	Risk Tables Description	Baseline Risk	Residual Risk
9.1	Toxic Materials – Onsite 1 Facility Worker	R: III	R: IV
9.2	Toxic Materials – Onsite 2 Co-located Worker	R: III	R: IV
9.3	Toxic Materials – MOI Offsite	R: IV	R: IV
9.4	Flammable & Combustible Materials – Onsite-1 Facility Worker	R: *	R: *
9.5	Flammable & Combustible Materials – Onsite-2 Co-located worker	R: *	R: *
9.6	Flammable & Combustible Materials – MOI Offsite	R: *	R: *
9.7	Electrical Energy – Onsite-1 Facility Worker	R: *	R: *
9.8	Electrical Energy – Onsite-2 Co-located Worker	R: *	R: *
9.9	Electrical Energy – MOI Offsite	R: *	R: *
9.10	Thermal Energy – Onsite-1 Facility Worker	R: *	R: *
9.11	Thermal Energy – Onsite-2 Co-located Worker	R: *	R: *
9.12	Thermal Energy – MOI Offsite	R: *	R: *
9.13	Kinetic Energy – Onsite-1 Facility Worker	R: *	R: *
9.14	Kinetic Energy – Onsite-2 Co-located Worker	R: *	R: *
9.15	Kinetic Energy – MOI Offsite	R: *	R: *
9.16	Potential Energy- Onsite-1 Facility Worker	R: *	R: *
9.17	Potential Energy – Onsite-2 Co-located Worker	R: *	R: *
9.18	Potential Energy – MOI Offsite	R: *	R: *
9.19	Other Hazards – Onsite-1 Facility Worker	R: *	R: *
9.20	Other Hazards – Onsite-2 Co-located Worker	R: *	R: *
9.21	Other Hazards – MOI Offsite	R: *	R: *
9.22	Access & Egress – Onsite-1 Facility Worker	R: I	R: IV
9.23	Access & Egress – Onsite-2 Co-located Worker	R: I	R: IV
9.24	Access & Egress – MOI Offsite	R: IV	R: IV
9.25	Environmental Hazards	R: *	R: *

#### Table 9. Summary of Baseline and Residual Risks - NOvA Near Detector

\* This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04 Safety Analysis. Work in the specified areas involving this hazard implements the controls specified in the common Risk Matrix table. No unique controls are in use.

#### NOTE:

Per DOE-HDBK-1163-2020, Appendix C, "Risk Assessment Methodology":

"Events with an unmitigated risk value 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; 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 9.1 Toxic Materials – Onsite 1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Liquid Scintillator	Hazard: NOvA's liquid scintillator oil contains 5.35% pseudocumene. The pseudocumene is an eyes, skin and respiratory irritant, central nervous system depressant, and is toxic to marine life. Physical contact via handling or airborne exposure via outgassing oil	L: A C: L R: III	<ul> <li>P - A job-specific hazard analysis and procedure govern filling the detector and prescribe Personal Protective Equipment (PPE) to prevent worker contact with the liquid scintillator.</li> <li>P - The PVC modules, once filled, completely contain the pseudocumene, resulting in no further exposure.</li> <li>P - The entire detector is inside of a secondary containment membrane that has the capacity to contain 100% of the liquid scintillator oil and prevent a release to the environment.</li> <li>M - Emergency spill equipment, an eye wash and PPE are stationed near the detector in the event of a release.</li> </ul>	L: BEU C: N R: IV

Chemical Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.													
Likelihood (L, of event)/year Consequence (C, of event)/year				Risk (R, Qualitative	Ranking)	Risk Matrix							
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Η	Ι	Ι	Π	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV		
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə							
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	н	C > PAC-2		C > PAC-3	C > IDL H	suo	L	III	ш	IV	IV		
$\mathbf{M} = $ Mitigative (reduces event consequences)	м	$PAC_{-2} > C > PAC_{-1}$	D/	$\Delta C \rightarrow PAC^{-2}$	DIH > C > PEL  or  TIV	Ŭ	Ν	IV	IV	IV	IV		
Acronyms	T	DAC 1 > C	17	$\frac{1}{1000} = \frac{1}{1000} = 1$	$\frac{1}{10} \frac{1}{10} \frac$	-							
<b>IDLH</b> = Immediately Dangerous to Life and Health		PAC-1>C	~	PAC-2>C	PEL or $1LV_c > C$								
MOI = Maximally-exposed Offsite Individual	N	Consequences less	Cor	nsequences less than	Consequences less than								
PAC - Protective Action Criteria		than those for Low	than those for Low those for		those for Low								
<b>PFI</b> – Permissible Exposure Limit		Consequence Level		Level	Consequence Level								
$TLV_c$ = Threshold Limit Value (ceiling)													

#### Table 9.2 Toxic Materials – Onsite 2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Liquid Scintillator	Hazard: NOvA's liquid scintillator oil contains 5.35% pseudocumene. The pseudocumene is an eyes, skin and respiratory irritant, central nervous system depressant, and is toxic to marine life. Airborne exposure via outgassing oil	L: A C: L R: III	<ul> <li>P - A job-specific hazard analysis and procedure govern filling the detector to prevent spilling and exposing the liquid scintillator.</li> <li>P - The PVC modules, once filled, completely contain the pseudocumene, resulting in no further exposure.</li> <li>P - The entire detector is inside of a secondary containment membrane that has the capacity to contain 100% of the liquid scintillator oil and prevent a release to the environment.</li> <li>M - Emergency spill equipment, an eye wash and PPE are stationed near the detector in the event of a release.</li> </ul>	L: BEU C: N R: IV

Chemical Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	Risk (R, Qualitative	Ranking)	Risk Matrix									
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV	
Control(s) Type	С	Offsite (MOI)	Onsite	nsite-2 (co-located worker)	Onsite-1 (facility worker)	nbə						
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C > PAC-2		C > PAC-3	C > IDL H	suo	L	III	ш	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)	м	$PAC_{-2} > C > PAC_{-1}$	P/	$\Delta C_{-3} > C > PAC_{-2}$	$DIH > C > PEL or TLV_{a}$	5	Ν	IV	IV	IV	IV	
Acronyms	T	$\frac{1}{1} \frac{1}{2} = \frac{1}{2} $	17	$\frac{10-370 \ge 110-2}{100-2}$	$\frac{1}{10} \frac{1}{10} \frac$							
<b>IDLH</b> = Immediately Dangerous to Life and Health		FAC-1>C	a	FAC-23C	FEL OI ILV <sub>c</sub> > C							
<b>MOI</b> = Maximally-exposed Offsite Individual	Ν	Consequences less	Cor	nsequences less than	Consequences less than							
$\mathbf{PAC}$ – Protective Action Criteria		than those for Low	those	for Low Consequence	those for Low							
$\mathbf{PEL} = \mathbf{Dermissible Expectate Limit}$		Consequence Level		Level	Consequence Level							
$\mathbf{PEL} = \text{Permissible Exposure Limit}$		-			-							
$TLV_c = Threshold Limit Value (ceiling)$												

## Table 9.3 Toxic Materials – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Liquid Scintillator	Hazard: NOvA's liquid scintillator oil contains 5.35% pseudocumene. The pseudocumene is an eyes, skin and respiratory irritant, central nervous system depressant, and is toxic to marine life. Airborne	L: EU C: N R: IV	<ul> <li>P - Access controls to area prevent contact.</li> <li>P - The PVC modules, once filled, completely contain the pseudocumene, resulting in no further exposure.</li> <li>P - The entire detector is inside of a secondary containment membrane that has the capacity to contain 100% of the liquid scintillator oil and prevent a release to the environment.</li> </ul>	L: BEU C: N R: IV

Chemical Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.														
Likelihood (L, of event)/year	Consequence (C, of event)/year			Risk (R, Qualitative	Risk (R, Qualitative Ranking)			Risk Matrix						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Likelihood					
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern		-	A	U	EU	BEU			
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	Π	III			
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	Π	II	III	IV			
Control(s) Type	С	Offsite (MOI) Onsi		e-2 (co-located worker)	Onsite-1 (facility worker)	nbə								
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C > PAC-2		C > PAC-3	$\mathbf{C} > \mathbf{IDLH}$	suo	L	ш	ш	IV	IV			
$\mathbf{M} = $ Mitigative (reduces event consequences)	м	PAC-2 > C > PAC-1	P	AC-3 > C > PAC-2	DLH > C > PFL or TLV	C	Ν	IV	IV	IV	IV			
Acronyms	T	$\frac{PAC-1 > C}{PAC-1 > C}$	11	1000000000000000000000000000000000000	$\frac{\text{DEH}}{\text{C}} \subset \frac{1}{2} \text{TEL} \text{ or } \text{TEV} \subset C$									
<b>IDLH</b> = Immediately Dangerous to Life and Health	N		Car	TAC-22C	$\frac{1}{2} = \frac{1}{2} = \frac{1}$									
MOI = Maximally-exposed Offsite Individual	IN	Consequences less		isequences less than	Consequences less than									
<b>PAC</b> = Protective Action Criteria		than those for Low	than those for Low those for		those for Low									
<b>PEL</b> = Permissible Exposure Limit		Consequence Level		Level	Consequence Level									
$TLV_c$ = Threshold Limit Value (ceiling)														

# Table 9.4 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	Hazard: N/A	L: C:	See Section 1, Chapter 4.	L: C:
materials		C:		C: D.
(cables, Boxes,		K.		K.
Paper, wood				
cribbing, etc.)				
Flammable	Hazard: N/A	L:	See Section 1, Chapter 4.	L:
Materials		C:		C:
(Flammable gas,		R:		R:
cleaning				
materials, etc.)				

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	Consequence (C, of event)/year			Risk (R, Qualitative	Ranking)	Risk Matrix					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = situation$ (eve	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (ev	ent) of concern		1	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	Π	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	×				
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	H	$\mathbf{C} >$ Irreversible.	$\mathbf{C} > \mathbf{F}$	Prompt worker fatality	$\mathbf{C} \ge \text{Prompt worker}$	ons	L	III	ш	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects.	or	acute injury that is	fatality or acute injury that	Ŭ	Ν	IV	IV	IV	IV
Acronyms		or symptoms which	i	immediately life-	is immediately life-				•		
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective		Ū.							
		action.									
		$C \ge Mild$ , transient	C	≥ Serious injury, no	$C \ge$ Serious injury, no						
		adverse effects.	imm	nediate 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
Ν	V	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 9.5 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	Hazard: N/A	L:	See Section 1, Chapter 4.	L:
materials		C:		C:
(cables, Boxes,		R:		R:
Paper, wood				
cribbing, etc.)				
Flammable	Hazard: N/A	L:	See Section 1, Chapter 4.	L:
Materials		C:		C:
(Flammable gas,		R:		R:
cleaning				
materials, etc.)				

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year Consequence (C, of				Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = situation$ (eve	nt) of major concern				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{d}\mathbf{e}\mathbf{r}\mathbf{a}\mathbf{t}\mathbf{e}$		$\mathbf{II} = \text{situation}$ (even	ent) of concern		-	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06>L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV	
Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)		Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	т	ш	ш	W	IV	
		$C \ge$ Irreversible, other serious effects,	$C \ge$ Prompt worker fatality or acute injury that is		$\mathbf{C} \ge \text{Prompt worker}$ fatality or acute injury that	Cons	L N	III IV	III IV	IV IV	IV	
Acronyms MOI = Maximally-exposed Offsite Individual		or symptoms which immediately life- could impair an threatening or permanently threatening or individual's ability to disabling permanently disabling										
		take protective action.		alouoling.	permanenti distolling.							
	М	C ≥ Mild, transient adverse effects.	C 2 imm	≥ Serious injury, no nediate loss of life no	$C \ge$ Serious injury, no immediate loss of life no							

			permanent disabilities;	permanent disabilities;
			hospitalization required.	hospitalization required.
L	M	Iild, transient	Minor injuries; no	Minor injuries; no
	adve	erse effects > C	hospitalization > C	hospitalization > C
N	Con	nsequences less	Consequences less than	Consequences less than
	than	n those for Low	those for Low Consequence	those for Low
	Con	sequence Level	Level	Consequence Level

### Table 9.6 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: N/A	L: C: R:	See Section 1, Chapter 4.	L: C: R:
Flammable Materials (Flammable gas, cleaning materials, etc.)	Hazard: N/A	L: C: R:	See Section 1, Chapter 4.	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						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Like	lihood		
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern		1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (ev	vent) of minor concern	es	Η	Ι	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	Π	III	IV	
Control(s) Type	С	Offsite (MOI)	Offsite (MOI) Onsite-2 (		Onsite-1 (facility worker)	edu						
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	н	$\mathbf{C} >$ Irreversible.	$\mathbf{C} > \mathbf{F}$	Prompt worker fatality	$C \ge$ Prompt worker fatality or acute injury that	ons	L	III	ш	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects	or	acute injury that is		Ŭ	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	i	immediately life-	is immediately life-							
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or							
		individual's ability to	uncu	disabling	permanently disabling							
		take protective		distoring.	permanentry disubiling.							
		action.										
	Μ	$C \ge Mild$ , transient	C	≥ Serious injury, no	$C \ge$ Serious injury, no							
		adverse effects.	imm	nediate loss of life no	immediate loss of life no							

			permanent disabilities;	permanent disabilities;
			hospitalization required.	hospitalization required.
L	M	Iild, transient	Minor injuries; no	Minor injuries; no
	adve	erse effects > C	hospitalization > C	hospitalization > C
N	Con	nsequences less	Consequences less than	Consequences less than
	than	n those for Low	those for Low Consequence	those for Low
	Con	sequence Level	Level	Consequence Level

# Table 9.7 Electrical Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
High Voltage Exposure	Hazard: N/A	L: C: R:	See Section 1, Chapter 4.	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)	/year	Risk (R, Qualitative Ranking)			Risk Matrix						
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E-}02)$		$\mathbf{H} = \text{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Like	lihood			
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern		1	Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	I	Ι	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	Ш	IV		
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	equ	-	ш	ш	TV.	117		
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	H	$\mathbf{C} \geq$ Irreversible.	$\mathbf{C} \ge \mathbf{P}$	Prompt worker fatality	$C \ge Prompt worker$	suo	L	ш	ш	1V	IV		
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects.	or	acute injury that is	fatality or acute injury that	C	Ν	IV	IV	IV	IV		
Acronyms		or symptoms which	i	immediately life-	is immediately life-								
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or								
		individual's ability to		disabling.	permanently disabling.								
		take protective		C									
		action.											
	М	$C \ge Mild$ , transient	<b>C</b> 2	≥ Serious injury, no	$C \ge$ Serious injury, no								
		adverse effects.	imm	nediate loss of life no	immediate loss of life no								
			per	manent disabilities;	permanent disabilities;								
			hosp	pitalization required.	hospitalization required.								
	L	Mild, transient	Ν	Minor injuries; no	Minor injuries; no								
		adverse effects $> C$	adverse effects $> C$ hos		hospitalization > C								
	Ν	Consequences less	Consequences less Conse		Consequences less than								
		than those for Low	those	for Low Consequence	those for Low								
		Consequence Level		Level	Consequence Level								

## Table 9.8 Electrical Energy Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
High Voltage Exposure	Hazard:	L: C: R:	See Section 1, Chapter 4.	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							
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (even	nt) of major concern				Likelihood					
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (eve	ent) of concern			Α	U	EU	BEU			
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Η	Ι	I	II	III			
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	Π	II	Ш	IV			
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	Ŧ							
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	H	$\mathbf{C} \geq$ Irreversible.	$\mathbf{C} > \mathbf{F}$	Prompt worker fatality	$\mathbf{C} \ge \text{Prompt worker}$	suo	L	III	111	IV	IV			
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects.	or	acute injury that is	fatality or acute injury that	C	Ν	IV	IV	IV	IV			
Acronyms		or symptoms which	i	immediately life-	is immediately life-									
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or									
		individual's ability to		disabling.	permanently disabling.									
		take protective		C C										
		action.												
	Μ	$C \ge Mild$ , transient	C	≥ Serious injury, no	$C \ge$ Serious injury, no									
		adverse effects.	imm	nediate loss of life no	immediate loss of life no									
			per	manent disabilities;	permanent disabilities;									
			hosp	pitalization required.	hospitalization required.									
	L	Mild, transient	N	Minor injuries; no	Minor injuries; no									
		adverse effects $> C$	h	ospitalization $> C$	hospitalization > C									
	Ν	Consequences less	Consequences less Conse		Consequences less than									
		than those for Low	those	for Low Consequence	those for Low									
		Consequence Level		Level	Consequence Level									

## Table 9.9 Electrical Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
High Voltage Exposure	Hazard: N/A	L: C: R:	See Section 1, Chapter 4.	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						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I}$ = situation (event) of major concern					Like	lihood			
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (eve	ent) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Η	Ι	Ι	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	Π	II	III	IV		
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	Ŧ				<b>TT</b> 7		
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	н	<b>C</b> > Irreversible	$\mathbf{C} > \mathbf{P}$	Prompt worker fatality	C > Prompt worker	suo	L	III	ш	IV	IV		
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects	or	acute injury that is	fatality or acute injury that	C	Ν	IV	IV	IV	IV		
Acronyms		or symptoms which	i	immediately life-	is immediately life-								
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or								
		individual's ability to		disabling.	permanently disabling.								
		take protective		6	1								
		action.											
	М	$C \ge Mild$ , transient	<b>C</b> 2	≥ Serious injury, no	$C \ge$ Serious injury, no								
		adverse effects.	imm	nediate loss of life no	immediate loss of life no								
			per	manent disabilities;	permanent disabilities;								
			hosp	pitalization required.	hospitalization required.								
	L	Mild, transient	Ν	Minor injuries; no	Minor injuries; no								
		adverse effects > C	adverse effects $> C$ hosConsequences lessConsequences		hospitalization > C								
	Ν	Consequences less			Consequences less than								
	tha			for Low Consequence	those for Low								
		Consequence Level		Level	Consequence Level								

# Table 9.10 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: N/A	L: C: R:	See Section 1, Chapter 4.	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)	)/year	Risk (R, Qualitative Ranking)			Risk Matrix							
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation (event) of major concern}$					Like	lihood				
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (eve	ent) of concern			Α	U	EU	BEU			
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Η	Ι	Ι	II	III			
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	Π	Π	ш	IV			
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	Ŧ				<b>TT</b> 7			
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	H	$\mathbf{C} >$ Irreversible.	<b>C</b> > <b>F</b>	Prompt worker fatality	$\mathbf{C} \ge \text{Prompt worker}$	suo	L	III	III	IV	IV			
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects.	or	acute injury that is	fatality or acute injury that	C	Ν	IV	IV	IV	IV			
Acronyms		or symptoms which	i	immediately life-	is immediately life-				•	•				
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	or permanently threatening or									
		individual's ability to		disabling.	permanently disabling.									
		take protective		C C										
		action.												
	Μ	$C \ge Mild$ , transient	C	≥ Serious injury, no	$C \ge$ Serious injury, no									
		adverse effects.	imm	nediate loss of life no	immediate loss of life no									
			per	manent disabilities;	permanent disabilities;									
			hos	pitalization required.	hospitalization required.									
	L	Mild, transient	N	Minor injuries; no	Minor injuries; no									
		adverse effects $> C$	h	ospitalization > C	hospitalization $> C$									
	Ν	Consequences less	Consequences less Conse		Consequences less than									
	than those for Low	those	for Low Consequence	those for Low										
		Consequence Level		Level	Consequence Level									

### Table 9.11 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: N/A	L: C: R:	See Section 1, Chapter 4.	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)	)/year	Risk (R, Qualitative	Ranking)	Risk	Matri	X			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (even	ation (event) of major concern				Like	lihood	
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (eve	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Η	Ι	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	equenc	М	Π	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)		Ŧ				
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	H	$\mathbf{C} > $ Irreversible.	<b>C</b> > <b>F</b>	Prompt worker fatality	$\mathbf{C} \ge \text{Prompt worker}$	suo	L	III	111	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects.	or	acute injury that is	fatality or acute injury that	C	Ν	IV	IV	IV	IV
Acronyms		or symptoms which	i	immediately life-	is immediately life-						
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	could impair an threaten		threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective		C	1 2 2						
		action.									
	Μ	$C \ge Mild$ , transient	C	≥ Serious injury, no	$C \ge$ Serious injury, no						
		adverse effects.	imm	nediate loss of life no	immediate loss of life no						
			per	manent disabilities;	permanent disabilities;						
			hos	pitalization required.	hospitalization required.						
	L	Mild, transient	N	Minor injuries; no	Minor injuries; no						
		adverse effects $> C$	adverse effects $> C$ hospit		hospitalization $> C$						
	N Consequences less C		Cor	nsequences less than	Consequences less than						
		than those for Low	those	for Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

## Table 9.12 Thermal Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Hot Work	Hazard: N/A	L: C: R:	See Section 1, Chapter 4.	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			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (even	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (eve	ent) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Η	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		<b>IV</b> = situation (ev	vent) of minimal concern	enc	М	Π	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	Ŧ				
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	$\mathbf{C} >$ Irreversible.	$\mathbf{C} > \mathbf{F}$	rompt worker fatality	$\mathbf{C} \ge \text{Prompt worker}$	ons	L	III	ш	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects.	or	acute injury that is	fatality or acute injury that	С	Ν	IV	IV	IV	IV
Acronyms		or symptoms which	i	immediately life-	is immediately life-				•		
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	ently threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective		e	1 2 2						
		action.									
	Μ	$C \ge Mild$ , transient	C	≥ Serious injury, no	$C \ge$ Serious injury, no						
		adverse effects.	imm	nediate loss of life no	immediate loss of life no						
			per	manent disabilities;	permanent disabilities;						
			hosp	pitalization required.	hospitalization required.						
	L	Mild, transient	Ν	Ainor injuries; no	Minor injuries; no						
		adverse effects $> C$	adverse effects $> C$ hosp		hospitalization $> C$						
	Ν	Consequences less	Cor	sequences less than	Consequences less than						
		than those for Low	those	for Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

# Table 9.13 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: N/A	L: C:	See Section 1, Chapter 4.	L: C:
		R:		R:
Pumps and Motors	Hazard: N/A	L: C: R:	See Section 1, Chapter 4.	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							
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = situation$ (eve	nt) of major concern				Like	lihood			
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (ev	ent) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	ses	Н	Ι	Ι	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	Π	II	ш	IV		
Control(s) Type	C         Offsite (MOI)         Onsite-2 (co-located worker)         Onsite-1 (facility worker)         J	T	ш	ш	TV.	117							
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	$\mathbf{C} \geq $ Irreversible,	$\mathbf{C} \ge \mathbf{P}$	Prompt worker fatality	$C \ge Prompt worker$	ons		III	ш	11	IV		
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or	acute injury that is	fatality or acute injury that is immediately life- threatening or	0	Ν	IV	IV	IV	IV		
Acronyms		or symptoms which	i	immediately life-									
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently									
		individual's ability to		disabling.	permanently disabling.								
		take protective		C									
		action.											
	Μ	$C \ge Mild$ , transient	<b>C</b> 2	≥ Serious injury, no	$C \ge$ Serious injury, no								
		adverse effects.	imm	ediate loss of life no	immediate loss of life no								
			per	manent disabilities;	permanent disabilities;								
			hosp	pitalization required.	hospitalization required.								
	L	Mild, transient	Ν	Ainor injuries; no	Minor injuries; no								
		adverse effects $> C$	h	ospitalization > C	hospitalization > C								

N	J	Consequences less	Consequences less than	Consequences less than	
		than those for Low	those for Low Consequence	those for Low	l
		Consequence Level	Level	Consequence Level	l

### Table 9.14 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: N/A	L:	See Section 1, Chapter 4.	L:
		C:		C:
		R:		R:
Pumps and	Hazard: N/A	L:	See Section 1, Chapter 4.	L:
Motors		C:		C:
		R:		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)	Risł	x Matri	x			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = situation$ (eve	ent) of major concern				Like	lihood	
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern		1	A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	s	Н	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	edu				TV.	117
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	$C \ge$ Irreversible.	$\mathbf{C} \ge \mathbf{P}$	rompt worker fatality	$C \ge Prompt worker$	ons	L	ш	ш	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)	= Mitigative (reduces event consequences) yms other serious effects, or or symptoms which			acute injury that is fatality or acute injury that			Ν	IV	IV	IV	IV
Acronyms				mmediately life-	is immediately life-						
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective		e	1 2 2						
		action.									
	М	$C \ge Mild$ , transient	<b>C</b> ≥	≥ Serious injury, no	$C \ge$ Serious injury, no						
		adverse effects.	imm	ediate loss of life no	immediate loss of life no						
		permar		manent disabilities;	permanent disabilities;						
	ĥ			pitalization required.	hospitalization required.						
	L	Mild, transient	N	Ainor injuries; no	Minor injuries; no						
		adverse effects > C	h	ospitalization > C	hospitalization > C						

## Table 9.15 Kinetic Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power Tools	Hazard: N/A	L: C:	See Section 1, Chapter 4.	L: C:
		R:		R:
Pumps and Motors	Hazard: N/A	L: C:	See Section 1, Chapter 4.	L: C:
11201013		R:		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						
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \text{High}$		$\mathbf{I} = situation (even$	nt) of major concern				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	ses	Н	Ι	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	Π	II	ш	IV	
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	T	ш	ш	TV.	117	
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	H	$\mathbf{C} \geq$ Irreversible,	$\mathbf{C} \ge \mathbf{P}$	Prompt worker fatality	$C \ge$ Prompt worker fatality or acute injury that	ons	L	III	ш	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or	acute injury that is		0	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	immediately life-		is immediately life-				•	•		
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or							
		individual's ability to	disabling.		permanently disabling.							
		take protective		C	1 5 6							
		action.										
	М	$\mathbf{C} \ge \mathbf{Mild}$ , transient	<b>C</b> 2	≥ Serious injury, no	$C \ge$ Serious injury, no							
		adverse effects.	imm	ediate loss of life no	immediate loss of life no							
			per	manent disabilities;	permanent disabilities;							
			hosp	pitalization required.	hospitalization required.							
	L	Mild, transient	Ν	Ainor injuries; no	Minor injuries; no							
		adverse effects $> C$	h	ospitalization > C	hospitalization > C							

# Table 9.16 Potential Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Compressed	Hazard: N/A	L:	See Section 1, Chapter 4.	L:
Gasses		C:		C:
		R:		R:
Vacuum /	Hazard: N/A	L:	See Section 1, Chapter 4.	L:
Pressure Vessel/		C:		C:
Piping		R:		R:
Material	Hazard: N/A	L:	See Section 1, Chapter 4.	L:
Handling		C:		C:
		R:		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					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	ent) of major concern			Likelihood			
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{O}\mathbf{P}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}O$		$\mathbf{II} = \text{situation}$ (ev	ent) of concern		1	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə					
<b>P</b> = Preventive (reduce event occurrence likelihood)	н	$\mathbf{C} > $ Irreversible	C > P	Prompt worker fatality	C > Prompt worker	Suc	L	Ш	ш	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects	or	acute injury that is	fatality or acute injury that	Ŭ	Ν	IV	IV	IV	IV
Acronyms		or symptoms which	immediately life-		is immediately life-						
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or						
		individual's ability to	unou	disabling.	permanently disabling.						
		take protective			r8.						
		action.									
	М	$C \ge Mild$ , transient	<b>C</b> 2	≥ Serious injury, no	$C \ge$ Serious injury, no						
		adverse effects.	imm	nediate loss of life no	immediate loss of life no						
			per	manent disabilities;	permanent disabilities;						
			hosp	pitalization required.	hospitalization required.						

L	Mild, transient	Minor injuries; no	Minor injuries; no
	adverse effects $> C$	hospitalization $> C$	hospitalization > C
Ν	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 9.17 Potential Energy – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Compressed	Hazard: N/A	L:	See Section 1, Chapter 4.	L:
Gasses		C:		C:
		R:		R:
Vacuum /	Hazard: N/A	L:	See Section 1, Chapter 4.	L:
Pressure		C:		C:
Vessels/ Piping		R:		R:
Material	Hazard: N/A	L:	See Section 1, Chapter 4.	L:
Handling		C:		C:
		R:		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)	Ris	Risk Matrix					
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = situation$ (eve	ent) of major concern			Likelihood				
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (ev	ent) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV	
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə						
<b>P</b> = Preventive (reduce event occurrence likelihood)	н	$\mathbf{C} > $ Irreversible	C > P	Prompt worker fatality	$\mathbf{C} > \mathbf{Prompt}$ worker	Suc	L	Ш	ш	IV	IV	
$\mathbf{M} = \mathbf{M}$ itigative (reduces event consequences)		other serious effects	or	acute injury that is	fatality or acute injury that	Ŭ	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	immediately life-		is immediately life-							
MOI = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or							
		individual's ability to	un out	disabling.	permanently disabling.							
		take protective		uisuomigi	permanenti j unuering.							
		action.										
	М	$C \ge Mild$ , transient	<b>C</b> ≥	≥ Serious injury, no	$C \ge$ Serious injury, no							
		adverse effects.	imm	ediate loss of life no	immediate loss of life no							
			per	manent disabilities;	permanent disabilities;							
			hosp	pitalization required.	hospitalization required.							

L	Mild, transient	Minor injuries; no	Minor injuries; no
	adverse effects $> C$	hospitalization $> C$	hospitalization > C
Ν	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 9.18 Potential Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Compressed	Hazard: N/A	L:	See Section 1, Chapter 4.	L:
Gasses		C:		C:
		R:		R:
Vacuum /	Hazard: N/A	L:	See Section 1, Chapter 4.	L:
Pressure		C:		C:
Vessels/ Piping		R:		R:
Material	Hazard: N/A	L:	See Section 1, Chapter 4.	L:
Handling		C:		C:
		R:		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)	Risł	x Matri	x			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = situation$ (eve	nt) of major concern			Likelihood			
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{O}\mathbf{P}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}O$		$\mathbf{II} = \text{situation}$ (ev	ent) of concern		1	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (e	vent) of minor concern	es	Н	Ι	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə					
<b>P</b> = Preventive (reduce event occurrence likelihood)	н	C > Irreversible	$\mathbf{C} > \mathbf{P}$	Prompt worker fatality	C > Prompt worker	Suo	L	III	ш	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects	or	acute injury that is	fatality or acute injury that	Ŭ	Ν	IV	IV	IV	IV
Acronyms		or symptoms which	or symptoms which immediately life-		is immediately life-						
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an			threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective		U	1 2 2						
		action.									
	М	$C \ge Mild$ , transient	<b>C</b> 2	≥ Serious injury, no	$C \ge$ Serious injury, no						
		adverse effects.	imm	nediate loss of life no	immediate loss of life no						
			per	manent disabilities;	permanent disabilities;						
			hosp	pitalization required.	hospitalization required.						

L	Mild, transient	Minor injuries; no	Minor injuries; no
	adverse effects $> C$	hospitalization $> C$	hospitalization > C
Ν	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 9.19 Other hazards – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Noise	Hazard: N/A	L: C: R:	See Section 1, Chapter 4.	L: C: R:
Silica	Hazard: N/A	L: C: R:	See Section 1, Chapter 4.	L: C: R:
Ergonomics	Hazard: N/A	L: C: R:	See Section 1, Chapter 4.	L: C: R:
Working at Heights	Hazard: N/A	L: C: R:	See Section 1, Chapter 4.	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	Consequence (C, of event)/year Risk (R, Qualitative Ranking) Ri				Ris	Risk Matrix					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (even	nt) of major concern				Likelihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (eve	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		III = situation (ev	vent) of minor concern	S	Н	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	Π	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	equ	Ţ			11.7	
<ul><li><b>P</b> = Preventive (reduce event occurrence likelihood)</li><li><b>M</b> = Mitigative (reduces event consequences)</li></ul>	н	$C \ge$ Irreversible, other serious effects,	$C \ge F$ or	Prompt worker fatality acute injury that is	$\mathbf{C} \ge \text{Prompt worker}$ fatality or acute injury that	Cons	L N	III IV	III IV	IV IV	IV IV
Acronyms		or symptoms which	i	immediately life-	is immediately life-						
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective		2							
		action.									

М	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$\mathbf{C} \geq \mathbf{Serious}$ 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
Ν	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 9.20 Other hazards – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Noise	Hazard: N/A	L: C: R:	See Section 1, Chapter 4.	L: C: R:
Silica	Hazard: N/A	L: C: R:	See Section 1, Chapter 4.	L: C: R:
Ergonomics	Hazard: N/A	L: C: R:	See Section 1, Chapter 4.	L: C: R:
Working at Heights	Hazard: N/A	L: C: R:	See Section 1, Chapter 4.	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	С	onsequence (C, of event)	)/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Likelihood			
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern		1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV	
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	equ						
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood) $\mathbf{M}$ = Mitigative (reduces event consequences)	Н	$\begin{array}{c c c c c c c c c c c c c c c c c c c $		Prompt worker fatality acute injury that is	$C \ge$ Prompt worker fatality or acute injury that	Cons	L N	III IV	III IV	IV IV	IV IV	
MOL = Maximally-exposed Offsite Individual		or symptoms which	i	immediately life-	is immediately life-							
<b>WOT</b> = Maximuny exposed offshe mervidual		could impair an	threat	tening or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective										
		action.										

М	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$\mathbf{C} \ge \mathbf{Serious}$ 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
Ν	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 9.21 Other hazards – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Noise	Hazard: N/A	L: C: R:	See Section 1, Chapter 4.	L: C: R:
Silica	Hazard: N/A	L: C: R:	See Section 1, Chapter 4.	L: C: R:
Ergonomics	Hazard: N/A	L: C: R:	See Section 1, Chapter 4.	L: C: R:
Working at Heights	Hazard: N/A	L: C: R:	See Section 1, Chapter 4.	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			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	$\mathbf{I}$ = situation (event) of major concern				Likelihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edu					
<ul> <li>P = Preventive (reduce event occurrence likelihood)</li> <li>M = Mitigative (reduces event consequences)</li> <li>Acronyms</li> <li>MOI = Maximally-exposed Offsite Individual</li> </ul>	H	C ≥ Irreversible, other serious effects, or symptoms which could impair an	$C \ge P$ or i threat	Prompt worker fatality acute injury that is immediately life- tening or permanently	C ≥ Prompt worker fatality or acute injury that is immediately life- threatening or	Cone	N	IV	IV	IV	IV
		individual's ability to take protective action.		disabling.	permanently disabling.						

М	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$\mathbf{C} \ge \mathbf{Serious}$ 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
Ν	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 9.22 Access & Egress – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Egress	hazardous area in case of an emergency. In the MINOS Underground, this would be an ODH or fire alarm. In the MINOS Surface Building, this would be a fire alarm or tornado warning.	C: H R: I	<ul> <li>Training. The most important part of this training concerns Life Safety Egress.</li> <li>P- In the case of a power outage, all Life Safety systems are powered by a large diesel generator: emergency lights, elevators, cranes (so the personnel basket to underground can be used), and air handling units (AHUs).</li> <li>M- First action on hearing an ODH or fire alarm underground is to exit to the Positive Pressure Emergency Passageway which should prevent smoke or toxic fumes from entering the area.</li> <li>M- Normally, workers should exit the underground via the main elevator. In the event the elevator is not working, the group should first call the emergency number X3131. If instructed to do so, the group should use the Secondary Escape Route explained in the MINOS Underground training and indicated with signs. The group may also be instructed to carry or use EEBDs.</li> </ul>	C: N R: IV
			M- In the MINOS Surface Building, workers should go to the Assembly Area in the parking lot in the case of a fire alarm and go to the Tornado Shelter in the mechanical room in the case of a tornado warning.	

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)	Risl	x Matri	X				
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	$\mathbf{I}$ = situation (event) of major concern				Likelihood			
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (ev	ent) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	event) of minimal concern		М	Π	II	III	IV	
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edn	т	TTT	ш	TV.	TV.	
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	$\mathbf{C} >$ Irreversible.	<b>C</b> > <b>F</b>	Prompt worker fatality	$\mathbf{C} \geq \text{Prompt worker}$	ons	L	111	ш	IV	1V	
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or	acute injury that is	fatality or acute injury that	C	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	i	immediately life-	is immediately life-							

<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or
		individual's ability to	disabling.	permanently disabling.
		take protective		
		action.		
	Μ	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$\mathbf{C} \ge \mathbf{Serious}$ 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
	Ν	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 9.23 Access & Egress – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety Egress	Hazard: Inability to leave hazardous area in case of an emergency. In the MINOS Underground, this would be an ODH or fire alarm. In the MINOS Surface Building, this would be a fire alarm or tornado warning.	L: A C: H R: I	<ul> <li>P- All MINOS Underground workers must take MINOS Underground Training. All tourists must receive a Safety Briefing, and sign a tour sheet to indicate they received this. The most important part of these concern Life Safety Egress.</li> <li>P- In the case of a power outage, all Life Safety systems are powered by a large diesel generator: emergency lights, elevators, cranes (so the personnel basket to underground can be used), and air handling units (AHUs).</li> <li>M- First action on hearing an ODH or fire alarm underground is to exit to the Positive Pressure Emergency Passageway which should prevent smoke or toxic fumes from entering the area.</li> <li>M- Normally, workers should exit the underground via the main elevator. In the event the elevator is not working, the group should first call the emergency number X3131. If instructed to do so, the group should use the Secondary Escape Route explained in the MINOS Underground training or the Safety Briefing for tourists and indicated with signs. The group may also be instructed to carry or use EEBDs.</li> <li>M- In the MINOS Surface Building, workers should go to the Assembly Area in the parking lot in the case of a fire alarm, and go to the Tornado Shelter in the mechanical room in the case of a tornado warning</li> </ul>	L: EU C: N R: IV

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					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \text{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (ev	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	s	Н	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	IV = situation (event) of minimal concern		М	II	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edn		тт		13.7	117
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	н	$\mathbf{C} >$ Irreversible.	$\mathbf{C} > \mathbf{P}$	Prompt worker fatality	$\mathbf{C} \ge \text{Prompt worker}$	suo	L	ш	ш	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or	acute injury that is	fatality or acute injury that	C	Ν	IV	IV	IV	IV

Acronyms		or symptoms which	immediately life-	is immediately life-
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or
		individual's ability to	disabling.	permanently disabling.
		take protective		
		action.		
	M	$C \ge Mild$ , transient	$\mathbf{C} \geq $ Serious injury, no	$\mathbf{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
	Ν	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 9.24 Access & Egress – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety Egress	Hazard: There are no life safety egress hazards outside the MINOS Surface Building.	L: BEU C: N R: IV	No further analysis required.	L: BEU C: N R: IV

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.													
Likelihood (L, of event)/year	Consequence (C, of event)/year			Risk (R, Qualitative	sk (R, Qualitative Ranking)			Risk Matrix					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$	$\mathbf{H} = \mathrm{High}$			$\mathbf{I}$ = situation (event) of major concern				Likelihood					
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{O}\mathbf{P}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}O$		$\mathbf{II} = \text{situation}$ (eve	ent) of concern			А	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathrm{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III		
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV		
Control(s) Type	С	C Offsite (MOI) Ons		e-2 (co-located worker)	Onsite-1 (facility worker)								
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	н	C > Irreversible	<b>C</b> > F	Prompt worker fatality	$\mathbf{C} > \text{Prompt worker}$	Suo	L	Ш	ш	IV	IV		
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects.	or	acute injury that is	fatality or acute injury that	Ŭ	Ν	IV	IV	IV	IV		
Acronyms		or symptoms which	i	immediately life-	is immediately life-								
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or								
		individual's ability to		disabling.	permanently disabling.								
		take protective		C	1 2 2								
		action.											
	Μ	$\mathbf{C} \ge $ Mild, transient	C	≥ Serious injury, no	$C \ge$ Serious injury, no								
		adverse effects.	imm	nediate loss of life no	immediate loss of life no								
			per	manent disabilities;	permanent disabilities;								
			hosj	pitalization required.	hospitalization required.								
	L	Mild, transient	Ν	Minor injuries; no	Minor injuries; no								
		adverse effects $> C$	h	ospitalization $> C$	hospitalization > C								
		Consequences less	Cor	nsequences less than	Consequences less than								
		than those for Low	those	for Low Consequence	those for Low								
		Consequence Level		Level	Consequence Level								

### Table 9.25 Environmental Hazards

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Hazard to Air	Hazard: N/A	L: C: R:	See Section 1, Chapter 4.	L: C: R:
Hazard to Water	Hazard: N/A	L: C: R:	See Section 1, Chapter 4.	L: C: R:
Hazard to Soil	Hazard: N/A	L: C: R:	See Section 1, Chapter 4.	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	Consequence (C, of event)/year			Risk (R, Qualitative Ranking)		Ris	k Matr	ix	x			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I}$ = situation (event) of major concern								
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	П	II	III	IV	
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə						
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	н	<b>C</b> > Irreversible	$\mathbf{C} > \mathbf{F}$	Prompt worker fatality	C > Prompt worker	suo	L	111	ш	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects.	or	acute injury that is	fatality or acute injury that	Ŭ	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	i	immediately life-	is immediately life-							
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective		C	1 5 6							
		action.										
		$C \ge Mild$ , transient	C	≥ Serious injury, no	$C \ge$ Serious injury, no							
		adverse effects.	imm	nediate loss of life no	immediate loss of life no							
			per	manent disabilities;	permanent disabilities;							
			hosp	pitalization required.	hospitalization required.							

L	Mild, transient	Minor injuries; no	Minor injuries; no
	adverse effects $> C$	hospitalization $> C$	hospitalization > C
Ν	Consequences less	Consequences less than	Consequences less than
	than those for Low	those for Low Consequence	those for Low
	Consequence Level	Level	Consequence Level