# WASTE HANDLING FACILITIES

## SECTION II CHAPTER 04
## OF THE FERMILAB SAD

Revision 01 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.

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## 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 | • Update to current SAD Chapter Format<br>• Inclusion of Risk Matrix and hazard discussion |
| David Hockin<br>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 *Safety of Accelerators* |
| $^{7}$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 |
| $^{3}H$ | 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 | Harge 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 |

| | |
|---|---|
| MCI | Maximum Credible Incident |
| 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 *(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.)* |
| 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 |
| NASH | Non-Accelerator Specific Hazard |
| $^{22}$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.

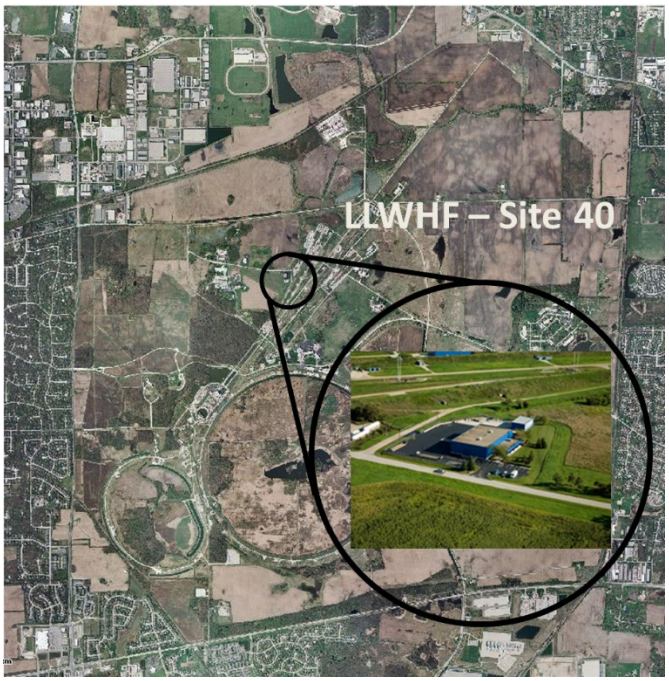


*Figure 2. Aerial view of the Fermilab site, indicating the location of the Low Level Waste Handling Facility (LLWHF) at Site 40.*

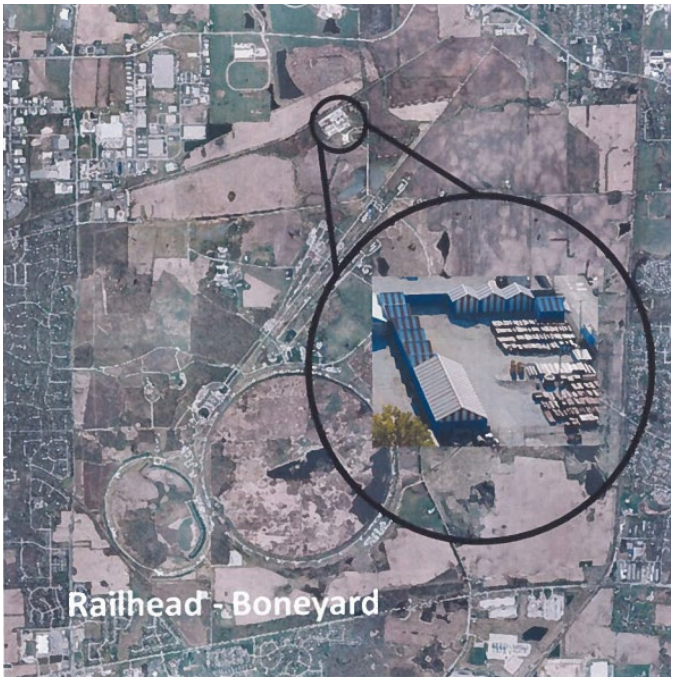


*Figure 3. Aerial view of the Fermilab site, indicating the location of the Boneyard at the Railhead.*

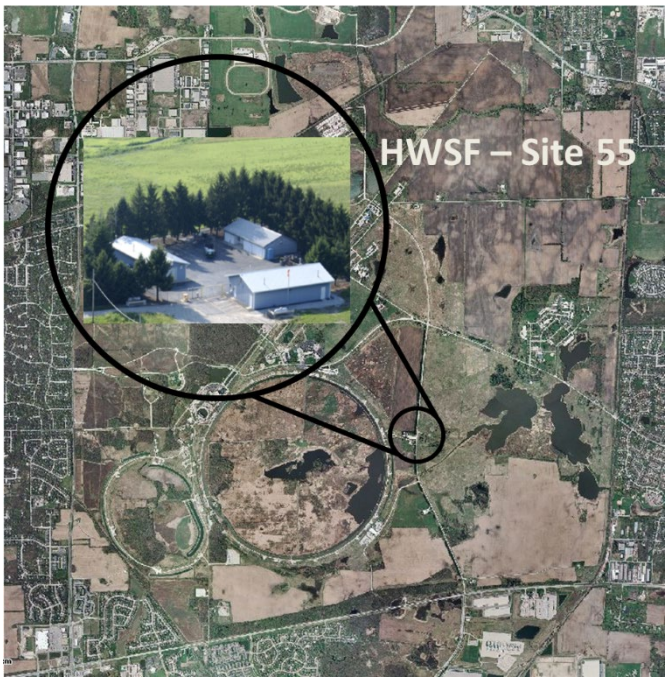


*Figure 4. Aerial view of the Fermilab site, indicating the location of the Hazardous Waste Storage Facility at Site 55.*

### 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 and Oxygen Deficiency Hazards due to cryogenic systems within accelerator enclosures 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 Non-Accelerator Specific Hazards (NASH), and their analysis will be summarized in this SAD Chapter.

*Table 1. Hazard Inventory for Waste Handling Facilities.*

| | Radiological | | Toxic Materials |
|---|---|---|---|
| ☐ | Prompt Ionizing Radiation | ☒ | Lead Shielding |
| ☒ | Residual Activation | ☐ | Beryllium |
| ☐ | Groundwater Activation | ☐ | Fluorinert & Its Byproducts |
| ☐ | Surface Water Activation | ☐ | Liquid Scintillator Oil |
| ☐ | Radioactive Water (RAW) Systems | ☐ | Pseudocumene |
| ☐ | Air Activation | ☐ | Ammonia |
| ☐ | Closed Loop Air Cooling | ☐ | Nanoparticle Exposures |
| ☐ | Soil Interactions | | **Flammables and Combustibles** |
| ☒ | Radioactive Waste | ☒ | Combustible Materials (e.g., cables, wood cribbing, etc.) |
| ☐ | Contamination | ☒ | Flammable Materials (e.g., flammable gas, cleaning materials, etc.) |
| ☐ | Beryllium-7 | | **Electrical Energy** |
| ☒ | Radioactive Sources | ☐ | Stored Energy Exposure |
| ☐ | Nuclear Material | ☐ | High Voltage Exposure |
| ☐ | Radiation Generating Devices (RGDs) | ☐ | Low Voltage, High Current Exposure |
| ☐ | Non-Ionizing Radiation Hazards | | **Kinetic Energy** |
| | Thermal Energy | ☒ | Power Tools |
| ☐ | Magnet Bakeouts | ☒ | Pumps and Motors |
| ☐ | Hot Work | ☒ | Motion Tables |
| ☐ | Cryogenic Liquids | ☒ | Mobile Shielding |
| | **Potential Energy** | | **Magnetic Fields** |
| ☒ | Crane Operations | ☐ | Fringe Fields |
| ☐ | Compressed Gasses | | **Other Hazards** |
| ☐ | Vacuum/Pressure Vessels | ☐ | Confined Spaces |
| ☐ | Vacuum Pumps | ☐ | Noise |
| ☒ | Material Handling | ☐ | Silica |
| | **Access & Egress** | ☒ | Ergonomics |
| ☐ | Life Safety Egress | ☐ | 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[2] 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.