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 Charter O4		

<sup>\*</sup> 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).

 $Table\ 2.1\ Radiological-Onsite-1\ Facility\ Worker$ 

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 P: Beam tuned to reduce generation of waste	R: IV
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	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 <b>R: IV</b>	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 R	lanking)	Risk Matrix					
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern					Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ever	nt) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		III = situation (eve	I = situation (event) of minor concern		Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible		<b>IV</b> = situation (event) of minimal concern		nence	M	TT	TT	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite	te-2 (co-located worker)	Onsite-1 (facility worker)	dne	IVI	- 11	11	111	1 V
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ 25.0 rem		<b>C</b> ≥ 100 rem	<b>C</b> ≥ 100 rem	onsec	L	III	III	IV	IV
M = Mitigative (reduces event consequences)	M	$25.0 \text{ rem} > \mathbb{C} \ge 5 \text{ rem}$	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-exposed Offsite Individual	L	5 rem > <b>C</b>		25 rem > C	25 rem > C	<u> </u>	l				
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 activation	Hazard: Radiation exposure	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	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)	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	
	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: U 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) 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  No analysis required	L: BEU C: H R: IV
	Exposure to Class 3R lasers	L: A C: L R: III	Two unarysis 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	nsequence (C, of event)/y	ear   Risk (R, Qualitative I	Risk (R, Qualitative Ranking)		Risk Matrix				
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (even	t) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situation (eve}$	nt) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situation (even	ent) of minor concern	8	Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible	IV = situation (even	ent) of minimal concern	ence	M	ш	II	III	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)	Н	C ≥ 25.0 rem	<b>C</b> ≥ 100 rem	<b>C</b> ≥ 100 rem	onse	L	III	III	IV	IV
M = Mitigative (reduces event consequences)	M	$25.0 \text{ rem} > \mathbb{C} \ge 5 \text{ rem}$	$100 \text{ rem} > \mathbb{C} \ge 25 \text{ rem}$	$100 \text{ rem} > \mathbb{C} \ge 25 \text{ rem}$	ŭ	N	IV	IV	IV	IV
Acronyms MOI = Maximally-exposed Offsite Individual	L	5 rem > C	25 rem > C	25 rem > C	] <del></del>	1				
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	Hazard: Radiation exposure	L: N/A	Hazard does not apply to the public	L: N/A
activation		C:		C:
		R:		R:
Radioactive	Hazard: Radiation exposure	L: N/A	Hazard does not apply to the public	L: N/A
waste		C:		C:
	Reference:	R:		R:
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)  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 R	lanking)	Risk	Matri	X			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		<b>I</b> = situation (event) of major concern					Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ever	nt) of concern			A	U	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
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible		<b>IV</b> = situation (eve	ent) of minimal concern	nence	M	TT	TT	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite	te-2 (co-located worker)	Onsite-1 (facility worker)	dne	IVI	- 11	11	111	1 V
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ 25.0 rem		<b>C</b> ≥ 100 rem	<b>C</b> ≥ 100 rem	onsec	L	III	III	IV	IV
M = Mitigative (reduces event consequences)	M	$25.0 \text{ rem} > \mathbb{C} \ge 5 \text{ rem}$	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-exposed Offsite Individual	L	5 rem > <b>C</b>		25 rem > C	25 rem > C	<u> </u>	l				
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:

Co	onsequence (C, of event)	/year	Risk (R, Qualitative Ranking)			Risk Matrix						
	$\mathbf{H} = \mathbf{High}$						Likelihood					
	$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H} = \text{situation (ev}$	ent) of concern			Α	U	EU	BEU		
	L = Low				Se	Н	I	I	II	III		
	N = Negligible		IV = situation (ev	vent) of minimal concern	uce	М	TT	п	TIT	IV		
C	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	ənt	IVI	11	11	111	1 V		
Н	<b>C</b> ≥ 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		
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								
	C	$\mathbf{H} = \text{High}$ $\mathbf{M} = \text{Moderate}$ $\mathbf{L} = \text{Low}$ $\mathbf{N} = \text{Negligible}$ $\mathbf{C} \qquad \mathbf{Offsite} \ (\mathbf{MOI})$ $\mathbf{H} \qquad \mathbf{C} \ge \text{PAC-2}$ $\mathbf{M} \qquad \mathbf{PAC-2} \ge \mathbf{C} \ge \mathbf{PAC-1}$ $\mathbf{L} \qquad \mathbf{PAC-1} \ge \mathbf{C}$ $\mathbf{N} \qquad \mathbf{Consequences} \ \text{less}$ $\mathbf{than} \ \mathbf{those} \ \mathbf{for} \ \mathbf{Low}$		$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		

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	Risk (R, Qualitative Ranking)			Risk Matrix						
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$			nt) of major concern			Likelihood						
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H} = \text{situation (ev}$	ent) of concern			A	U	EU	BEU			
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low			vent) of minor concern	S	Н	I	I	II	III			
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible		IV = situation (ev	vent) of minimal concern	nce	M	П	п	Ш	IV			
Control(s) Type	C	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	ant	IVI	- 11	11	111	1 V			
<ul><li>P = Preventive (reduce event occurrence likelihood)</li><li>M = Mitigative (reduces event consequences)</li></ul>	Н	C ≥ PAC-2		C ≥ PAC-3	C ≥ IDLH	onsec	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-1 > <b>C</b>		PAC-2 > C	PEL or $TLV_c > C$	L	1							
MOI = Maximally-exposed Offsite Individual PAC = Protective Action Criteria PEL = Permissible Exposure Limit	N	Consequences less than those for Low Consequence Level		sequences less than for Low Consequence Level	Consequences less than those for Low Consequence Level									

**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:

Co	onsequence (C, of event)	/year	Risk (R, Qualitative Ranking)			Risk Matrix						
	$\mathbf{H} = \mathbf{High}$						Likelihood					
	$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H} = \text{situation (ev}$	ent) of concern			A	U	EU	BEU		
	L = Low				Se	Н	I	I	II	III		
	N = Negligible		IV = situation (ev	vent) of minimal concern	uce	М	TT	п	TTT	IV		
C	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	ənt	1V1	111	11	111	1 V		
Н	<b>C</b> ≥ PAC-2		C ≥ PAC-3	C ≥ IDLH	onsec	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		
L	PAC-1 > <b>C</b>		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								
	C	$\mathbf{H} = \text{High}$ $\mathbf{M} = \text{Moderate}$ $\mathbf{L} = \text{Low}$ $\mathbf{N} = \text{Negligible}$ $\mathbf{C} \qquad \mathbf{Offsite} \ (\mathbf{MOI})$ $\mathbf{H} \qquad \mathbf{C} \geq \text{PAC-2}$ $\mathbf{M} \qquad \mathbf{PAC-2} \geq \mathbf{C} \geq \mathbf{PAC-1}$ $\mathbf{L} \qquad \mathbf{PAC-1} \geq \mathbf{C}$ $\mathbf{N} \qquad \mathbf{Consequences} \ \text{less}$ $\text{than those for Low}$		$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		

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-1	l, "E	xample Qualitative Cons	equence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year Risk (R, Qualitative	Ranking)	Risk					
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)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (even	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	s,	Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		vent) of minimal concern	saces	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	anbas	1V1	11	11	111	1 V
P = Preventive (reduce event occurrence likelihood)  M = Mitigative (reduces event consequences)			C ≥ Prompt worker fatality	C ≥ Prompt worker	E	L	III	III	IV	IV
Acronyms		other serious effects,	or acute injury that is	fatality or acute injury that	Ö	N	IV	IV	IV	IV
MOI = Maximally-exposed Offsite Individual		or symptoms which	immediately life-	is immediately life-		1				
1101 Manimum Superson Street Marviasar		-	threatening or permanently	threatening or						
		individual's ability to	disabling.	permanently disabling.						
		take protective								
	2.7	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;						
	<u></u>	2011	hospitalization required.	hospitalization required.						
	L	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						
			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, "E	Example Qualitative Cons	equence Matrix", DOE-I	IDBK-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 (e	ve Ranking) vent) of major concern event) of concern	Risl	k Matr	ix A	Like U	lihood EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06) BEU = Beyond Extremely Unlikely (1.0E-06> L)		L = Low $N = Negligible$	III = situation	III = situation (event) of minor concern IV = situation (event) of minimal concern			I	I	II	III
Control(s) Type  P = Preventive (reduce event occurrence likelihood)  M = Mitigative (reduces event consequences)  Acronyms  MOI = Maximally-exposed Offsite Individual	C H	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sednences	M L	III	III	III IV	IV IV
	Н	other serious effects, or symptoms which	C ≥ Prompt worker fatalit or acute injury that is immediately life- threatening or permanently disabling.	fatality or acute injury that is immediately life-	Con	N	IV	IV	IV	IV
	M L	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.  Minor injuries; no	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.  Minor injuries; no						
	N	adverse effects > C  Consequences less than those for Low Consequence Level	hospitalization > C  Consequences less than those for Low Consequence Level	hospitalization > C  Consequences less than those for Low 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	Example 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)	Consequence (C, of event)/year H = High M = Moderate			Risk (R, Qualitative I = situation (eve II = situation (eve	nt) of major concern	Risk	Matri	X A	Like U	lihood EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06) BEU = Beyond Extremely Unlikely (1.0E-06> L)		L = Low N = Negligible		III = situation (ev	vent) of minor concern	nces	Н	I	I	II	III
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)  Acronyms MOI = Maximally-exposed Offsite Individual	C H	Offsite (MOI)		-2 (co-located worker)	Onsite-1 (facility worker)	edne	M L	III	III	IV	IV IV
	Н	other serious effects, or symptoms which	or a	rompt worker fatality acute injury that is mmediately life-ening or permanently disabling.	C ≥ Prompt worker fatality or acute injury that is immediately lifethreatening or permanently disabling.	Con	N	IV	IV	IV	IV
	M L	C ≥ Mild, transient adverse effects.  Mild, transient	imme perr hosp	Serious injury, no ediate loss of life no manent disabilities; italization required. Inor injuries; no	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.  Minor injuries; no						
	N	adverse effects > C  Consequences less than those for Low Consequence Level	Con	sequences less than for Low Consequence Level	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	sequence Matrix", DOE-HD	DBK-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)				ent) of major concern				Likelihood			
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (ev	vent) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	<b>III</b> = situation (e	vent) of minor concern	s,	Н	I	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		vent) of minimal concern	saces	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	ənbəs	1V1	11	11	111	1 V	
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	W	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-		1					
1101 Manimum Superson Street Marviasar		could impair an	threatening or permanently	threatening or							
		individual's ability to	disabling.	permanently disabling.							
		take protective									
	3.4	action.		G : G :							
	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;							
	-	3.611.1	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 2.11 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: 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	sequence Matrix", DOE-HD	DBK-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)				ent) of major concern				Likelihood			
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (ev	vent) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	<b>III</b> = situation (e	vent) of minor concern	s,	Н	I	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		vent) of minimal concern	saces	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	ənbəs	1V1	11	11	111	1 V	
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	W	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-		1					
1101 Manimum Superson Street Marviasar		could impair an	threatening or permanently	threatening or							
		individual's ability to	disabling.	permanently disabling.							
		take protective									
	3.4	action.		G : G :							
	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;							
	-	3.611.1	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 2.12 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	sequence Matrix", DOE-HD	DBK-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)				ent) of major concern				Likelihood			
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (ev	vent) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	<b>III</b> = situation (e	vent) of minor concern	s,	Н	I	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		vent) of minimal concern	saces	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	ənbəs	1V1	11	11	111	1 V	
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	W	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-		1					
1101 Manimum Superson Street Marviasar		could impair an	threatening or permanently	threatening or							
		individual's ability to	disabling.	permanently disabling.							
		take protective									
	3.4	action.		G : G :							
	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;							
	-	3.611.1	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 2.13 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:

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	Ranking)	Risk	Matri	X					
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (eve	<b>I</b> = situation (event) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\Pi$ = situation (evo	ent) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	III = situation (ex	vent) of minor concern	8	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		vent) of minimal concern	suces	М	II	П	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	edne	171	11	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	ప	N	IV	IV	IV	IV		
MOI = Maximally-exposed Offsite Individual		or symptoms which	immediately life-	is immediately life-								
		could impair an	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.								
	$\mathbf{L}$	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)/	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 (eve	ent) of concern			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	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	) iii	М	II	п	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	dne	1V1	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	ű	N	IV	IV	IV	IV	
MOI = Maximally-exposed Offsite Individual		or symptoms which	immediately life-	is immediately life-					ı		
1701 Waximany exposed onsite marvidual		could impair an	threatening or permanently	threatening or							
		individual's ability to	disabling.	permanently disabling.							
		take protective									
	М	action. C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no							
	141	adverse effects.	immediate loss of life no	immediate loss of life no							
		adverse effects.	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:

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)/y	year Risk (R, Qualitative	Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern			Risk Matrix					
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (eve				Likelihood					
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\Pi$ = situation (evo				Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	III = situation (ex	III = situation (event) of minor concern IV = situation (event) of minimal concern		Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible				М	II	II	III	IV		
Control(s) Type		Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	edne	171	11	11	111	1 V		
<ul> <li>P = Preventive (reduce event occurrence likelihood)</li> <li>M = Mitigative (reduces event consequences)</li> <li>Acronyms</li> </ul>	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	Prompt worker some acute injury that	L	III	III	IV	IV		
		other serious effects,	or acute injury that is	fatality or acute injury that		N	IV	IV	IV	IV		
MOI = Maximally-exposed Offsite Individual		or symptoms which	immediately life-	is immediately life-								
		could impair an	threatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective										
	М	action. 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.								
		Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization > C								
		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 2.16 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)		H = High M = Moderate		I = situation (event) of major concern II = situation (event) of concern					Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)								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		
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06 > L)$	N = Negligible			<b>IV</b> = situation (event) of minimal concern		ences	M	II	II	III	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)	edue	IVI	-11	11	111	1 V		
	Н			Prompt worker fatality	C ≥ Prompt worker	6	L	III	III	IV	IV		
		other serious effects,		acute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV		
		or symptoms which	immediately life- threatening or permanently		is immediately life- threatening or								
		could impair an											
		individual's ability to	disabling.		permanently disabling.								
		take protective											
	2.7	action.		g : ::	G : G : · · ·								
	M	$C \ge Mild$ , transient		≥ Serious injury, no	C ≥ Serious injury, no								
		adverse effects.		nediate loss of life no	immediate loss of life no								
				manent disabilities;	permanent disabilities;								
	Ļ	2011		oitalization required.	hospitalization required.								
		Mild, transient	Minor injuries; no		Minor injuries; no								
	_	adverse effects > C		ospitalization > 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 2.17 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	xample Qualitative Cons	equence Matrix", DOF	-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/y	year   Risk (R, Qualita	tive	Ranking)	Risk Matrix					
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 = situatio	n (ev	ent) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situati	on (ev	vent) of minor concern	S	Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation	n (ev	vent) of minimal concern	saces	M	TT	II	III	IV
Control(s) Type	$\mathbf{C}$	Offsite (MOI)	Onsite-2 (co-located work	er)	Onsite-1 (facility worker)	anb	101	11	- 11	111	1 V
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Н		C ≥ Prompt worker fata		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
<b>MOI</b> = Maximally-exposed Offsite Individual		or symptoms which	immediately life-	.41	is immediately life-						
• •		could impair an individual's ability to	threatening or permaner	шу	threatening or						
		,	disabling.		permanently disabling.						
		take protective action.									
	M	$C \ge Mild$ , transient	C ≥ Serious injury, n	)	C ≥ Serious injury, no						
		adverse effects.	immediate loss of life	10	immediate loss of life no						
			permanent disabilities	3;	permanent disabilities;						
			hospitalization require	d.	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	l, "E	xample Qualitative Conse	equence Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/y	ear Risk (R, Qualitative	ualitative Ranking)			Risk Matrix					
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 (ev	ent) of concern	_		Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	$III = situation (e^{-1})$	vent) of minor concern	ses	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ex	vent) of minimal concern	nce	М	ш	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	ənb	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	onse	L	III	III	IV	IV		
Acronyms		other serious effects,	or acute injury that is	fatality or acute injury that	С	N	IV	IV	IV	IV		
<b>MOI</b> = Maximally-exposed Offsite Individual		or symptoms which could impair an	immediately life-	is immediately life- threatening or								
		individual's ability to	threatening or permanently disabling.	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 > 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 Con	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								
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (event) 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	s.	Н	I	I	II	III		
<b>BEU</b> = 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	Ш	III	IV	IV		
		other serious effects,	or	acute injury that is	fatality or acute injury that	Č	N	IV	IV	IV	IV		
Acronyms MOI = Maximally-exposed Offsite Individual		or symptoms which		mmediately life-	is immediately life-		1						
Wild - Waximany-exposed Offsite individual		could impair an	threat	atening or permanently threatening or									
		individual's ability to		disabling.	permanently disabling.								
		take protective											
		action.											
	M	$C \ge Mild$ , transient	<b>C</b> ≥	≥ 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		Minor 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	for Low Consequence	those for Low								
		Consequence Level		Level	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, "E	Example Qualitative Cons	equence Matrix", DOE-I	IDBK-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 (e	ve Ranking) vent) of major concern event) of concern	Risl	k Matr	ix A	Like U	lihood EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06) BEU = Beyond Extremely Unlikely (1.0E-06> L)		L = Low $N = Negligible$	III = situation	(event) of minor concern (event) of minimal concern	nces	Н	I	I	II	III
Control(s) Type  P = Preventive (reduce event occurrence likelihood)  M = Mitigative (reduces event consequences)  Acronyms  MOI = Maximally-exposed Offsite Individual	C H	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sedne	M L	III	III	III IV	IV IV
	Н	other serious effects, or symptoms which	C ≥ Prompt worker fatalit or acute injury that is immediately life- threatening or permanently disabling.	fatality or acute injury that is immediately life-	Con	N	IV	IV	IV	IV
	M L	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.  Minor injuries; no	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.  Minor injuries; no						
	N	adverse effects > C  Consequences less than those for Low Consequence Level	hospitalization > C  Consequences less than those for Low Consequence Level	hospitalization > C  Consequences less than those for Low 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	l, "E	Example Qualitative Conse	equence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year A = Anticipated (L > 1.0E-02)	C	onsequence (C, of event)/y H = High	I = situation (ever	nt) of major concern	Risk	Matri	ix	Like	lihood	DEV
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)		<ul> <li>M = Moderate</li> <li>L = Low</li> <li>N = Negligible</li> </ul>	III = situation (ev IV = situation (ev	II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern			I II	I	EU II	BEU III IV
M = Mitigative (reduces event consequences)  Acronyms  MOI = Maximally-exposed Offsite Individual	H H	C ≥ Irreversible,	C ≥ Prompt worker fatality				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.	0	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						
	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, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year Risk (R, Qualitative	e Ranking)	Risk Matrix						
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (ev	ent) of major concern				Likelihood			
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (e	vent) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	<b>III</b> = situation (	event) of minor concern	S	Н	I	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (e	event) of minimal concern	ences	M	II	П	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	anb	1V1	11	11	111	1 V	
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality		onsedne	L	III	III	IV	IV	
Acronyms		other serious effects,	or acute injury that is	fatality or acute injury that	Ü	N	IV	IV	IV	IV	
MOI = Maximally-exposed Offsite Individual		or symptoms which	immediately life-	is immediately life-							
Wild Waximany exposed on site marvidual		could impair an	threatening 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							
		than those for Low	those for Low Consequence								
		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	C	onsequence (C, of event)/ye	ear Risk (R, Qualitative	Ranking)	Risk	Matr	ix				
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (eve	nt) of major concern				Like	lihood		
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)		$\mathbf{L} = \mathbf{Low}$	III = situation (evolution)	vent) of minor concern	S.	Н	I	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible	IV = situation (ev	vent) of minimal concern	) Juce	M	ш	II	III	IV	
Control(s) Type  P = Preventive (reduce event occurrence likelihood)  M = Mitigative (reduces event consequences)	C	Offsite (MOI)	nsite-2 (co-located worker)	Onsite-1 (facility worker)	sednences	171	11	-11	111	1 V	
	Н		C ≥ Prompt worker fatality	C ≥ Prompt worker	Conse	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-			1				
Marinary exposed offsite marriadar			nreatening or permanently	threatening or							
		individual's ability to	disabling.	permanently disabling.							
		take protective									
	N. /	action.	6. 6	G : G :							
	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;							
	T	N4:11 4	hospitalization required.	hospitalization required.							
	L	Mild, transient	Minor injuries; no	Minor injuries; no							
	N.T	adverse effects > C	hospitalization > C	hospitalization > C	-						
	IN	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	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)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situation (ev}$	rent) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	*	vent) of minor concern	S.	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible IV = situation (event) of minimal concern	ences	М	II	II	III	IV				
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	onb	141	-11	-11	111	1,		
<ul> <li>P = Preventive (reduce event occurrence likelihood)</li> <li>M = Mitigative (reduces event consequences)</li> </ul>	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	onsedno	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-								
international composed crisical materials.		could impair an	threatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective										
	N/I	action.	G : G : : :	G : G : · · ·								
	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;								
	_	M:11 4	hospitalization required.	hospitalization required.								
	L	Mild, transient adverse effects > C	Minor injuries; no	Minor injuries; no								
	NI	_	hospitalization > C	hospitalization > C								
	17	Consequences less	Consequences less than	Consequences less than those for Low								
		than those for Low	those for Low Consequence Level									
		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	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	Ranking)	Risk Matrix							
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	<b>I</b> = 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	<b>III</b> = situation (e	vent) of minor concern	s,	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		vent) of minimal concern	saces	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	anbas	1V1	11	11	111	1 V		
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual	Н		C ≥ Prompt worker fatality	C ≥ Prompt worker	E	L	III	III	IV	IV		
		other serious effects,	or acute injury that is	fatality or acute injury that	Ö	N	IV	IV	IV	IV		
		or symptoms which	immediately life-	is immediately life-		1						
1202 Hammary enposes officer fractional		-	threatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective										
	3.4	action.	G : G : : :	6, 6,								
	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;								
	-	3.611.	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 2.26 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-1	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)	C	onsequence (C, of event)/y H = High	I = situation (ever	nt) of major concern	Risk	Matri	ix	Like	lihood	DEV		
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		<ul> <li>M = Moderate</li> <li>L = Low</li> <li>N = Negligible</li> </ul>	III = situation (ev IV = situation (ev	II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern			I II	I	EU II	BEU III IV		
	H H	C ≥ Irreversible,	C ≥ Prompt worker fatality		onsedn	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.	0	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								
	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 2.27 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-	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 (e	ve Ranking) vent) of major concern event) of concern	Risl	k Matr	rix Likelihood A U EU			BEU		
EU = Extremely Unlikely (1.0E-04) BEU = Beyond Extremely Unlikely (1.0E-06) BEU = Beyond Extremely Unlikely (1.0E-06> L)		L = Low $N = Negligible$	III = situation	(event) of minor concern (event) of minimal concern	nces	Н	I	I	II	III		
Control(s) Type  P = Preventive (reduce event occurrence likelihood)  M = Mitigative (reduces event consequences)  Acronyms  MOI = Maximally-exposed Offsite Individual	C H	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sedne	M L	III	III	III IV	IV IV		
	Н	other serious effects, or symptoms which	C ≥ Prompt worker fatalit or acute injury that is immediately life- threatening or permanently disabling.	fatality or acute injury that is immediately life-	Con	N	IV	IV	IV	IV		
	M L	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.  Minor injuries; no	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.  Minor injuries; no								
	N	adverse effects > C  Consequences less than those for Low Consequence Level	hospitalization > C  Consequences less than those for Low Consequence Level	hospitalization > C  Consequences less than those for Low Consequence Level	_							

**Table 2.31 Environmental** 

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

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