Table 2. Summary of Baseline and Residual Risks (Other Radioactive Material Storage Areas)

	Risk Tables Description	Baseline Risk	Residual Risk
2,1	Radiological – Onsite-1 Facility Worker	R: I	R: III, IV
2.2	Radiological – Onsite-2 Co-located Worker	R: I	R: III, IV
2.3	Radiological – MOI Offsite	R: I	R: III, IV
2.4	Toxic Materials – Onsite 1 Facility Worker	R: *	R: *
2.5	Toxic Materials – Onsite 2 Co-located Worker	R: *	R: *
2.6	Toxic Materials – MOI Offsite	R: *	R: *
2.7	Flammable & Combustible Materials – Onsite-1 Facility Worker	R: *	R: *
2.8	Flammable & Combustible Materials – Onsite-2 Co-located worker	R: *	R: *
2.9	Flammable & Combustible Materials – MOI Offsite	R: *	R: *
2.10	Electrical Energy – Onsite-1 Facility Worker	R: *	R: *
2.11	Electrical Energy – Onsite-2 Co-located Worker	R: *	R: *
2.12	Electrical Energy – MOI Offsite	R: *	R: *
2.13	Thermal Energy – Onsite-1 Facility Worker	R: *	R: *
2.14	Thermal Energy – Onsite-2 Co-located Worker	R: *	R: *
2.15	Thermal Energy – MOI Offsite	R: *	R: *
2.16	Kinetic Energy – Onsite-1 Facility Worker	R: *	R: *
2.17	Kinetic Energy – Onsite-2 Co-located Worker	R: *	R: *
2.18	Kinetic Energy – MOI Offsite	R: *	R: *
2.19	Potential Energy- Onsite-1 Facility Worker	R: *	R: *
2.20	Potential Energy – Onsite-2 Co-located Worker	R: *	R: *
2.21	Potential Energy – MOI Offsite	R: *	R: *
2.22	Magnetic Fields – Onsite-1 Facility Worker	R: *	R: *
2.23	Magnetic Fields – Onsite-2 Co-located Worker	R: *	R: *
2.24	Magnetic Fields – MOI Offsite	R: *	R: *
2.25	Other Hazards – Onsite-1 Facility Worker	R: *	R: *
2.26	Other Hazards – Onsite-2 Co-located Worker	R: *	R: *
2.27	Other Hazards – MOI Offsite	R: *	R: *
2.28	Access & Egress – Onsite-1 Facility Worker	R: *	R: *
2.29	Access & Egress – Onsite-2 Co-located Worker	R: *	R: *
2.30	Access & Egress – MOI Offsite	R: *	R: *
2.31	Environmental Hazards	R: *	R: *
*	L Chantag O4		

^{*} Section I Chapter 04

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).

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Table 2.1 Radiological – Onsite-1 Facility Worker

Hazard Hazard Description		Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual	Hazard: Radiation exposure	L: A	M: Shielding to reduce activation	L: EU
activation		C: H	M: Proper dosimetry	C: L
		R: I	P: Employee Rad Worker training P: ALARA plan	R: IV
Radioactive	Hazard: Radiation exposure	L: A	M: Shielding to reduce generation of waste	L: EU
waste		C: H	M: Material survey and release process	C: L
		R: I	P: Postings	R: IV
			P: Beam tuned to reduce generation of waste	
Radioactive	Hazard: Various low activity sealed	L: A	P: All low activity sealed sources are kept in a lock box and registered	L: U
Sources	sources (Sr-90, Co-60, CS-137, Fe-55,	C: M	through Radiological Control.	C: L
	Ru-106, etc.)	R: II	M : Radiological training is required for source handling.	R: III

Hazard Hazard Description		Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)	
Nuclear Material	Hazard: Potential inhalation/ingestion Exposure to Am-Be (Accountable Nuclear Materials -SNM) (Other Radioactive material Storage Areas: BNB & NEUTRINO CAMPUS- MINOS MUON ALCOVES, RPCF)	L: A C: H R: I	P- All Am-Be sources are kept in sealed, to prevent exposure to inhalation hazard. All Am-Be sources are inspected for potential leaks to prevent exposure during source use. P- All Am-Be sealed sources are kept in the RPCF Cave 1 (concrete walled) neutron storage cave to prevent exposure. M- Workers implement the ALARA Program by minimizing time working with sources.	L: EU C: M R: IV	
	Hazard: Potential radiation exposure to neutrons from Am-Be (Accountable Nuclear Materials – SNM) (Other Radioactive material Storage Areas: BNB & NEUTRINO CAMPUS-MINOS MUON ALCOVES, RPCF) Hazard: Potential inhalation/ingestion	L: A C: M R: III	M- Am-Be sources in are kept the RPCF Cave 1 (concrete walled shielding) to mitigate exposure to personnel from neutrons. M- Am-Be sources are handled on 3 ft (~1m) long rods to mitigate exposure to neutron radiation. M- Workers implement the ALARA Program by minimizing time working with Am-Be sources.	L: A C: N R:IV	
	Exposure to Depleted 238-U (Other Accountable Nuclear Material-OANM) (Other radioactive material storage	L: A C: L R: III	P- depleted uranium is encased in steel plates to prevent inhalation/ingestion exposure (DZero calorimeter, DZero cryostat). P- depleted uranium encased in steel plates and this are enclosed behind a shielding wall (D-Zero Calorimeter)	L: U* C: L R: III	
	areas: DZero Calorimeter, DZero Cryostat, Meson East (ME)7 north, Hadron Calorimeter, and Site 40)		P - depleted uranium (ME7) is contained in modules and canisters to prevent inhalation/ingestion exposure. P- depleted uranium (Hadron calorimeter) is sealed in steel plates to prevent inhalation/ingestion exposure. P - depleted uranium (Site 40, source room) is sealed in aluminum cans.	*one prevention/st orage area only reduces likelihood 1 bin.	
Radiation Generating Devices (RDGs)	Hazard: Various size strength RGDs are utilized throughout the campus and pose a personnel exposure hazard	L: A C: H R: I	P – Designed to be self-shielded. M – Radiological worker training M – Self-shielding verification protocol performed by RSO/RCT	L: U C: L R: III	

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		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

Likelihood (L, of event)/year	Co	nsequence (C, of event)/	year	Risk (R, Qualitative Ranking)		Risk	Matri	X			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (even	I = situation (event) of major concern				Likelihood		
U = Unlikely (1.0E-02 > L > 1.0E-04)	$\mathbf{M} = \mathbf{Moderate}$			II = situation (ever	ion (event) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)	L = Low			III = situation (eve	ent) of minor concern	es	Н	I	I	II	III
BEU = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible		IV = situation (event) of minimal concern		nence	M	TT	TT	III	IV
Control(s) Type	C	Offsite (MOI)	Onsit	te-2 (co-located worker)	Onsite-1 (facility worker)	ent —	IVI	11	11	111	1 V
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ 25.0 rem		C ≥ 100 rem	C ≥ 100 rem	onsec	L	III	III	IV	IV
M = Mitigative (reduces event consequences)	M	$25.0 \text{ rem} > \mathbf{C} \ge 5 \text{ rem}$	10	$00 \text{ rem} > \mathbf{C} \ge 25 \text{ rem}$	$100 \text{ rem} > \mathbb{C} \ge 25 \text{ rem}$	ŭ	N	IV	IV	IV	IV
Acronyms MOI - Maximally avacced Offsite Individual	L	5 rem > C		25 rem > C	25 rem > C	L					ı
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	N	0.5 rem > C		5 rem > C	5 rem > C						

Table 2.2 Radiological – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual Hazard: Radiation exposure activation		L: A C: H R: I	M: Shielding to reduce activation M: Proper dosimetry P: Employee Rad Worker training P: ALARA plan	L: EU C: L R: IV
Radioactive waste	Hazard: Radiation exposure	L: A C: H R: I	M: Shielding to reduce generation of waste M: Material survey and release process P: Postings P: Beam tuned to reduce generation of waste	L: EU C: L R: IV
Hazard: Various low activity sealed sources (Sr-90, Co-60, CS-137, Fe-55, Ru-106, etc.)	L: A C: M R: II	P: All low activity sealed sources are kept in a lock box and registered through Radiological Control. M: Radiological training is required for source handling.	L: U C: L R: III	Hazard: Various low activity sealed sources (Sr-90, Co-60, CS-137, Fe-55, Ru-106, etc.)

Hazard	Hazard Description		Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)	
Nuclear Material	Hazard: Potential inhalation/ingestion Exposure to Am-Be (Accountable Nuclear Materials -SNM) (Other Radioactive material Storage Areas: BNB & NEUTRINO CAMPUS- MINOS MUON ALCOVES, RPCF)	L: A C: H R: I	P- All Am-Be sources are kept in sealed, to prevent exposure to inhalation hazard. All Am-Be sources are inspected for potential leaks to prevent exposure during source use. P- All Am-Be sealed sources are kept in the RPCF Cave 1 (concrete walled) neutron storage cave to prevent exposure. M- Workers implement the ALARA Program by minimizing time working with sources.	L: EU C: M R: IV	
	Hazard: Potential radiation exposure to neutrons from Am-Be (Accountable Nuclear Materials – SNM) (Other Radioactive material Storage Areas: BNB & NEUTRINO CAMPUS- MINOS MUON ALCOVES, RPCF)	L: U C: M R: III	M- Am-Be sources in are kept the RPCF Cave 1 (concrete walled shielding) to mitigate exposure to personnel from neutrons. M- Am-Be sources are handled on 3 ft (~1m) long rods to mitigate exposure to neutron radiation. M- Workers implement the ALARA Program by minimizing time working with Am-Be sources.	L: U C: N R:IV	
			P- depleted uranium is encased in steel plates to prevent inhalation/ingestion exposure (DZero calorimeter, DZero cryostat). P- depleted uranium encased in steel plates and this are enclosed behind a shielding wall (D-Zero Calorimeter) P - depleted uranium (ME7) is contained in modules and canisters to prevent inhalation/ingestion exposure. P- depleted uranium (Hadron calorimeter) is sealed in steel plates to prevent inhalation/ingestion exposure. P - depleted uranium (Site 40, source room) is sealed in aluminum cans.	L: EU* C: L R: III *one prevention/st orage area only reduces likelihood 1 bin.	
Radiation Generating Devices (RDGs)	Hazard: Various size strength RGDs are utilized throughout the campus and pose a personnel exposure hazard	L: A C: H R: I	P – Designed to be self-shielded. M – Radiological worker training M – Self-shielding verification protocol performed by RSO/RCT	L: U C: L R: III	

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		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

Likelihood (L, of event)/year	Co	Consequence (C, of event)/year		Risk (R, Qualitative Ranking)		Risk Matrix					
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern					Likelihood		
U = Unlikely (1.0E-02 > L > 1.0E-04)	$\mathbf{M} = \mathbf{Moderate}$			II = situation (ever	nt) of concern			A	Ü	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)	L = Low			III = situation (eve	ent) of minor concern	s	Н	I	I	II	III
BEU = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible		IV = situation (eve	ent) of minimal concern	ence	M	TT	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	ant	IVI	11	11	111	1 V
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ 25.0 rem		C ≥ 100 rem	C ≥ 100 rem	onse	L	III	III	IV	IV
M = Mitigative (reduces event consequences) Acronyms MOL = Manipuella, appeared Officia Individual		$25.0 \text{ rem} > \mathbf{C} \ge 5 \text{ rem}$	100 ı	rem > $\mathbb{C} \ge 25 \text{ rem}$	$100 \text{ rem} > \mathbb{C} \ge 25 \text{ rem}$	ŭ	N	IV	IV	IV	IV
		5 rem > C		25 rem > C	25 rem > C	L	l				
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	N	0.5 rem > C		5 rem > C	5 rem > C						

Table 2.3 Radiological – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual activation	Hazard: Radiation exposure	L: N/A C: R:	Hazard does not apply to the public	L: N/A C: R:
Radioactive waste	Hazard: Radiation exposure Reference:	L: N/A C: R:	Hazard does not apply to the public	L: N/A C: R:
Radioactive Sources	Hazard: Various low activity sealed sources (Sr-90, Co-60, CS-137, Fe-55, Ru-106, etc.)	L: A C: M R: II	P: All low activity sealed sources are kept in a lock box and registered through Radiological Control. M: Radiological training is required for source handling.	L: U C: L R: III

Hazard	Hazard Hazard Description		Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Nuclear Material	Hazard: Potential inhalation/ingestion Exposure to Am-Be (Accountable Nuclear Materials -SNM) (Other Radioactive material Storage Areas: BNB & NEUTRINO CAMPUS-MINOS MUON ALCOVES, RPCF) Hazard: Potential radiation exposure to neutrons from Am-Be (Accountable Nuclear Materials – SNM) (Other Radioactive material Storage Areas: BNB & NEUTRINO CAMPUS-MINOS MUON ALCOVES, RPCF) Hazard: Potential inhalation/ingestion Exposure to Depleted 238-U (Other Accountable Nuclear Material-OANM) (Other radioactive material storage areas: DZero Calorimeter, DZero Cryostat, Meson East (ME)7 north, Hadron Calorimeter, and Site 40)	L: EU C: N R: IV	P-access to storage caves, and internal storage areas by the public is prevented by way of locked access gates. P-access to material exposures is prevented by the materials being encased.	L: BEU C: N R: IV
Radiation Generating Devices (RDGs)	Hazard: Various size strength RGDs are utilized throughout the campus and pose a personnel exposure hazard	L: A C: H R: I	P – Designed to be self-shielded. M – Radiological worker training M – Self-shielding verification protocol performed by RSO/RCT	L: U C: L R: III
Non-ionizing Radiation Hazards	Hazard: N/A	L: C: R:		L: C: R:

Likelihood (L, of event)/year	Co	nsequence (C, of event)/	year	Risk (R, Qualitative Ranking)		Risk	Matri	X			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (even	I = situation (event) of major concern				Likelihood		
U = Unlikely (1.0E-02 > L > 1.0E-04)	$\mathbf{M} = \mathbf{Moderate}$			II = situation (ever	ion (event) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)	L = Low			III = situation (eve	ent) of minor concern	es	Н	I	I	II	III
BEU = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible		IV = situation (event) of minimal concern		nence	M	TT	TT	III	IV
Control(s) Type	C	Offsite (MOI)	Onsit	te-2 (co-located worker)	Onsite-1 (facility worker)	ent —	IVI	11	11	111	1 V
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ 25.0 rem		C ≥ 100 rem	C ≥ 100 rem	onsec	L	III	III	IV	IV
M = Mitigative (reduces event consequences)	M	$25.0 \text{ rem} > \mathbf{C} \ge 5 \text{ rem}$	10	$00 \text{ rem} > \mathbf{C} \ge 25 \text{ rem}$	$100 \text{ rem} > \mathbb{C} \ge 25 \text{ rem}$	ŭ	N	IV	IV	IV	IV
Acronyms MOI - Maximally avacced Offsite Individual	L	5 rem > C		25 rem > C	25 rem > C	L					ı
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	N	0.5 rem > C		5 rem > C	5 rem > C						

Table 2.4 Toxic Materials – Onsite 1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Lead Shielding	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Beryllium	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Liquid Scintillator Oil	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Pseudocumene	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Ammonia	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Nanoparticle Exposures	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Likelihood (L, of event)/year	Co	onsequence (C, of event))/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (ever	nt) of major concern				Like	lihood		
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H} = \text{situation (evolution } \mathbf{H} = \mathbf{H} \mathbf{H} \mathbf{H} \mathbf{H} \mathbf{H} \mathbf{H} \mathbf{H} \mathbf{H}$	ent) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low			vent) of minor concern	es	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible		IV = situation (ev	vent) of minimal concern	ence	M	ш	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	dne	IVI	11	11	111	1 V	
P = Preventive (reduce event occurrence likelihood)M = Mitigative (reduces event consequences)	Н	C ≥ PAC-2		C ≥ PAC-3	C ≥ IDLH	onse	L	III	III	IV	IV	
	M	$PAC-2 > C \ge PAC-1$	PA	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$	Č	N	IV	IV	IV	IV	
Acronyms IDLH = Immediately Dangerous to Life and Health	L	PAC-1 > C		PAC-2 > C	PEL or $TLV_c > C$		l					
MOI = Maximally-exposed Offsite Individual	N	Consequences less	Con	sequences less than	Consequences less than							
PAC = Protective Action Criteria		than those for Low	those	for Low Consequence	those for Low							
PEL = Permissible Exposure Limit		Consequence Level		Level	Consequence Level							
TLV _c = Threshold Limit Value (ceiling)												

Table 2.5 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 Shielding	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Beryllium	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Liquid Scintillator Oil	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Pseudocumene	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Ammonia	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Nanoparticle Exposures	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Likelihood (L, of event)/year	Co	onsequence (C, of event))/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (even)	nt) of major concern							
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H} = \text{situation (evolution } \mathbf{H} = \mathbf{H} \mathbf{H} \mathbf{H} \mathbf{H} \mathbf{H} \mathbf{H} \mathbf{H} \mathbf{H}$	ent) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low			vent) of minor concern	es	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	ence	M	ш	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	dne	IVI	11	- 11	111	1 V	
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ PAC-2		C ≥ PAC-3	C ≥ IDLH	onse	L	III	III	IV	IV	
M = Mitigative (reduces event consequences)	M	$PAC-2 > C \ge PAC-1$	PA	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$	Č	N	IV	IV	IV	IV	
Acronyms IDLH = Immediately Dangerous to Life and Health	L	PAC-1 > C		PAC-2 > C	PEL or $TLV_c > C$		l					
MOI = Maximally-exposed Offsite Individual	N	Consequences less	Con	sequences less than	Consequences less than							
PAC = Protective Action Criteria		than those for Low	those	for Low Consequence	those for Low							
PEL = Permissible Exposure Limit		Consequence Level		Level	Consequence Level							
TLV _c = Threshold Limit Value (ceiling)												

Table 2.6 Toxic Materials – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Lead Shielding	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Beryllium	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Liquid Scintillator Oil	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Pseudocumene	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Ammonia	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Nanoparticle Exposures	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Likelihood (L, of event)/year	Co	onsequence (C, of event)	/year	Risk (R, Qualitative	Risk Matrix						
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (ever	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (evolution } \mathbf{II} = \mathbf{II}$	ent) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low			vent) of minor concern	Sa	Н	I	I	II	III
BEU = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible		IV = situation (ev	vent) of minimal concern	l c	M	II	т	Ш	IV
Control(s) Type	C	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	- ant	IVI	11	11	111	1 V
P = Preventive (reduce event occurrence likelihood)M = Mitigative (reduces event consequences)	Н	H $C \ge PAC-2$	C ≥ PAC-3	C ≥ IDLH	onse	L	III	III	IV	IV	
	M	$PAC-2 > C \ge PAC-1$	PA	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$	ŭ	N	IV	IV	IV	IV
Acronyms IDLH = Immediately Dangerous to Life and Health	L			PAC-2 > C	PEL or $TLV_c > C$		1		-		
MOI = Maximally-exposed Offsite Individual	N	Consequences less	Con	sequences less than	Consequences less than						
PAC = Protective Action Criteria		than those for Low	those	for Low Consequence	those for Low						
PEL = Permissible Exposure Limit		Consequence Level		Level	Consequence Level						
TLV _c = Threshold Limit Value (ceiling)											

 ${\bf Table~2.7~Flammable~and~Combustible~Materials-Onsite~-1~Facility~Worker}$

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:	L: C: R:	See Section I Chapter 04	L: C: R:
Flammable Materials (Flammable gas, cleaning materials, etc.)	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-	, " F	Example Qualitative Cons	sequence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year Risk (R, Qualitative	Ranking)	Risk	Matri	ix			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (eve	ent) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situation (ev}$	II = situation (event) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situation (e	vent) of minor concern	8	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (evaluation)	vent) of minimal concern	nces	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	edne	IVI	11	11	111	1 V
P = Preventive (reduce event occurrence likelihood)M = Mitigative (reduces event consequences)	Н		C ≥ Prompt worker fatality	C ≥ Prompt worker fatality or acute injury that	ons	L	III	III	IV	IV
Acronyms		other serious effects,	or acute injury that is		C	N	IV	IV	IV	IV
MOI = Maximally-exposed Offsite Individual		or symptoms which	immediately life-	is immediately life-						
MOT Maximally expessed efforce marviadar		*	threatening or permanently	threatening or						
		individual's ability to	disabling.	permanently disabling.						
		take protective								
	L	action.								
	M	$C \ge Mild$, transient	$C \ge$ Serious injury, no	C ≥ Serious injury, no						
		adverse effects.	immediate loss of life no	immediate loss of life no						
			permanent disabilities;	permanent disabilities;						
			hospitalization required.	hospitalization required.						
	L	Mild, transient	Minor injuries; no	Minor injuries; no						
		adverse effects > C	hospitalization > C	hospitalization > C						
	N	Consequences less	Consequences less than	Consequences less than						
			those for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

Table 2.8 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:	L: C: R:	See Section I Chapter 04	L: C: R:
Flammable Materials (Flammable gas, cleaning materials, etc.)	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1	l, "E	Example Qualitative Cons	sequen	ce Matrix", DOE-HD	BK-1163-2020.							
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
A = Anticipated (L > 1.0E-02)		$\hat{\mathbf{H}} = \text{High}$		I = situation (eve	ent) of major concern				Like	lihood		
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ev	ent) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (e	vent) of minor concern	Ş.	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ex	vent) of minimal concern	nce	M	II	II	III	IV	
ontrol(s) Type		Offsite (MOI)	Onsite-2 (co-located worker)		Onsite-1 (facility worker)	ant	IVI	-11	111	111	1 V	
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Н	C ≥ Irreversible,	C ≥ P1	rompt worker fatality	C ≥ Prompt worker	Consequences	L	III	III	IV	IV	
		other serious effects,	or a	acute injury that is	fatality or acute injury that	ŭ	N	IV	IV	IV	IV	
Acronyms MOI = Maximally-exposed Offsite Individual		or symptoms which			is immediately life-	<u> </u>	1					
Wioi – Waximany-exposed Offsite individual		could impair an	threate	ening or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.					IV		
		take protective										
		action.										
	M	$C \ge Mild$, transient	C ≥	Serious injury, no	$C \ge Serious injury, no$							
		adverse effects.	imme	ediate loss of life no	immediate loss of life no							
				nanent disabilities;	permanent disabilities;							
			hosp	italization required.	hospitalization required.							
	L	Mild, transient		Iinor injuries; no	Minor injuries; no							
		adverse effects > C	ho	ospitalization > C	hospitalization > C							
	N	Consequences less		sequences less than	Consequences less than							
		than those for Low	those f	for Low Consequence	those for Low							
		Consequence Level		Level	Consequence Level							

Table 2.9 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:	L: C: R:	See Section I Chapter 04	L: C: R:
Flammable Materials (Flammable gas, cleaning materials, etc.)	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1	l, "E	xample Qualitative Cons	sequen	ce Matrix", DOE-HD	BK-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) Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual	С	C ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective	Onsite- $C \ge \Pr$ or a ir	II = situation (ev III = situation (ev	ent) of major concern	Consequences	H M L N	A I III III IV	Like U I II III IV	EU II III IV IV	BEU III IV IV IV
	M L N	action. C ≥ Mild, transient adverse effects. Mild, transient adverse effects > C Consequences less than those for Low Consequence Level	imme perm hosp: M ho Cons	Serious injury, no ediate loss of life no manent disabilities; italization required. Inor injuries; no ospitalization > C sequences less than for Low Consequence Level	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no hospitalization > C Consequences less than those for Low Consequence Level						

Table 2.10 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:	L: C: R:	See Section I Chapter 04	L: C: R:
High Voltage Exposure	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Low Voltage, High Current Exposure.	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1	l, "E	Example Qualitative Cons	sequenc	ce Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year	Risk (R, Qualitative	Ranking)	Risk	k Matri	ix			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$,	ent) of major concern						
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (evolution)				Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$			vent) of minor concern	sa	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible			vent) of minimal concern	ences	M	II	П	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	nba		- 11	11		
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Н	C ≥ Irreversible,	C≥Pr	≥ Prompt worker fatality	C ≥ Prompt worker)S(L	III	III	IV	IV
Acronyms		other serious effects,		acute injury that is	fatality or acute injury that	Col	N	IV	IV	IV	IV
MOI = Maximally-exposed Offsite Individual		or symptoms which	immediately life-		is immediately life-	<u> </u>	1				
Waxintary exposed offsite mervidual		could impair an	threate	ening or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective									
	N /	action.	<u> </u>	a : ::	G . G						
	M	$C \ge Mild$, transient		Serious injury, no	C ≥ Serious injury, no						
		adverse effects.		ediate loss of life no	immediate loss of life no						
				nanent disabilities;	permanent disabilities;						
	-	3.671.1		italization required.	hospitalization required.						
	L	Mild, transient		linor injuries; no	Minor injuries; no						
	. .	adverse effects > C		spitalization > C	hospitalization > C						
	IN	Consequences less		sequences less than	Consequences less than						
			tnose fo	or Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

 Table 2.11 Electrical Energy 1 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:	L: C:	See Section I Chapter 04	L: C:
Laposure		R:		R:
High Voltage Exposure	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Low Voltage, High Current Exposure.	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1	l, "E	Example Qualitative Cons	sequenc	ce Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year	Risk (R, Qualitative	Ranking)	Risk	k Matri	ix			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$,	ent) of major concern						
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (evolution)				Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$			vent) of minor concern	sa	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible			vent) of minimal concern	ences	M	II	П	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	nba		- 11	11		
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Н	C ≥ Irreversible,	C≥Pr	≥ Prompt worker fatality	C ≥ Prompt worker)S(L	III	III	IV	IV
Acronyms		other serious effects,		acute injury that is	fatality or acute injury that	Col	N	IV	IV	IV	IV
MOI = Maximally-exposed Offsite Individual		or symptoms which	immediately life-		is immediately life-	<u> </u>	1				
Waxintary exposed offsite mervidual		could impair an	threate	ening or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective									
	N /	action.	<u> </u>	a : ::	G . G						
	M	$C \ge Mild$, transient		Serious injury, no	C ≥ Serious injury, no						
		adverse effects.		ediate loss of life no	immediate loss of life no						
				nanent disabilities;	permanent disabilities;						
	-	3.671.1		italization required.	hospitalization required.						
	L	Mild, transient		linor injuries; no	Minor injuries; no						
	. .	adverse effects > C		spitalization > C	hospitalization > C						
	IN	Consequences less		sequences less than	Consequences less than						
			tnose fo	or Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 2.12 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:	L: C: R:	See Section I Chapter 04	L: C: R:
High Voltage Exposure	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Low Voltage, High Current Exposure.	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1	l, "E	Example Qualitative Cons	sequenc	ce Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year	Risk (R, Qualitative	Ranking)	Risk	k Matri	ix			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$,	ent) of major concern						
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (evolution)				Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$			vent) of minor concern	sa	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible			vent) of minimal concern	ences	M	II	П	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	nba		- 11	11		
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Н	C ≥ Irreversible,	C≥Pr	≥ Prompt worker fatality	C ≥ Prompt worker)S(L	III	III	IV	IV
Acronyms		other serious effects,		acute injury that is	fatality or acute injury that	Col	N	IV	IV	IV	IV
MOI = Maximally-exposed Offsite Individual		or symptoms which	immediately life-		is immediately life-	<u> </u>	1				
Waxintary exposed offsite mervidual		could impair an	threate	ening or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective									
	N /	action.	<u> </u>	a : ::	G . G						
	M	$C \ge Mild$, transient		Serious injury, no	C ≥ Serious injury, no						
		adverse effects.		ediate loss of life no	immediate loss of life no						
				nanent disabilities;	permanent disabilities;						
	-	3.671.1		italization required.	hospitalization required.						
	L	Mild, transient		linor injuries; no	Minor injuries; no						
	. .	adverse effects > C		spitalization > C	hospitalization > C						
	IN	Consequences less		sequences less than	Consequences less than						
			tnose fo	or Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 2.13 Thermal Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Hot Work	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Cryogenic Liquids	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Likelihood (L, of event)/year	C	onsequence (C, of event)/y	year Risk (R, Qualitative	Ranking)	Risk Matrix							
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (eve				Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	III = situation (ev	vent) of minor concern	ses	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern) ju	М	II	П	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	- da	IVI	111	11	111	1 V		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	nse	L	III	III	IV	IV		
M = Mitigative (reduces event consequences) Acronyms		other serious effects,	or acute injury that is	fatality or acute injury that	ŭ	N	IV	IV	IV	IV		
MOI = Maximally-exposed Offsite Individual		or symptoms which	immediately life-	is immediately life-								
Maximally exposed offsite marriadar			threatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective action.										
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization > C								
	N	Consequences less	Consequences less than	Consequences less than								
		than those for Low	those for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

Table 2.14 Thermal Energy – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Hot Work	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Cryogenic Liquids	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Likelihood (L, of event)/year	C	onsequence (C, of event)/y	year Risk (R, Qualitative	Ranking)	Risk Matrix							
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (eve				Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	III = situation (ev	vent) of minor concern	ses	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern) ju	М	II	П	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	- da	IVI	111	11	111	1 V		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	nse	L	III	III	IV	IV		
M = Mitigative (reduces event consequences) Acronyms		other serious effects,	or acute injury that is	fatality or acute injury that	ŭ	N	IV	IV	IV	IV		
MOI = Maximally-exposed Offsite Individual		or symptoms which	immediately life-	is immediately life-								
Maximally exposed offsite marriadar			threatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective action.										
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization > C								
	N	Consequences less	Consequences less than	Consequences less than								
		than those for Low	those for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

Table 2.15 Thermal Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Hot Work	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Cryogenic Liquids	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Likelihood (L, of event)/year	C	onsequence (C, of event)/yea	r Risk (R, Qualitative	Ranking)	Risk	Matri	ix			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \text{High}$	7	I = situation (event) of major concern						
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (ev	7 3			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situation (ev	vent) of minor concern	S	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	ences	М	П	ш	III	IV
Control(s) Type	C	Offsite (MOI) On	site-2 (co-located worker)	Onsite-1 (facility worker)	edne	IVI	11	- 11	111	1 V
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible, C	≥ Prompt worker fatality	C ≥ Prompt worker	onse	L	III	III	IV	IV
M = Mitigative (reduces event consequences) Acronyms		other serious effects,	or acute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV
MOI = Maximally-exposed Offsite Individual		or symptoms which	immediately life-	is immediately life-			1			
		•	reatening or permanently	threatening or						
		individual's ability to take protective	disabling.	permanently disabling.						
		action.								
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no						
		adverse effects.	nmediate loss of life no	immediate loss of life no						
			permanent disabilities;	permanent disabilities;						
			ospitalization required.	hospitalization required.						
	L	Mild, transient	Minor injuries; no	Minor injuries; no						
		adverse effects > C	hospitalization > C	hospitalization > C						
	N		Consequences less than	Consequences less than						
			se for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

Table 2.16 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:	L: C: R:	See Section I Chapter 04	L: C: R:
Pumps and Motors	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Motion Tables	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.														
Likelihood (L, of event)/year	C	Consequence (C, of event)/year		Risk (R, Qualitative Ranking)		Risk Matrix								
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern				Likelihood						
U = Unlikely (1.0E-02> L > 1.0E-04)	$\mathbf{M} = \mathbf{Moderate}$			II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern				A	U	EU	BEU			
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$ $\mathbf{N} = \text{Negligible}$				s	Н	I	I	II	III			
BEU = Beyond Extremely Unlikely (1.0E-06> L)						ences	M	II	П	III	IV			
Control(s) Type	C	Offsite (MOI)	Onsite-	-2 (co-located worker)	Onsite-1 (facility worker)	nbəsı			11					
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Н	$C \ge Irreversible$, $C \ge F$	C ≥ P ₁	rompt worker fatality	C ≥ Prompt worker		L	III	III	IV	IV			
Acronyms				acute injury that is	fatality or acute injury that is immediately life-	Co	N	IV	IV	IV	IV			
MOI = Maximally-exposed Offsite Individual		or symptoms which	immediately life-			<u> </u>								
Waxintary exposed offsite mervidual		could impair an	threate	ening or permanently	threatening or									
		individual's ability to		disabling.	permanently disabling.									
		take protective												
	M	action.	~ .	~	a. a									
		$C \ge Mild$, transient		Serious injury, no	C ≥ Serious injury, no									
		adverse effects.	immediate loss of life no		immediate loss of life no									
				manent disabilities;	permanent disabilities;									
		2011		oitalization required.	hospitalization required.									
	L N	Mild, transient		Inor injuries; no	Minor injuries; no									
		adverse effects > C		ospitalization > C	hospitalization > C									
		Consequences less		sequences less than	Consequences less than									
			those f	for Low Consequence	those for Low									
		Consequence Level		Level	Consequence Level									

Table 2.17 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:	L: C: R:	See Section I Chapter 04	L: C: R:
Pumps and Motors	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Motion Tables	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-	1, "E	Example Qualitative Cons	sequence Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/y	year Risk (R, Qualitative	Ranking)	Risk Matrix							
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (eve	ent) of major concern				Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (ev	ent) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situation (e	vent) of minor concern	8	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (evolution)	vent) of minimal concern	l oi	M	ш	II	Ш	IV		
Control(s) Type	\mathbf{C}	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	ənb	171	11	111	111	1 V		
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Н	-	C ≥ Prompt worker fatality	C ≥ Prompt worker	onse	L	III	III	IV	IV		
Acronyms		other serious effects,	or acute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV		
MOI = Maximally-exposed Offsite Individual		or symptoms which	immediately life-	is immediately life-								
			threatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective action.										
	M	$C \ge Mild$, transient	$C \ge Serious injury, no$	C ≥ Serious injury, no								
		adverse effects.	immediate loss of life no permanent disabilities;	immediate loss of life no permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization > C								

Table 2.18 Kinetic Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power tools	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Pumps and Motors	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Motion Tables	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1	1, "F	Example Qualitative Conse	equence Matrix", DOE-HD	BK-1163-2020.							
Likelihood (L, of event)/year	C	onsequence (C, of event)/y	year Risk (R, Qualitative	Ranking)	Risk Matrix						
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (eve	nt) of major concern							
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{H} = \text{situation (ev}$				Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situation (e	vent) of minor concern	S	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ex	vent) of minimal concern	sacus	M	ш	ш	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	ənbə	IVI	11	111	111	1 V	
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)			C ≥ Prompt worker fatality	C ≥ Prompt worker	onse	L	III	III	IV	IV	
Acronyms	other ser		or acute injury that is	fatality or acute injury that	С	N	IV	IV	IV	IV	
MOI = Maximally-exposed Offsite Individual		or symptoms which could impair an	immediately life-	is immediately life-							
		individual's ability to	threatening or permanently disabling.	threatening or permanently disabling.							
		take protective	disabiling.	permanentry disabiling.							
		action.									
	M	$C \ge Mild$, transient	C ≥ Serious injury, no	C ≥ Serious injury, no							
		adverse effects.	immediate loss of life no	immediate loss of life no							
			permanent disabilities;	permanent disabilities;							
			hospitalization required.	hospitalization required.							
	L	Mild, transient	Minor injuries; no	Minor injuries; no							
		adverse effects $> \mathbf{C}$	hospitalization $> C$	hospitalization > C							

Table 2.19 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:	L: C: R:	See Section I Chapter 04	L: C: R:
Compressed Gasses	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Vacuum/ Pressure Vessels	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Vacuum Pumps	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Material Handling	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1	l, "E	xample Qualitative Cons	sequen	ce Matrix", DOE-HD	BK-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) Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual	С	C ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective	Onsite- $C \ge Pr$ or a	II = situation (ev III = situation (ev	ent) of major concern	Consequences	H M L N	A I III III IV	Like U I II III IV	EU II III IV IV	BEU III IV IV IV
	M L N	action. C ≥ Mild, transient adverse effects. Mild, transient adverse effects > C Consequences less than those for Low Consequence Level	immo perr hosp M ho	e Serious injury, no ediate loss of life no manent disabilities; oitalization required. Minor injuries; no ospitalization > C usequences less than for Low Consequence Level	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no hospitalization > C Consequences less than those for Low Consequence Level						

Table 2.20 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:	L: C: R:	See Section I Chapter 04	L: C: R:
Compressed Gasses	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Vacuum/ Pressure Vessels	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Vacuum Pumps	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Material Handling	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1	l, "E	Example Qualitative Cons	sequen	ce Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year	Risk (R, Qualitative	Ranking)	Risk	Matri	X			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern							
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ev	ent) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ex	event) of minor concern	y,	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	nce	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-	-2 (co-located worker)	Onsite-1 (facility worker)	ant	IVI	-11	111	111	1 V
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Н	C ≥ Irreversible,	C ≥ P	rompt worker fatality	C ≥ Prompt worker	Consequences	L	III	III	IV	IV
		other serious effects,	or a	acute injury that is	fatality or acute injury that	ŭ	N	IV	IV	IV	IV
Acronyms MOI = Maximally-exposed Offsite Individual		or symptoms which		mmediately life-	is immediately life-	<u> </u>	1				
Wioi – Waximany-exposed Offsite individual		could impair an	threat	ening or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective									
		action.									
	M	$C \ge Mild$, transient	C ≥	Serious injury, no	$C \ge Serious injury, no$						
		adverse effects.	imm	ediate loss of life no	immediate loss of life no						
				manent disabilities;	permanent disabilities;						
			hosp	oitalization required.	hospitalization required.						
	L	Mild, transient		Inor injuries; no	Minor injuries; no						
		adverse effects > C	ho	ospitalization > C	hospitalization > C						
	N	Consequences less		sequences less than	Consequences less than						
		than those for Low	those f	for Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 2.21 Potential Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane Operations	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Compressed Gasses	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Vacuum/ Pressure Vessels	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Vacuum Pumps	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Material Handling	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-	1, "F	Example Qualitative Conse	equence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year A = Anticipated (L > 1.0E-02) U = Unlikely (1.0E-02> L >1.0E-04)	C	onsequence (C, of event)/y H = High M = Moderate	I = situation (ever	nt) of major concern	Risk	Matri	ix 	Like	lihood EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06) BEU = Beyond Extremely Unlikely (1.0E-06> L)	G	$\mathbf{L} = \mathbf{Low}$ $\mathbf{N} = \mathbf{Negligible}$	III = situation (ev IV = situation (ev	II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern			I	I	II III	III IV
Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual	Н	C ≥ Irreversible,	Onsite-2 (co-located worker) C ≥ Prompt worker fatality	Onsite-1 (facility worker) C ≥ Prompt worker	Consequ	L	III	III	IV	IV
		other serious effects, or symptoms which could impair an individual's ability to take protective action.	or acute injury that is immediately life- threatening or permanently disabling.	fatality or acute injury that is immediately life- threatening or permanently disabling.		N	IV	IV	IV	IV
	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 hose for Low Consequence Level	Consequences less than those for Low Consequence Level						

Table 2.22 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:	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-	1, "E	Example Qualitative Conse	quence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	Co	onsequence (C, of event)/ye	ear Risk (R, Qualitative	Ranking)	Risk	Matri	x			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (eve	ent) of major concern						
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (even	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situation (evolution)	vent) of minor concern	s.	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	ences	М	TT	II	III	IV
Control(s) Type	C	Offsite (MOI)	nsite-2 (co-located worker)	Onsite-1 (facility worker)	- -	IVI	11	111	111	1 V
P = Preventive (reduce event occurrence likelihood M = Mitigative (reduces event consequences)	Н	C ≥ Irreversible, C	C ≥ Prompt worker fatality	C ≥ Prompt worker	onsedne	L	III	III	IV	IV
Acronyms		other serious effects,	or acute injury that is	fatality or acute injury that	ŭ	N	IV	IV	IV	IV
MOI = Maximally-exposed Offsite Individual		or symptoms which	immediately life-	is immediately life-	L					
With Widamiany-exposed Offsite mervidual			nreatening or permanently	threatening or						
		individual's ability to	disabling.	permanently disabling.						
		take protective								
		action.								
	M	$C \ge Mild$, transient	$C \ge$ Serious injury, no	$C \ge$ Serious injury, no						
		adverse effects.	immediate loss of life no	immediate loss of life no						
			permanent disabilities;	permanent disabilities;						
			hospitalization required.	hospitalization required.						
	L	Mild, transient	Minor injuries; no	Minor injuries; no						
		adverse effects > C	hospitalization > C	hospitalization > C						
	N	Consequences less	Consequences less than	Consequences less than						
		than those for Low th	ose for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

Table 2.23 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:	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	Co	onsequence (C, of event)/ye	ear Risk (R, Qualitative	Ranking)	Risk Matrix							
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (eve	I = situation (event) of major concern				Like	lihood			
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (evolution)	ent) of concern	_		Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situation (ev	vent) of minor concern	8	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	ences	M	ш	II	III	IV		
Control(s) Type	C	Offsite (MOI)	nsite-2 (co-located worker)	Onsite-1 (facility worker)	edne	IVI	-11	11	111	1 V		
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Н	C ≥ Irreversible, C	C ≥ Prompt worker fatality	C ≥ Prompt worker	onse	L	III	III	IV	IV		
Acronyms		other serious effects,	or acute injury that is	fatality or acute injury that	Č	N	IV	IV	IV	IV		
MOI = Maximally-exposed Offsite Individual		or symptoms which	immediately life-	is immediately life-	L							
TYPOT Maximally exposed offsite marvidual			reatening or permanently	-								
		individual's ability to	disabling.	permanently disabling.								
		take protective										
		action.										
	M	$C \ge Mild$, transient	$C \ge$ Serious injury, no	$C \ge$ Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization > C								
	N	Consequences less	Consequences less than	Consequences less than								
			ose for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

Table 2.24 Magnetic Fields – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.													
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year Risk (R, Qualitative	Risk (R, Qualitative Ranking)			Risk Matrix						
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (ever	I = situation (event) of major concern									
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (eve	,			A	U	EU	BEU			
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	`	vent) of minor concern	sa	Н	I	I	II	III			
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		vent) of minimal concern	ences	M	П	П	III	IV			
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	nb	171	11	-11	111	1,4			
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	onbəsuo	L	III	III	IV	IV			
Acronyms		other serious effects,	or acute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV			
MOI = Maximally-exposed Offsite Individual		or symptoms which	immediately life-	is immediately life-									
The second secon		•	threatening or permanently										
		individual's ability to	disabling.	permanently disabling.									
		take protective											
	M	action.	C > C · · · ·	G > G · · · ·									
	IVI	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no	C ≥ Serious injury, no immediate loss of life no									
		adverse effects.	permanent disabilities;	permanent disabilities;									
			hospitalization required.	hospitalization required.									
	T	Mild, transient	Minor injuries; no	Minor injuries; no									
	L	adverse effects > C	hospitalization > C	hospitalization > C									
	N	Consequences less	Consequences less than	Consequences less than									
	1	*	those for Low Consequence	those for Low									
		Consequence Level	Level	Consequence Level									

Table 2.25 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:	L: C: R:	See Section I Chapter 04	L: C: R:
Noise	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Silica	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Ergonomics	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Asbestos	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Working at Heights	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1	l, "E	Example Qualitative Cons	sequen	ce Matrix", DOE-HD	BK-1163-2020.							
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
A = Anticipated (L > 1.0E-02)		$\hat{\mathbf{H}} = \text{High}$		I = situation (eve	I = situation (event) of major concern				Likelihood			
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ev	ent) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ex	vent) of minor concern	y,	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	nce	М	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-	-2 (co-located worker)	Onsite-1 (facility worker)	ant	IVI	-11	111	111	1 V	
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Н	C ≥ Irreversible,	C ≥ P	rompt worker fatality	C ≥ Prompt worker	Consequences	L	III	III	IV	IV	
		other serious effects,	or a	acute injury that is	fatality or acute injury that is immediately life-	ŭ	N	IV	IV	IV	IV	
Acronyms MOI = Maximally-exposed Offsite Individual		or symptoms which		mmediately life-		<u> </u>	I					
Wioi – Waximany-exposed Offsite individual		could impair an	threatening or permanently disabling.		threatening or							
		individual's ability to			permanently disabling.							
		take protective										
		action.										
	M	$C \ge Mild$, transient	C ≥	Serious injury, no	$C \ge Serious injury, no$							
		adverse effects.	imm	ediate loss of life no	immediate loss of life no							
				manent disabilities;	permanent disabilities;							
			hosp	oitalization required.	hospitalization required.							
	L	Mild, transient		Inor injuries; no	Minor injuries; no							
		adverse effects > C	ho	ospitalization > C	hospitalization > C							
	N	Consequences less		sequences less than	Consequences less than							
		than those for Low	those f	for Low Consequence	those for Low							
		Consequence Level		Level	Consequence Level							

Table 2.26 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:	L: C: R:	See Section I Chapter 04	L: C: R:
Noise	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Silica	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Ergonomics	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Asbestos	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Working at Heights	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-	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)	C	onsequence (C, of event)/y H = High M = Moderate	I = situation (ever	nt) of major concern	Risk	Matri	ix 	Like	lihood EU	BEU			
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06) BEU = Beyond Extremely Unlikely (1.0E-06> L)	G	$\mathbf{L} = \mathbf{Low}$ $\mathbf{N} = \mathbf{Negligible}$	III = situation (ev IV = situation (ev	II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern			I	I	II III	III IV			
Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Н	C ≥ Irreversible,	Onsite-2 (co-located worker) C ≥ Prompt worker fatality	Onsite-1 (facility worker) C ≥ Prompt worker	Consequ	L	III	III	IV	IV			
Acronyms MOI = Maximally-exposed Offsite Individual		other serious effects, or symptoms which could impair an individual's ability to take protective action.	or acute injury that is immediately life- threatening or permanently disabling.	fatality or acute injury that is immediately life- threatening or permanently disabling.		N	IV	IV	IV	IV			
	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.									
]		Mild, transient adverse effects > C	Minor injuries; no hospitalization > C	Minor injuries; no hospitalization > C									
		Consequences less than those for Low Consequence Level	Consequences less than hose for Low Consequence Level	Consequences less than those for Low Consequence Level									

Table 2.27 Other hazards – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Noise	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Silica	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Ergonomics	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Asbestos	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:
Working at Heights	Hazard:	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1	l, "E	Example Qualitative Cons	sequen	ce Matrix", DOE-HD	BK-1163-2020.							
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
A = Anticipated (L > 1.0E-02)		$\hat{\mathbf{H}} = \text{High}$		I = situation (event) of major concern					Likelihood			
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ev	ent) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ex	vent) of minor concern	y,	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	nce	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-	-2 (co-located worker)	Onsite-1 (facility worker)	ant	IVI	-11	111	111	1 V	
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Н	C ≥ Irreversible,	C ≥ P	rompt worker fatality	C ≥ Prompt worker	Consequences	L	III	III	IV	IV	
		other serious effects,	or a	acute injury that is	fatality or acute injury that is immediately life-	ŭ	N	IV	IV	IV	IV	
Acronyms MOI = Maximally-exposed Offsite Individual		or symptoms which		mmediately life-		<u> </u>	1					
Wioi – Waximany-exposed Offsite individual		could impair an	threatening or permanently disabling.		threatening or							
		individual's ability to			permanently disabling.							
		take protective										
		action.										
	M	$C \ge Mild$, transient	C ≥	Serious injury, no	C ≥ Serious injury, no							
		adverse effects.	imm	ediate loss of life no	immediate loss of life no							
				manent disabilities;	permanent disabilities;							
			hosp	oitalization required.	hospitalization required.							
	L	Mild, transient		Inor injuries; no	Minor injuries; no							
		adverse effects > C	ho	ospitalization > C	hospitalization > C							
	N	Consequences less		sequences less than	Consequences less than							
		than those for Low	those f	for Low Consequence	those for Low							
		Consequence Level		Level	Consequence Level							

Table 2.31 Environmental

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Airborne	 Airborne release of radionuclides beyond permitted limits. Discharge of chemicals into onsite surface waters beyond permitted limits. Reference: Fermilab Lifetime Operating Air Pollution Permit.	L: C: R:	See Section I Chapter 04	L: C: R:
Water	 Discharge of radionuclides into onsite surface waters beyond permitted limits. Discharge of chemicals into onsite surface waters beyond permitted limits. Reference: NPDES Permit	L: C: R:	See Section I Chapter 04	L: C: R:

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Soil	 Radioactive soil in beam loss areas beyond allowable concentrations of radionuclides beyond calculated Fermilab limits. Discharge of chemicals into onsite soils beyond permitted limits. Reference: Fermilab Environmental Assessment.	L: C: R:	See Section I Chapter 04	L: C: R: