Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Summary of Baseline and Residual Risks for Non-Accelerator Specific Hazards

Risk Tables Description		Baseline Risk	Residual Risk
C.1	Non-Ionizing Radiation – Onsite-1 Facility Worker	R: I	R: III, IV
C.1	Non-Ionizing Radiation – Onsite-2 Co-located Worker	R: I	R: III, IV
C.1	Non-Ionizing Radiation – MOI Offsite	R: N/A	R: N/A
C.2	Toxic Materials – Onsite 1 Facility Worker	R: II	R: III, IV
C.2	Toxic Materials – Onsite 2 Co-located Worker	R: II	R: III, IV
C.2	Toxic Materials – MOI Offsite	R: II	R: III, IV
C.3	Flammable & Combustible Materials – Onsite-1 Facility Worker	R: I	R: IV
C.3	Flammable & Combustible Materials – Onsite-2 Co-located worker	R: II	R: IV
C.3	Flammable & Combustible Materials – MOI Offsite	R: III	R: IV
C.4	Electrical Energy – Onsite-1 Facility Worker	R: I	R: IV
C.4	Electrical Energy – Onsite-2 Co-located Worker	R: I	R: IV
C.4	Electrical Energy – MOI Offsite	R: I	R: IV
C.5	Thermal Energy – Onsite-1 Facility Worker	R: I	R: IV
C.5	Thermal Energy – Onsite-2 Co-located Worker	R: I	R: IV
C.5	Thermal Energy – MOI Offsite	R: III	R: IV
C.6	Kinetic Energy – Onsite-1 Facility Worker	R: I	R: III, IV
C.6	Kinetic Energy – Onsite-2 Co-located Worker	R: I	R: III, IV
C.6	Kinetic Energy – MOI Offsite	R: N/A	R: N/A
C.7	Potential Energy- Onsite-1 Facility Worker	R: I	R: III, IV
C.7	Potential Energy – Onsite-2 Co-located Worker	R: I	R: III, IV
C.7	Potential Energy – MOI Offsite	R: I	R: III
C.8	Magnetic Fields – Onsite-1 Facility Worker	R: I	R: III, IV
C.8	Magnetic Fields – Onsite-2 Co-located Worker	R: I	R: III, IV
C.8	Magnetic Fields – MOI Offsite	R: I	R: III, IV
C.9	Other Hazards – Onsite-1 Facility Worker	R: I	R: IV
C.9	Other Hazards – Onsite-2 Co-located Worker	R: I	R: IV
C.9	Other Hazards – MOI Offsite	R: I	R: IV
C.10	Access & Egress – Onsite-1 Facility Worker	R: I	R: IV
C.10	Access & Egress – Onsite-2 Co-located Worker	R: II	R: IV
C.10	Access & Egress – MOI Offsite	R: N/A	R: N/A
C.11	Environmental Hazards	R: I	R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

NOTE:
Per DOE-HDBK-1163-2020, Appendix C, "Risk Assessment Methodology":
"Events with an unmitigated risk values of III or IV would not require additional control assignments to provide reasonable assurance of adequate protection. Whereas, for events with an unmitigated risk value of I or II, controls would need to be assigned to either reduce the likelihood or the consequence, and therefore the overall mitigated risk. 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. Each control is credited for a single "bin drop" either in likelihood or consequence; not both. Following a standard hierarchy of controls, controls are applied until the residual risk is acceptable – reflecting a mitigated risk value of III or IV. After controls are credited, events with a remaining unacceptable residual risk (i.e., I or II) are candidates for additional analyses and additional controls, often quantitative in nature." For Fermilab, these controls for accelerator-specific hazards are identified as Credited Controls and further summarized in the Accelerator Safety Envelope (ASE).

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

C.1 Non-ionizing Radiation– Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Non-ionizing radiation-Laser	*Hazard: Exposure to Class 3B and 4 lasers*	L: A C: H R: I	P: Class 1 (light tight) enclosures P: ORC and work planning processes P: Locked/Interlocked system P: LOTO procedure or other procedure approved by the LSO P: Affected areas are posted M: Use of PPE	L: BEU C: M R: IV
	Exposure to Class 3R lasers	L: A C: L R: III	No analysis required	L: A C: L R: III
	Exposure to Class 1 and 2 Lasers	L: A C: N R: IV	No analysis required	L: A C: N R: IV
Non-ionizing radiation-RF	*Hazard: Exposure from RF energy above allowed limits*	L: A C: M R: II	P: RF Shielding P: ES&H periodic monitoring P: LOTO procedure P: Affected area postings	L: BEU C: M R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Non-ionizing Radiation – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Non-ionizing radiation-Laser	*Hazard: Exposure to Class 3B and 4 lasers*	L: A C: H R: I	P: Class 1 (light tight) enclosures P: Locked/Interlocked system or administrative control approved by the LSO P: LOTO procedure or other procedure approved by the LSO P: Affected areas are posted	L: BEU C: H R: IV
	Exposure to Class 3R lasers	L: A C: L R: III	No analysis required	L: A C: L R: III
	Exposure to Class 1 and 2 Lasers	L: A C: N R: IV	No analysis required	L: A C: N R: IV
Non-ionizing radiation-RF	*Hazard: Exposure from RF energy above allowed limits*	L: A C: M R: II	P: RF Shielding P: ES&H periodic monitoring P: LOTO procedure performed by facility worker P: Affected area postings	L: BEU C: M R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Non-ionizing Radiation – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Non-ionizing Radiation-Laser	*Hazard: N/A*	L: C: R:		L: C: R:
Non-ionizing Radiation-RF	*Hazard: N/A*	L: C: R:		L: C: R:

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

C.2 Toxic Materials – Onsite 1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Lead	*Hazard:* Potential exposure to lead during manual handling of un-encased lead bricks, lead shot, lead sheets, lead paint, and soldering operations. *Reference: FESHM, Chapter XXXX*	L: A C: M R: II	P: Administrative policy (moving 10 bricks per day per FESHM) P: Lead handling training M: PPE (dermal and respiratory) M: IH Sampling (vertical standard)	L: EU C: N R: IV
Beryllium	*Hazard:* Potential exposure to beryllium dust during manual handling of un-encased activities (including clean-up). *Reference: FESHM, Chapter XXXY*	L: A C:M R: II	P: Administrative policy (ESH review required per FESHM, permitting, etc.) P: Training (Three current beryllium trainings maintained at Fermilab) M: IH Sampling (vertical standard) M: PPE (dermal and respiratory)	L: EU C: L R: IV
Fluorinert & Its byproducts	*Hazard:* • Potential exposure to fluorinert • Potential exposure to Fluorinert decomposition products (HF, PFIB). *Reference: SDS-HF, and PFIB*	L: U C: N R: IV L: U C: H R: II	Evaluated as non-hazardous through pattern of use P: Fluorinert and decomposition products are contained in a closed system M: Filtration installed to remove hazardous byproducts and reduces consequence of exposure	L: U C: N R: IV L: EU C: M R: III
Liquid Scintillator Oil	*Hazard:* • Airborne exposure via outgassing oil *Reference:* NOvA scintillator oil	L: A C: L R: III	P: Secondary containment prevents contact if leakage occurs P: WPC program reviews this hazard to prevent potential exposure during handling M: Administrative control (perform the work with sufficient ventilation) M: PPE during filling and draining evolutions	L: EU C: N R: IV
Ammonia	*Hazard:* • Exposure to target material	L: A C: M R: II	P: Standard Operating Procedures for handling M: PPE (dermal) M: Engineering control (Room ventilation)	L: U C: M R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Nanoparticle Exposures	*Hazard:* • Airborne exposure	L: A C: L R: III	P: ESH review (work planning, Hazard Analysis, SOP, etc.) P: Administrative controls (training)	L: EU C: L R: IV

Chemical Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
IDLH = Immediately Dangerous to Life and Health
MOI = Maximally-exposed Offsite Individual
PAC = Protective Action Criteria
PEL = Permissible Exposure Limit
TLV_c = Threshold Limit Value (ceiling)

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ PAC-2	**C** ≥ PAC-3	**C** ≥ IDLH
M	PAC-2 > **C** ≥ PAC-1	PAC-3 > **C** ≥ PAC-2	IDLH > **C** ≥ PEL or TLV_c
L	PAC-1 > **C**	PAC-2 > **C**	PEL or TLV_c > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Toxic Materials – Onsite 2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Lead	*Hazard:* Potential exposure to lead during manual handling of un-encased lead bricks, lead shot, lead sheets, lead paint, and soldering operations. *Reference: FESHM*	L: A C: L R: III	P: Work practice control (preventing access to area, prohibiting food and drink, etc.) P: Barriers established for lead work	L: EU C: L R: IV
Beryllium *	*Hazard:* • Potential exposure to beryllium dust for personnel in the vicinity of manual handling of un-encased material. *Reference: FESHM*	L: U C: H R: II	P: Work planning (ESH oversite, i.e. Fermilab doesn't typically allow machining beryllium in general) P: Work practice control (preventing access to area, prohibiting food and drink, etc.) P: Beryllium work signage	L: BEU C: H R: III
Fluorinert & Its byproducts	*Hazard:* • Potential exposure to fluorinert • Potential exposure to fluorinert decomposition products (HF, PFIB). *Reference: SDS-HF, and PFIB*	L: U C: N R: IV L: U C: M R: II	Evaluated as non-hazardous through pattern of use P: Fluorinert and decomposition products are contained in a closed system M: Filtration installed to remove hazardous byproducts and reduces consequence of exposure	L: U C: N R: IV L: EU C: L R: IV
Liquid Scintillator Oil	*Hazard:* • Airborne exposure via outgassing oil *Reference:* NOvA scintillator oil	L: A C: N R: IV	No further analysis required	L: A C: N R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Ammonia	*Hazard:* • Exposure to target material	L: A C: L R: III	M: Engineering control (room ventilation)	L: A C: N R: IV
Nanoparticle Exposures	*Hazard:* • Airborne exposure	L: A C: N R: IV	No further analysis required	L: A C: N R: IV

Chemical Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)

Acronyms
IDLH = Immediately Dangerous to Life and Health
MOI = Maximally-exposed Offsite Individual
PAC = Protective Action Criteria
PEL = Permissible Exposure Limit
TLV$_c$ = Threshold Limit Value (ceiling)

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ PAC-2	**C** ≥ PAC-3	**C** ≥ IDLH
M	PAC-2 > **C** ≥ PAC-1	PAC-3 > **C** ≥ PAC-2	IDLH > **C** ≥ PEL or TLV$_c$
L	PAC-1 > **C**	PAC-2 > **C**	PEL or TLV$_c$ > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Toxic Materials – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Lead	*Hazard:* Potential exposure to un-encased lead bricks, lead shot, lead sheets, and lead paint waste. *Reference: FESHM*	L: EU C: M R: III	P: Access prevention (facility doors are typically locked)	L: BEU C: M R: IV
Beryllium	*Hazard:* • Potential exposure to beryllium. *Reference: FESHM*	L: EU C: H R: II	P: Access prevention (facility doors are typically locked)	L: BEU C: H R: III
Fluorinert & Its byproducts	*Hazard:* • Potential exposure to fluorinert • Potential exposure to fluorinert decomposition products (HF, PFIB). *Reference: SDS-HF, and PFIB*	L: EU C: N R: IV L: EU C: H R : II	Evaluated as non-hazardous through pattern of use P: Access to the public is prevented M: Filtration installed to remove hazardous byproducts and reduces consequence of exposure	L: U C: N R: IV L: BEU C: M R: IV
Liquid Scintillator Oil	*Hazard:* Airborne exposure via outgassing oil	L: EU C: N R: IV	Further analysis not required	L: EU C: N R: IV
Ammonia	*Hazard:* Exposure to target material	L: EU C: N R: IV	Further analysis not required	L: EU C: N R: IV
Nanoparticle Exposures	*Hazard:* Airborne exposure	L: EU C: N R: IV	Further analysis not required	L: EU C: N R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Chemical Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)

Acronyms
IDLH = Immediately Dangerous to Life and Health
MOI = Maximally-exposed Offsite Individual
PAC = Protective Action Criteria
PEL = Permissible Exposure Limit
TLV_c = Threshold Limit Value (ceiling)

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ PAC-2	**C** ≥ PAC-3	**C** ≥ IDLH
M	PAC-2 > **C** ≥ PAC-1	PAC-3 > **C** ≥ PAC-2	IDLH > **C** ≥ PEL or TLV_c
L	PAC-1 > **C**	PAC-2 > **C**	PEL or TLV_c > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

C.3 Flammable and Combustible Materials – Onsite -1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Combustible materials (cables, boxes, paper, wood cribbing, etc.)	*Hazard:* *This hazard is a potential facility fire.* *The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices.* *This hazard can add to the fuel load of a potential facility fire.* *Poor housekeeping can also lead to life safety concerns, such as egress obstructions and tripping hazards.* *The exposure of the hazard to the facility worker is of major concern.* *Reference: FESHM Chapter 2005 Operational Readiness Clearance & 6010 Fire Protection Program*	L: A C: H R: I	P: The use of Operational Readiness Clearance (ORC) and/or WPC process determine if additional combustibles will be introduced to the area P: Fire Safety and Life Safety Inspections are performed by the Fire Protection Group and the Fire Department P: Fire alarm systems ITM is performed at prescribed frequencies P: Prior to restart, a walkdown is conducted of the complex verifying transient combustibles are removed before operational activities commence P: Hot work program administered by the Fire Department M: Smoke, heat, sprinklers, are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days M: Fire detection and/or suppression is present M: Manual fire suppression services are provided, i.e., fire hydrants, throughout the complex M: Egress stairways are constructed as fire barriers M: On-site fire department trained in radiological environments	L: BEU C: N R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Flammable Materials (Flammable gas, cleaning materials, etc.)	*Hazard:* *The presence of flammable gases in cylinders or storage containers pose an inherent hazard due to their flammability/combustibility properties.* *Exposure to hot work provides a dangerous situation where flammable liquids will ignite. Unmitigated this could lead to an explosion and subsequent fire.* *The exposure of the hazard to the facility worker is of major concern.* *Reference: FESHM Chapters 2005 Operational Readiness Clearance, 6010 Fire Protection Program, 6020.3 Flammable Gases, 6020.4, Combustible & Flammable Liquids*	L: A C: H R: I	P – The use of Operational Readiness Clearance (ORC) and/or WPC process determine if additional combustibles will be introduced to the area P: Fire Safety and Life Safety Inspections are performed by the Fire Protection Group and the Fire Department P: Fire alarm systems ITM is performed at prescribed frequencies P: Prior to restart, a walkdown is conducted of the complex verifying transient combustibles are removed before operational activities commence P: Hot work program administered by the Fire Department M: Smoke, heat, sprinklers, are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days M: Fire detection and/or suppression is present M: Manual fire suppression services are provided, i.e., fire hydrants, throughout the complex M: Egress stairways are constructed as fire barriers M: On-site fire department trained in radiological environments	L: BEU C: N R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Flammable and Combustible Materials – Onsite -2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Combustible materials (cables, Boxes, Paper, wood cribbing, etc.)	*Hazard:* *The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices.* *This hazard can add to the fuel load of a potential fire.* *Poor housekeeping can also lead to life safety concerns, such as egress obstructions and tripping hazards.* *The exposure of the hazard to the co-located worker is of concern.* *Reference: FESHM 2005 Operational Readiness Clearance & 6010 Fire Protection Program*	L: A C: M R: II	P: The use of Operational Readiness Clearance (ORC) and/or WPC process determine if additional combustibles will be introduced to the area P: Fire Safety and Life Safety Inspections are performed by the Fire Protection Group and the Fire Department P: Fire alarm systems ITM is performed at prescribed frequencies P: Prior to restart, a walkdown is conducted of the complex verifying transient combustibles are removed before operational activities commence P: Hot work program administered by the Fire Department M: Smoke, heat, sprinklers, are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days M: Fire detection and/or suppression is present M: Manual fire suppression services are provided, i.e., fire hydrants, throughout the complex M: Egress stairways are constructed as fire barriers M: On-site fire department trained in radiological environments	L: BEU C: N R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Flammable Materials (Flammable gas, cleaning materials, etc.)	*Hazard:* *The presence of flammable gases in cylinders or storage containers pose an inherent hazard due to their flammability/combustibility properties.* *Exposure to hot work provides a dangerous situation where flammable liquids will ignite. Unmitigated this could lead to an explosion and subsequent fire.* *The exposure of the hazard to the co-located worker is of concern.* *Reference: FESHM Chapters 2005 Operational Readiness Clearance, 6010 Fire Protection Program, 6020.3 Flammable Gases, 6020.4, Combustible & Flammable Liquids 4*	L: A C: M R: II	P: The use of Operational Readiness Clearance (ORC) and/or WPC process determine if additional combustibles will be introduced to the area P: Fire Safety and Life Safety Inspections are performed by the Fire Protection Group and the Fire Department P: Fire alarm systems ITM is performed at prescribed frequencies P: Prior to restart, a walkdown is conducted of the complex verifying transient combustibles are removed before operational activities commence P: Hot work program administered by the Fire Department P: EPHS demonstrates no risk of off-site releases to the public M: Smoke, heat, sprinklers, are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days M: Fire detection and/or suppression is present M: Manual fire suppression services are provided, i.e., fire hydrants, throughout the complex M: Egress stairways are constructed as fire barriers M: On-site fire department trained in radiological environments	L: BEU C: N R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Flammable and Combustible Materials – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Combustible materials (cables, Boxes, Paper, wood cribbing, etc.)	*Hazard:* *The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices.* *This hazard can add to the fuel load of a potential fire.* *Poor housekeeping can also lead to life safety concerns, such as egress obstructions and tripping hazards.* *The exposure of the hazard to the public is of minimal concern.* *Reference: FESHM 2005 Operational Readiness Clearance & 6010 Fire Protection Program*	L: U C: L R: III	P: Public is screened at Fermi site boundary, and Fermilab restricts public access to accelerator complex. P: The use of Operational Readiness Clearance (ORC) and/or WPC process determine if additional combustibles will be introduced to the area P: Fire Safety and Life Safety Inspections are performed by the Fire Protection Group and the Fire Department P: Fire alarm systems ITM is performed at prescribed frequencies P: Prior to restart, a walkdown is conducted of the complex verifying transient combustibles are removed before operational activities commence P: Hot work program administered by the Fire Department P: EPHS demonstrates no risk of off-site releases to the public M: Smoke, heat, sprinklers, are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days M: Fire detection and/or suppression is present M: Manual fire suppression services are provided, i.e., fire hydrants, throughout the complex M: Egress stairways are constructed as fire barriers M: On-site fire department trained in radiological environments M: In the event of a fire, site security prohibits access to the public	L: BEU C: N R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Flammable Materials (Flammable gas, cleaning materials, etc.)	*Hazard:* *The presence of flammable gases in cylinders or storage containers pose an inherent hazard due to their flammability/combustibility properties.* *Exposure to hot work provides a dangerous situation where flammable liquids will ignite. Unmitigated this could lead to an explosion and subsequent fire.* *The exposure of the hazard to the public is of minor concern.* *Reference: FESHM Chapters 2005 Operational Readiness Clearance, 6010 Fire Protection Program, 6020.3 Flammable Gases, 6020.4, Combustible & Flammable Liquids*	L: U C: L R: III	P: Public is screened at Fermi site boundary, and Fermilab restricts public access to accelerator complex. P: The use of Operational Readiness Clearance (ORC) and/or WPC process determine if additional combustibles will be introduced to the area P: Fire Safety and Life Safety Inspections are performed by the Fire Protection Group and the Fire Department P: Fire alarm systems ITM is performed at prescribed frequencies P: Prior to restart, a walkdown is conducted of the complex verifying transient combustibles are removed before operational activities commence P: Hot work program administered by the Fire Department M: Smoke, heat, sprinklers, are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days M: Fire detection and/or suppression is present M: Manual fire suppression services are provided, i.e., fire hydrants, throughout the complex M: Egress stairways are constructed as fire barriers M: On-site fire department trained in radiological environments M: In the event of a fire, site security prohibits access to the public	L: BEU C: N R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

C.4 Electrical Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Stored Energy Exposure	*Hazard:* • *Shock hazard, >50 V, Non-interlocked enclosures* • *Arc Flash, Non-interlocked enclosures*	L: A C: H R: I L: A C: H R: I	P: Equipment is enclosed (dead front panels), and tool use or lock removal is required to access P: Training for electrical workers including no energized manipulative work policy P: Hazard Analysis / LOTO Procedures / Standard Operating Procedures for work on electrical equipment M: Personnel protective equipment and training in proper use. M: Ground current monitors inhibit magnet power supply operation when excessive ground current is detected. Intended for equipment protection but provides some shock mitigation	L: BEU C: L R: IV L: BEU C: L R: IV
Stored Energy Exposure	*Hazard:* • *Shock hazard,>50 V, Interlocked enclosure area* • *Arc Flash, Interlocked enclosure area*	L: A C: H R: I L: A C: H R: I	P: Equipment is enclosed (dead front panels), and tool use or lock removal is required to access OR Electrical Safety System turns off systems with exposed conductors when key issued P: Access to enclosure requires key issued for specific, daily access P: Training for electrical workers including no energized manipulative work policy P: Hazard Analysis / LOTO Procedures / Standard Operating Procedures for work on electrical equipment M: Personnel protective equipment and training in proper use. M: Ground current monitors inhibit magnet power supply operation when excessive ground current is detected. Intended for equipment protection but provides some shock mitigation M: Passive dissipation of stored energy for magnet power supplies	L: BEU C: N R: IV L: BEU C: N R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
High Voltage Exposure	*Hazard:* • *Shock hazard, voltage > 50 V, Non-interlocked enclosures* • *Arc Flash, Non-interlocked enclosures*	L: A C: H R: I L: A C: H R: I	P: Equipment is enclosed (dead front panels), and tool use or lock removal is required to access P: Training for electrical workers including no energized manipulative work policy P: Hazard Analysis / LOTO Procedures / Standard Operating Procedures for work on electrical equipment M: Personnel protective equipment and training in proper use. M: Ground current monitors inhibit power supply operation when excessive ground current is detected. Intended for equipment protection but provides some shock mitigation	L: BEU C: L R: IV L: BEU C: L R: IV
High Voltage Exposure	*Hazard:* *Shock hazard, voltage > 50 V, Interlocked enclosures* • *Arc Flash, Interlocked enclosures*	L: A C: H R: I L: A C: H R: I	P: Equipment is enclosed (dead front panels), and tool use or lock removal is required to access OR Electrical Safety System turns off systems with exposed conductors when key issued. P: Access to enclosure requires key issued for specific, daily access P: Training for electrical workers including no energized manipulative work policy P: Hazard Analysis / LOTO Procedures / Standard Operating Procedures for work on electrical equipment M: Personnel protective equipment and training in proper use. M: Ground current monitors inhibit power supply operation when excessive ground current is detected. Intended for equipment protection but provides some shock mitigation	L: BEU C: L R: IV L: BEU C: L R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Low Voltage, High Current Exposure.	*Hazard:* • *Arc Flash, Non-interlocked enclosures*	L: U C: H R: I	P: Equipment is enclosed, and tool use or lock removal is required to access P: Training for electrical workers including no energized manipulative work policy P: Hazard Analysis / LOTO Procedures / Standard Operating Procedures for work on electrical equipment M: Personnel protective equipment and training in proper use. M: Ground current monitors inhibit power supply operation when excessive ground current is detected. Intended for equipment protection but provides some shock mitigation.	L: BEU C: L R: IV
	• *Fire hazard from high current causing smoke inhalation and burns.*	L: U C: H R: I	P: Equipment is enclosed preventing fire initiation. P: Overcurrent protection devices are designed into equipment. P: Ground current monitors inhibit power supply operation when excessive ground current is detected. M: Combustible controls mitigate potential fire initiation. M: Smoke detectors mitigate potential personnel exposure to smoke inhalation.	L: BEU C: L R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Low Voltage, High Current Exposure.	*Hazard:* • *Arc Flash, Interlocked enclosures*	L: U C: H R: I	P: Equipment is enclosed, and tool use or lock removal is required to access OR Electrical Safety System turns off systems with exposed conductors when key issued. P: Access to enclosure requires key issued for specific, daily access P: Training for electrical workers including no energized manipulative work policy P: Hazard Analysis / LOTO Procedures / Standard Operating Procedures for work on electrical equipment M: Personnel protective equipment and training in proper use. M: Ground current monitors inhibit power supply operation when excessive ground current is detected. Intended for equipment protection but provides some shock mitigation.	L: BEU C: L R: IV
	• *Fire hazard from high current causing smoke inhalation and burns.*	L: U C: H R: I	P: Equipment is enclosed preventing fire initiation. P: Overcurrent protection devices are designed into equipment. P: Ground current monitors inhibit power supply operation when excessive ground current is detected. M: Combustible controls mitigate potential fire initiation. M: Fire detectors mitigate potential personnel exposure to smoke inhalation.	L: BEU C: L R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Electrical Energy Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Stored Energy Exposure	*Hazard:* • *Shock hazard, >50 V, Non-interlocked enclosures* • *Arc Flash, Non-interlocked enclosures*	L: A C: H R: I L: A C: H R: I	P: Equipment is enclosed (dead front panels), and tool use or lock removal is required to access P: Building access restricted to trained individuals P: Basic electrical training for all workers M: Ground current monitors inhibit magnet power supply operation when excessive ground current is detected. Intended for equipment protection but provides some shock mitigation.	L: BEU C: M R: IV L: BEU C: M R: IV
Stored Energy Exposure	*Hazard:* • *Shock hazard, >50 V, Interlocked enclosures* • *Arc Flash, Interlocked enclosures*	L: A C: H R: I L: A C: H R: I	P: Equipment is enclosed (dead front panels), and tool use or lock removal is required to access OR Electrical Safety System turns off systems with exposed conductors when key issued P: Building access restricted to trained individuals P: Access to enclosure requires key issued for specific, daily access P: Basic electrical training for all workers M: Ground current monitors inhibit magnet power supply operation when excessive ground current is detected. Intended for equipment protection but provides some shock mitigation. M: Passive dissipation of stored energy for magnet power supplies	L: BEU C: L R: IV L: BEU C: L R: IV
High Voltage Exposure	*Hazard:* *Shock hazard, voltage > 50 V, Non-interlocked enclosures* • *Arc Flash, Non-interlocked enclosures*	L: A C: H R: I L: A C: H R: I	P: Equipment is enclosed (dead front panels), and tool use or lock removal is required to access P: Building access restricted to trained individuals P: Basic electrical training for all workers M: Ground current monitors inhibit power supply operation when excessive ground current is detected. Intended for equipment protection but provides some shock mitigation	L: BEU C: M R: IV L: BEU C: M R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
High Voltage Exposure	*Hazard:* *Shock hazard, voltage > 50 V, Interlocked enclosures* • *Arc Flash, Interlocked enclosures*	L: A C: H R: I L: A C: H R: I	P: Equipment is enclosed (dead front panels) and tool use or lock removal is required to access OR Electrical Safety System turns off systems with exposed conductors when key issued. P: Building access restricted to trained individuals P: Access to enclosure requires key issued for specific, daily access P: Basic electrical training for all workers M: Ground current monitors inhibit power supply operation when excessive ground current is detected. Intended for equipment protection but provides some shock mitigation	L: BEU C:M R: IV L: BEU C: M R: IV
Low Voltage, High Current Exposure.	*Hazard:* • *Arc Flash Non-interlocked enclosures* • *Fire hazard from high current causing smoke inhalation and burns service building areas*.	L: U C: H R: I L: U C: H R: I	P: Equipment is enclosed, and tool use or lock removal is required to access P: Training for electrical workers including no energized manipulative work policy P: Hazard Analysis / Standard Operating Procedures for work on electrical equipment M: Personnel protective equipment and training in proper use. M: Ground current monitors inhibit power supply operation when excessive ground current is detected. Intended for equipment protection but provides some shock mitigation P: Equipment is enclosed preventing fire initiation. P: Overcurrent protection devices are designed into equipment. P: Ground current monitors inhibit power supply operation when excessive ground current is detected. M: Combustible controls mitigate potential fire initiation. M: Smoke detectors mitigate potential personnel exposure to smoke inhalation.	L: BEU C: L R: IV L: BEU C: L R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Low Voltage, High Current Exposure.	*Hazard:* • *Arc Flash, Interlocked enclosures*	L: U C: H R: I	P: Equipment is enclosed and tool use or lock removal is required to access OR Electrical Safety System turns off systems with exposed conductors when key issued. P: Building access restricted to trained individuals P: Access to enclosure requires key issued for specific, daily access P: Basic electrical training for all workers M: Ground current monitors inhibit power supply operation when excessive ground current is detected. Intended for equipment protection but provides some shock mitigation	L: BEU C: M R: IV
	• *Fire hazard from high current causing smoke inhalation and burns, beam line enclosure areas*	L: U C: H R: I	P: Equipment is enclosed preventing fire initiation. P: Overcurrent protection devices are designed into equipment. P: Ground current monitors inhibit power supply operation when excessive ground current is detected.	L: BEU C: L R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Electrical Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Stored Energy Exposure	*Hazard: Shock hazard, >50 V, Arc flash*	L: A C: H R: I	P: Equipment is enclosed (dead front panels), and tool use is required for access P: Site access monitored by security staff P: Lock removal is required to access M: Passive dissipation of stored energy for magnet power supplies	L: BEU C: M R: IV
High Voltage Exposure	*Hazard: Shock hazard, >50 V, Arc flash outside* *Reference*:	L: A C: H R: I	P: Equipment is enclosed (dead front panels), and tool use id required for access P: Site access monitored by security staff P: Lock removal is required to access M: Ground current monitors inhibit power supply operation when excessive ground current is detected. Intended for equipment protection but provides some shock mitigation	L: BEU C: M R: IV
Low Voltage, High Current Exposure.	*Hazard: N/A*	L: C: R:	Public does not have access to this hazard	L: C: R:

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

C.5 Thermal Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Bakeout	*Hazard:* *A bakeout will cause elevated temperatures.* *Hotter than 100 C (212 F) degrees for 4-5 days.* *If the bake out were to not have runaway temperature capabilities, this could lead to excessive heat and burning, which could potentially lead to a fire.* *The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices.* *This hazard can add to the fuel load of a potential fire.* *The exposure of the hazard to the facility worker is of major concern.* *Reference*: *FESHM Chapter 6020.2 Hot Work Program*	L: A C: H R: I	P: The bakeout happens once the space access is restricted, and transient combustibles have been removed. P: Hot work permits are issued to qualified and trained personnel and they must meet all the requirements of the hot work permit. Hot work permits are managed by Fermilab's Fire Department. P: WPC process determines if additional combustibles will be introduced to the area P: Fire Safety and Life Safety Inspections are performed Fire Protection Group and the Fire Department. P: Fire alarm systems ITM is performed at prescribed frequencies M: Smoke, heat, sprinklers, are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days M: Fire detection and/or suppression is present M: Manual fire suppression services are provided, i.e., fire hydrants, throughout the complex M: Egress stairways are constructed as fire barriers M: On-site fire department trained in radiological environments	L: BEU C: N R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Hot Work	*Hazard:* *Hot work will cause elevated temperatures. If hot work is not supervised, there is a potential for combustibles in the surrounding area to be ignited due to exposure to slag or elevated temperatures. This could lead to excessive heat and burning, which could potentially lead to a fire.* *The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices.* *This hazard can add to the fuel load of a potential fire.* *The exposure of the hazard to the facility worker is of major concern.* *Reference*: *FESHM Chapter 6020.2 Hot Work Program*	L: A C: H R: I	P: Hot work permits are issued to qualified and trained personnel and they must meet all the requirements of the hot work permit. Hot work permits are managed by Fermilab Fire Department. P: WPC process determines if additional combustibles will be introduced to the area P: Fire Safety and Life Safety Inspections are performed Fire Protection Group and the Fire Department. P: Fire alarm systems ITM is performed at prescribed frequencies M: Smoke, heat, sprinklers, are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days M: Fire detection and/or suppression is present M: Manual fire suppression services are provided, i.e., fire hydrants, throughout the complex M: Egress stairways are constructed as fire barriers M: On-site fire department trained in radiological environments	L: BEU C: N R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Cryogenics	*Hazard:* *Cryogenics are inherently a low risk on their own as they are non-flammable and non-toxic.* *However, if exposed to the cryogenic liquids, they have the potential of burning skin and creating an oxygen deficient atmosphere which can lead to death.* *The exposure of the hazard to the facility worker is of major concern.* *Reference: FESHM 4240 ODH, 5032 Cryogenics System Review, 5032.1 Liquid Nitrogen Dewar Installation and Operation Rules, 5032.2 Liquid Cryogenic Targets*	ODH L: A C: H R: I Burns L: A C: H R: I	P: Personnel must be medically qualified to enter ODH spaces. P: Portable Oxygen Monitoring is provided for ODH spaces in accordance with the WPC P: Fire Safety and Life Safety Inspections are performed Fire Protection Group and the Fire Department. P: ODH alarm systems are tested and maintained M: ODH alarms are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days. M: Area/fixed Oxygen Monitoring provided in areas where cryogenic liquids are stored M: Onsite Emergency services are provided. P: Cryogenic system designed and reviewed by qualified personnel P: WPC process provides instructions for use P: Protective clothing rules are enforced when working in areas with exposure to cryogenic liquids. P: Training required for all personnel handling cryogenics M: Onsite Emergency services are provided	ODH L: BEU C: N R: IV Burns L: BEU C: M R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Thermal Energy – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Bakeout	*Hazard:* *A bakeout will cause elevated temperatures. If the bake out were to not have runaway temperature capabilities, this could lead to excessive heat and burning, which could potentially lead to a fire.* *The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices.* *This hazard can add to the fuel load of a potential fire.* *The exposure of the hazard to the co-located worker is of minor concern.* *Reference: FESHM Chapter 6020.2 Hot Work Program*	L: A C:H R: I	P: The bakeout happens once the space access is restricted, and transient combustibles have been removed. P: Hot work permits are issued to qualified and trained personnel and they must meet all the requirements of the hot work permit. Hot work permits are managed by Fermilab's Fire Department. P: WPC process determines if additional combustibles will be introduced to the area P: Fire Safety and Life Safety Inspections are performed Fire Protection Group and the Fire Department. P: Fire alarm systems ITM is performed at prescribed frequencies M: Smoke, heat, sprinklers, are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days M: Fire detection and/or suppression is present M: Manual fire suppression services are provided, i.e., fire hydrants, throughout the complex M: Egress stairways are constructed as fire barriers M: On-site fire department trained in radiological environments	L: BEU C: N R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Hot Work	*Hazard:* *Hot work will cause elevated temperatures. If hot work is not supervised, there is a potential for combustibles in the surrounding area to be ignited due to exposure to slag or elevated temperatures. This could lead to excessive heat and burning, which could potentially lead to a fire.* *The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices.* *This hazard can add to the fuel load of a potential fire.* *The exposure of the hazard to the co-located worker is of minor concern.* *Reference: FESHM Chapter 6020.2*	L: A C: H R: I	P: Hot work permits are issued to qualified and trained personnel and they must meet all the requirements of the hot work permit. Hot work permits are managed by Fermilab Fire Department. P: WPC process determines if additional combustibles will be introduced to the area P: WPC prescribes welding screens and signage P: Fire Safety and Life Safety Inspections are performed Fire Protection Group and the Fire Department. P: Fire alarm systems ITM is performed at prescribed frequencies M: Smoke, heat, sprinklers, are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days M: Fire detection and/or suppression is present M: Manual fire suppression services are provided, i.e., fire hydrants, throughout the complex M: Egress stairways are constructed as fire barriers M: On-site fire department trained in radiological environments	L: BEU C: N R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Cryogenic Liquids	*Hazard:* *Cryogenic liquids, such as liquid helium and nitrogen are inherently a low risk on their own as they are non-flammable and non-toxic.* *However, if exposed to the cryogenic liquids, they have the potential of burning skin and creating an oxygen deficient atmosphere which can lead to death.* *The exposure of the hazard to the co-located worker is of minimal concern.* *Reference: FESHM 4240, 5032, 5032.1, 5032.3*	ODH L: A C:H R: I Burns L: A C: H R: I	P: Personnel must be medically qualified to enter ODH spaces. P: Portable Oxygen Monitoring is provided for ODH spaces in accordance with the WPC P: Fire Safety and Life Safety Inspections are performed Fire Protection Group and the Fire Department. P: ODH alarm systems are tested and maintained M: ODH alarms are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days. M: Area/fixed Oxygen Monitoring provided in areas where cryogenic liquids are stored M: Onsite Emergency services are provided. P: Cryogenic system designed and reviewed by qualified personnel P: WPC process provides instructions for use P: Protective clothing rules are enforced when working in areas with exposure to cryogenic liquids. P: Training required for all personnel handling cryogenics M: Onsite Emergency services are provided	ODH L: BEU C: N R: IV Burns L: BEU C:M R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Thermal Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Bakeout	*Hazard: N/A* *A bakeout will cause elevated temperatures. If the bake out were to not have runaway temperature capabilities, this could lead to excessive heat and burning, which could potentially lead to a fire.* *The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices.* *This hazard can add to the fuel load of a potential fire.* *The exposure of the hazard to the public is of minimal concern.* *Reference*: *FESHM 6020.2*	L: U C: L R: III	P: Public is screened at Fermi site boundary, and Fermilab restricts public access to accelerator complex. P: Hot work permits are issued to qualified and trained personnel and they must meet all the requirements of the hot work permit. Hot work permits are managed by Fermilab's Fire Department. P: the use of operational readiness clearance ensures if additional combustibles will be introduced to the area P: All materials are reviewed prior to entering accelerator complex. P: Fire Safety and Life Safety Inspections are performed Fire Protection Group and the Fire Department. P: Fire alarm systems are tested prior to maintenance activities in shutdown mode. P: Prior to restart, a walkdown is conducted of the complex verifying flammables are removed before operational activities commence. M: Smoke, heat, sprinklers, are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days. M: Line type heat detection throughout the accelerator complex M: Air sampling smoke (early) detection is present M: Automatic sprinkler protection at the alcoves and service buildings. M: Manual fire suppression services are provided. M – Egress stairways are constructed as fire barriers	L: BEU C: N R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Hot Work	*Hazard:* *Hot work will cause elevated temperatures. If hot work is not supervised, there is a potential for combustibles in the surrounding area to be ignited due to exposure to slag or elevated temperatures. This could lead to excessive heat and burning, which could potentially lead to a fire.* *The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices.* *This hazard can add to the fuel load of a potential fire.* *The exposure of the hazard to the public is of minimal concern.* *Reference*: *FESHM 6020.2*	L: U C: L R: III	P: Public is screened at Fermi site boundary, and Fermilab restricts public access to accelerator complex. P: Hot work permits are issued to qualified and trained personnel and they must meet all the requirements of the hot work permit. Hot work permits are managed by Fermilab's Fire Department. P: the use of operational readiness clearance ensures if additional combustibles will be introduced to the area P: All materials are reviewed prior to entering accelerator complex. P: Fire Safety and Life Safety Inspections are performed Fire Protection Group and the Fire Department. P: Fire alarm systems are tested prior to maintenance activities in shutdown mode. P: Prior to restart, a walkdown is conducted of the complex verifying flammables are removed before operational activities commence. M: Smoke, heat, sprinklers, are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days. M: Line type heat detection throughout the accelerator complex M: Air sampling smoke (early) detection is present M: Automatic sprinkler protection at the alcoves and service buildings. M: Manual fire suppression services are provided. M: Egress stairways are constructed as fire barriers	L: BEU C: N R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Cryogenic Liquids	*Hazard: Burns from contact* *Cryogenic liquids, such as liquid helium and nitrogen are inherently a low risk on their own as they are non-flammable and non-toxic.* *However, if exposed to the cryogenic liquids, they have the potential of burning skin and creating an oxygen deficient atmosphere which can lead to death.* *The exposure of the hazard to the public is of minimal concern.* *Reference: FESHM 4240, 5032, 5032.1, 5032.3*	L: U C: L R: III	P: Cryogenic systems designed and reviewed by qualified personnel M: Site security plans monitor access to outside tanks M: Onsite Emergency services are provided	L: BEU C: N R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

C.6 Kinetic Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power tools	*Hazard: Personnel injury due to improper use of power tools.*	L: A C: H R: I	P: Training to inform personnel on proper tool operations. P: All machine guarding required to be in place prior to use to prevent injury. P: Sharing of tool use lessons learned M: Use of PPE	L: BEU C: M R: IV
Pumps and Motors	*Hazard: Personnel injury due to entrapment/entanglement.*	L: A C: H R: I	P: All machine guarding required to be in place prior to use to prevent injury P: Lockout/Tagout procedure prevents personnel from accessing rotating shafts or motors. Zero energy is verified prior to equipment access. P: All areas perform hazard analysis and/or WPC process	L: BEU C: H R: III
Motion Tables	*Hazard: Personnel injury due to pinch points, tip-overs, caught in between.*	L: A C: H R: I	P: Lock out/ Tag out procedure prevents motor from activating P: Engineering Notes/ ORC procedure P: Safety stops P: Warning labels	L: BEU C: H R: III
Mobile Shielding	*Hazard: Personnel injury due to pinch points, tip-overs, caught in between, crushing.*	L: A C: H R: I	P: Securing shielding prevents tip over and pinch points P: Proper placement through hoisting/rigging with supervision P: Work control processes prevent unnecessary movement P: Spotters placed during movement	L: BEU C: H R: III

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Kinetic Energy – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power tools	*Hazard: Personnel injury due to power tool use (flying debris, struck by object).*	L: U C: H R: I	P: Tech shops are locked and not accessible to collocated personnel (unless trained).* P: Tool Operator controls work area and prevents exposure to non-working personnel. M: Proper tool setup prior to use mitigates the potential for flying objects to cause injury. M: Personal protective equipment mitigates the severity of injury by protecting the individual.	L: EU *BEU C: L R: IV
Pumps and Motors	*Hazard: Personnel injury due to entrapment/entanglement.*	L: U C: H R: I	P: All machine guarding required to be in place prior to use to prevent injury P: Lockout/Tagout procedure prevents personnel from accessing rotating shafts or motors. Zero energy is verified prior to equipment access P: All areas perform hazard analysis and/or WPC process M: WPC reduces consequence of co-located worker injury	L: BEU C: M R: IV
Motion Tables	*Hazard: Personnel injury due to tip-overs, caught in between, crushing*	L: A C: H R: I	P: Lock out/ Tag out procedure prevents the motor from activating P: Engineering Notes/ ORC procedure evaluates the tables for stability and user safety P: Safety stops (where applicable) prevent injury due to pinch points and getting caught in between events P: Warning labels provide information to prevent pinching of fingers while using motion tables	L: BEU C: H R: III
Mobile Shielding	*Hazard: Personnel injury due to tip-overs, caught in between, crushing*	L: A C: H R: I	P: Securing shielding prevents tip over and pinch points P: Proper placement through hoisting/rigging with supervision P: Work control processes prevent unnecessary movement P: Spotters placed during movement	L: BEU C: H R: III

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Kinetic Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power tools	*Hazard: N/A*	L: C: R:	Public is prevented from having access to work areas	L: C: R:
Pumps and Motors	*Hazard: N/A*	L: C: R:	Public is prevented from having access to work areas	L: C: R:
Motion Tables	*Hazard: N/A*	L: C: R:	Public is prevented from having access to work areas	L: C: R:
Mobile Shielding	*Hazard: N/A*	L: C: R:	Public is prevented from having access to work areas	L: C: R:

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

C.7 Potential Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane Operations	*Hazard: personnel injury due to improper crane operations.*	L: A C: H R: I	P: All overhead crane operators must take crane operator training FN000005/CR/OJ/EV P: Mobile Crane operators are trained and certified/licensed and take FN000360/CR. P: Qualified riggers are determined by their supervisor. P: All cranes are inspected on prescribed frequencies by an outside vendor M: Personal Protective Equipment mitigates the severity of injury by protecting the individual	L: BEU C: M R: IV
Compressed Gasses	*Hazard: Personnel injury due to unexpected release, or unsecure tanks.*	L: A C: H R: I	P: All personnel handling compressed gasses have to take Pressure Safety orientation training FN000271 P: All personnel handling compressed gasses have to take compressed gas cylinder safety training FN000213 P: All personnel must be familiar with FESHM 5000 series and apply requirements P: Gas cylinders are secured and capped when not in use M: Personal Protective Equipment mitigates severity of injury	L: BEU C: M R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Vacuum/ Pressure Vessels/Piping	*Hazard: Personnel injury due to unexpected pressure release.*	L: A C: H R: I	P: All involved personnel are required to take Pressure Safety orientation training FN000271 P: All vacuum/ pressure vessels have pressure safety devices that are tested and inspected every 5 years, tracked in Fermilab pressure vessel and pressure relief device database P: All vacuum/ pressure vessels go through the Operational Readiness Clearance and engineering note process with peer review and must meet applicable regulatory requirements M: Personal Protective Equipment mitigates severity of injury.	L: BEU C: M R: IV
	Hazard: Beam pipes under vacuum	L: A C: H R: I	P: All involved personnel are required to be familiar with FESHM 5000 series and apply requirements P: All involved personnel are required to take Pressure Safety orientation training FN000271 P: Training for mechanical technicians FN000100 P: Beamline components go through the Operational Readiness Clearance and engineering note process with peer review and must meet applicable regulatory requirements	L: BEU C: H R: III
Vacuum Pumps	*Hazard: Personnel injury due to interaction with existing vacuum.*	L: A C: H R: I	P: All involved personnel are required to be familiar with FESHM 5000 series and apply requirements P: All involved personnel are required to take Pressure Safety orientation training FN000271 P: Training for mechanical technicians FN000100	L: BEU C: H R: III

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Material Handling	*Hazard: Personnel injury due to moving/handing material (rollovers, crush, etc.)*	L: A C: H R: I	P: All operators must complete Forklift Operator Training FN000014/CR/EV P: All operators have to be familiar with FESHM 10000 series and apply requirements P: All PITs are inspected annually by an offsite vendor P: Backworks Safety training FN000335/CR P: Industrial Hygiene's reviews ergonomics and maintains a database and FESHM 4120 M: Personal Protective Equipment mitigates severity of injury	L: BEU C: M R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Potential Energy – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane Operations	*Hazard: Struck by falling, swinging loads*	L: A C: H R: I	M: Wear all required PPE as posted P: Barricade/spotters isolate the area and prevent unauthorized access P: All cranes are inspected on prescribed frequencies by an outside vendor P: Restrict crane and/or hoist use by unqualified personnel	L: BEU C: M R: IV
Compressed Gasses	*Hazard: Collocated personnel injury due to unexpected release, or unsecure tanks*	L: A C: H R: I	P: Complete New Employee ES&H Orientation, Subcontractor Orientation, New User/Affiliate Orientation, or Facility Specific Hazard Awareness Training P: Ensure that compressed gas cylinders are properly secured while in-use P: Ensure that compressed gas cylinders are properly stored with valve protection caps in-place.	L: BEU C: H R: III
Vacuum/ Pressure Vessels	*Hazard: Collocated personnel injury due to unexpected pressure release*	L: A C: H R: I	P: Complete New Employee ES&H Orientation, Subcontractor Orientation, New User/Affiliate Orientation, or Facility Specific Hazard Awareness Training P: All vacuum/ pressure vessels have pressure safety devices that are tested and inspected every 5 years, tracked in Fermilab pressure vessel and pressure relief device database P: All vacuum/ pressure vessels go through the Operational Readiness Clearance and engineering note process with peer review and must meet applicable regulatory requirements.	L: BEU C: H R: III
	Hazard: Beam pipes under vacuum	L: U C: H R: I	P: Complete New Employee ES&H Orientation, Subcontractor Orientation, New User/Affiliate Orientation, or Facility Specific Hazard Awareness Training P: Beamline components go through the Operational Readiness Clearance and engineering note process with peer review and must meet applicable regulatory requirements P: System integrity verified following maintenance	L: BEU C: H R: III

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Vacuum Pumps	*Hazard: Personnel injury due to interaction with existing vacuum.*	L: U C: H R: I	P: Complete New Employee ES&H Orientation, Subcontractor Orientation, New User/Affiliate Orientation, or Facility Specific Hazard Awareness Training P: System integrity verified following maintenance	L: BEU C: H R: III
Material Handling	*Hazard: Collocated personnel injury due to moving/handing material (rollovers, crush, etc.)*	L: A C: H R: I	P: Complete New Employee ES&H Orientation, Subcontractor Orientation, New User/Affiliate Orientation, or Facility Specific Hazard Awareness Training P: All operators shall warn collocated personnel of a material movement evolution P: Material movements are performed by trained personnel	L: BEU C: H R: III

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Potential Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane Operations	*Hazard: N/A*	L: C: R:		L: C: R:
Compressed Gasses	*Hazard: Injury due to unexpected release, or unsecure tanks outside of buildings*	L: U C: H R: I	P: Ensure that compressed gas cylinders are properly secured while in-use P: Ensure that compressed gas cylinders are properly stored with valve protection caps in-place.	L: BEU C: H R: III
Vacuum/ Pressure Vessels	*Hazard: Injury due to unexpected release, or unsecure tanks outside of buildings*	L: U C: H R: I	P: All vacuum/ pressure vessels have pressure safety devices that are tested and inspected every 5 years, tracked in Fermilab pressure vessel and pressure relief device database P: All vacuum/ pressure vessels go through the Operational Readiness Clearance and engineering note process with peer review and must meet applicable regulatory requirements	L: BEU C: H R: III
Vacuum Pumps	*Hazard: N/A*	L: C: R:		L: C: R:
Material Handling	*Hazard: N/A*	L: C: R:		L: C: R:

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

C.8 Magnetic Fields – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields	*Hazard:* • *Exposure to fringe fields beyond allowable limits (worker **with** ferromagnetic or electronic medical device(s))*	L: A C: H R: I	P: Industrial hygiene conducts field assessments/surveys to establish safe field boundaries for workers. P: Access control points and individual components of concern (e.g., ion pumps) have postings to notify workers of magnetic hazard. P: Work planning that warns about magnetic hazard. P: Magnetic hazard warning included in Hazard Specification Sheet OR in facility specific training	L: BEU C: H R: III
	• *Exposure to fringe fields beyond allowable limits (worker **without** ferromagnetic or electronic medical device(s))*	L: A C: L R: III	P: Industrial hygiene conducts field assessments/surveys to establish safe field boundaries for workers. P: Access control points and individual components of concern (e.g., ion pumps) have postings to notify workers of magnetic hazard.	L: EU C: L R: IV
	• *Exposure to flying metallic objects causing potential injury.* *Reference*: FESHM	L: A C: M R: II	P: Brass tools are used to prevent flying metallic objects from occurring, thereby preventing worker injury. P: Work Control procedure/SOP (ferromagnetic object control) requires that all ferromagnetic objects are removed prior to entry into a fringe field area (30G administrative limit). P: Work Control procedure/SOP requires worker training while in areas possessing fringe fields (300 G administrative limit).	L: EU C: M R: III

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative onsequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Magnetic Fields – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields	*Hazard:* • *Exposure to fringe fields beyond allowable limits (worker **with** ferromagnetic or electronic medical device(s))*	L: A C: H R: I	P: Industrial hygiene conducts field assessments/surveys to establish safe field boundaries for workers. P: Access control points and individual components of concern (e.g., ion pumps) have postings to notify workers of magnetic hazard. P: Work planning that warns about magnetic hazard. P: Magnetic hazard warning included in Hazard Specification Sheet OR in facility specific training	L: BEU C: H R: III
	• *Exposure to fringe fields beyond allowable limits (worker **without** ferromagnetic or electronic medical device(s))*	L: A C: L R: III	P: Industrial hygiene conducts field surveys to establish safe field boundaries for workers. P: Access control points and individual components of concern (e.g., ion pumps) have postings to notify workers of magnetic hazard.	L: EU C: L R: IV
	• *Exposure to flying metallic objects causing potential injury.* *Reference*: FESHM	L: A C: M R: II	P: Brass tools are used to prevent flying metallic objects from occurring, thereby preventing worker injury. P: Work Control procedure/SOP (ferromagnetic object control) requires that all ferromagnetic objects are removed prior to entry into a fringe field area (30G administrative limit). P: Work Control procedure/SOP requires worker training while in areas possessing fringe fields (300 G administrative limit).	L: EU C: M R: III

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Magnetic Fields – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields	*Hazard:* • *Exposure to fringe fields beyond allowable limits (worker **with** ferromagnetic or electronic medical device(s))* • *Exposure to fringe fields beyond allowable limits (worker **without** ferromagnetic or electronic medical device(s))* • *Exposure to flying metallic objects causing potential injury.* *Reference*: FESHM	L: C: R: L: C: R: L: C: R:	Fringe field hazards are not applicable to members of the public.	L: C: R: L: C: R: L: C: R:

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

C.9 Other hazards – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	*Hazard:* • *Toxic atmosphere* • *Limited egress* • *Poor quality walking surface* *Reference*: FESHM 4230	L: A C: H R: I	P: Training P: Work practice procedure (attendant) P: Permit required Permit and reclassification permit (ESH involvement) P: atmospheric monitoring M: mechanical ventilation when required M: PPE, harness, tripod, etc. when required	L: BEU C: H R: III
Noise	*Hazard:* • *Exposure above OELs via use of machinery, tools, co-location w/ equipment, etc.* *Reference*: FESHM 4140	L: A C: L R: III	P: Hearing Conservation Training P: Equipment isolation M: Engineering controls (isolation, sound barriers) M: PPE (HPDs) M: IH Surveys and follow up w/ workers-administrative controls M: Hearing Conservation Program	L: EU C: N R: IV
Silica	*Hazard:* • *Airborne exposure above OEL via concrete (or similar material) machining, moving dirt or gravel* *Reference*: FESHM 4195	L: A C: H R: I	P: Silica Awareness Training, Respiratory Protection Training P: Work Planning (HA, SOP) M: Engineering Controls (HEPA, wet method) M: PPE (respirator, PAPR)	L: EU C: L R: IV
Ergonomics	*Hazard:* • *Office space* • *Industrial space (over lifting, repetitive motion, static posture)* *Reference*: FESHM 4120	L: A C: H R: I	P: Ergo assessment (ESH SME) P: Training (Back works, office ergo) P: Work planning (HA, prescribed techniques, etc.) M: Administrative Controls, i.e. Lifting techniques, office ergo techniques (stand, sit, 20 min breaks, etc)	L: BEU C: M R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Asbestos	*Hazard:* • *Deteriorating building materials* *Reference*: FESHM 4180	L: A C: H R: I	P: Asbestos Management Plan (FESHM) P: building material sampling (licensed) M: Building walkthroughs (AFMSs, ESH SMEs, etc.) M: Abatement	L: EU C: L R: IV
Working at Heights	*Hazard:* • *Falls, dropped tools/material* *Reference*: FESHM 7060, 7070	L: A C: H R: I	P: Fall protection program P: Training for scaffolding, ladders, mobile elevating work platforms P: Guard rails M: PPE-PFAS including approved anchor points, hard hats	L: EU C: M R: III

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other hazards – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	*Hazard:* • *Toxic atmosphere* • *Accidental entry* *Reference*: FESHM	L: BEU C: H R: III	P: Work practice procedure (attendant performs warning) P: atmospheric monitoring M: mechanical ventilation M: physical barriers, signage	L: BEU C: L R: IV
Noise	*Hazard:* • *Exposure above OELs via use of machinery, tools, co-location w/ equipment, etc.* *Reference*: FESHM	L: A C: L R: III	M: Engineering controls (isolation, sound barriers) M: PPE (HPDs) P: Hearing Conservation Training P: IH Surveys and follow up w/ workers P: Equipment isolation	L: BEU C: N R: IV
Silica	*Hazard:* • *Airborne exposure above OEL via concrete (or similar material) machining, moving dirt or gravel* *Reference*: FESHM	L: A C: H R: I	P: Work Planning (HA, SOP) P: Work oversite (Work planner, ESH) M: Engineering Controls (HEPA, wet method)	L: EU C: M R: III
Ergonomics	*Hazard: N/A*	L: C: R:		L: C: R:
Asbestos	*Hazard:* • *Deteriorating building materials*	L: A C: H R: I	P: Asbestos Management Plan (FESHM) P: building material sampling (licensed) M: Building walkthroughs (AFMSs, ESH SMEs, etc.) M: Abatement	L: EU C: L R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Working at Heights	*Hazard:* • *Struck by dropped tools/material* *Reference*: FESHM	L: A C: H R: I	P: Fall protection program P: Work planning M: PPE-hard hats	L: EU C: M R: III

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other hazards – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	*Hazard:* • *Toxic atmosphere* • *Accidental entry* *Reference*: FESHM	L: BEU C: H R: III	P: Work practice procedure (attendant performs warning) P: atmospheric monitoring M: mechanical ventilation M: physical barriers	L: BEU C: L R: IV
Noise	*Hazard:* • *Exposure above OELs via use of machinery, tools, co-location w/ equipment, etc.* *Reference*: FESHM	L: A C: N R: IV	No further analysis required	L: A C: N R: IV
Silica	*Hazard:* • *Airborne exposure above OEL via concrete (or similar material) machining, moving dirt or gravel* *Reference*: FESHM	L: A C: H R: I	P: Work Planning (HA, SOP) P: Work oversite (Work planner, ESH) M: Engineering Controls (HEPA, wet method)	L: EU C: M R: III
Ergonomics	*Hazard: N/A*	L: C: R:		L: C: R:
Asbestos	*Hazard: N/A*	L: C: R:		L: C: R:

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Working at Heights	*Hazard:* • *Struck by dropped tools/material* *Reference*: FESHM	L: A C: H R: I	P: Fall protection program P: Work planning P: Construction Barriers prevent public access to this hazard.	L: EU C: M R: III

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

C.10 Access & Egress – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety Egress	*Hazard:* *A blocked egress would be of major life safety concern.* *An egress might be blocked due to construction work, poor housekeeping, or faulty doors.* *In the event of a fire or other life-threatening event, a blocked egress would be life threatening.* *The exposure of the hazard to the facility worker is of major concern.* *Reference*: *FESHM 6010*	L: A C: H R: I	P: Alternate paths of egress are provided. P: Egress pathways are clearly marked P: Exit signs and emergency lighting is present P: Fire Safety and Life Safety Inspections are performed Fire Protection Group and the Fire Department. P: Life safety systems testing is performed at prescribed frequencies M: Life safety systems are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days M: Fire detection and/or suppression is present M: Manual fire suppression services are provided, i.e., fire hydrants, throughout the complex M: Egress stairways are constructed as fire barriers	L: BEU C: N R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Access & Egress – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety Egress	*Hazard:* *A blocked egress would be of major life safety concern.* *An egress might be blocked due to construction work, poor housekeeping, or faulty doors.* *In the event of a fire, a blocked egress would be life threatening.* *The exposure of the hazard to the co-located worker is of concern.* *Reference: FESHM 6010*	L: EU C: M R: II	P: Alternate paths of egress are provided. P: Egress pathways are clearly marked P: Exit signs and emergency lighting is present P: Fire Safety and Life Safety Inspections are performed Fire Protection Group and the Fire Department. P: Life safety systems testing is performed at prescribed frequencies M: Life safety systems are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days M: Fire detection and/or suppression is present M: Manual fire suppression services are provided, i.e., fire hydrants, throughout the complex M: Egress stairways are constructed as fire barriers	L: BEU C: N R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

		Likelihood			
		A	U	EU	BEU
Consequences	H	I	I	II	III
	M	II	II	III	IV
	L	III	III	IV	IV
	N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Access & Egress – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety Egress	*Hazard: N/A* *Reference*: *FESHM 6010*	L: C R:		L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

C.11 Environmental

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Airborne	*Hazard:* • Airborne release of radionuclides beyond permitted limits	L: A C: N R: IV	P: Shielding Assessments for new facilities or facility modification identify potential airborne releases of radionuclides so measures to prevent releases are engineered into new facilities. P: Facility designed to confine airborne release at the designated release point M: Facility designed ventilation to delay airborne release to reduce emission of short half-lived radionuclides M: Facility designed ventilation stack heights, stack locations, and ventilation flow rates to reduce potential doses from radionuclides M: Continuous monitoring of radiological stacks is performed for primary facilities where airborne radionuclides are released and periodic measurements at and around other release points are taken and shared with the facilities so that information can be used to improve operations and mitigate releases. M: Weekly review of year-to-date emissions by a Radiation Physicist M: Administrative controls specified in FESHM/FRCM, Environmental Monitoring Plan, and Environmental Radiological Protection Program.	L: EU C: N R: IV
	• Airborne release of chemicals beyond permitted limits (Consequences based on Onsite Worker qualitative consequence matrix)	L: A C: N R: IV	P: Stacks associated with fossil fuel combustion are designed to contain emission controls to reduce content P: Generators only operate when needed or for a short period during monthly PM activities. M: Tracking of emissions sources	L: EU C: N R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Water	*Hazard:* • Discharge of radionuclides into onsite waters beyond permitted limits	L: A C: N R: IV	P: Shielding Assessments for new facilities or facility modification identify potential surface water impacts, so that engineering controls to prevent discharge are designed into new facilities. M: Monitoring onsite water to understand the source term for potential offsite discharge M: Monitoring surface water onsite, at NPDES sampling points, and surveillance monitoring at the site boundary M: Monitoring sanitary system at Batavia and Warrenville M: Monitoring onsite wells for accelerator-produced radionuclides M: Administrative controls specified in FESHM/FRCM, Environmental Monitoring Plan, and Environmental Radiological Protection Program	L: U C: N R: IV
	• Discharge of chemicals into onsite waters beyond permitted limits (Consequence based on Onsite worker qualitative consequence matrix) *Reference: FESHM 8000 series*	L: A C: H R: I	P: ORC and NEPA process to review planned activities with the purpose of preventing future releases. M: Monitoring onsite water to understand the source term for potential offsite discharge, to mitigate releases where possible. M: Monitoring surface water onsite, at NPDES sampling points, and at the site boundary to mitigate releases where possible. M: Monitoring sanitary system at Batavia and Warrenville M: Monitoring onsite wells for hazardous chemicals M: Administrative controls specified in FESHM, Environmental Monitoring Plan, and Environmental Protection Program mitigate chemical discharges.	L: U C: N R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Soil	*Hazard:* • Radioactive soil in beam loss areas beyond allowable concentrations of radionuclides above Fermilab limits	L: A C: N R: IV	P: Shielding Assessments for new facilities or facility modification identify potential soil activation and groundwater impacts so measures to prevent beam loss are engineered into new facilities. P: Review of excavation and digging across site and monitoring of soil prior to project commencement prevents uncontrolled spread of radioactive soil. P: Requirements for digging the soil near beam enclosures, target stations and beam absorber, to protect against erosion, prevent contaminant spread, and return the likely activated soil back to its original depth. M: Decontamination or soil removal mitigates spread of contamination if limits are exceeded M: Administrative controls specified in FESHM/FRCM, Environmental Monitoring Plan, and Environmental Radiological Protection Program	L: BEU C: N R: IV
	• Discharge of chemicals into onsite soils beyond RCRA limits (Consequence based on Onsite worker qualitative consequence matrix)	L: A C: H R: I	P: ORC and NEPA process to review planned activities with the purpose of preventing future releases P: Routine inspections of equipment prevent potential chemical releases due to equipment malfunctions. M: Engineering controls and containments have been put in place to reduce spread of contamination M: Contract is in place with remediation company for emergency response if a release occurs, mitigating the release and restoration of the event-affected area. M: Administrative controls specified in FESHM, EMP, ERPP mitigate contaminant spread by controlling work processes associated with material discharges.	L: EU C: L R: IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables

Radiological Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual
rem = Roentgen equivalent man

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ 25.0 rem	**C** ≥ 100 rem	**C** ≥ 100 rem
M	25.0 rem > **C** ≥ 5 rem	100 rem > **C** ≥ 25 rem	100 rem > **C** ≥ 25 rem
L	5 rem > **C**	25 rem > **C**	25 rem > **C**
N	0.5 rem > **C**	5 rem > **C**	5 rem > **C**

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
H = High
M = Moderate
L = Low
N = Negligible

Risk (R, Qualitative Ranking)
I = situation (event) of major concern
II = situation (event) of concern
III = situation (event) of minor concern
IV = situation (event) of minimal concern

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)
Acronyms
MOI = Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Appendix C
Non-Accelerator Specific Hazard (NASH) Risk Matrix Tables