Table 22. Summary of Baseline and Residual Risks – Meson Switchyard 120 Experimental Areas

	Risk Tables Description	Baseline Risk	Residual Risk
22,1	Radiological – Onsite-1 Facility Worker	R: IV	R: IV
22.2	Radiological – Onsite-2 Co-located Worker	R: IV	R: IV
22.3	Radiological – MOI Offsite	R: IV	R: IV
22.4	Toxic Materials – Onsite 1 Facility Worker	R: *	R: *
22.5	Toxic Materials – Onsite 2 Co-located Worker	R: *	R: *
22.6	Toxic Materials – MOI Offsite	R: *	R: *
22.7	Flammable & Combustible Materials – Onsite-1 Facility Worker	R: *	R: *
22.8	Flammable & Combustible Materials – Onsite-2 Co-located worker	R: *	R: *
22.9	Flammable & Combustible Materials – MOI Offsite	R: *	R: *
22.10	Electrical Energy – Onsite-1 Facility Worker	R: *	R: *
22.11	Electrical Energy – Onsite-2 Co-located Worker	R: *	R: *
22.12	Electrical Energy – MOI Offsite	R: *	R: *
22.13	Thermal Energy – Onsite-1 Facility Worker	R: I	R: IV
22.14	Thermal Energy – Onsite-2 Co-located Worker	R: I	R: IV
22.15	Thermal Energy – MOI Offsite	R: *	R: *
22.16	Kinetic Energy – Onsite-1 Facility Worker	R: I	R: IV
22.17	Kinetic Energy – Onsite-2 Co-located Worker	R: I	R: IV
22.18	Kinetic Energy – MOI Offsite	R: *	R: *
22.19	Potential Energy- Onsite-1 Facility Worker	R: I	R: IV
22.20	Potential Energy – Onsite-2 Co-located Worker	R: *	R: *
22.21	Potential Energy – MOI Offsite	R: *	R: *
22.22	Magnetic Fields – Onsite-1 Facility Worker	R: I	R: III, IV
22.23	Magnetic Fields – Onsite-2 Co-located Worker	R: I	R: III, IV
22.24	Magnetic Fields – MOI Offsite	R: IV	R: IV
22.25	Other Hazards – Onsite-1 Facility Worker	R: *	R: *
22.26	Other Hazards – Onsite-2 Co-located Worker	R: *	R: *
22.27	Other Hazards – MOI Offsite	R: *	R: *
22.28	Access & Egress – Onsite-1 Facility Worker	R: *	R: *
22.29	Access & Egress – Onsite-2 Co-located Worker	R: *	R: *
22.30	Access & Egress – MOI Offsite	R: *	R: *
22.31	Environmental Hazards	R: *	R: *

<sup>\*</sup> 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 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 22.1 Radiological – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual	Hazard:	L: A	P – Radiological worker training	L: A
activation	Positioning detector components in the path of the beam may result in activation of the components. Experiments wish to take equipment offsite upon project completion.	C: N R: IV	<ul> <li>P – Radiological work permit as relevant</li> <li>M – Any item in a beam enclosure during beam-on conditions is removed and surveyed by radiological workers and classified appropriately</li> <li>M – Any item requiring shipment or unrestricted release is surveyed and processed by Radiological Control organization personnel in accordance with FRCM chapter 4.</li> <li>M – Run Conditions to ensure total radiation levels are within expected parameters</li> </ul>	C: N R: IV
Groundwater Activation	Hazard:  • Radionuclides in groundwater exceed regulatory levels.	L: A C: N R: IV	<ul> <li>M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment.</li> <li>M - Facility designs employ shielding to mitigate the production of activation products in groundwater</li> <li>M - Run Conditions to ensure total radiation levels are within expected parameters</li> </ul>	L: A C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Surface Water Activation	Hazard:  • Radionuclides in surface water exceed regulatory levels.	L: A C: N R: IV	<ul> <li>M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment.</li> <li>M - Facility designs employ shielding to mitigate the production of activation products in surface water</li> <li>M - Run Conditions to ensure total radiation levels are within expected parameters</li> </ul>	L: A C: N R: IV
Air Activation	Hazard:  • Radionulcides in air exceed regulatory levels.	L: A C: N R: IV	<ul> <li>M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment.</li> <li>M - Run Conditions to ensure total radiation levels are within expected parameters</li> </ul>	L: A C: N R: IV
Soil Interactions	Hazard:  • Scattered beam has potential to activate soil at low levels calculated in the shield assessment.	L: A C: N R: IV	P – No excavation work without an RWP  M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment.  M – Run Conditions to ensure total radiation levels are within expected parameters  M – Beam dump to contain radiation	L: U C: N R: IV

Hazard	lazard Hazard Description		Hazard Description  Risk (without controls)  Preventative (P)/ Mitigative (M)		
Radioactive	Hazard:	L: A	P – Radiological worker training	L: U	
waste	• Activation potential is low in these spaces and experiments typically remove equipment upon completion. Any materials that cannot be cleared and removed by an experiment are subject to the labs radioactive waste program.	C: N R: IV	<ul> <li>M – Any item in a beam enclosure during beam-on conditions is removed and surveyed by radiological workers and classified appropriately (typically class 0 at these facilities).</li> <li>M – Any item identified for disposal is surveyed and processed by Radiological Control organization personnel in accordance with FRCM chapter 4.</li> </ul>	C: N R: IV	
Contamination	<ul> <li>Hazard:         <ul> <li>Potential contaminated items brought into facility by experimenters.</li> </ul> </li> <li>Potential contamination from beam activation (M03)</li> </ul>	L: A C: N R: IV L: A C: N R: IV	P – Radiological control prescreens items with contamination potential prior to acceptance. If contamination exists, the item is rejected.  M – Radiological worker training to recognize hazard  M – RCT coverage and job specific RWP as determined by the RSO M – Contamination wipes to monitor space and equipment	L: U C: N R: IV L: A C: N R: IV	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
<sup>7</sup> Be	Hazard: • Potential radiation exposure to 7Be	L: A C: N R: IV	Not Applicable. No prevention or mitigation is required. <sup>7</sup> Be isn't hazardous in this pattern of use by facility.	L: A C: N R: IV
	(uptake/committed dose).			
Radioactive	Hazard:	L: A	P – All low activity sealed sources are kept in a lock box and	L: EU
Sources	<ul> <li>Various low activity sealed</li> </ul>	C: N	registered through Radiological Control.	C: N
	sources (Sr-90, Co-60, CS-137, Fe-55, Ru-106, etc.)	R: IV	P – Radiological training is required for source handling.	R: IV
Non-ionizing	Hazard:	L:	See Section I, Chapter 4	L:
Radiation		C:		C:
Hazards		R:		R:

Likelihood (L, of event)/year	Consequence (C, of event)/year		Risk (R, Qualitative Ranking)		Risk	Matri	X				
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (even)	t) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (even}$	nt) of concern	_		A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		<b>III</b> = situation (event) of minor concern		es	Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \text{Negligible}$		<b>IV</b> = situation (event) of minimal concern		ences	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nba	_				
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> 25.0 rem		C <sup>3</sup> 100 rem	C <sup>3</sup> 100 rem	ons	L	III	III	IV	IV
$\mathbf{M} = \mathbf{Mitigative}$ (reduces event consequences)	M	25.0 rem > <b>C</b> <sup>3</sup> 5 rem	100	0 rem > C <sup>3</sup> 25 rem	100 rem > C <sup>3</sup> 25 rem	S	N	IV	IV	IV	IV
Acronyms	L	5 rem > <b>C</b>		25 rem > C	25 rem > <b>C</b>						
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	N	0.5 rem > <b>C</b>		5 rem > <b>C</b>	5 rem > C						

Table 22.2 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:  • Positioning detector components in the path of the beam may result in activation of the components. Experiments wish to take equipment offsite upon project completion.	L: A C: N R: IV	<ul> <li>P – GERT training at minimum to recognize hazard</li> <li>M – Any item in a beam enclosure during beam-on conditions is removed and surveyed by radiological workers and classified appropriately</li> <li>M – Any item requiring shipment or unrestricted release is surveyed and processed by Radiological Control organization personnel in accordance with FRCM chapter 4.</li> </ul>	L: U C: N R: IV
Groundwater Activation	Hazard:  • Radionuclides in groundwater exceed regulatory levels.	L: A C: N R: IV	<ul> <li>M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment.</li> <li>M - Facility designs employ shielding to mitigate the production of activation products in groundwater</li> <li>M - Run Conditions to ensure total radiation levels are within expected parameters</li> </ul>	L: A C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Surface Water Activation	Hazard:  • Radionuclides in surface water exceed regulatory levels.	L: A C: N R: IV	<ul> <li>M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment.</li> <li>M - Facility designs employ shielding to mitigate the production of activation products in surface water</li> <li>M - Run Conditions to ensure total radiation levels are within expected parameters</li> </ul>	L: A C: N R: IV
Air Activation	Hazard:  • Radionulcides in air exceed regulatory levels.	L: A C: N R: IV	<ul> <li>M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment.</li> <li>M - Run Conditions to ensure total radiation levels are within expected parameters</li> </ul>	L: A C: N R: IV
Soil Interactions	Hazard:  • Scattered beam has potential to activate soil at low levels calculated in the shield assessment.	L: A C: N R: IV	P – No excavation work without an RWP  M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment.  M – Run Conditions to ensure total radiation levels are within expected parameters  M – Beam dump to contain radiation	L: U C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive waste	Hazard:  • Activation potential is low in these spaces and experiments typically remove equipment upon completion. Any materials that cannot be cleared and removed by an experiment are subject to the labs radioactive waste program.	L: A C: N R: IV	<ul> <li>P – GERT training provides recognition further training required</li> <li>M – Any item in a beam enclosure during beam-on conditions is removed and surveyed by radiological workers and classified appropriately (typically class 0 at these facilities).</li> <li>M – Any item identified for disposal is surveyed and processed by Radiological Control organization personnel in accordance with FRCM chapter 4.</li> </ul>	L: U C: N R: IV
Contamination	<ul> <li>Potential contaminated items brought into facility by experimenters.</li> <li>Potential contamination from beam activation (M03)</li> </ul>	L: A C: N R: IV L: A C: N R: IV	<ul> <li>P – Radiological control prescreens items with contamination potential prior to acceptance. If contamination exists the item is rejected.</li> <li>P – GERT training provides recognition further training required</li> <li>M – RCT coverage and job specific RWP as determined by the RSO M – Contamination wipes to monitor space and equipment</li> </ul>	L: U C: N R: IV L: A C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
<sup>7</sup> Be	Hazard:	L: A	Not Applicable. No prevention or mitigation is required. <sup>7</sup> Be isn't	L: A
	<ul> <li>Potential radiation</li> </ul>	C: N	hazardous in this pattern of use by facility.	C: N
	exposure to 7Be	R: IV		R: IV
	(uptake/committed dose).			
Radioactive	Hazard:	L: A	P – All low activity sealed sources are kept in a lock box and	L: EU
Sources	<ul> <li>Various low activity sealed</li> </ul>	C: N	registered through Radiological Control.	C: N
	sources (Sr-90, Co-60, CS-	R: IV	P – GERT provides recognition that source training is required	R: IV
	137, Fe-55, Ru-106, etc.)			
Non-ionizing	Hazard:	L:	See Section I, Chapter 4	L:
Radiation		C:		C:
Hazards		R:		R:

Radiological 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							
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (even	t) of major concern				Like	lihood		
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (even}$	nt) 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 (eve	ent) of minor concern	es	Н	I	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = $ Negligible		<b>IV</b> = situation (event) of minimal concern		ienc	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsit	te-2 (co-located worker)	Onsite-1 (facility worker)	sedu		TTT	TTT	13.7	13.7	
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> 25.0 rem		C <sup>3</sup> 100 rem	C <sup>3</sup> 100 rem	ons	L	III	III	IV	IV	
<b>M</b> = Mitigative (reduces event consequences)	M	25.0 rem > <b>C</b> <sup>3</sup> 5 rem	10	00 rem > C <sup>3</sup> 25 rem	100 rem > C <sup>3</sup> 25 rem	C	N	IV	IV	IV	IV	
Acronyms	L	5 rem > <b>C</b>		25 rem > <b>C</b>	25 rem > <b>C</b>							
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	N	0.5 rem > <b>C</b>		5 rem > <b>C</b>	5 rem > C							

**Table 22.3 Radiological – MOI Offsite** 

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual activation	Hazard:  • Positioning detector components in the path of the beam may result in activation of the components. Experiments wish to take equipment offsite upon project completion.	L: BEU C: N R: IV	No further analysis required; this hazard is not accessible to the public in this segments pattern of use	L: BEU C: N R: IV
Groundwater Activation	Hazard:  • Scattered beam has potential to activate ground water at low levels calculated in the shield assessment.	L: BEU C: N R: IV	No further analysis required	L: BEU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Surface Water Activation	Hazard:  • Scattered beam has potential to activate surface water at low levels calculated in the shield assessment.	L: BEU C: N R: IV	No further analysis required	L: BEU C: N R: IV
Air Activation	Hazard:  • Scattered beam has potential to activate air at low levels calculated in the shield assessment.	L: BEU C: N R: IV	No further analysis required	L: BEU C: N R: IV
Soil Interactions	Hazard:  • Scattered beam has potential to activate soil at low levels calculated in the shield assessment.	L: BEU C: N R: IV	No further analysis required	L: BEU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive waste	Hazard:  • Activation potential is low in these spaces and experiments typically remove equipment upon completion. Any materials that cannot be cleared and removed by an experiment are subject to the labs radioactive waste program.	L: BEU C: N R: IV	No further analysis required; this hazard is not accessible to the public in this segments pattern of use	L: BEU C: N R: IV
Contamination	Hazard:  • Potential contaminated items brought into facility by experimenters.	L: BEU C: N R: IV	No further analysis required; this hazard is not accessible to the public in this segments pattern of use	L: BEU C: N R: IV
<sup>7</sup> Be	Hazard:  • Potential radiation exposure to 7Be (uptake/committed dose).	L: A C: N R: IV	Not Applicable. No prevention or mitigation is required. <sup>7</sup> Be isn't hazardous in this pattern of use by facility.	L: A C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive	Hazard:	L: BEU	No further analysis required; this hazard is not accessible to the	L: BEU
Sources	<ul> <li>Various low activity sealed</li> </ul>	C: N	public in this segments pattern of use	C: N
	sources (Sr-90, Co-60, CS-	R: IV		R: IV
	137, Fe-55, Ru-106, etc.)			
Non-ionizing	Hazard:	L:	See section I, chapter 4	L:
Radiation		C:	•	C:
Hazards		R:		R:

Radiological Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.													
Likelihood (L, of event)/year	Likelihood (L, of event)/year   Consequence (C, of event)/year   Risk (R, Qualitative Ranking)						Risk Matrix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (even	t) of major concern			Likelihood					
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (even}$	nt) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		<b>III</b> = situation (eve	ent) of minor concern	ences	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			M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsi	te-2 (co-located worker)	Onsite-1 (facility worker)	nbə	_	TTT	777	77.7	TY 7		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> 25.0 rem		C <sup>3</sup> 100 rem	C <sup>3</sup> 100 rem	ons	L	III	III	IV	IV		
<b>M</b> = Mitigative (reduces event consequences)	M	25.0 rem > <b>C</b> <sup>3</sup> 5 rem	10	00 rem > C <sup>3</sup> 25 rem	100 rem > C <sup>3</sup> 25 rem	С	N	IV	IV	IV	IV		
Acronyms	L	5 rem > <b>C</b>		25 rem > C	25 rem > <b>C</b>								
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	N	0.5 rem > <b>C</b>		5 rem > <b>C</b>	5 rem > C								

Table 22.4 Toxic Materials – Onsite 1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative	Preventative (P)/	Residual Qualitative
nazaru	Hazard Description	Risk	Mitigative (M)	Risk (with controls)

		(without controls)		
Lead*	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Beryllium*	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Liquid	Hazard:	L:	See Section I, Chapter 4	L:
Scintillator		C:		C:
		R:		R:
Nanoparticle	Hazard:	L:	See Section I, Chapter 4	L:
Exposures		C:		C:
		R:		R:

Chemical 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 Ranking)			Risk Matrix					
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	<b>I</b> = situation (event) of major concern				Like	lihood		
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		<b>II</b> = situation (event) of concern				Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		<b>III</b> = 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 (ev	vent) of minimal concern	enc	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	equ	т	Ш	Ш	IV	IV	
	Н	C 3 PAC-2		C <sup>3</sup> PAC-3	C <sup>3</sup> IDLH	Ouo	L	111	111	1 V	1 V	
<b>M</b> = Mitigative (reduces event consequences)	M	PAC-2 > C 3 PAC-1	PA	AC-3 > C 3 PAC-2	IDLH > C 3 PEL or TLVc		N	IV	IV	IV	IV	

Acronyms	L	PAC-1 > <b>C</b>	PAC-2 > C	PEL or $TLV_c > C$
<b>IDLH</b> = Immediately Dangerous to Life and Health	N	Consequences less	Consequences less than	Consequences less than
MOI = Maximally-exposed Offsite Individual		than those for Low	those for Low Consequence	those for Low
PAC = Protective Action Criteria		Consequence Level	Level	Consequence Level
<b>PEL</b> = Permissible Exposure Limit				
$TLV_c$ = Threshold Limit Value (ceiling)				

**Table 22.5 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 *	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Beryllium*	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Liquid	Hazard:	L:	See Section I, Chapter 4	L:
Scintillator		C:		C:
		R:		R:
Nanoparticle	Hazard:	L:	See Section I, Chapter 4	L:
Exposures		C:		C:
		R:		R:

Chemical 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)			Matri	x			
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	I = situation (event) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (ev}$	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		<b>III</b> = situation (e	vent) of minor concern	es	Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		<b>IV</b> = situation (ev	vent) of minimal concern	ences	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edn	_	TTT	777	***	***
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C 3 PAC-2		C 3 PAC-3	C 3 IDLH	ons	L	III	III	IV	IV
$\mathbf{M} = \text{Mitigative (reduces event consequences)}$	М	PAC-2 > C 3 PAC-1	P	AC-3 > C <sup>3</sup> PAC-2	IDLH > C <sup>3</sup> PEL or TLV <sub>c</sub>	S	N	IV	IV	IV	IV
Acronyms	L	PAC-1 > <b>C</b>		PAC-2 > <b>C</b>	PEL or $TLV_c > C$						
<b>IDLH</b> = Immediately Dangerous to Life and Health	N	Consequences less	Cor	nsequences less than	Consequences less than						
<b>MOI</b> = Maximally-exposed Offsite Individual		than those for Low		for Low Consequence	those for Low						
<b>PAC</b> = Protective Action Criteria		Consequence Level	urose	Level	Consequence Level						
<b>PEL</b> = Permissible Exposure Limit		Consequence Lever		Level	Consequence Lever						
$TLV_c$ = Threshold Limit Value (ceiling)											

**Table 22.6 Toxic Materials – MOI Offsite** 

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Lead*	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Beryllium*	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Liquid	Hazard:	L:	See Section I, Chapter 4	L:
Scintillator		C:		C:
		R:		R:
Nanoparticle	Hazard:	L:	See Section I, Chapter 4	L:
Exposures		C:		C:
		R:		R:

Chemical 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			
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern							
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H} = \text{situation (ev}$	ent) of concern		1	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		<b>III</b> = situation (e	vent) of minor concern		Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		<b>IV</b> = situation (ev	vent) of minimal concern	ences	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edn		TTT	***	77.7	***
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C 3 PAC-2		C 3 PAC-3	C 3 IDLH	ons	L	III	III	IV	IV
$\mathbf{M} = \text{Mitigative (reduces event consequences)}$	М	PAC-2 > C 3 PAC-1	P	AC-3 > C <sup>3</sup> PAC-2	IDLH > C <sup>3</sup> PEL or TLV <sub>c</sub>	S	N	IV	IV	IV	IV
Acronyms	L	PAC-1 > <b>C</b>		PAC-2 > <b>C</b>	PEL or $TLV_c > C$			•			
<b>IDLH</b> = Immediately Dangerous to Life and Health	N	Consequences less	Cor	nsequences less than	Consequences less than						
<b>MOI</b> = Maximally-exposed Offsite Individual		than those for Low		for Low Consequence	those for Low						
<b>PAC</b> = Protective Action Criteria		Consequence Level	urose	Level	Consequence Level						
<b>PEL</b> = Permissible Exposure Limit		Consequence Lever		Level	Consequence Lever						
$TLV_c$ = Threshold Limit Value (ceiling)											

Table 22.7 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	Hazard:	L:	See Section I, Chapter 4	L:
materials		C:		C:
(cables, Boxes,		R:		R:
Paper, wood				
cribbing, etc.)				
Flammable	Hazard:	L:	See Section I, Chapter 4	L:
Materials		C:		C:
(Flammable gas,		R:		R:
cleaning				
materials, etc.)				

Other Hazard Consequences, derived from Figure C-	1, "F	Example Qualitative Cons	sequence Matrix", DOE-HD	BK-1163-2020.							
Likelihood (L, of event)/year	C	onsequence (C, of event)/	Risk	Matr	ix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$	I = situation (eve	nt) of major concern				Likelihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situation (ev}$	ent) of concern	l	1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$	$III = situation (e^{-1})$	vent) of minor concern	nces	Н	I	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (evolution)	vent) of minimal concern	lenc	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sedner	ī	III	III	IV	IV	
<b>P</b> = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	Cons						
<b>M</b> = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is		N	IV	IV	IV	IV	
Acronyms		symptoms which	immediately life-	immediately life-							
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or							
		individual's ability to	disabling.	permanently disabling.							
		take protective									
		action.									
	M	C <sup>3</sup> Mild, transient	C <sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no							
		adverse effects.	immediate loss of life no	immediate loss of life no							
			permanent disabilities;	permanent disabilities;							
			hospitalization required.	hospitalization required.							
	L	Mild, transient	Minor injuries; no	Minor injuries; no							
		adverse effects > C	hospitalization > C	hospitalization > C							
	N	Consequences less	Consequences less than	Consequences less than							
		than those for Low	those for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

Table 22.8 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	Hazard:	L:	See Section I, Chapter 4	L:
materials		C:		C:
(cables, Boxes,		R:		R:
Paper, wood				
cribbing, etc.)				
Flammable	Hazard:	L:	See Section I, Chapter 4	L:
Materials		C:		C:
(Flammable gas,		R:		R:
cleaning				
materials, etc.)				

Other Hazard Consequences, derived from Figure C-	1, "E	xample Qualitative Cons	equence Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/y	Risk	Matri	ix							
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$	I = situation (eve	<b>I</b> = situation (event) of major concern				Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{H} = \text{situation (ev}$	ent) of concern		1	Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$	<b>III</b> = situation (e	vent) of minor concern	ses	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		N = Negligible	$IV = situation (e^{-1})$	vent) of minimal concern	enc	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	III	III	IV	IV		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	111	111	1 V	1 V		
<b>M</b> = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is		N	IV	IV	IV	IV		
Acronyms		symptoms which	immediately life-	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 <sup>3</sup> Mild, transient	C <sup>3</sup> Serious injury, no	C <sup>3</sup> 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 $> \mathbf{C}$								
	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 22.9 Flammable and Combustible Materials – MOI Offsite** 

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Combustible	Hazard:	L:	See Section I, Chapter 4	L:
materials		C:		C:
(cables, Boxes,		R:		R:
Paper, wood				
cribbing, etc.)				
Flammable	Hazard:	L:	See Section I, Chapter 4	L:
Materials		C:		C:
(Flammable gas,		R:		R:
cleaning				
materials, etc.)				

Other Hazard Consequences, derived from Figure C-	1, "F	Example Qualitative Cons	sequence Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/	Risk	Matr	ix							
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$	I = situation (eve	I = situation (event) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situation (ev}$	ent) of concern	l ——	1	Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$	<b>III</b> = situation (e <sup>x</sup>	vent) of minor concern	nces	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (evaluation)	vent) of minimal concern	lenc	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sedner	ī	III	III	IV	IV		
<b>P</b> = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	Cons							
<b>M</b> = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is		N	IV	IV	IV	IV		
Acronyms		symptoms which	immediately life-	immediately life-								
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective										
		action.										
	M	C <sup>3</sup> Mild, transient	C <sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization $> C$								
	N	Consequences less	Consequences less than	Consequences less than								
		than those for Low	those for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

Table 22.10 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	Hazard:	L:	See Section I, Chapter 4	L:
Exposure		C:		C:
		R:		R:
High Voltage	Hazard:	L:	See Section I, Chapter 4	L:
Exposure		C:		C:
		R:		R:
Low Voltage,	Hazard:	L:	See Section I, Chapter 4	L:
High Current		C:		C:
Exposure.		R:		R:

Other Hazard Consequences, derived from Figure C-	1, "F	Example Qualitative Cons	sequence	e Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	consequence (e) or eveno//jeur lines (ii) Quantum (e)					Matri	ix			
$\mathbf{A} = \text{Anticipated } (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern					Likelihood		
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H} = \text{situation (ev}$	·			A	Ū	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		`	vent) of minor concern	sea	Н	1	1	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \text{Negligible}$		,	vent) of minimal concern	l ien	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2	(co-located worker)	Onsite-1 (facility worker)	Consequences	I	III	III	IV	IV
<b>P</b> = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> Irreversible, other	C 3 Pro	mpt worker fatality	C <sup>3</sup> Prompt worker fatality	]   ŭ					
$\mathbf{M} = \text{Mitigative (reduces event consequences)}$		serious effects, or	or ac	cute injury that is	or acute injury that is		N	IV	IV	IV	IV
Acronyms		symptoms which	imi	mediately life-	immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	threaten	ning or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective									
		action.									
	M	C <sup>3</sup> Mild, transient	C 3 S	Serious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	immed	diate loss of life no	immediate loss of life no						
			perma	anent disabilities;	permanent disabilities;						
			hospita	alization required.	hospitalization required.						
	L	Mild, transient	Mir	nor injuries; no	Minor injuries; no						
		adverse effects > C	hosp	pitalization > C	hospitalization $> \mathbf{C}$						
	N	Consequences less	Conse	equences less than	Consequences less than						
		than those for Low	those for	or Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

**Table 22.11 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	Hazard:	L:	See Section I, Chapter 4	L:
Exposure		C:		C:
		R:		R:
High Voltage	Hazard:	L:	See Section I, Chapter 4	L:
Exposure		C:		C:
		R:		R:
Low Voltage,	Hazard:	L:	See Section I, Chapter 4	L:
High Current		C:		C:
Exposure.		R:		R:

Other Hazard Consequences, derived from Figure C-1	l, "F	Example Qualitative Cons	equence Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/	Risk	Matr	ix							
$\mathbf{A} = \text{Anticipated } (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathbf{High}$	I = situation (eve	= situation (event) 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	l —	1	Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$	· ·	vent) of minor concern	nces	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	· ·	vent) of minimal concern	ien	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sedner	T	III	III	IV	IV		
<b>P</b> = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	Con							
<b>M</b> = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is		N	IV	IV	IV	IV		
Acronyms		symptoms which	immediately life-	immediately life-								
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective										
		action.										
	M	C <sup>3</sup> Mild, transient	C <sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization > C								
	N	Consequences less	Consequences less than	Consequences less than								
		than those for Low	those for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

Table 22.12 Electrical Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Stored Energy	Hazard:	L:	See Section I, Chapter 4	L:
Exposure		C:		C:
		R:		R:
High Voltage	Hazard:	L:	See Section I, Chapter 4	L:
Exposure		C:		C:
		R:		R:
Low Voltage,	Hazard:	L:	See Section I, Chapter 4	L:
High Current		C:		C:
Exposure.		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, Qualitativ	e Ranking)	Risk	Matri	ix				
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$	I = situation (ev	ent) of major concern			Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situation (e}$	vent) of concern	l	1	A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$	III = situation (	event) of minor concern	ses	Н	I	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (	event) of minimal concern	lenc	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	III	III	IV	IV	
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	ous	L	111	111	1 V	1 V	
<b>M</b> = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is immediately life-		N	IV	IV	IV	IV	
Acronyms		symptoms which	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									
	M	action.									
		C <sup>3</sup> Mild, transient	C <sup>3</sup> Serious injury, no	C <sup>3</sup> 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							
		Consequences less Consequences less than Consequences less than									
			those for Low Consequence								
		Consequence Level	Level	Consequence Level							

Table 22.13 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:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Cryogenics	Hazard:	ODH for		ODH
		MTest/MCenter	ODH	L: BEU
	Cryogenics are inherently a low risk on	L: A	P – TSW flags intended cryogenics for SME review prior to arrival	C: N
	their own as they are non-flammable and	C: N	P – SMEs produce engineering notes on piping and vessel system and ODH	R: IV
non-toxic.		R: IV	calculations. At present all amounts of cryogenic liquids in these spaces are ODH 0 or rejected	
	However, if exposed to the cryogenic		P – ORC process has SMEs review installed system and documentation prior to	Burns
	liquids, they have the potential of burning	Burns	operation	L: BEU
	skin and creating an oxygen deficient	L: A		C:M
	atmosphere which can lead to death.	C: H	Burns	R: IV
		R: I	P – Cryogenic system designed and reviewed by qualified personnel	
	The exposure of the hazard to the facility		P – WPC process provides instructions for use	
worker is of major concern.			P - Protective clothing rules are enforced when working in areas with exposure to	
			cryogenic liquids.	
			P- Training required for all personnel handling cryogenics	
			M – Onsite Emergency services are provided	

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									
$\mathbf{A} = \text{Anticipated (L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern				Likelihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		<b>II</b> = 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 (ev	(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 (ev	situation (event) of minimal concern		M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	l nba				***	
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C 3 P	Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	III	III	IV	IV
<b>M</b> = Mitigative (reduces event consequences)		serious effects, or		acute injury that is	or acute injury that is	ŭ	N	IV	IV	IV	IV

Acronyms		symptoms which	immediately life-	immediately life-
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or
		individual's ability to	disabling.	permanently disabling.
		take protective		
		action.		
	M	C <sup>3</sup> Mild, transient	C <sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no
		adverse effects.	immediate loss of life no	immediate loss of life no
			permanent disabilities;	permanent disabilities;
			hospitalization required.	hospitalization required.
	L	Mild, transient	Minor injuries; no	Minor injuries; no
		adverse effects > C	hospitalization $> C$	hospitalization $> C$
	N	Consequences less	Consequences less than	Consequences less than
		than those for Low	those for Low Consequence	those for Low
		Consequence Level	Level	Consequence Level

Table 22.14 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 4	L: C: R:
Cryogenics	Hazard:  Cryogenics are inherently a low risk on their own as they are non-flammable and non-toxic.  However, if exposed to the cryogenic liquids, they have the potential of burning skin and creating an oxygen deficient atmosphere which can lead to death.  The exposure of the hazard to the facility worker is of major concern.	ODH L: A C: N R: IV  Burns L: A C: H R: I	P – TSW flags intended cryogenics for SME review prior to arrival P – SMEs produce engineering notes on piping and vessel system and ODH calculations. At present all amounts of cryogenic liquids in these spaces are ODH 0 or rejected P – ORC process has SMEs review installed system and documentation prior to operation  P – Cryogenic system designed and reviewed by qualified personnel P – WPC process provides instructions for use P - Protective clothing rules are enforced when working in areas with exposure to cryogenic liquids. P- Training required for all personnel handling cryogenics M – Onsite Emergency services are provided	ODH L: BEU C: N R: IV  Burns L: BEU C:M R: IV

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)	Ri	sk Ma	trix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern	ļ			Likeliho					
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (ev}$	ent) of concern	_		A	Ţ	J	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		<b>III</b> = situation (ex	vent) of minor concern		B I	I	]		II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		<b>IV</b> = situation (event) of minimal concern		enc	N	1 II	I	I	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	l De	;   _	ı III	II	т	IV	IV		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	<b>C</b> <sup>3</sup> P	Prompt worker fatality	C <sup>3</sup> Prompt worker fatality			, 111	11	.1	1 V	1 V		
$\mathbf{M} = \text{Mitigative (reduces event consequences)}$		serious effects, or	, and the second		or acute injury that is		,   1	1 IV	Г	V	IV	IV		
Acronyms		symptoms which	j	immediately life-	immediately life-									

MOI = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or
		individual's ability to	disabling.	permanently disabling.
		take protective		
		action.		
	M	C <sup>3</sup> Mild, transient	C <sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no
		adverse effects.	immediate loss of life no	immediate loss of life no
			permanent disabilities;	permanent disabilities;
			hospitalization required.	hospitalization required.
	L	Mild, transient	Minor injuries; no	Minor injuries; no
		adverse effects $> \mathbf{C}$	hospitalization $> \mathbf{C}$	hospitalization $> \mathbf{C}$
	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 22.15 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:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Cryogenics	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:

Other Hazard Consequences, derived from Figure C-	l, "F	Example Qualitative Con	sequei	nce Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year  A = Anticipated (L > 1.0E-02)	C	onsequence (C, of event) H = High	/year	`	ent) of major concern	Risk	Matri		Like	lihood EU	BEU
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)		$\mathbf{M} = \mathbf{M}$ oderate $\mathbf{L} = \mathbf{L}$ ow $\mathbf{N} = \mathbf{N}$ egligible		,	ent) of concern vent) of minor concern vent) of minimal concern	ences	Н	I	I	II	III
Control(s) Type P = Preventive (reduce event occurrence likelihood)	С	Offsite (MOI)  C <sup>3</sup> Irreversible, other		e-2 (co-located worker) Prompt worker fatality	Onsite-1 (facility worker)  C <sup>3</sup> Prompt worker fatality	nbesu	M L	III	III	IV	IV
<ul> <li>M = Mitigative (reduces event consequences)</li> <li>Acronyms</li> <li>MOI = Maximally-exposed Offsite Individual</li> </ul>		serious effects, or symptoms which could impair an individual's ability to take protective action.	or	acute injury that is immediately life-tening or permanently disabling.	or acute injury that is immediately life-threatening or permanently disabling.	Cor	N	IV	IV	IV	IV
	M	C <sup>3</sup> Mild, transient adverse effects.  Mild, transient	imm per hos	<sup>3</sup> Serious injury, no nediate loss of life no rmanent disabilities; pitalization required. Minor injuries; no	C <sup>3</sup> Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.  Minor injuries; no						
	N	adverse effects > C  Consequences less	h	ospitalization > C  nsequences less than	hospitalization > C  Consequences less than						
	14	than those for Low Consequence Level		for Low Consequence Level	those for Low Consequence Level						

**Table 22.16 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 4	L: C: R:
Pumps and Motors	Hazard:	L: C: R:	See Section I, Chapter 4	L: C: R:
Motion Tables	Hazard:  • Personnel injury due to pinch points, tip-overs, caught in between, crushing.	L: A C: H R: I	P – Engineering notes/ORC procedure P – Safety stops P – Computer authorization for motion table controls P – Physical isolation of system (FTBF absorbers) M – Emergency stop as determined by SME M – Speed restrictions on motor	L: BEU C: L R: IV

Other Hazard Consequences, derived from Figure C-	1, "E	xample Qualitative Cons	equence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/y	vear   Risk (R, Qualitative	Ranking)	Risk	Matri	ix			
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$	I = situation (eve	ent) of major concern					lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{H} = \text{situation (ev}$	ent) of concern		1	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$	<b>III</b> = situation (e	vent) of minor concern	ses	Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		N = Negligible	<b>IV</b> = situation (e	vent) of minimal concern	enc	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	III	III	IV	IV
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	111	111	1 V	1 V
<b>M</b> = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is		N	IV	IV	IV	IV
Acronyms		symptoms which	immediately life-	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 <sup>3</sup> Mild, transient	C <sup>3</sup> Serious injury, no	C <sup>3</sup> 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 $> \mathbf{C}$						
	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 22.17 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 4	L: C: R:
Pumps and Motors	Hazard:	L: C: R:	See Section I, Chapter 4	L: C: R:
Motion Tables	Hazard:  • Personnel injury due to pinch points, tip-overs, caught in between, crushing.	L: A C: H R: I	P – Engineering Notes/ORC procedure evaluates the tables for stability and user safety P – Safety stops (where applicable) prevent injury due to pinch points and getting caught in between events P – Computer authorization to access motion table control systems P – Physical isolation of system (FTBF absorbers) M – Speed restrictions on motor M – General facility HA training to recognize hazard	L: BEU C: L R: IV

Other Hazard Consequences, derived from Figure C-1	l, "E	xample Qualitative Cons	sequen	ce Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year (	Risk (R, Qualitative	Ranking)	Ris	k Mat	rix			
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern				Like	elihood	
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)		$\mathbf{L} = \text{Low}$		III = situation (evaluation	vent) of minor concern	uces	Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern		M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	ī	III	III	IV	IV
P = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> Irreversible, other		rompt worker fatality	C <sup>3</sup> Prompt worker fatality	Cons					
M = Mitigative (reduces event consequences)		serious effects, or	or	acute injury that is	or acute injury that is		N	IV	IV	IV	IV
Acronyms		symptoms which	i	mmediately life-	immediately life-						
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	ening or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective									
		action.									
	M	C <sup>3</sup> Mild, transient	C <sup>3</sup>	Serious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	imm	ediate loss of life no	immediate loss of life no						
			per	manent disabilities;	permanent disabilities;						
			hosp	oitalization required.	hospitalization required.						
	L	Mild, transient	N	Ainor injuries; no	Minor injuries; no						
		adverse effects > C	ho	ospitalization > C	hospitalization > C						

**Table 22.18 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 4	L: C: R:
Pumps and Motors	Hazard:	L: C: R:	See Section I, Chapter 4	L: C: R:
Motion Tables	Hazard:	L: C: R:	See Section I, Chapter 4	L: C: R:

Other Hazard Consequences, derived from Figure C-1	l, "E	Example Qualitative Cons	sequen	ce Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year (	Risk (R, Qualitative	Ranking)	Ris	k Matı	ix			
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (ev}$	ent) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (evaluation	vent) of minor concern	es	Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	ences	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	nbəs		Ш	III	IV	IV
<b>P</b> = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> Irreversible, other	C 3 P	rompt worker fatality	C <sup>3</sup> Prompt worker fatality	Cons					
<b>M</b> = Mitigative (reduces event consequences)		serious effects, or	or	acute injury that is	or acute injury that is		N	IV	IV	IV	IV
Acronyms		symptoms which	i	mmediately life-	immediately life-						
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	ening or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective									
		action.									
	M	C <sup>3</sup> Mild, transient	C <sup>3</sup>	<sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	imm	ediate loss of life no	immediate loss of life no						
			per	manent disabilities;	permanent disabilities;						
			hosp	oitalization required.	hospitalization required.						
	L	Mild, transient	N	Ainor injuries; no	Minor injuries; no						
		adverse effects > C	ho	ospitalization > C	hospitalization > C						

Table 22.19 Potential Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane	Hazard:	L:	See Section I, Chapter 4	L:
Operations		C: R:		C: R:
Compressed	Hazard:	L: A	P – Engineering notes to evaluate ODH for gases brought to facility. All	L: BEU
Gasses	<ul> <li>Personnel injury due to unexpected release, or unsecure tanks.</li> <li>May also present flammability and ODH concerns</li> </ul>	C: H R: I	gas bottles are in quantities to remain ODH 0 for a given enclosure. New or modified piping/manifolds similarly evaluated.  P – TSW and/or ORC process to evaluate gas bottle and distribution installation and operation before use  P: All personnel handling compressed gasses have to take Pressure Safety orientation training.  P: All personnel handling compressed gasses have to take compressed gas cylinder safety training  P: All personnel have to be familiar with FESHM 5000 series and apply requirements.  P: Gas cylinders are secured and capped when not in use.  M: Personal Protective Equipment mitigates severity of injury.	C: M R: IV
Vacuum/	Hazard:	L:	See Section I, Chapter 4	L:
Pressure		C:		C:
Vessels/ Piping		R:		R:
Vacuum Pumps	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Material	Hazard:	L:	See Section I, Chapter 4	L:
Handling		C:		C:
		R:		R:

Likelihood (L, of event)/year	Co	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk	Matri	x			
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	ent) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ev	ent) of concern		,	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (expression)	vent) of minor concern	જ	Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	M	II	П	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edn	_	III	III	IV	IV
<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 <sup>3</sup> Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	or i	rompt worker fatality acute injury that is mmediately life- tening or permanently disabling.	C <sup>3</sup> Prompt worker fatality or acute injury that is immediately life- threatening or permanently disabling.	Consequences	N	IV	IV	IV	IV
	M	C <sup>3</sup> Mild, transient adverse effects.	imm per	Serious injury, no nediate loss of life no manent disabilities; pitalization required.	C <sup>3</sup> Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.						

L	,	Mild, transient	Minor injuries; no	Minor injuries; no
		adverse effects $> \mathbf{C}$	hospitalization $> \mathbf{C}$	hospitalization $> \mathbf{C}$
N	ſ	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 22.20 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	Hazard:	L:	See Section I, Chapter 4	L:
Operations		C:		C:
		R:		R:
Compressed	Hazard:	L:	See Section I, Chapter 4	L:
Gasses		C:		C:
		R:		R:
Vacuum/	Hazard:	L:	See Section I, Chapter 4	L:
Pressure		C:		C:
Vessels/		R:		R:
Piping				
Vacuum Pumps	Hazard:	L:	See Section I, Chapter 4	L:
_		C:	-	C:
		R:		R:
Material	Hazard:	L:	See Section I, 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	Matr	ix	X					
$\mathbf{A} = \text{Anticipated (L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathbf{High}$	I = situation (even)	ent) of major concern				Likelihood					
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{H} = \text{situation (ev}$	<b>II</b> = situation (event) of concern			Α	U	EU	BEU			
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$	$\mathbf{III} = \text{situation } (\epsilon)$	event) of minor concern	uces	Н	I	I	II	III			
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	<b>IV</b> = situation (e	event) of minimal concern	enc	M	II	II	III	IV			
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sedner	ī	III	III	IV	IV			
<b>P</b> = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	Cons								
<b>M</b> = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is		N	IV	IV	IV	IV			
Acronyms		symptoms which	immediately life-	immediately life-									
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or									
		individual's ability to	disabling.	permanently disabling.									
		take protective											
		action.											
	M	C <sup>3</sup> Mild, transient	C <sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no									
		adverse effects.	immediate loss of life no	immediate loss of life no									
			permanent disabilities;	permanent disabilities;									
			hospitalization required.	hospitalization required.									
	L	Mild, transient	Minor injuries; no	Minor injuries; no									
		adverse effects > C	hospitalization > C	hospitalization > C									
	N	Consequences less	Consequences less than	Consequences less than									
		than those for Low	those for Low Consequence	those for Low									
		Consequence Level	Level	Consequence Level									

Table 22.21 Potential Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane	Hazard:	L:	See Section I, Chapter 4	L:
Operations		C:		C:
		R:		R:
Compressed	Hazard:	L:	See Section I, Chapter 4	L:
Gasses		C:		C:
		R:		R:
Vacuum/	Hazard:	L:	See Section I, Chapter 4	L:
Pressure		C:		C:
Vessels/		R:		R:
Piping				
Vacuum Pumps	Hazard:	L:	See Section I, Chapter 4	L:
_		C:	-	C:
		R:		R:
Material	Hazard:	L:	See Section I, 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, Qu	ualitative	Ranking)	Risk	Matri	ix	¥ .						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$	$\mathbf{I} = \operatorname{situ}$	ation (eve	nt) of major concern				Likelihood						
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \operatorname{sitt}$	uation (ev	ent) of concern			Α	U	EU	BEU				
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$	III = si	tuation (ev	vent) of minor concern	ences	Н	I	I	II	III				
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		`	vent) of minimal concern	lenc	M	II	II	III	IV				
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located	worker)	Onsite-1 (facility worker)	sedno	ī	III	III	IV	IV				
<b>P</b> = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker	fatality	C <sup>3</sup> Prompt worker fatality	Cons	L								
<b>M</b> = Mitigative (reduces event consequences)		serious effects, or	or acute injury t	hat is	or acute injury that is		N	IV	IV	IV	IV				
Acronyms		symptoms which	immediately li	immediately life-											
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or pern	nanently	threatening or										
		individual's ability to	disabling.		permanently disabling.										
		take protective													
		action.													
	M	C <sup>3</sup> Mild, transient	C <sup>3</sup> Serious injui	•	C <sup>3</sup> Serious injury, no										
		adverse effects.	immediate loss of		immediate loss of life no										
			permanent disabi		permanent disabilities;										
	_		hospitalization re	•	hospitalization required.										
	L	Mild, transient	Minor injuries		Minor injuries; no										
	<u></u>	adverse effects > C	hospitalization		hospitalization > C										
	N	Consequences less	Consequences les		Consequences less than										
			those for Low Cons	sequence	those for Low										
		Consequence Level	Level		Consequence Level										

Table 22.22 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:  • Exposure to fringe fields beyond allowable limits (worker with ferromagnetic or electronic medical device(s))	L: A C: H R: I	P- Industrial hygiene conducts field surveys to establish safe field boundaries for workers. P- Access control points and individual components of concern (e.g., experiment permanent magnet) have postings to notify workers of magnetic hazard. P – Facility specific hazard awareness training alerting to fringe fields	L: BEU C: H R: III
	• Exposure to fringe fields beyond allowable limits (worker without ferromagnetic or electronic medical device(s))	L: A C: L R: III	P- Industrial hygiene conducts field surveys to establish safe field boundaries for workers. P- Access control points and individual components of concern (e.g., experiment permanent magnet) have postings to notify workers of magnetic hazard. P – Facility specific hazard awareness training alerting to fringe fields	L: BEU C: L R: IV
	• Exposure to flying metallic objects causing potential injury.	L: A C: M R: II	P- Brass tools are used to prevent flying metallic objects from occurring, thereby preventing worker injury as prescribed by relevant magnet SOP P-Work Control procedure/SOP (ferromagnetic object control) requires that all ferromagnetic objects are removed prior to entry into a fringe field area (30G administrative limit). P-Work Control procedure/SOP requires worker training while in areas possessing fringe fields (300 G administrative limit).	L: BEU C: M 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, Qualitativ	e Ranking)	Risk							
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$	$\mathbf{I} = \text{situation (e}$	vent) of major concern				Likelihood				
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)		$\mathbf{L} = \text{Low}$	III = situation	(event) of minor concern	ences	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		(event) of minimal concern	lenc	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	т	III	III	IV	IV		
<b>P</b> = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	Cons		111	111	1 V			
<b>M</b> = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is		N	IV	IV	IV	IV		
Acronyms		symptoms which	immediately life-									
MOI = Maximally-exposed Offsite Individual		could impair an										
		individual's ability to	disabling.	permanently disabling.								
		take protective										
		action.										
	M	C <sup>3</sup> Mild, transient	C <sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
	_		hospitalization required.	hospitalization required.	1							
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
	_	adverse effects > C	hospitalization > C	hospitalization > C	4							
	N	Consequences less	Consequences less than	Consequences less than								
			those for Low Consequenc									
		Consequence Level	Level	Consequence Level								

**Table 22.23 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:  • Exposure to fringe fields beyond allowable limits (worker with ferromagnetic or electronic medical device(s))	L: A C: H R: I	P- Industrial hygiene conducts field surveys to establish safe field boundaries for workers. P- Access control points and individual components of concern (e.g., experiment permanent magnet) have postings to notify workers of magnetic hazard. P – Facility specific hazard awareness training alerting to fringe fields	L: BEU C: H R: III
	• Exposure to fringe fields beyond allowable limits (worker without ferromagnetic or electronic medical device(s))	L: A C: L R: III	P- Industrial hygiene conducts field surveys to establish safe field boundaries for workers. P- Access control points and individual components of concern (e.g., experiment permanent magnet) have postings to notify workers of magnetic hazard. P – Facility specific hazard awareness training alerting to fringe fields	L: BEU C: L R: IV
	• Exposure to flying metallic objects causing potential injury.	L: A C: M R: II	P- Brass tools are used to prevent flying metallic objects from occurring, thereby preventing worker injury as prescribed by relevant magnet SOP P-Work Control procedure/SOP (ferromagnetic object control) requires that all ferromagnetic objects are removed prior to entry into a fringe field area (30G administrative limit). P-Work Control procedure/SOP requires worker training while in areas possessing fringe fields (300 G administrative limit).	L: BEU C: M 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, Qualitativ	e Ranking)	Risk							
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$	$\mathbf{I} = \text{situation (e}$	vent) of major concern				Likelihood				
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)		$\mathbf{L} = \text{Low}$	III = situation	(event) of minor concern	ences	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		(event) of minimal concern	lenc	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	т	III	III	IV	IV		
<b>P</b> = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	Cons		111	111	1 V			
<b>M</b> = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is		N	IV	IV	IV	IV		
Acronyms		symptoms which	immediately life-									
MOI = Maximally-exposed Offsite Individual		could impair an										
		individual's ability to	disabling.	permanently disabling.								
		take protective										
		action.										
	M	C <sup>3</sup> Mild, transient	C <sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
	_		hospitalization required.	hospitalization required.	1							
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
	_	adverse effects > C	hospitalization > C	hospitalization > C	4							
	N	Consequences less	Consequences less than	Consequences less than								
			those for Low Consequenc									
		Consequence Level	Level	Consequence Level								

**Table 22.24 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: BEU C: N R: IV	No fringe fields are accessible to the public, 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	Co	onsequence (C, of event)/	year   Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated (L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathbf{High}$	$\mathbf{I} = \text{situation (even}$	situation (event) of major concern				elihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situation (ev}$	vent) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$	<b>III</b> = situation (e	vent) of minor concern	જ	Н	I	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (e	vent) of minimal concern	enc	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sedneuces		***	***	***	***	
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	Cons	L	III	III	IV	IV	
<b>M</b> = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	၁	N	IV	IV	IV	IV	
Acronyms		symptoms which	immediately life-	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	<u> </u>								
		action.									
	M	C <sup>3</sup> Mild, transient	C <sup>3</sup> Serious injury, no	C <sup>3</sup> 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 $> \mathbf{C}$							
	N Consequences less Cons		Consequences less than	Consequences less than							
		than those for Low	those for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

Table 22.25 Other hazards – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined	Hazard:	L:	See Section I, Chapter 4	L:
Spaces		C:		C:
		R:		R:
Silica	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Ergonomics	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Working at	Hazard:	L:	See Section I, Chapter 4	L:
Heights		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 R	Risk (R, Qualitative	<u>.</u>	Risk	Matri	ix			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		`	nt) of major concern				A U EU B		
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ev	*		**	A	Ū		BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		`	vent) of minor concern	ses	Н	1	1	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		,	vent) of minimal concern	nen	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 (	(co-located worker)	Onsite-1 (facility worker)	Consequences	T	III	III	IV	IV
<b>P</b> = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> Irreversible, other	C 3 Pron	mpt worker fatality	C <sup>3</sup> Prompt worker fatality	) j					
$\mathbf{M} = \text{Mitigative (reduces event consequences)}$				ute injury that is	or acute injury that is		N	IV	IV	IV	IV
Acronyms		symptoms which	imn	mediately life-	immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	threateni	ing or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective									
		action.									
	M	C <sup>3</sup> Mild, transient	C <sup>3</sup> Se	erious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	immedi	iate loss of life no	immediate loss of life no						
			permai	anent disabilities;	permanent disabilities;						
			hospital	alization required.	hospitalization required.						
	L	Mild, transient	Mine	nor injuries; no	Minor injuries; no						
		adverse effects > C	hosp	pitalization > C	hospitalization $> \mathbf{C}$						
	N	Consequences less	Conseq	quences less than	Consequences less than						
		than those for Low	those for	r Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 22.26 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	Hazard:	L:	See Section I, Chapter 4	L:
Spaces		C:		C:
		R:		R:
Silica	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Ergonomics	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Working at	Hazard:	L:	See Section I, Chapter 4	L:
Heights		C:		C:
		R:		R:

Other Hazard Consequences, derived from Figure C-	1, "F	Example Qualitative Cons	sequence	e Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year	Risk (R, Qualitative	<u>.</u>	Risk	Matri	ix			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		•	nt) of major concern			_	A U EU BEU		
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ev	*		**	A	Ū		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		,	vent) of minor concern	ses	Н	1	1	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible			vent) of minimal concern	llen	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	Consequences	ī	III	III	IV	IV
<b>P</b> = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> Irreversible, other	C 3 Pro	ompt worker fatality	C <sup>3</sup> Prompt worker fatality	, on					
$\mathbf{M} = \text{Mitigative (reduces event consequences)}$		serious effects, or	or ac	cute injury that is	or acute injury that is		N	IV	IV	IV	IV
Acronyms		symptoms which	im	nmediately life-	immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	threater	ning or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective									
		action.									
	M	C <sup>3</sup> Mild, transient	C 3 S	Serious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	immed	diate loss of life no	immediate loss of life no						
			perm	nanent disabilities;	permanent disabilities;						
			hospit	talization required.	hospitalization required.						
	L	Mild, transient	Mi	inor injuries; no	Minor injuries; no						
		adverse effects > C	hos	spitalization > C	hospitalization $> \mathbf{C}$						
	N	Consequences less		equences less than	Consequences less than						
		than those for Low	those fo	or Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

**Table 22.27 Other hazards – MOI Offsite** 

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined	Hazard:	L:	See Section I, Chapter 4	L:
Spaces		C:		C:
		R:		R:
Silica	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Ergonomics	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Working at	Hazard:	L:	See Section I, Chapter 4	L:
Heights		C:		C:
		R:		R:

Other Hazard Consequences, derived from Figure C-	1, "F	Example Qualitative Con	sequer	nce Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk	Matr	ix			
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (even)	nt) of major concern					lihood	
U = Unlikely (1.0E-02> L>1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (eve	ent) of concern		ı	A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		<b>III</b> = situation (ev	vent) of minor concern	səc	Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	ienc	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	,	Ш	III	IV	IV
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C 3 P	Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	111	Ш	1 V	1 V
<b>M</b> = Mitigative (reduces event consequences)		serious effects, or		acute injury that is	or acute injury that is	C	N	IV	IV	IV	IV
Acronyms		symptoms which		immediately life-	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									
		action.									
	M	C <sup>3</sup> Mild, transient	<b>C</b> :	<sup>3</sup> Serious injury, no	C <sup>3</sup> 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 $> \mathbf{C}$						
	N	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 22.28 Access & Egress – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety	Hazard:	L:	See Section I, Chapter 4	L:
Egress		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	Co	onsequence (C, of event)/	/year Ris	sk (R, Qualitative	Ranking)	Risk	Matri	x			
$\mathbf{A} = \text{Anticipated } (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (even	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (even}$	ent) of concern		ı	A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		<b>III</b> = 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	secuentes	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 (c	co-located worker)	Onsite-1 (facility worker)	edn		***	777	77.7	***
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prom	pt worker fatality	C <sup>3</sup> Prompt worker fatality	Cons	L	III	III	IV	IV
$\mathbf{M} = \mathbf{Mitigative}$ (reduces event consequences)		serious effects, or		te injury that is	or acute injury that is	၁	N	IV	IV	IV	IV
Acronyms		symptoms which		ediately life-	immediately life-	-					
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatenin	ng or permanently	threatening or						
		individual's ability to	d	disabling.	permanently disabling.						
		take protective		-							
		action.									
	M	C <sup>3</sup> Mild, transient	C 3 Ser	rious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	immedia	ate loss of life no	immediate loss of life no						
			perman	ent disabilities;	permanent disabilities;						
			hospitali	ization required.	hospitalization required.						
	L	Mild, transient	Mino	or injuries; no	Minor injuries; no						
		adverse effects > C	hospit	talization > C	hospitalization $> \mathbf{C}$						
	N	Consequences less		uences less than	Consequences less than						
		than those for Low	those for I	Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 22.29 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	Hazard:	L:	See Section I, Chapter 4	L:
Egress		C:		C:
		R:		R:

Likelihood (L, of event)/year	C	onsequence (C, of event)	year Risk (R, Qualitati	ve Ranking)	Ris	sk Matri	ix		•	•
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$	I = situation (	event) of major concern						
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation	(event) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situation	(event) of minor concern	nces	Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation	(event) of minimal concern	enc	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker	Onsite-1 (facility worker)	mba					
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatalit	C <sup>3</sup> Prompt worker fatality	<u> </u>	L	III	III	IV	IV
<b>M</b> = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	ت ا	N	IV	IV	IV	IV
Acronyms		symptoms which	immediately life-	immediately life-						
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatening or permanent							
		individual's ability to	disabling.	permanently disabling.						
		take protective	•							
		action.								
	M	C <sup>3</sup> Mild, transient	C <sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	immediate loss of life no	immediate loss of life no						
			permanent disabilities;	permanent disabilities;						
			hospitalization required.	hospitalization required.						
	L	Mild, transient	Minor injuries; no	Minor injuries; no						
		adverse effects > C	hospitalization > C	hospitalization > C						
	N	Consequences less	Consequences less than	Consequences less than						
		than those for Low	those for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

**Table 22.30 Access & Egress – MOI Offsite** 

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety	Hazard:	L:	See Section I, Chapter 4	L:
Egress		C:		C:
		R:		R:

Likelihood (L, of event)/year	C	onsequence (C, of event)	/year   Risk (R, Qualitative	Ranking)	Risk	Matri	ix			
$\mathbf{A} = \text{Anticipated } (L > 1.0\text{E}-02)$		$\mathbf{H} = \text{High}$		ent) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	<b>II</b> = situation (e	, ,			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	· ·	event) of minor concern	SS SS	Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	<b>IV</b> = situation (e	event) of minimal concern	ences	М	П	П	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	edno					
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	Suc	L	III	III	IV	IV
<b>M</b> = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	ರ	N	IV	IV	IV	IV
Acronyms		symptoms which	immediately life-	immediately life-		<u>l</u>				
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or						
		individual's ability to	disabling.	permanently disabling.						
		take protective	C							
		action.								
	M	C <sup>3</sup> Mild, transient	C <sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	immediate loss of life no	immediate loss of life no						
			permanent disabilities;	permanent disabilities;						
			hospitalization required.	hospitalization required.						
	L	Mild, transient	Minor injuries; no	Minor injuries; no						
		adverse effects > C	hospitalization > C	hospitalization > C						
	N	Consequences less	Consequences less than	Consequences less than						
		than those for Low	those for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

**Table 22.31 Environmental** 

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Airborne	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Water	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Soil	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R: