OTHER RADIOACTIVE MATERIAL STORAGE AREAS

SECTION II CHAPTER 07 OF THE FERMILAB SAD

Revision 1 August 11, 2023

This Chapter of the Fermilab Safety Assessment Document (SAD) contains a summary of the results of the Safety Analysis for the Other Radioactive Material Storage Areas 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 07 of the Fermi National Accelerator Laboratory (Fermilab) Safety Assessment Document (SAD), *Other Radioactive Material Storage Areas*, was prepared and reviewed by the staff of 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

☐ _____
Accelerator Safety Department Head

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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 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
Maddie Schoell	1	August 11, 2023	• Updated formatting to be consistent with full SAD Update • Included Risk Matrix tables for applicable hazards
Kathy Graden	0	March 11, 2015	Initial release of Other Radioactive Material Storage Areas Fermilab Safety Assessment Document

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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

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
^{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-7. Other Radioactive Material Storage Areas

II-7.1. Introduction

This Section II, Chapter 07 of the Fermi National Accelerator Laboratory (Fermilab) Safety Assessment Document (SAD) covers the Other Radioactive Material Storage Areas at Fermilab.

II-7.1.1 Purpose/Function

The purpose of Other Radioactive Material Storage Areas is to facilitate various research activities in support of accelerator operations, accelerator research, and the Fermilab Mission.

II-7.1.2 Current Status

The Other Radioactive Material Storage Areas are supporting accelerator operations and research and are currently: **Operational**.

II-7.1.3 Description

Activities within the Other Radioactive Material Storage Areas is wide ranging, and includes work with radioactive material, radioactive sources, lasers, and other potentially hazardous materials. The general Work Planning and Control (WPC) process outlined in the Fermilab Environment, Safety & Health Manual (FESHM) [1] is followed for performing work safely.

II-7.1.4 Location

The Other Radioactive Material Storage Areas are located on the Fermilab site in Batavia, IL.

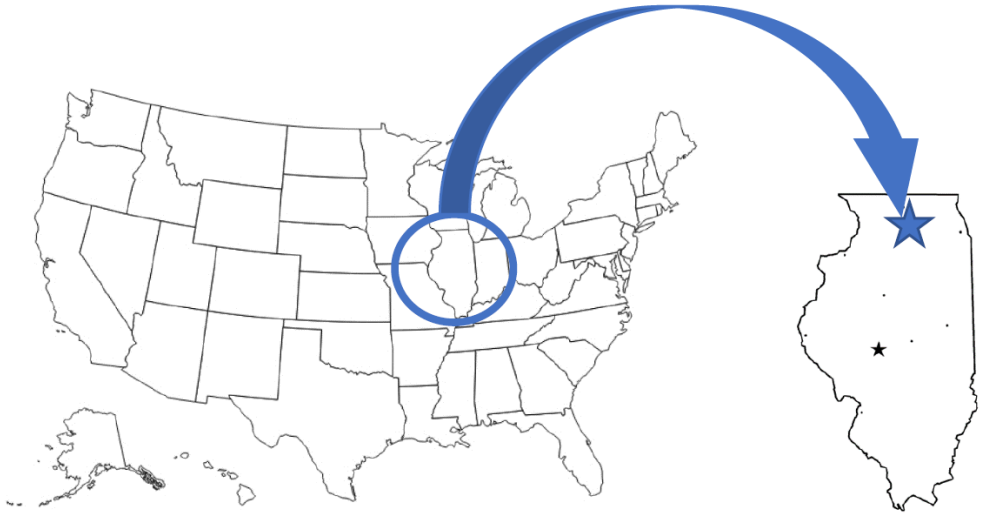

Figure 1. Regional view showing the location of the Fermilab site in Batavia, IL.

Other radioactive material storage areas encompass all areas on the Fermilab site that have not been addressed in the Fermi National Accelerator Laboratory Safety Assessment Document Sections II through

VI that may from time to time contain radioactive materials. These areas comprise many different locations on the Fermilab site including accelerator areas, beam line areas, Wilson Hall, and the Village. Radiation Physics Form 85 (R.P. Form 85), *List of Facilities Containing Radioactive Material*,[2] identifies facilities that are permitted to store and use radioactive material.

Figure 2. Aerial view of the Fermilab site.

II-7.1.5 Management Organization

Multiple facilities across the Fermilab site, owned by different management organizations, are permitted to store and handle radioactive materials.

II-7.1.6 Operating Modes

n/a

II-7.1.7 Inventory of Hazards

The following table lists all of the identified hazards found in the Other Radioactive Material Storage Areas. 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.*

All other hazards present in the Other Radioactive Material Storage 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 Other Radioactive Material Storage Areas.

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

II-7.2. Safety Assessment

All hazards for the Other Radioactive Material Storage Areas are summarized in this section, with additional details of the analyses for accelerator specific hazards.

II-7.2.1 Radiological Hazards

II-7.2.1.1 Prompt Ionizing Radiation

Not applicable for Other Radioactive Material Storage Areas.

II-7.2.1.2 Residual Activation

Radioactivated material located in storage areas is managed in accordance with the requirements of the Fermilab Radiological Control Manual (FRCM)[1] that implement 10 CFR 835. Special controls for use and

storage of radioactive material and sealed radioactive sources located in Wilson Hall are described in FRCM Chapter 9.

II-7.2.1.3 Groundwater Activation

Not applicable for Other Radioactive Material Storage Areas.

II-7.2.1.4 Surface Water Activation

Not applicable for Other Radioactive Material Storage Areas.

II-7.2.1.5 Radioactive Water (RAW) Systems

Not applicable for Other Radioactive Material Storage Areas.

II-7.2.1.6 Air Activation

Not applicable for Other Radioactive Material Storage Areas.

II-7.2.1.7 Closed Loop Air Cooling

Not applicable for Other Radioactive Material Storage Areas.

II-7.2.1.8 Soil Interactions

Not applicable for Other Radioactive Material Storage Areas.

II-7.2.1.9 Radioactive Waste

Radioactive waste produced in the course of work within Other Radioactive Material Storage Areas 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. 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.

II-7.2.1.10 Contamination

Not applicable for Other Radioactive Material Storage Areas.

II-7.2.1.11 Beryllium-7

Not applicable for Other Radioactive Material Storage Areas.

II-7.2.1.12 Radioactive Sources

Various types of sealed radioactive sources are used and stored in many locations on the Fermilab site. Sealed radioactive sources are stored, transported, and used in accordance with the requirements of the

FRCM and the Fermilab Sealed Source Control and Accountability Program requirements.[4] An inventory of all radioisotopes is maintained by the Source Physicist.

II-7.2.1.13 Nuclear Material

Depleted uranium and other nuclear material located in specifically approved areas on the Fermilab site are stored, transported, and used in accordance with FRCM requirements and the Fermilab Nuclear Materials Control and Accountability (MC&A) Plan[5] requirements. All depleted uranium (DU) and neutron sources are located in locked buildings, in cryostats, test modules, locked in a safe, or locked in a storage cave. An inventory of all nuclear material is maintained by the Nuclear Material Representative.

II-7.2.1.14 Radiation Generating Devices (RGDs)

Radiation Generating Devices (RGDs) may be approved for use within the Other Radioactive Material Storage Areas. Use of RGDs is managed through ESH-RPO-RGD-01, *Radiation Generating Devices*,[6] and tracked in R.P. Form 108, *List of Radiation Generating Devices* [3]. Fermilab's management of RGDs incorporates requirements found in several standards and reference documents:

- ANSI/HPS N43.1-2011 – Radiation Safety for the Design and Operation of Particle Accelerators
- ANSI/HPS N43.2-2021 – Radiation Safety for X-ray Diffraction and Fluorescence Analysis Equipment
- ANSI/HPS N43.3-2008 – Installations Using Non-Medical X-Ray and Sealed Gamma-Ray Sources, Energies
- Up to 10 MeV
- DOE G 441.1-1C – Radiation Protection Programs Guide for Use with Title 10, Code of Federal
- Regulations, Part 835, Occupational Radiation Protection
- NRCP Report No. 72 – Radiation Protection and Measurement for Low-Voltage Neutron Generators

Accelerators with approved equivalencies are exempt from certain requirements of DOE O 420.2D and are managed as RGDs.

II-7.2.1.15 Non-Ionizing Radiation Hazards

Lasers may be used for alignment, calibration, or research purposes. It is unlikely that a hazard class 1, 2, or 3A laser used for alignment of equipment would cause an inadvertent injury. On the other hand, hazard class 3B and 4 lasers have a significant potential for causing accidental injuries due to their inherently higher beam power. All laser installations (class 3B or greater) must be reviewed by the Fermilab Laser Safety Officer (LSO) prior to commencement of operations according to FESHM and are screened through the TSW and ORC process. This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04 Safety Analysis. When present, work involving this hazard implements the controls specified in the common Risk Matrix table. For class 3b and above the unmitigated risk is reduced from I to IV. The unmitigated risk of 3R lasers is III and for class 1 and 2 is IV so no additional mitigation is required and remains at discretion of the LSO. No unique controls are in use.

II-7.2.2 Toxic Materials

II-7.2.2.1 Lead

Lead presents a potential exposure hazard from manual handling of un-encased materials. Lead could come in the form of shielding or be brought by an experiment as a detector component such as a calorimeter. This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04 Safety Analysis. When present, work involving this hazard implements the controls specified in the common Risk Matrix table which reduces the unmitigated risk from II to IV. No unique controls are in use.

II-7.2.2.2 Beryllium

Beryllium presents a potential exposure hazard during manual handling of un-encased material. This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04 Safety Analysis. When present, work involving this hazard implements the controls specified in the common Risk Matrix table which reduces the unmitigated risk from II to IV. No unique controls are in use.

II-7.2.2.3 Fluorinert & Its Byproducts

Not applicable for Other Radioactive Material Storage Areas.

II-7.2.2.4 Liquid Scintillator Oil

There is potential for liquid scintillator to be used within Other Radioactive Material Storage Areas. This liquid scintillator may include toxic additives such as pseudocumene or other dopants. This presents a potential exposure hazard from touching or inhaling. This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04 Safety Analysis. When present, work involving this hazard implements the controls specified in the common Risk Matrix table which reduces the unmitigated risk from III to IV. No unique controls are in use.

II-7.2.2.5 Ammonia

Not applicable for Other Radioactive Material Storage Areas.

II-7.2.2.6 Nanoparticle Exposures

There is potential for use of nanoparticle material within Other Radioactive Material Storage Areas. If the material breaks apart or degrades, this presents a potential inhalation event. This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04. When present, work involving this hazard implements the controls specified in the common Risk Matrix table which reduces the unmitigated risk from III to IV. No unique controls are in use.

II-7.2.3 Flammables and Combustibles

II-7.2.3.1 Combustible Materials

The Other Radioactive Material Storage Areas contains cables and some building materials that are combustible. These hazards have been evaluated as standard industrial hazards within the common risk table in Section I Chapter 04 of this document. No unique controls used.

II-7.2.3.2 Flammable Materials

The Other Radioactive Material Storage Areas contains cables and some building materials that are flammable. Various cleaning products used throughout the facility are flammable. These hazards have been evaluated as standard industrial hazards within the common risk table in Section I Chapter 04 of this document. No unique controls used.

II-7.2.4 Electrical Energy

II-7.2.4.1 Stored Energy Exposure

Power supplies used within Other Radioactive Material Storage Areas may contain capacitors that can store energy even when the power supplies are off. These power supplies all implement dedicated written LOTO procedures. This hazard has been evaluated as standard industrial hazards within the common risk table in Section I Chapter 04 of this document. No unique controls used.

II-7.2.4.2 High Voltage Exposure

Power supplies used within Other Radioactive Material Storage Areas may have the potential for high voltage exposure. This hazard has been evaluated as standard industrial hazards within the common risk table in Section I Chapter 04 of this document. No unique controls used.

II-7.2.4.3 Low Voltage, High Current Exposure

Power supplies used within Other Radioactive Material Storage Areas may have the potential for low voltage, high current exposure. This hazard has been evaluated as standard industrial hazards within the common risk table in Section I Chapter 04 of this document. No unique controls used.

II-7.2.5 Thermal Energy

II-7.2.5.1 Bakeouts

Not applicable for Other Radioactive Material Storage Areas.

II-7.2.5.2 Hot Work

Hot work, such as welding, brazing, and grinding, may occur in Other Radioactive Material Storage Areas. All work will have an HA and required permits before being performed. Individuals will also have approved training. When present, work involving this hazard implements the controls specified in the common Risk Matrix table which reduces the unmitigated risk from I to IV. No unique controls are in use.

II-7.2.5.3 Cryogenics

Cryogenic materials may be present in Other Radioactive Material Storage Areas. Special training in the handling of all cryogenic materials is required for personnel working with cryogens.

Some facilities may have oxygen deficiency hazards (ODH) due to its cryogenic use. ODH Safety System controls are in place as determined by the ODH Analysis for the specific area. The facilities within this Other Radioactive Material Areas Chapter are not considered Applicable Accelerator Facilities, and therefore any ODH Safety Systems in place are not identified as Credited Controls.

When present, work involving cryogenic materials implements the controls specified in the common Risk Matrix table which reduces the unmitigated risk from I to IV. No unique controls are in use.

II-7.2.6 Kinetic Energy

II-7.2.6.1 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-7.2.6.2 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-7.2.6.3 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-7.2.6.4 Mobile Shielding

Not applicable for Other Radioactive Material Storage Areas.

II-7.2.7 Potential Energy

II-7.2.7.1 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-7.2.7.2 Compressed Gasses

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-7.2.7.3 Vacuum/Pressure Vessels/Piping

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-7.2.7.4 Vacuum Pumps

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-7.2.7.5 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-7.2.8 Magnetic Fields

II-7.2.8.1 Fringe Fields

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-7.2.9 Other Hazards

II-7.2.9.1 Confined Spaces

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-7.2.9.2 Noise

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-7.2.9.3 Silica

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-7.2.9.4 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-7.2.9.5 Asbestos

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-7.2.9.6 Working at Heights

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-7.2.10 Access & Egress

II-7.2.10.1 Life Safety Egress

Not applicable for Other Radioactive Material Storage Areas.

II-7.2.11 Environmental

II-7.2.11.1 Hazard to Air

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-7.2.11.2 Hazard to Water

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-7.2.11.3 Hazard to Soil

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-7.3. Summary of Hazards to Members of the Public

There is no public access to Other Radioactive Material Storage Areas.

II-7.4. Summary of Credited Controls

Not applicable for Other Radioactive Material Storage Areas.

II-7.4.1 Passive Credited Controls

II-7.4.1.1 Shielding

II-7.4.1.1.1 Permanent Shielding Including Labyrinths

Not applicable for Other Radioactive Material Storage Areas.

II-7.4.1.1.2 Movable Shielding

Not applicable for Other Radioactive Material Storage Areas.

II-7.4.1.1.3 Penetration Shielding

Not applicable for Other Radioactive Material Storage Areas.

II-7.4.1.2 Fencing

II-7.4.1.2.1 Radiation Area Fencing

Not applicable for Other Radioactive Material Storage Areas.

II-7.4.1.2.2 Controlled Area Fencing

Not applicable for Other Radioactive Material Storage Areas.

II-7.4.2 Active Engineered Credited Controls

II-7.4.2.1 Radiation Safety Interlock System

Not applicable for Other Radioactive Material Storage Areas.

II-7.4.2.2 ODH Safety System

Not applicable for Other Radioactive Material Storage Areas.

II-7.4.3 Administrative Credited Controls

II-7.4.3.1 Operation Authorization Document

Not applicable for Other Radioactive Material Storage Areas.

II-7.4.3.2 Staffing

Not applicable for Other Radioactive Material Storage Areas.

II-7.4.3.3 Accelerator Operating Parameters

Not applicable for Other Radioactive Material Storage Areas.

II-7.5. Defense-in-Depth Controls

Not applicable for Other Radioactive Material Storage Areas.

II-7.6. Machine Protection Controls

Not applicable for Other Radioactive Material Storage Areas.

II-7.7. Decommissioning

DOE Field Element Manager approval shall be obtained prior to the decommissioning activities for applicable accelerator facilities.

II-7.8. Summary and Conclusion

Specific hazards associated with Other Radioactive Material Storage Areas are identified and assessed in this Chapter of the Fermilab Safety Assessment Document. In addition to these safety considerations, Other Radioactive Material Storage Areas 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, Other Radioactive Material Storage Areas on Fermilab site 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 and the FRCM.

II-7.9. References

[1] Fermilab Environment, Safety & Health Manual. Web link: https://publicdocs.fnal.gov/cgi-bin/ListBy?topicid=49
[2] Fermilab Radiological Control Manual. Web link: https://publicdocs.fnal.gov/cgi-bin/ListBy?topicid=91
[3] R.P. Form 85, *List of Facilities Containing Radioactive Materials*. Web link: https://esh-docdb.fnal.gov/cgi-bin/sso/ShowDocument?docid=1004
[4] R.P. Form 108, *List of Radiation Generating Devices*. Web link: https://esh-docdb.fnal.gov/cgi-bin/sso/ShowDocument?docid=1004
[5] Fermilab Sealed Source Control and Accountability Program. Web link: https://esh-docdb.fnal.gov/cgi-bin/sso/ShowDocument?docid=156
[6] Fermilab Nuclear Materials Control and Accountability (MC&A) Plan. Web link: https://esh-docdb.fnal.gov/cgi-bin/sso/ShowDocument?docid=2024
[7] ESH-RPO-RGD-01, *Radiation Generating Devices*. Web link: https://esh-docdb.fnal.gov/cgi-bin/sso/ShowDocument?docid=7004

II-7.10. 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).