



# WASTE HANDLING FACILITIES

## SECTION II CHAPTER 04 OF THE FERMILAB SAD

Revision 1 August 02, 2023

This Chapter of the Fermilab Safety Assessment Document (SAD) contains a summary of the results of the Safety Analysis for the Waste Handling Facilities of the that are pertinent to understanding the risks to the workers, the public, and the environment due to its operation.



## SAD Chapter Review

This Section II, Chapter 04 of the Fermi National Accelerator Laboratory (Fermilab) Safety Assessment Document (SAD), *Waste Handling Facilities*, was prepared and reviewed by the staff of the ES&H Division, Hazard Control Technology Team (HCTT) in conjunction with the Environment, Safety & Health Division (ESH) Accelerator Safety Department.

Signatures below indicate review of this Chapter, and recommendation that it be approved and incorporated into the Fermilab SAD.

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### Revision History

Printed versions of this Chapter of the Fermilab Safety Assessment Document (SAD) may not be the currently approved revision. The current revision of this Chapter can also be found on ESH DocDB #1066 along with all other current revisions of all Chapters of the Fermilab SAD.

Author	Rev. No.	Date	Description of Change
Jon Ylinen	1	August 2, 2023	<ul style="list-style-type: none"> <li>• Update to current SAD Chapter Format</li> <li>• Inclusion of Risk Matrix and hazard discussion</li> </ul>
David Hockin Jon Ylinen	0	May 12, 2015	Initial release of the Waste Handling Facilities Chapter for the Fermi National Accelerator Laboratory Safety Assessment Document (SAD)



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## Acronyms and Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
ACNET	Accelerator Control Network System
AD	Accelerator Directorate
AHJ	Authority Having Jurisdiction
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
APS-TD	Applied Physics and Superconducting Technology Directorate
ARA	Airborne Radioactivity Area
ASE	Accelerator Safety Envelope
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASO	Accelerator Safety Order, referring to DOE O 420.2D <i>Safety of Accelerators</i>
<sup>7</sup> Be	Beryllium-7
BLM	Beam Loss Monitor
BNB	Booster Neutrino Beam
BPM	Beam Position Monitor
BY	Boneyard
CA	Controlled Area
CA	Contamination Area
CAS	Contractor Assurance System
CC	Credited Control
CCL	Coupled Cavity Linac
CDC	Critical Device Controller
CERN	European Organization for Nuclear Research
CFM	Cubic Feet per Minute
CFR	Code of Federal Regulations (United States)
Ci	Curie
CLW	Co-Located Worker (the worker in the vicinity of the work but not actively participating)
cm	centimeter
CPB	Cryogenics Plant Building
CSO	Chief Safety Officer
CUB	Central Utility Building
CW	Continuous Wave
CX	Categorically Excluded
D&D	Decontamination and Decommissioning
DA	Diagnostic Absorber
DAE	Department of Atomic Energy India

DCS	Derived Concentration Standard
DocDB	Document Database
DOE	Department of Energy
DOT	Department of Transportation
DR	Delivery Ring
DSO	Division Safety Officer
DSS	Division Safety Specialist
DTL	Drift Tube Linac
DUNE	Deep Underground Neutrino Experiment
EA	Environmental Assessment
EA	Exclusion Area
EAV	Exhaust Air Vent
EENF	Environmental Evaluation Notification Form
EMS	Environmental Management System
EOC	Emergency Operations Center
EPA	Environmental Protection Agency
ES&H	Environment, Safety and Health
Fermilab	Fermi National Accelerator Laboratory, see also FNAL
FESHCom	Fermilab ES&H Committee
FESHM	Fermilab Environment, Safety and Health Manual
FHS	Fire Hazard Subcommittee
FIRUS	Fire Incident Reporting Utility System
FNAL	Fermi National Accelerator Laboratory, see also Fermilab
FODO	Focus-Defocus
FONSI	Finding of No Significant Impact
FQAM	Fermilab Quality Assurance Manual
FRA	Fermi Research Alliance
FRCM	Fermilab Radiological Control Manual
FSO	Fermilab Site Office
FW	Facility Worker (the worker actively performing the work)
GERT	General Employee Radiation Training
GeV	Giga-electron Volt
<sup>3</sup> H	Tritium
HA	Hazard Analysis
HAR	Hazard Analysis Report
HCA	High Contamination Area
HCTT	Hazard Control Technology Team
HEP	High Energy Physics
HFD	Hold for Decay

HLCF	High Level Calibration Facility
HPR	Highly Protected Risk
Hr	Hour
HRA	High Radiation Area
HSSD	High Sensitivity Air Sampling Detection
HVAC	Heating, Ventilation, and Air Conditioning
HWSF	Hazardous Waste Storage Facility
Hz	Hertz
IB	Industrial Building
IBC	International Building Code
ICW	Industrial Cooling Water
IEPA	Illinois Environmental Protection Agency
IEEE	Institute of Electrical and Electronics Engineers
INFN	Istituto Nazionale di Fisica Nucleare
IMPACT	Integrated Management Planning and Control Tool
IPCB	Illinois Pollution Control Board
IQA	Integrated Quality Assurance
ISD	Infrastructure Services Division
ISM	Integrated Safety Management
ITNA	Individual Training Needs Assessment
KeV	kilo-electron volt
kg	kilo-grams
kW	kilo-watt
LBNF	Long Baseline Neutrino Facility
LCW	Low Conductivity Water
LHC	Large Hadron Collider
LLCF	Low Level Calibration Facility
LLWCP	Low Level Waste Certification Program
LLWHF	Low Level Waste Handling Facility
LOTO	Lockout/Tagout
LPM	Laser Profile Monitor
LSND	Liquid Scintillator Neutrino Detector
LSO	Laser Safety Officer
m	meter
mA	milli-amp
MABAS	Mutual Aid Box Alarm System
MARS	Monte Carlo Shielding Computer Code
MC	Meson Center
MC&A	Materials Control and Accountability

MCR	Main Control Room
MEBT	Medium Energy Beam Transport
MEI	Maximally Exposed Individual
MeV	Mega-electron volt
MI	Main Injector
MINOS	Main Injector Neutrino Oscillation Search
MMR	Material Move Request
MOI	Maximally-Exposed Offsite Individual <i>(Note: due to the Fermilab Batavia Site being open to the public, the location of the MOI is taken to be the location closest to the accelerator that is accessible to members of the public.)</i>
MP	Meson Polarized
mrad	milli-radian
mrem	milli-rem
mrem/hr	milli-rem per hour
MT	Meson Test
MTA	400 MeV Test Area
MTF	Magnet Test Facility
<sup>22</sup> Na	Sodium-22
NC	Neutrino Center
NE	Neutrino East
NEC	National Electrical Code
NEPA	National Environmental Policy Act
NESHAPS	National Emissions Standards for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NM	Neutrino Muon
NMR	Nuclear Material Representative
NOvA	Neutrino Off-axis Electron Neutrino (ve) Appearance
NPH	Natural Phenomena Hazard
NRTL	Nationally Recognized Testing Laboratory
NIF	Neutron Irradiation Facility
NTSB	Neutrino Target Service Building, see also TSB
NuMI	Neutrinos at the Main Injector
NW	Neutrino West
ODH	Oxygen Deficiency Hazard
ORC	Operational Readiness Clearance
OSHA	Occupational Safety and Health Administration
pCi	pico-Curie
pCi/mL	pico-Curie per milliliter
PE	Professional Engineer

PIN	Personal Identification Number
PIP	Proton Improvement Plan
PIP-II	Proton Improvement Plan - II
PHAR	Preliminary Hazards Analysis Report
PPD	Particle Physics Directorate
PPE	Personnel Protective Equipment
QA	Quality Assurance
QAM	Quality Assurance Manual
RA	Radiation Area
RAF	Radionuclide Analysis Facility
RAW	Radioactive Water
RCT	Radiological Control Technician
RF	Radio-Frequency
RFQ	Radio-Frequency Quadrupole
RIL	RFQ Injector Line
RMA	Radioactive Material Area
RMS	Root Mean Square
RPCF	Radiation Physics Calibration Facility
RPE	Radiation Physics Engineering Department
RPO	Radiation Physics Operations Department
RRM	Repetition Rate Monitor
RSI	Reviewed Safety Issue
RSIS	Radiation Safety Interlock System
RSO	Radiation Safety Officer
RWP	Radiological Work Permit
SA	Shielding Assessment
SAA	Satellite Accumulation Areas
SAD	Safety Assessment Document
SCF	Standard Cubic Feet
SCFH	Standard Cubic Feet per Hour
SEWS	Site-Wide Emergency Warning System
SNS	Spallation Neutron Source
SR	Survey Riser
SRF	Superconducting Radio-Frequency
SRSO	Senior Radiation Safety Officer
SSB	Switchyard Service Building
SSP	Site Security Plan
SWIC	Segmented Wire Ionization Chambers
TLM	Total Loss Monitor

TLVs	Threshold Limit Values
TPC	Time Projection Chamber
TPES	Target Pile Evaporator Stack
TPL	Tagged Photon Lab
TSB	Target Service Building, see also NTSB
TSCA	Toxic Substances Control Act
TSW	Technical Scope of Work
T&I	Test and Instrumentation
UPB	Utility Plant Building
UPS	Uninterruptible Power Supply
USI	Unreviewed Safety Issue
VCTF	Vertical Cavity Test Facility
VHRA	Very High Radiation Area
VMS	Village Machine Shop
VMTF	Vertical Magnet Test Facility
VTS	Vertical Test Stand
WSHP	Worker Safety and Health Program
μs	micro-second



## II-4. Waste Handling Facilities

### II-4.1. Introduction

This Section II, Chapter 04 of the Fermi National Accelerator Laboratory (Fermilab) Safety Assessment Document (SAD) covers the Waste Handling Facilities segment of the laboratory.

#### II-4.1.1 [Purpose/Function](#)

The purpose of the Low-Level Waste Handling Facility (LLWHF) is to receive, prepare, and ship radioactive waste and is further described in Fermilab’s Low-Level Waste Certification Program (LLWCP). The purpose of the Bone Yard (BY) is to hold for decay high dose rate radioactive waste and items that are not practical to ship for disposal due to their size and weight. The materials constitute low dose rate waste. The purpose of the Hazardous Waste Storage Facility (HWSF) is for the temporary storage of hazardous and non-hazardous waste.

#### II-4.1.2 [Current Status](#)

The Waste Handling Facilities segment of the is currently: **Operational**

#### II-4.1.3 [Description](#)

The description of the LLWHF is described in Fermilab’s LLWCP. The BY is a gravel hardstand of about 32,000 sq. ft. surrounded by a 6 foot tall chain link fence with razor ribbon affixed to the top of the fence. The hardstand is used for open storage of large items that have a low dose rate. There are 11 caves of various sizes and one 2,604 sq. ft. storage shed these structures are used for inside storage of higher dose rate waste. All structures are located inside the perimeter of the 6 foot chain link fence. The description of the HWSF is described in Fermilab’s Illinois Environmental Protection Agency Part B Storage Permit (Part B Permit)

#### II-4.1.4 [Location](#)

The Waste Handling Facilities are located on the Fermilab site in Batavia, IL.



Figure 1. Regional view showing the location of the Fermilab site in Batavia, IL.

The Waste Handling Facilities are in 3 locations on the Fermilab site.



Figure 2. Aerial view of the Fermilab site, indicating the location of the Low Level Waste Handling Facility (LLWHF) at Site 40.

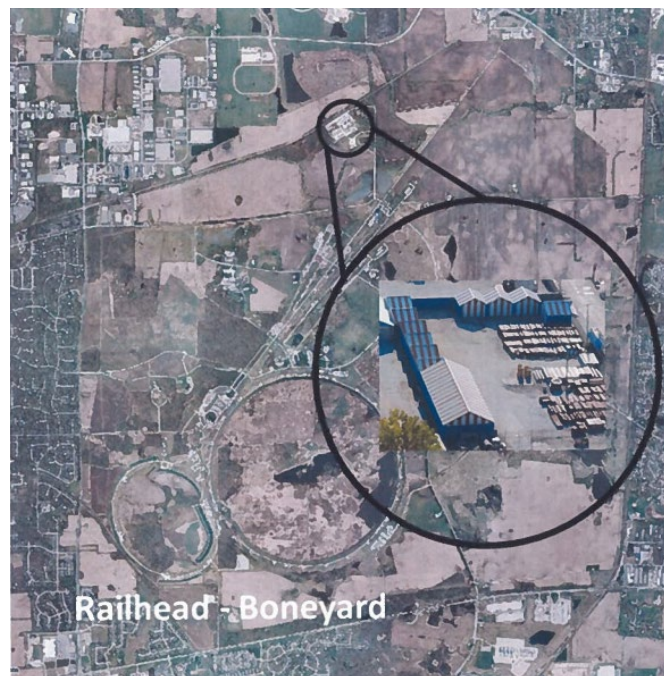


Figure 3. Aerial view of the Fermilab site, indicating the location of the Boneyard at the Railhead.



Figure 4. Aerial view of the Fermilab site, indicating the location of the Hazardous Waste Storage Facility at Site 55.

#### II-4.1.5 Management Organization

The Waste Handling Facilities are managed by the Hazard Control Technology Team of the ES&H Division. The teams offices are located at the LLWHF and they manage the Bone Yard and Hazardous Waste Storage Facility.

#### II-4.1.6 Operating Modes

N/A

#### II-4.1.7 Inventory of Hazards

The following table lists all of the identified hazards found in the Waste Handling Facilities. Section I-1.10 *Appendix – Risk Matrices* describes the baseline risk (i.e., unmitigated risk), any preventative controls and/or mitigative controls in place to reduce the risk, and residual risk (i.e., mitigated risk) for facility worker, co-located worker and Maximally Exposed Offsite Individual (MOI) (i.e., members of the public). A summary of these controls is described within Section I-1.2 *Safety Assessment*.

Prompt ionizing, Oxygen Deficiency Hazards due to cryogenic systems within accelerator enclosures, and fluorinert byproducts due to use of fluorinert that is subject to particle beam have been identified as accelerator specific hazards, and as such their controls are identified as Credited Controls. The analysis of these hazards and their Credited Controls will be discussed within this SAD Chapter, and their Credited Controls summarized in the Accelerator Safety Envelope for the. Accelerator specific controls are identified as **purple/bold** throughout this Chapter.

All other hazards present in the Waste Handling Facilities are safely managed by other DOE approved applicable safety and health programs and/or processes, and their analyses have been performed according to applicable DOE requirements as flowed down through the Fermilab Environment, Safety and Health Manual (FESHM). These hazards are considered to be Standard Industrial Hazards (SIH), and their analysis will be summarized in this SAD Chapter.

Table 1. Hazard Inventory for Waste Handling Facilities.

Radiological		Toxic Materials	
<input type="checkbox"/>	Prompt Ionizing Radiation	<input checked="" type="checkbox"/>	Lead Shielding
<input checked="" type="checkbox"/>	Residual Activation	<input type="checkbox"/>	Beryllium
<input type="checkbox"/>	Groundwater Activation	<input type="checkbox"/>	Fluorinert & Its Byproducts
<input type="checkbox"/>	Surface Water Activation	<input type="checkbox"/>	Liquid Scintillator Oil
<input type="checkbox"/>	Radioactive Water (RAW) Systems	<input type="checkbox"/>	Pseudocumene
<input type="checkbox"/>	Air Activation	<input type="checkbox"/>	Ammonia
<input type="checkbox"/>	Closed Loop Air Cooling	<input type="checkbox"/>	Nanoparticle Exposures
<input type="checkbox"/>	Soil Interactions	Flammables and Combustibles	
<input checked="" type="checkbox"/>	Radioactive Waste	<input checked="" type="checkbox"/>	Combustible Materials (e.g., cables, wood cribbing, etc.)
<input type="checkbox"/>	Contamination	<input checked="" type="checkbox"/>	Flammable Materials (e.g., flammable gas, cleaning materials, etc.)
<input type="checkbox"/>	Beryllium-7	Electrical Energy	
<input checked="" type="checkbox"/>	Radioactive Sources	<input type="checkbox"/>	Stored Energy Exposure
<input type="checkbox"/>	Nuclear Material	<input type="checkbox"/>	High Voltage Exposure
<input type="checkbox"/>	Radiation Generating Devices (RGDs)	<input type="checkbox"/>	Low Voltage, High Current Exposure
<input type="checkbox"/>	Non-Ionizing Radiation Hazards	Kinetic Energy	
Thermal Energy		<input checked="" type="checkbox"/>	Power Tools
<input type="checkbox"/>	Magnet Bakeouts	<input checked="" type="checkbox"/>	Pumps and Motors
<input type="checkbox"/>	Hot Work	<input checked="" type="checkbox"/>	Motion Tables
<input type="checkbox"/>	Cryogenic Liquids	<input checked="" type="checkbox"/>	Mobile Shielding
Potential Energy		Magnetic Fields	
<input checked="" type="checkbox"/>	Crane Operations	<input type="checkbox"/>	Fringe Fields
<input type="checkbox"/>	Compressed Gasses	Other Hazards	
<input type="checkbox"/>	Vacuum/Pressure Vessels	<input type="checkbox"/>	Confined Spaces
<input type="checkbox"/>	Vacuum Pumps	<input type="checkbox"/>	Noise
<input checked="" type="checkbox"/>	Material Handling	<input type="checkbox"/>	Silica
Access & Egress		<input checked="" type="checkbox"/>	Ergonomics
<input type="checkbox"/>	Life Safety Egress	<input type="checkbox"/>	Asbestos

## II-4.2. Safety Assessment

All hazards for the Waste Handling Facilities segment are summarized in this section.

### II-4.2.1 Radiological Hazards

The Waste Handling Facilities present radiological hazards in the form of Radioactive Waste, Residual Activation, and Radioactive Sources. Operations at these facilities comply with the Fermilab Radiological Control Manual (FRCM)[1]. The baseline qualitative risks due to this hazard were assessed and determined for each of the identified radiological categories below. The baseline qualitative risk was determined to be risk level III (a minor concern) for workers and co-located workers. Through the use of preventive and mitigative hazard controls by the facility, residual qualitative risk is reduced to level IV (a



minimal concern). For the public, risks for the radiological hazards at the Waste Handling Facilities was deemed to be not applicable, because members of the public are not given access to the LLWHF, BY, or HWSF.

#### II-4.2.1.1 Prompt Ionizing Radiation

N/A

#### II-4.2.1.2 Residual Activation

As the Waste Handling Facilities are not physically connected to the accelerator complex, there is no residual activation produced at the Waste Handling Facilities. Activated material management is discussed in the Radioactive Waste section II-4.2.1.9.

#### II-4.2.1.3 Groundwater Activation

N/A

#### II-4.2.1.4 Surface Water Activation

N/A

#### II-4.2.1.5 Radioactive Water (RAW) Systems

N/A

#### II-4.2.1.6 Air Activation

N/A

#### II-4.2.1.7 Closed Loop Air Cooling

N/A

#### II-4.2.1.8 Soil Interactions

N/A

#### II-4.2.1.9 Radioactive Waste

Radioactive wastes are not produced in the course of the three Waste Handling Facilities operations. Activated materials are transported to the LLWHF for processing, packaging and shipment for disposal. Work at the LLWHF is performed according to approved procedures and/or an approved radiological Work Permit (RWP). Radiological hazards are not directly associated with accelerator operations and are managed in accordance with the requirements of the FRCM that implement Code of Federal Regulations Title 10 (CFR Title10).

Activated materials are transported to the BY and HFD until ALARA constitutes off-site shipments for disposal. Work at the BY is performed according to approved procedures and/or an approved Radiological Work Permit (RWP). Radioactive sources stored at the BY are stored in accordance with FRCM policies.

Radiological hazards are not directly associated with accelerator operations and are managed in accordance with the requirements of the FRCM<sup>2</sup> that implement applicable parts of the Code of Federal Regulations Title 10.

Activated PCB fluorescent light ballasts are stored at the HWSF. Ballasts are shipped for disposal after they have decayed. Radiological hazards are not directly associated with accelerator operations and are managed in accordance with the requirements of the Fermilab Radiological Control Manual (FRCM).

#### II-4.2.1.10 Contamination

N/A

#### II-4.2.1.11 Beryllium-7

N/A

#### II-4.2.1.12 Radioactive Sources

Radioactive sources stored at the LLWHF are issued and stored in accordance with Fermilab's Radiological Control Manual (FRCM).

#### II-4.2.1.13 Nuclear Material

N/A

#### II-4.2.1.14 Radiation Generating Devices (RGDs)

N/A

#### II-4.2.1.15 Non-Ionizing Radiation Hazards

N/A

### II-4.2.2 Toxic Materials

This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04 *Safety Analysis*. Work in the Waste Handling Facilities involving this hazard implements the controls specified in the common Risk Matrix table. No unique controls are in use.

#### II-4.2.2.1 Lead

This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04 *Safety Analysis*. Work in the Waste Handling Facilities involving this hazard implements the controls specified in the common Risk Matrix table. No unique controls are in use.

#### II-4.2.2.2 Beryllium

N/A

II-4.2.2.3 Fluorinert & Its Byproducts

N/A

II-4.2.2.4 Liquid Scintillator Oil

N/A

II-4.2.2.5 Pseudocumene

N/A

II-4.2.2.6 Ammonia

N/A

II-4.2.2.7 Nanoparticle Exposures

N/A

### II-4.2.3 Flammables and Combustibles

II-4.2.3.1 Combustible Materials

This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04 *Safety Analysis*. Work in the Waste Handling Facilities involving this hazard implements the controls specified in the common Risk Matrix table. No unique controls are in use.

II-4.2.3.2 Flammable Materials

This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04 *Safety Analysis*. Work in the Waste Handling Facilities involving this hazard implements the controls specified in the common Risk Matrix table. No unique controls are in use.

### II-4.2.4 Electrical Energy

II-4.2.4.1 Stored Energy Exposure

N/A

II-4.2.4.2 High Voltage Exposure

N/A

II-4.2.4.3 Low Voltage, High Current Exposure

N/A

### II-4.2.5 [Thermal Energy](#)

#### II-4.2.5.1 Bakeouts

N/A

#### II-4.2.5.2 Hot Work

This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04 *Safety Analysis*. Work in the Waste Handling Facilities (only at the LLRWF, no hot work occurs at the BY or HWSF) involving this hazard implements the controls specified in the common Risk Matrix table. No unique controls are in use.

#### II-4.2.5.3 Cryogenics

N/A

### II-4.2.6 [Kinetic Energy](#)

This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04 *Safety Analysis*. Work in the Waste Handling Facilities involving this hazard implements the controls specified in the common Risk Matrix table. No unique controls are in use.

#### II-4.2.6.1 Power Tools

This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04 *Safety Analysis*. Work in the Waste Handling Facilities involving this hazard implements the controls specified in the common Risk Matrix table. No unique controls are in use.

#### II-4.2.6.2 Pumps and Motors

This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04 *Safety Analysis*. Work in the Waste Handling Facilities involving this hazard implements the controls specified in the common Risk Matrix table. No unique controls are in use.

#### II-4.2.6.3 Motion Tables

This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04 *Safety Analysis*. Work in the Waste Handling Facilities involving this hazard implements the controls specified in the common Risk Matrix table. No unique controls are in use.

#### II-4.2.6.4 Mobile Shielding

This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04 *Safety Analysis*. Work in the Waste Handling Facilities involving this hazard implements the controls specified in the common Risk Matrix table. No unique controls are in use.



### II-4.2.7 Potential Energy

#### II-4.2.7.1 Crane Operations

This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04 *Safety Analysis*. Work in the Waste Handling Facilities involving this hazard implements the controls specified in the common Risk Matrix table. No unique controls are in use.

#### II-4.2.7.2 Compressed Gasses

N/A

#### II-4.2.7.3 Vacuum/Pressure Vessels/Piping

N/A

#### II-4.2.7.4 Vacuum Pumps

N/A

#### II-4.2.7.5 Material Handling

This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04 *Safety Analysis*. Work in the Waste Handling Facilities involving this hazard implements the controls specified in the common Risk Matrix table. No unique controls are in use.

### II-4.2.8 Magnetic Fields

#### II-4.2.8.1 Fringe Fields

N/A

### II-4.2.9 Other Hazards

#### II-4.2.9.1 Confined Spaces

N/A

#### II-4.2.9.2 Noise

N/A

#### II-4.2.9.3 Silica

N/A

#### II-4.2.9.4 Ergonomics

This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04 *Safety Analysis*. Work in the Waste Handling Facilities involving this hazard implements the controls specified in the common Risk Matrix table. No unique controls are in use.

II-4.2.9.5 Asbestos

N/A

II-4.2.9.6 Working at Heights

N/A

II-4.2.10 [Access & Egress](#)

II-4.2.10.1 Life Safety Egress

N/A

II-4.2.11 [Environmental](#)

II-4.2.11.1 Hazard to Air

N/A

II-4.2.11.2 Hazard to Water

N/A

II-4.2.11.3 Hazard to Soil

N/A

### II-4.3. Summary of Hazards to Members of the Public

Members of the public are not allowed at LLWHF, BY, or HWSF. This section does not apply to the Waste Handling Facilities.

### II-4.4. Summary of Credited Controls

N/A

#### II-4.4.1 [Passive Credited Controls](#)

II-4.4.1.1 Shielding

N/A

*II-4.4.1.1.1 Permanent Shielding Including Labyrinths*

N/A

*II-4.4.1.1.2 Movable Shielding*

N/A

II-4.4.1.1.3 *Penetration Shielding*

N/A

II-4.4.1.2 *Fencing*

N/A

II-4.4.1.2.1 *Radiation Area Fencing*

N/A

II-4.4.1.2.2 *Controlled Area Fencing*

N/A

II-4.4.2 Active Engineered Credited Controls

II-4.4.2.1 *Radiation Safety Interlock System*

N/A

II-4.4.2.2 *ODH Safety System*

N/A

II-4.4.3 Administrative Credited Controls

II-4.4.3.1 *Operation Authorization Document*

N/A

II-4.4.3.2 *Staffing*

N/A

II-4.4.3.3 *Accelerator Operating Parameters*

N/A

II-4.5. *Defense-in-Depth Controls*

N/A

II-4.6. *Machine Protection Controls*

N/A

II-4.7. *Decommissioning*

DOE Field Element Manager approval shall be obtained prior to the start of any decommissioning activities for Waste Handling Facilities.

## II-4.8. Summary and Conclusion

N/A

## II-4.9. References

[1] Fermilab Radiological Control Manual

## II-4.10. Appendix – Risk Matrices

Risk Assessment methodology was developed based on the methodology described in DOE-HDBK-1163-2020. Hazards and their potential events are evaluated for likelihood and potential consequence assuming no controls in place, which results in a baseline risk. A baseline risk (i.e., an unmitigated risk) value of III and IV does not require further controls based on the Handbook. Events with a baseline risk value of I or II do require prevention and/or mitigation measures to be established in order to reduce the risk value to an acceptable level of III or IV. Generally, preventive controls are applied prior to a loss event, reflecting a likelihood reduction, and mitigative controls are applied after a loss event, reflecting a consequence reduction. For each control put in place, likelihood or consequence can have a single “bin drop”, resulting in a new residual risk (i.e., a mitigated risk). This risk assessment process is repeated for each hazard for Facility Workers (FW), Co-Located Workers (CLW), and Maximally-Exposed Offsite Individual (MOI). At the conclusion of the risk assessments, controls that are in place for the identified accelerator specific hazards are identified as Credited Controls and further summarized in Section I-1.4 of this Chapter.