RAILHEAD

SECTION II CHAPTER 01 OF THE FERMILAB SAD

Revision 1 August 4th, 2023

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

SAD Chapter Review

This Section V, Chapter 01 of the Fermi National Accelerator Laboratory (Fermilab) Safety Assessment Document (SAD), *Railhead*, was prepared and reviewed by the staff of the ISD/LPC 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.

☐ _____
Line Organization Owner

☐ Madelyn Scheell
Accelerator Safety Department Head

☐ Madelyn Scheell
SAD Review Subcommittee Chair

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 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
Scott Borton	1	August 4, 2023	Update to current SAD Chapter Format. Inclusion of Risk Matrix tables
Sue McGimpsey	0	April 28, 2015	Initial release of the Railhead chapter of the Fermilab Safety Assessment Document.

Table of Contents

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-1. Railhead

II-1.1. Introduction

This Section V, Chapter 01 of the Fermi National Accelerator Laboratory (Fermilab) Safety Assessment Document (SAD) covers the Railhead segment of the Fermi Site.

II-1.1.1 Purpose/Function

The Railhead is used for the purpose of outdoor storage, scrap metal collection area.

II-1.1.2 Current Status

The Railhead segment of the Fermi Site is currently: **operational**

II-1.1.3 Description

The railhead is used as a collection point for scrap metal, also used for storage of material determined to able to be stored in the elements. Also used as storage of shielding blocks

II-1.1.4 Location

The Railhead of the Fermi Site is located on the Fermilab site in Batavia, IL.

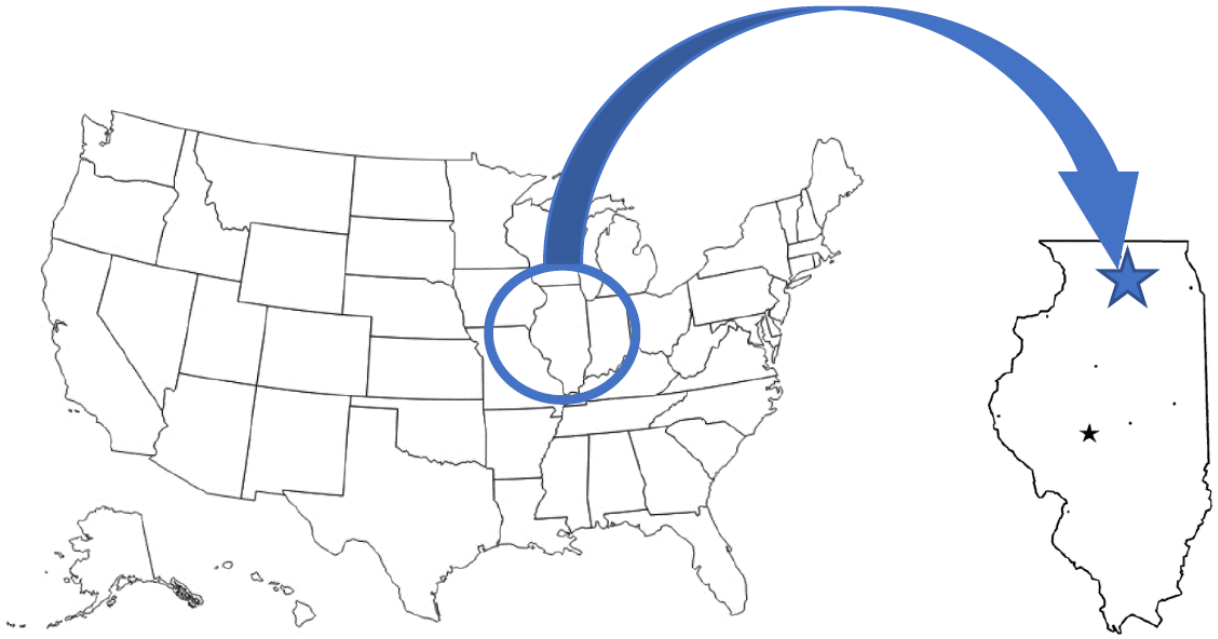

Figure 1. Regional view showing the location of the Fermilab site in Batavia, IL.

The Railhead is located in the Northwest corner on the Fermilab site.

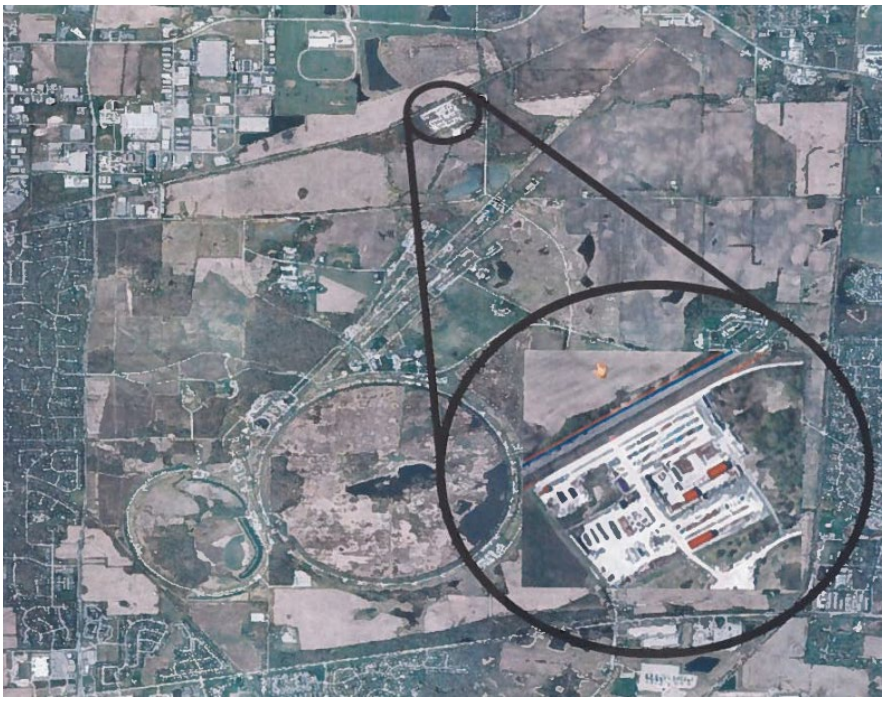

Figure 2. Aerial view of the Fermilab site, indicating the location of the Railhead.

II-1.1.5 Management Organization

Railhead is managed by Infrastructure Services Division.

II-1.1.6 Operating Modes

This functional area does not include any accelerator operations.

II-1.1.7 Inventory of Hazards

The following table lists all of the identified hazards found in the Railhead enclosure and support buildings. 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 II-1.2 *Safety Assessment.*

Prompt ionizing, and Oxygen Deficiency Hazards due to cryogenic systems within accelerator enclosureshave 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 Fermi Site. Accelerator specific controls are identified as **purple/bold** throughout this Chapter.

All other hazards present in the Railhead 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 Railhead.

	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-1.2. Safety Assessment

All hazards for the Railhead segment of the Fermi Site are summarized in this section, with additional details of the analyses for accelerator specific hazards.

II-1.2.1 Radiological Hazards

The Railhead presents radiological hazards in the form of radioactive waste, sources and Beryllium-7. A more detailed description of these hazards is provided below. Baseline risk for this hazard group was R I and after control measure were evaluated the residual risk level was a R III/IV.

II-1.2.1.1 Prompt Ionizing Radiation

This Hazard is not Applicable to this area

II-1.2.1.2 Residual Activation

This Hazard is not Applicable to this area

II-1.2.1.3 Groundwater Activation

This Hazard is not Applicable to this area

II-1.2.1.4 Surface Water Activation

This Hazard is not Applicable to this area

II-1.2.1.5 Radioactive Water (RAW) Systems

This Hazard is not Applicable to this area

II-1.2.1.6 Air Activation

This Hazard is not Applicable to this area

II-1.2.1.7 Closed Loop Air Cooling

This Hazard is not Applicable to this area

II-1.2.1.8 Soil Interactions

This Hazard is not Applicable to this area

II-1.2.1.9 Radioactive Waste

Radioactive waste produced in the course of Railhead operations will be managed within the established Radiological Protection Program (RPP) and as prescribed in the Fermilab Radiological Control Manual (FRCM).

Radioactive waste is a standard radiological hazard that is managed within the established Radiological Protection Program (RPP) and as prescribed in the Fermilab Radiological Control Manual (FRCM). Waste minimization is an objective of the equipment design and operational procedures. Although production of radioactive material is not an operational function of the Railhead, beam loss and, in the case of some beam diagnostics devices, intentional interception of the beam will result in activation of beam line elements. Reuse of activated items will be carried out when feasible. Activated items that cannot be reused will be disposed of as radioactive waste in accordance with the FRCM requirements. Baseline risk for this hazard was R II and after control measure were evaluated the residual risk level was a R IV.

II-1.2.1.10 Contamination

The Railhead is not physically connected to the accelerator complex, as a result, there is no contamination at Railhead.

II-1.2.1.11 Beryllium-7

Beryllium is stored in Lundy Barn and owned by PPD. The material is stored in 55 gallon drums and LPC team members have been instructed not to open containers. Baseline risk for this hazard was R II and after control measure were evaluated the residual risk level was a R IV.

II-1.2.1.12 Radioactive Sources

The sources at the Railhead are limited to the check-sources on monitoring equipment in the area. Site monitoring systems and FRCM controls are are in place. Railhead personnel have no direct contact with the sources and they are controlled by radiological control technicians. Baseline risk for this hazard was R I and after control measure were evaluated the residual risk level was a R III/IV.

II-1.2.1.13 Nuclear Material

Deuterium has been removed from railhead, and no nuclear material is currently located at railhead.

II-1.2.1.14 Radiation Generating Devices (RGDs)

No RGD devices are located at railhead.

II-1.2.1.15 Non-Ionizing Radiation Hazards

This Hazard is not Applicable to this area

II-1.2.2 Toxic Materials

The toxic material hazards at the railhead are limited to lead and beryllium.

II-1.2.2.1 Lead

Lead is stored in Nevis Barn and is property of PPD. Team members have lead handling training. Lead is contained and wrapped when required.

Baseline risk for this hazard was R II and after control measures were evaluated the residual risk level was a R IV.

II-1.2.2.2 Beryllium

Beryllium metal is stored at the Railhead in Lundy Barn, and this material is also owned by PPD. These Beryllium plates are also radioactive, typically with a very small amount of Be-7, and is stored in 55 gallon steel drums. Baseline risk for this hazard was R II and after control measure were evaluated the residual risk level was a R IV.

II-1.2.2.3 Liquid Scintillator Oil

This Hazard is not Applicable to this area

II-1.2.2.4 Pseudocumene

This Hazard is not Applicable to this area

II-1.2.2.5 Ammonia

This Hazard is not Applicable to this area

II-1.2.2.6 Nanoparticle Exposures

This Hazard is not Applicable to this area

II-1.2.3 Flammables and Combustibles

This Hazard is not Applicable to this area

II-1.2.3.1 Combustible Materials

Cable determined to be scrap is stockpiled at the railhead classified as group 2 and not eligible for recycling. Wood cribbing and wooden skids are both used for storage of material. Baseline risk for this hazard was R I and after control measure were evaluated the residual risk level was a R IV.

II-1.2.3.2 Flammable Materials

Acetylene and Propane are used for cutting/disassembly of various sizes of scrap metal for easier removal from site. This task is performed very infrequently. Baseline risk for this hazard was R II and after control measure were evaluated the residual risk level was a R IV.

II-1.2.4 Electrical Energy

This Hazard is not Applicable to this area

II-1.2.4.1 Stored Energy Exposure

This Hazard is not Applicable to this area

II-1.2.4.2 High Voltage Exposure

This Hazard is not Applicable to this area

II-1.2.4.3 Low Voltage, High Current Exposure

This Hazard is not Applicable to this area

II-1.2.5 Thermal Energy

This Hazard is not Applicable to this area

II-1.2.5.1 Bakeouts

This Hazard is not Applicable to this area

II-1.2.5.2 Hot Work

Acetylene and Oxygen are used for cutting/disassembly of various sizes of scrap metal for easier removal from site. This task is performed very infrequently. Baseline risk for this hazard was R II and after control measure were evaluated the residual risk level was a R IV.

II-1.2.5.3 Cryogenics

This Hazard is not Applicable to this area

II-1.2.6 Kinetic Energy

This Hazard is not Applicable to this area

II-1.2.6.1 Power Tools

Team uses battery powered drills for disassembly of scrap components for easier disposal purposes. Baseline risk for this hazard was R II and after control measure were evaluated the residual risk level was a R IV.

II-1.2.6.2 Pumps and Motors

This Hazard is not Applicable to this area

II-1.2.6.3 Motion Tables

This Hazard is not Applicable to this area

II-1.2.6.4 Mobile Shielding

This Hazard is not Applicable to this area

II-1.2.7 Potential Energy

II-1.2.7.1 Crane Operations

This Hazard is not Applicable to this area

II-1.2.7.2 Compressed Gasses

Team use Oxygen/Acetylene torches for metal cutting purposes and propane as fuel for forklifts, used for material handling. All compressed gasses are secured within gas racks and oxygen tanks have safety caps in place. Baseline risk for this hazard was R II and after control measure were evaluated the residual risk level was a R IV.

II-1.2.7.3 Vacuum/Pressure Vessels/Piping

This Hazard is not Applicable to this area

II-1.2.7.4 Vacuum Pumps

This Hazard is not Applicable to this area

II-1.2.7.5 Material Handling

Team uses forklift for material movements (unloading and loading vehicles, relocating items within the railhead). Railhead receives both excess and stored items, excessed material is sorted by commodities upon receipt (Aluminum, Copper, SS) to obtain the greatest benefit to the laboratory upon sale. Stored items are assigned a location and entered into the laboratories tracking system (Sunflower) for future tracking. Baseline risk for this hazard was R I and after control measure were evaluated the residual risk level was a R IV.

II-1.2.8 Magnetic Fields

II-1.2.8.1 Fringe Fields

This Hazard is not Applicable to this area

II-1.2.9 Other Hazards

II-1.2.9.1 Confined Spaces

This Hazard is not Applicable to this area

II-1.2.9.2 Noise

Noise generated by the operation of forklifts and end loader. Personnel are provided hearing protection to minimize noise levels. Noise level is minimal at the railhead as it is an outdoor storage/excess area, noise is not contained within a building. Baseline risk for this hazard was R I and after control measure were evaluated the residual risk level was a R IV.

II-1.2.9.3 Silica

This Hazard is not Applicable to this area

II-1.2.9.4 Ergonomics

This Hazard is not Applicable to this area

II-1.2.9.5 Asbestos

This Hazard is not Applicable to this area

II-1.2.9.6 Working at Heights

This Hazard is not Applicable to this area

II-1.2.10 Access & Egress

The Railhead is managed and manned by the ISD/LPC department/division. Employees are instructed to depart the railhead in the event of inclimate weather, also instructed not to open the railhead for normal activities if weather is a concern. There is one point of exit and entry to the railhead and the nearest shelter is Lab A, approximately ¼ of a mile from the exit and entry point. Baseline risk for this hazard was R II and after control measure were evaluated the residual risk level was a R IV.

II-1.2.10.1 Life Safety Egress

The nearest severe storm shelter is located at Lab A located directly off of McChesney Road. Personnel are instructed to vacate the area if severe weather is forecast. Railhead employees a two man rule to assist in ensuring safe evacuation if necessary. Employees are trained in the safe handling of compressed gases, oxygen/acetylene torch is broken down after each use.

II-1.2.11 Environmental

Railhead is an outdoor storage/excess area. Entire area is primarily gravel with some areas utilizing crushed asphalt as a base, one small area (forklift storage building) is concrete. Located within the railhead are stored transformers containing oil, these items are not currently contained within secondary containment primarily due to their dimensions. We do not accept scrap items containing oil or freon in an effort to avoid spills and employee exposure to contaminates.

II-1.2.11.1 Hazard to Air

This Hazard is not Applicable to this area

II-1.2.11.2 Hazard to Water

This Hazard is not Applicable to this area

II-1.2.11.3 Hazard to Soil

This Hazard is not Applicable to this area

II-1.3. Summary of Hazards to Members of the Public

This area presents no hazards to the general public.

II-1.4. Summary of Credited Controls

No Credited Controls required for the Railhead

II-1.4.1 Passive Credited Controls

II-1.4.1.1 Shielding

Not applicable

II-1.4.1.1.1 Permanent Shielding Including Labyrinths

Not applicable

II-1.4.1.1.2 Movable Shielding

Not applicable

II-1.4.1.1.3 Penetration Shielding

Not applicable

II-1.4.1.2 Fencing

II-1.4.1.2.1 Radiation Area Fencing

Not applicable.

II-1.4.1.2.2 Controlled Area Fencing

Not applicable

II-1.4.2 Active Engineered Credited Controls

II-1.4.2.1 Radiation Safety Interlock System

Not applicable

II-1.4.2.2 ODH Safety System

Not applicable

II-1.4.3 Administrative Credited Controls

II-1.4.3.1 Operation Authorization Document

Not applicable

II-1.4.3.2 Staffing

Not applicable

II-1.4.3.3 Accelerator Operating Parameters

Not applicable

II-1.5. Defense-in-Depth Controls

There are no Defense-in-Depth Controls for the Railhead.

II-1.6. Machine Protection Controls

There are no Machine Protection Controls for the Railhead.

II-1.7. Decommissioning

Not applicable

II-1.8. Summary and Conclusion

Specific hazards associated with the Railhead operations are identified and assessed in this Chapter of the Fermilab Safety Assessment Document. The designs, controls, and procedures to mitigate Railhead specific hazards are identified and described. In addition to these specific safety considerations, the Railhead is subject to the safety requirements, controls and procedures outlined in Section I of this Fermilab Safety Assessment Document.

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

II-1.9. References

[1] Fermilab Radiological Control Manual

II-1.10. 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.