessment Document. The designs, controls, and procedures to mitigate specific hazards in these facilities are identified and described. In addition to these specific safety considerations, the identified TD facilities are subject to the global and more generic safety requirements, controls and procedures outlined in Section I of this Fermilab Safety Assessment Document.

Within the specific and generic considerations of this assessment, all TD facilities can be operated with a level of safety that will protect people and property and is equal to or exceeding that currently prescribed by DOE orders and Fermilab regulations as put forth in the FESHM including FRCM.

V – 6.7 Glossary, Acronyms

ALARA	As Low As Reasonably Achievable
ASE	Accelerator Safety Envelope
DOE	Department of Energy
DSO	Division Safety Officer
ESH&Q	Environment, Safety, Health and Quality
FESHM	Fermilab Environment, Safety, and Health Manual
FRCM	Fermilab Radiological Control Manual
GERT	General Employee Radiation Training
IB	Industrial Building
LOTO	Lockout/Tagout
MTF	Magnet Test Facility
ODH	Oxygen Deficiency Hazard
RWP	Radiological Work Permit
SAD	Safety Assessment Document
SRF	Superconducting Radiofrequency
TD	Technical Division
TPL	Tagged Photon Lab
T&I	Test and Instrumentation
VCTF	Vertical Cavity Test Facility
VMS	Village Machine Shop
VMTF	Vertical Magnet Test Facility
VTS	Vertical Test Stand

V – 6.8 References

[1] Fermilab Environment, Safety, and Health Manual. – The current web link is: http://esh.fnal.gov/xms/FESHM

[2] Fermilab Radiological Control Manual. - The current web link is: http://esh.fnal.gov/xms/FRCM

[3] Test & Instrumentation Department Documents – The current web link is: http://tiweb.fnal.gov/website/controller/220