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

	Risk Tables Description	Baseline	Residual
		Risk	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: *

\* 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: EU
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	<ul> <li>Hazard:</li> <li>Radionuclides in surface water exceed regulatory levels.</li> </ul>	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	<ul> <li>Hazard:</li> <li>Scattered beam has potential to activate soil at low levels calculated in the shield assessment.</li> </ul>	L: A C: N R: IV	<ul> <li>P – No excavation work without an RWP</li> <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> <li>M – Beam dump to contain radiation</li> </ul>	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	<ul> <li>Hazard:</li> <li>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.</li> </ul>	L: A C: N R: IV	<ul> <li>P – Radiological worker training</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>Hazard:</li> <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>M – Radiological worker training to recognize hazard</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: • 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
Radioactive Sources	Hazard: • Various low activity sealed sources (Sr-90, Co-60, CS- 137, Fe-55, Ru-106, etc.)	L: A C: N R: IV	P – All low activity sealed sources are kept in a lock box and registered through Radiological Control. P – Radiological training is required for source handling.	L: EU C: N R: IV
Non-ionizing Radiation Hazards	Hazard:	L: C: R:	See Section I, Chapter 4	L: C: R:

Radiological Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	(L, of event)/year Consequence (C, of event)/year		Risk (R, Qualitative Ranking)		Risk Matrix							
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I}$ = situation (event) of major concern		oncern		Li		Likelihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{e}\mathbf{r}\mathbf{a}\mathbf{t}\mathbf{e}$		$\mathbf{II} = \text{situation}$ (even	nt) of concern			Α	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	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = $ Negligible		IV = situation (event) of minimal concern		enc	М	II	II	ш	IV	
Control(s) Type	С	Offsite (MOI)	Onsi	te-2 (co-located worker)	Onsite-1 (facility worker)	eđn	т			TV.	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	suo	L	ш	ш	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)	Μ	25.0 rem > C <sup>3</sup> 5 rem	1	00 rem > C <sup>3</sup> 25 rem	100 rem > C <sup>3</sup> 25 rem	C	Ν	IV	IV	IV	IV	
Acronyms	L	5 rem > <b>C</b>		25 rem > C	25 rem > C							
<b>MOI</b> = Maximally-exposed Offsite Individual <b>rem</b> = Roentgen equivalent man	Ν	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	<ul> <li>Hazard:</li> <li>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.</li> </ul>	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	<ul> <li>Hazard:</li> <li>Radionuclides in surface water exceed regulatory levels.</li> </ul>	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	<ul> <li>Hazard:</li> <li>Scattered beam has potential to activate soil at low levels calculated in the shield assessment.</li> </ul>	L: A C: N R: IV	<ul> <li>P – No excavation work without an RWP</li> <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> <li>M – Beam dump to contain radiation</li> </ul>	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	<ul> <li>Hazard:</li> <li>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.</li> </ul>	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>Hazard:</li> <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: EU 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
	Potential radiation	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	• Various low activity sealed	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							
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \text{High}$		$\mathbf{I}$ = situation (event) of major concern					Like	lihood		
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	nt) of concern	-		Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	$\mathbf{L} = \mathbf{Low}$		nt) of minor concern	ences	Н	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = $ Negligible		<b>IV</b> = situation (event) of minimal concern			М	Π	II	III	IV	
Control(s) Type	С	Offsite (MOI)	Onsi	te-2 (co-located worker)	Onsite-1 (facility worker)	equ	T		ш	117	13.7	
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> 25.0 rem		C <sup>3</sup> 100 rem	<b>C</b> <sup>3</sup> 100 rem	ons	L	ш	ш	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)	Μ	25.0 rem > C <sup>3</sup> 5 rem	1	00 rem > C <sup>3</sup> 25 rem	100 rem > C <sup>3</sup> 25 rem	С	Ν	IV	IV	IV	IV	
Acronyms	L	5 rem $>$ C		25 rem > C	25 rem > C							
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	Ν	0.5 rem > <b>C</b>		5 rem > C	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	Hazard:	L: BEU	No further analysis required; this hazard is not accessible to the	L: BEU
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.	R: IV	public in this segments pattern of use	R: IV
Groundwater	Hazard:	L: BEU	No further analysis required	L: BEU
Activation	<ul> <li>Scattered beam has potential to activate ground water at low levels calculated in the shield assessment.</li> </ul>	R: IV		R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Surface Water Activation	<ul> <li>Hazard:</li> <li>Scattered beam has potential to activate surface water at low levels calculated in the shield assessment.</li> </ul>	L: BEU C: N R: IV	No further analysis required	L: BEU C: N R: IV
Air Activation	<ul> <li>Hazard:</li> <li>Scattered beam has potential to activate air at low levels calculated in the shield assessment.</li> </ul>	L: BEU C: N R: IV	No further analysis required	L: BEU C: N R: IV
Soil Interactions	<ul> <li>Hazard:</li> <li>Scattered beam has potential to activate soil at low levels calculated in the shield assessment.</li> </ul>	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	<ul> <li>Hazard:</li> <li>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.</li> </ul>	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	<ul> <li>Hazard:</li> <li>Potential contaminated items brought into facility by experimenters.</li> </ul>	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: BEU 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: BEU 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	• Various low activity sealed	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 Consequence (C, of event)/year			Risk (R, Qualitative R	anking)	Risk Matrix							
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation (even})$	t) of major concern			Likelihood				
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{e}\mathbf{r}\mathbf{a}\mathbf{t}\mathbf{e}$		$\mathbf{II} = situation$ (even	nt) of concern		1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (eve	ent) of minor concern	es	Н	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06>L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (event) of minimal concern		enc	М	II	II	III	IV	
Control(s) Type	С	Offsite (MOI)	Onsit	te-2 (co-located worker)	Onsite-1 (facility worker)	equ	T		ш	17.7	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	Suo	L	ш	ш	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)	Μ	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	Ν	IV	IV	IV	IV	
Acronyms	L	5 rem > <b>C</b>		25 rem > C	25 rem > C							
<b>MOI</b> = Maximally-exposed Offsite Individual <b>rem</b> = 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 Risk	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
--------	--------------------	---------------------------------	-------------------------------------	--

		(without controls)		
Lead*	Hazard:	L: C:	See Section I, Chapter 4	L: C:
Beryllium*	Hazard:	R: L:	See Section I, Chapter 4	R: L:
		C: R:		C: R:
Liquid Scintillator	Hazard: Airborne exposure via outgassing oil	L: A C: L R: III	<ul> <li>P – TSW and ORC process for SME to screen hazard and establish appropriate protections and work planning for use</li> <li>P - A job-specific hazard analysis and procedure will prescribe Personal Protective Equipment (PPE) to prevent worker contact with the liquid scintillator.</li> <li>P - Detectors, once filled, will completely contain the scintillator, resulting in no further exposure.</li> <li>P - A secondary containment membrane that has the capacity to contain 100% of the liquid scintillator oil will prevent a release to the environment.</li> <li>M - Emergency spill equipment, an eye wash and PPE will be stationed near the detector in the event of a release.</li> </ul>	L: BEU C: N R: IV
Nanoparticle Exposures	Hazard:	L: C:	See Section I, Chapter 4	L: C:

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

Likelihood (L, of event)/year	Consequence (C, of event)/year		Risk (R, Qualitative	Risk (R, Qualitative Ranking)			Risk Matrix					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	$\mathbf{I}$ = situation (event) of major concern				Likelihood			
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern		1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	М	II	II	Ш	IV	
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	Ţ					
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> PAC-2		C <sup>3</sup> PAC-3	C <sup>3</sup> IDLH	ons		III	ш	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)	М	$PAC-2 > C^{3}PAC-1$	P	$AC-3 > C^{3} PAC-2$	IDLH > $C^{3}$ PEL or TLV <sub>c</sub>	Ö	Ν	IV	IV	IV	IV	
Acronyms	L	PAC-1 > C		PAC-2 > C	PEL or $TLV_c > C$						•	
<b>IDLH</b> = Immediately Dangerous to Life and Health	Ν	Consequences less	Cor	nsequences less than	Consequences less than							
<b>MOI</b> = Maximally-exposed Offsite Individual	- 1	than those for Low	those	for Low Consequence	those for Low							
<b>PAC</b> = Protective Action Criteria		Consequence Level	those	I evel	Consequence Level							
<b>PEL</b> = Permissible Exposure Limit		Consequence Lever		Level	Consequence Lever							
TLV <sub>c</sub> = 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: C: R:	See Section I, Chapter 4	L: C: R:
Beryllium*	Hazard:	L: C: R:	See Section I, Chapter 4	L: C: R:
Liquid Scintillator	Hazard: Airborne exposure via outgassing oil	L: A C: L R: III	<ul> <li>P – TSW and ORC process for SME to screen hazard and establish appropriate protections and work planning for use</li> <li>P - A job-specific hazard analysis and procedure will prescribe Personal</li> <li>Protective Equipment (PPE) to prevent worker contact with the liquid scintillator.</li> <li>P - Detectors, once filled, will completely contain the scintillator, resulting in no further exposure.</li> <li>P - A secondary containment membrane that has the capacity to contain</li> <li>100% of the liquid scintillator oil will prevent a release to the environment.</li> <li>M - Emergency spill equipment, an eye wash and PPE will be stationed near the detector in the event of a release.</li> </ul>	L: BEU C: N R: IV
Nanoparticle Exposures	Hazard:	L: C: R:	See Section I, Chapter 4	L: C: 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	litative Ranking)			Risk Matrix							
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern			Likelihood							
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (ev	ent) of concern			А	U	EU	BEU				
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (ev	vent) of minor concern	s	Η	Ι	Ι	Π	III				
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV				
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə									
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> PAC-2		C <sup>3</sup> PAC-3	C <sup>3</sup> IDLH	ons	L	III	ш	IV	IV				
$\mathbf{M} = $ Mitigative (reduces event consequences)	М	$PAC-2 > C^{3}PAC-1$	P	$AC-3 > C^{3} PAC-2$	$IDLH > C^{3} PEL \text{ or } TLV_{c}$	Ŭ	Ν	IV	IV	IV	IV				
Acronyms	L	PAC-1 > C		PAC-2 > C	$\frac{PEL \text{ or } TLV_{c} > C}{PEL \text{ or } TLV_{c} > C}$	L									
<ul> <li>IDLH = Immediately Dangerous to Life and Health</li> <li>MOI = Maximally-exposed Offsite Individual</li> <li>PAC = Protective Action Criteria</li> <li>PEL = Permissible Exposure Limit</li> <li>TLV = Thrasheld Limit Value (aziling)</li> </ul>	N	Consequences less than those for Low Consequence Level	Cor those	nsequences less than for Low Consequence Level	Consequences less than those for Low Consequence Level										

#### 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: C: R:	See Section I, Chapter 4	L: C: R:
Beryllium*	Hazard:	L: C: R:	See Section I, Chapter 4	L: C: R:
Liquid Scintillator	Hazard: <u>Airborne exposure via</u> outgassing oil-	L: EU C: N R: IV	<ul> <li>P – Access controls to area prevent contact.</li> <li>P - Detectors, once filled, will completely contain the scintillator, resulting in no further exposure.</li> <li>P - A secondary containment membrane that has the capacity to contain 100% of the liquid scintillator oil will prevent a release to the environment.</li> </ul>	L: BEU C: N R: IV
Nanoparticle Exposures	Hazard:	L: C: R:	See Section I, Chapter 4	L: C: 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 Matrix						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = $ Negligible		IV = situation (ev	vent) of minimal concern	enc	М	Π	Π	Ш	IV		
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edn	т	ш	ш	TV.	11/		
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> PAC-2		C <sup>3</sup> PAC-3	C <sup>3</sup> IDLH	suo	L	ш	ш	IV	IV		
$\mathbf{M} = $ Mitigative (reduces event consequences)	М	PAC-2 > C <sup>3</sup> PAC-1	P	AC-3 > C <sup>3</sup> PAC-2	IDLH > $C^{3}$ PEL or TLV <sub>c</sub>	0	Ν	IV	IV	IV	IV		
Acronyms	L	PAC-1 > C		PAC-2 > C	PEL or $TLV_c > C$								
<b>IDLH</b> = Immediately Dangerous to Life and Health <b>MOI</b> = Maximally-exposed Offsite Individual	Ν	Consequences less	Cor	nsequences less than	Consequences less than								
PAC = Protective Action Criteria PEL = Permissible Exposure Limit		than those for Low Consequence Level	those	for Low Consequence Level	those for Low Consequence Level								
TLV <sub>c</sub> = 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	l, "E	xample Qualitative Con	seque	nce Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk	Matri	x					
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Likelihood				
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern		1	Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	М	II	Π	III	IV		
Control(s) Type	С	Offsite (MOI) Onsite-2		e-2 (co-located worker)	Onsite-1 (facility worker)	edu	T		ш	117	13.7		
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other C <sup>3</sup> Pro		Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	ш	ш	1V	IV		
$\mathbf{M} = \mathbf{Mitigative}$ (reduces event consequences)		serious effects, or or a		acute injury that is	or acute injury that is	C	Ν	IV	IV	IV	IV		
Acronyms		symptoms which ir		immediately life-	immediately life-				•				
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	could impair an threat		threatening or								
		individual's ability to		disabling.	permanently disabling.								
		take protective											
		action.											
	Μ	C <sup>3</sup> Mild, transient	C	<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;								
			hos	pitalization required.	hospitalization required.								
	L	Mild, transient	Mild, transient Mi		Minor injuries; no								
		adverse effects $> C$	adverse effects $> C$ hosp		hospitalization > C								
	Ν	Consequences less Conse		nsequences 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	l, "E	xample 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	Matri	x					
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (even	nt) of major concern				Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (eve	ent) of concern	r	1	Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	М	II	П	ш	IV		
Control(s) Type	С	Offsite (MOI) Onsite-2		e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	т	TIT	ш	TV.	11.7		
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> Irreversible, other C <sup>3</sup> Pro		Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	suo	L	ш	ш	IV	IV		
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or or a		acute injury that is	or acute injury that is	C	Ν	IV	IV	IV	IV		
Acronyms		symptoms which in		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.											
	Μ	C <sup>3</sup> Mild, transient	C	<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;								
			hos	pitalization required.	hospitalization required.								
	L	Mild, transient M		Minor injuries; no	Minor injuries; no								
		adverse effects $> C$	adverse effects $> C$ hosp		hospitalization > C								
	N Consequences less Cons		nsequences 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	l, "E	xample 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	Matri						
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{O}\mathbf{P}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}O$		$\mathbf{II} = \text{situation}$ (even	ent) of concern		1	Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (ev	vent) of minor concern	ses	Н	Ι	Ι	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	М	II	П	ш	IV		
Control(s) Type	С	Offsite (MOI)	Offsite (MOI) Onsite-2		Onsite-1 (facility worker)	nbə	т	TIT	ш	TV.	11.7		
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other C <sup>3</sup> Pro		Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	suo	L	ш	ш	IV	IV		
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or or a		acute injury that is	or acute injury that is	C	Ν	IV	IV	IV	IV		
Acronyms		symptoms which in		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.											
	Μ	C <sup>3</sup> Mild, transient	C	<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;								
			hosj	pitalization required.	hospitalization required.								
	L	Mild, transient Mi		Minor injuries; no	Minor injuries; no								
		adverse effects $> C$	adverse effects $> C$ hosp		hospitalization > C								
	Ν	N Consequences less Conse		nsequences 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	l, "E	xample 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	Matri	x					
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (even	nt) of major concern				Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (eve	ent) of concern	r	1	Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	М	II	П	ш	IV		
Control(s) Type	С	Offsite (MOI) Onsite-2		e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	т	TIT	ш	TV.	11.7		
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> Irreversible, other C <sup>3</sup> Pro		Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	suo	L	ш	ш	IV	IV		
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or or a		acute injury that is	or acute injury that is	C	Ν	IV	IV	IV	IV		
Acronyms		symptoms which in		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.											
	Μ	C <sup>3</sup> Mild, transient	C	<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;								
			hos	pitalization required.	hospitalization required.								
	L	Mild, transient M		Minor injuries; no	Minor injuries; no								
		adverse effects $> C$	adverse effects $> C$ hosp		hospitalization > C								
	N Consequences less Cons		nsequences less than	Consequences less than									
		than those for Low	those	for 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, "E	xample 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	Matri	x					
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation (even}$	nt) of major concern				Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (eve	ent) of concern	r	1	Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	М	II	П	ш	IV		
Control(s) Type	С	Offsite (MOI) Onsite-2		e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	т	TIT	ш	TV.	11.7		
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other C <sup>3</sup> Pro		Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	ш	ш	IV	IV		
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or or a		acute injury that is	or acute injury that is	C	Ν	IV	IV	IV	IV		
Acronyms		symptoms which in		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.											
	Μ	C <sup>3</sup> Mild, transient	C	<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;								
			hos	pitalization required.	hospitalization required.								
	L	Mild, transient M		Minor injuries; no	Minor injuries; no								
		adverse effects $> C$	adverse effects $> C$ hosp		hospitalization > C								
	Ν	N Consequences less Conse		nsequences 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	l, "E	xample Qualitative Cons	sequer	nce Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year	Risk (R, Qualitative	Ranking)	Risk Matrix							
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{e}\mathbf{r}\mathbf{a}\mathbf{t}\mathbf{e}$		$\mathbf{II} = \text{situation}$ (even	ent) of concern		1	Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	М	II	П	Ш	IV		
Control(s) Type	С	Offsite (MOI) Onsite-2		e-2 (co-located worker)	Onsite-1 (facility worker)	edn	т	TIT	ш	TV.	TV.		
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> Irreversible, other C <sup>3</sup> Pro		rompt worker fatality	C <sup>3</sup> Prompt worker fatality	suo	L	ш	ш	1V	IV		
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or or a		acute injury that is	or acute injury that is	0	Ν	IV	IV	IV	IV		
Acronyms		symptoms which in		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.											
	Μ	C <sup>3</sup> Mild, transient	C	<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;								
			hosj	pitalization required.	hospitalization required.								
	L	Mild, transient	Mild, transient M		Minor injuries; no								
		adverse effects $> C$ hos		ospitalization > C	hospitalization > C								
	Ν	Consequences less Conse		nsequences less than	Consequences less than								
		than those for Low	those	for Low Consequence	those for Low								
		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	ODH	ODH
		L: A	P – TSW flags intended cryogenics for SME review prior to arrival	L: BEU
	Cryogenics are inherently a low risk on	C: N	P – SMEs produce engineering notes on piping and vessel system and ODH	C: N
	their own as they are non-flammable and non-toxic.	R: IV	calculations. At present all amounts of cryogenic liquids in these spaces are ODH 0 or rejected	R: IV
	However if exposed to the emogenic		P – ORC process has SMEs review installed system and documentation prior to	
	liquids, they have the potential of burning		operation	Burns
	skin and creating an oxygen deficient	Burns	Burns	L: BEU
	atmosphere which can lead to death.	L: A	P – Cryogenic system designed and reviewed by qualified personnel	C:M
		C: H	P – WPC process provides instructions for use	R: IV
	The exposure of the hazard to the facility	R: I	P - Protective clothing rules are enforced when working in areas with exposure to	
	worker is of major concern.		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 Consequence (C,			uence (C, of event)/year Risk (R, Qualitative Ranking)					X				
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (ev	ent) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (e	vent) of minor concern	es	Н	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = $ Negligible		<b>IV</b> = situation (e	vent) of minimal concern	enc	М	II	II	III	IV	
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	Ţ					
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	$\mathbf{C}^{3}$ Irreversible other $\mathbf{C}^{3}$ Pro		Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	suo	L		ш	IV	IV	
$\mathbf{M} = \mathbf{M}$ itigative (reduces event consequences)		serious effects, or or ac		acute injury that is	or acute injury that is	Ŭ	Ν	IV	IV	IV	IV	
Acronyms		symptoms which	i	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.		
	Μ	C 3 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
	Ν	Consequences less	Consequences less than	Consequences less than
		than those for Low	those for Low Consequence	those for Low
		Consequence Level	Level	Consequence Level

# Table 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	<ul> <li>Hazard:</li> <li>Cryogenics are inherently a low risk on their own as they are non-flammable and non-toxic.</li> <li>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.</li> <li>The exposure of the hazard to the facility worker is of major concern.</li> </ul>	ODH L: A C: N R: IV Burns L: A C: H R: I	<ul> <li>P – TSW flags intended cryogenics for SME review prior to arrival</li> <li>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</li> <li>P – ORC process has SMEs review installed system and documentation prior to operation</li> <li>P – Cryogenic system designed and reviewed by qualified personnel</li> <li>P – WPC process provides instructions for use</li> <li>P - Protective clothing rules are enforced when working in areas with exposure to cryogenic liquids.</li> <li>P - Training required for all personnel handling cryogenics</li> <li>M – Onsite Emergency services are provided</li> </ul>	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)	Risl	x Matri	X			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	= situation (event) of major concern				Like	lihood	
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (ev	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (e	vent) of minor concern	es	Н	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		<b>IV</b> = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	equ	Ţ		ш		11.7
$\mathbf{P}$ = 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	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	or	acute injury that is	or acute injury that is	Ŭ	Ν	IV	IV	IV	IV
Acronyms		symptoms which	i	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.		
	Μ	C 3 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
	Ν	Consequences less	Consequences less than	Consequences less than
		than those for Low	those for Low Consequence	those for Low
		Consequence Level	Level	Consequence Level

### Table 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-1	l, "E	xample 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 Matrix					
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{e}\mathbf{r}\mathbf{a}\mathbf{t}\mathbf{e}$		$\mathbf{II} = \text{situation}$ (even	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$	$\mathbf{L} = Low$		vent) of minor concern	ses	Н	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = $ Negligible		IV = situation (ev	vent) of minimal concern	enc	М	II	II	ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	T	ш	ш	TV.	TV.
$\mathbf{P}$ = 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	suo	L	ш	ш	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or or acute		acute injury that is	or acute injury that is	C	Ν	IV	IV	IV	IV
Acronyms		symptoms which	symptoms which imm		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.									
	М	C <sup>3</sup> Mild, transient	C	<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;						
			hos	pitalization required.	hospitalization required.						
	L Mild, transient M		Minor injuries; no	Minor injuries; no							
		adverse effects $> C$ hospi		ospitalization > C	hospitalization > C						
N Consequences		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 22.16 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	<ul> <li>Hazard:</li> <li>Personnel injury due to pinch points, tip-overs, caught in between, crushing.</li> </ul>	L: A C: H R: I	<ul> <li>P – Engineering notes/ORC procedure</li> <li>P – Safety stops</li> <li>P – Computer authorization for motion table controls</li> <li>P – Physical isolation of system (FTBF absorbers)</li> <li>M – Emergency stop as determined by SME</li> <li>M – Speed restrictions on motor</li> </ul>	L: BEU C: L R: IV

Other Hazard Consequences, derived from Figure C-1	l, "E	xample Qualitative Con	seque	nce Matrix", DOE-HD	BK-1163-2020.							
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{o}\mathbf{d}\mathbf{e}\mathbf{r}\mathbf{a}\mathbf{t}\mathbf{e}$		$\mathbf{II} = \text{situation}$ (even	ent) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	$\mathbf{L} = \mathbf{Low}$		vent) of minor concern	ses	Н	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = $ Negligible		IV = situation (ev	vent) of minimal concern	enc	М	II	П	Ш	IV	
Control(s) Type	С	Offsite (MOI)	Offsite (MOI) Onsite-2 (co-		Onsite-1 (facility worker)	nbə	т	TIT	ш	TV.	117	
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Irreversible, other C <sup>3</sup> Prompt		C <sup>3</sup> Prompt worker fatality	suo	L	ш	ш	1V	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	serious effects, or or acute		or acute injury that is	C	Ν	IV	IV	IV	IV	
Acronyms		symptoms which	i	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.										
	Μ	C <sup>3</sup> Mild, transient	C	<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;							
			hos	pitalization required.	hospitalization required.							
	L	L Mild, transient Mine		Minor injuries; no	Minor injuries; no							
		adverse effects > C	h	ospitalization > C	hospitalization $> C$							
	Ν	Consequences less Consequ		nsequences 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	<ul> <li>Hazard:</li> <li>Personnel injury due to pinch points, tip-overs, caught in between, crushing.</li> </ul>	L: A C: H R: I	<ul> <li>P – Engineering Notes/ORC procedure evaluates the tables for stability and user safety</li> <li>P – Safety stops (where applicable) prevent injury due to pinch points and getting caught in between events</li> <li>P – Computer authorization to access motion table control systems</li> <li>P – Physical isolation of system (FTBF absorbers)</li> <li>M – Speed restrictions on motor</li> <li>M – General facility HA training to recognize hazard</li> </ul>	L: BEU C: L R: IV

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.													
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year	Risk (R, Qualitative	Ranking)	Risk Matrix							
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	ent) of major concern				Like	lihood			
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (ev	ent) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	ent) of minimal concern	enc	М	II	II	Ш	IV		
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	T	ш	ш	TV.	TV/		
$\mathbf{P}$ = 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	ons	L	ш	ш	IV	IV		
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	or	acute injury that is	or acute injury that is	C	Ν	IV	IV	IV	IV		
Acronyms		symptoms which	symptoms which imme		immediately life-				•				
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or								
		individual's ability to		disabling.	permanently disabling.								
		take protective		Ū.									
		action.											
	Μ	C <sup>3</sup> Mild, transient	<b>C</b> <sup>2</sup>	<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	Ν	Minor injuries; no	Minor injuries; no								
		adverse effects $> C$	h	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:	See Section I, Chapter 4	L: C:
		R:		R:
Pumps and Motors	Hazard:	L: C: R:	See Section I, Chapter 4	L: C: R:
Motion Tables	Hazard:	L:	See Section I, Chapter 4	L:
		C: R:		C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	ent) of major concern				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (ev	ent) of concern		1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathrm{Low}$	$\mathbf{L} = Low$		vent) of minor concern	es	Н	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$	$\mathbf{N} = \mathbf{Negligible}$		ent) of minimal concern		М	II	II	Ш	IV	
Control(s) Type	С	Offsite (MOI)	Offsite (MOI) Onsite-2		Onsite-1 (facility worker)	nbə	T	ш	ш	TV.	TV/	
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Irreversible, other C <sup>3</sup> Pror		C <sup>3</sup> Prompt worker fatality	suo	L	ш	ш	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or or ac		acute injury that is	or acute injury that is	C	Ν	IV	IV	IV	IV	
Acronyms		symptoms which	i	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		Ū								
		action.										
	Μ	C <sup>3</sup> Mild, transient	<b>C</b> <sup>2</sup>	<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	Ν	Minor injuries; no	Minor injuries; no							
		adverse effects $> C$	h	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 Gasses	<ul> <li>Hazard:</li> <li>Personnel injury due to unexpected release, or unsecure tanks.</li> <li>May also present flammability and ODH concerns</li> </ul>	L: A C: H R: I	<ul> <li>P – Engineering notes to evaluate ODH for gases brought to facility. All gas bottles are in quantities to remain ODH 0 for a given enclosure. New or modified piping/manifolds similarly evaluated.</li> <li>P – TSW and/or ORC process to evaluate gas bottle and distribution installation and operation before use</li> <li>P: All personnel handling compressed gasses have to take Pressure Safety orientation training.</li> <li>P: All personnel handling compressed gasses have to take compressed gas cylinder safety training</li> <li>P: All personnel have to be familiar with FESHM 5000 series and apply requirements.</li> <li>P: Gas cylinders are secured and capped when not in use.</li> <li>M: Personal Protective Equipment mitigates severity of injury.</li> </ul>	L: BEU C: M R: IV
Vacuum/ Pressure Vessels/ Piping	Hazard:	L: C: R:	See Section I, Chapter 4	L: C: R:
Vacuum Pumps	Hazard:	L: C: R:	See Section I, Chapter 4	L: C: R:
Material Handling	Hazard:	L: C: R:	See Section I, Chapter 4	L: C: R:

Other Hazard Consequences, derived from Figure C-	1, "E	Example Qualitative Con	ısequei	nce Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	С	onsequence (C, of event	)/year	Risk (R, Qualitative	Ranking)	Ris	x Matr	x			
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \text{High}$	•	$\mathbf{I} = \text{situation}$ (eve	ent) of major concern						
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (ev	ent) of concern			А	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (e	vent) of minor concern	s	Н	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enco	М	П	п	ш	IV
Control(s) Type	С	Offsite (MOI)	Offsite (MOI) Onsite-2 (		Onsite-1 (facility worker)	nba					
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	н	C 3 Irreversible other	3 Irrayarsible other C 3 Prop		C <sup>3</sup> Prompt worker fatality	) SU(	L	III	III	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)	11	serious effects or	or	acute injury that is	or acute injury that is	ŭ	Ν	IV	IV	IV	IV
Acronyms		symptoms which	01	immediately life-							
MOI = Maximally-exposed Offsite Individual		could impair an	threa	tening or permanently	threatening or						
		individual's ability to	uncu	disabling	permanently disabling						
		take protective		disubility.	permanentry disability.						
		action.									
	М	C <sup>3</sup> Mild, transient	С	<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	rmanent disabilities;	permanent disabilities;						
			hos	pitalization required.	hospitalization required.						

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

# Table 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	l, "E	xample Qualitative Con	seque	nce Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk	Matri	X	Σ. C.				
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Like	lihood			
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{e}\mathbf{r}\mathbf{a}\mathbf{t}\mathbf{e}$		$\mathbf{II} = \text{situation}$ (even	ent) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$	$\mathbf{L} = \mathrm{Low}$		vent) of minor concern	ses	Н	Ι	Ι	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = $ Negligible	N = Negligible		vent) of minimal concern	enc	М	II	II	Ш	IV		
Control(s) Type	С	Offsite (MOI)	Offsite (MOI) Onsite-2 (		Onsite-1 (facility worker)	nbə	T	ш	ш	TV.	TV.		
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Irreversible, other C <sup>3</sup> Pro		C <sup>3</sup> Prompt worker fatality	ous	L	ш	ш	1V	IV		
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	serious effects, or or act		or acute injury that is	C	Ν	IV	IV	IV	IV		
Acronyms		symptoms which	symptoms which im		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.											
	М	C <sup>3</sup> Mild, transient	C	<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;								
			hos	pitalization required.	hospitalization required.								
	L	Mild, transient	Ν	Minor injuries; no	Minor injuries; no								
		adverse effects $> C$	h	ospitalization > C	hospitalization > C								
	Ν	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 22.21 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	l, "E	xample Qualitative Cons	sequer	nce Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year	Risk (R, Qualitative	Ranking)	Risk	Matri	x	:				
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (even	nt) of major concern				Like	lihood			
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{e}\mathbf{r}\mathbf{a}\mathbf{t}\mathbf{e}$		$\mathbf{II} = \text{situation}$ (eve	ent) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	$\mathbf{L} = \mathbf{Low}$		vent) of minor concern	ses	Н	Ι	Ι	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$	N = Negligible		vent) of minimal concern	enc	М	II	П	ш	IV		
Control(s) Type	С	Offsite (MOI)	Offsite (MOI) Onsite-2 (		Onsite-1 (facility worker)	nbə	T	TIT	ш	TV.	117		
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Irreversible, other C <sup>3</sup> Pro-		C <sup>3</sup> Prompt worker fatality	ous	L	III	ш	IV	IV		
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	serious effects, or or ac		or acute injury that is	C	Ν	IV	IV	IV	IV		
Acronyms		symptoms which	symptoms which imr		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.											
	М	C <sup>3</sup> Mild, transient	C	<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	Ν	Minor injuries; no	Minor injuries; no								
		adverse effects > C	h	ospitalization > C	hospitalization > C								
	Ν	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 22.22 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	<ul> <li>P- Industrial hygiene conducts field surveys to establish safe field boundaries for workers.</li> <li>P- Access control points and individual components of concern (e.g., experiment permanent magnet) have postings to notify workers of magnetic hazard.</li> <li>P – Facility specific hazard awareness training alerting to fringe fields</li> </ul>	L: BEU C: H R: III
	• Exposure to fringe fields beyond allowable limits (worker <b>without</b> ferromagnetic or electronic medical device(s))	L: A C: L R: III	<ul> <li>P- Industrial hygiene conducts field surveys to establish safe field boundaries for workers.</li> <li>P- Access control points and individual components of concern (e.g., experiment permanent magnet) have postings to notify workers of magnetic hazard.</li> <li>P - Facility specific hazard awareness training alerting to fringe fields</li> </ul>	L: BEU C: L R: IV
	• Exposure to flying metallic objects causing potential injury.	L: A C: M R: II	<ul> <li>P- Brass tools are used to prevent flying metallic objects from occurring, thereby preventing worker injury as prescribed by relevant magnet SOP</li> <li>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).</li> <li>P-Work Control procedure/SOP requires worker training while in areas possessing fringe fields (300 G administrative limit).</li> </ul>	L: BEU C: M R: IV

Other Hazard Consequences, derived from Figure C-1	l, "E	xample Qualitative Con	seque	nce Matrix", DOE-HD	BK-1163-2020.							
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				lihood			
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{M} = \mathbf{M}$ oderate		ent) of concern	r	1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	Π	III	IV	
Control(s) Type	С	Offsite (MOI)	Offsite (MOI) Onsite-2 (		Onsite-1 (facility worker)	nbə	T		ш	TV.	11.7	
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	$C^{3}$ Irreversible, other C <sup>3</sup> Pror		C <sup>3</sup> Prompt worker fatality	ons	L	ш	ш	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	serious effects, or or ac		or acute injury that is	C	Ν	IV	IV	IV	IV	
Acronyms		symptoms which	symptoms which im		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.										
	Μ	C <sup>3</sup> Mild, transient	С	<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;							
			hos	pitalization required.	hospitalization required.							
	L	Mild, transient	Ν	Minor injuries; no	Minor injuries; no							
		adverse effects $> C$	dverse effects $> C$ hospi		hospitalization > C							
	Ν	Consequences less	onsequences less Conseq		Consequences less than							
		than those for Low	those	for Low Consequence	those for Low							
		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	<ul> <li>P- Industrial hygiene conducts field surveys to establish safe field boundaries for workers.</li> <li>P- Access control points and individual components of concern (e.g., experiment permanent magnet) have postings to notify workers of magnetic hazard.</li> <li>P – Facility specific hazard awareness training alerting to fringe fields</li> </ul>	L: BEU C: H R: III
	• Exposure to fringe fields beyond allowable limits (worker <b>without</b> ferromagnetic or electronic medical device(s))	L: A C: L R: III	<ul> <li>P- Industrial hygiene conducts field surveys to establish safe field boundaries for workers.</li> <li>P- Access control points and individual components of concern (e.g., experiment permanent magnet) have postings to notify workers of magnetic hazard.</li> <li>P - Facility specific hazard awareness training alerting to fringe fields</li> </ul>	L: BEU C: L R: IV
	• Exposure to flying metallic objects causing potential injury.	L: A C: M R: II	<ul> <li>P- Brass tools are used to prevent flying metallic objects from occurring, thereby preventing worker injury as prescribed by relevant magnet SOP</li> <li>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).</li> <li>P-Work Control procedure/SOP requires worker training while in areas possessing fringe fields (300 G administrative limit).</li> </ul>	L: BEU C: M R: IV

Other Hazard Consequences, derived from Figure C-1	l, "E	xample 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 Matrix					
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				lihood		
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{e}\mathbf{r}\mathbf{a}\mathbf{t}\mathbf{e}$		$\mathbf{II} = \text{situation}$ (even	ent) of concern		1	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	ses	Н	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	М	II	П	ш	IV
Control(s) Type	С	Offsite (MOI)	Offsite (MOI) Onsite-2 (c		Onsite-1 (facility worker)	nbə	т	TIT	ш	TV.	117
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Irreversible, other C <sup>3</sup> Pror		C <sup>3</sup> Prompt worker fatality	ons	L	ш	ш	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	serious effects, or or act		or acute injury that is	C	Ν	IV	IV	IV	IV
Acronyms		symptoms which	symptoms which imm		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.									
	Μ	C <sup>3</sup> Mild, transient	C	<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;						
			hosj	pitalization required.	hospitalization required.						
	L	Mild, transient	N	Minor injuries; no	Minor injuries; no						
		adverse effects $> C$	h	ospitalization > C	hospitalization $> C$						
	Ν	Consequences less	Cor	nsequences less than	Consequences less than						
		than those for Low	those	for Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

### Table 22.24 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					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (even	$\mathbf{I} = \text{situation (event) of major concern}$				Like	lihood	
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (eve	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Η	Ι	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = $ Negligible		IV = situation (ev	vent) of minimal concern	enc	М	Π	II	ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	Ŧ				
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	<sup>3</sup> Irreversible other C <sup>3</sup> Prom		C <sup>3</sup> Prompt worker fatality	suo	L	III	ш	IV	IV
$\mathbf{M} = \mathbf{Mitigative}$ (reduces event consequences)		serious effects, or	or	acute injury that is	or acute injury that is	C	Ν	IV	IV	IV	IV
Acronyms		symptoms which	i	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.									
	М	C <sup>3</sup> Mild, transient	C	<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	Mild, transient Min		Minor injuries; no						
		adverse effects $> C$	lverse effects > C hospit		hospitalization > C						
	Ν	Consequences less Conseq		nsequences less than	Consequences less than						
	than those for Low those for Lo			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	Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	$\mathbf{I} = \text{situation (event) of major concern}$				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern		1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	Π	III	IV	
Control(s) Type	С	Offsite (MOI) Onsite-2 (c		e-2 (co-located worker)	Onsite-1 (facility worker)	edu	т		ш	117	13.7	
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	H C <sup>3</sup> Irreversible, other C <sup>3</sup> Pron		rompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	ш	ш	IV	IV	
$\mathbf{M} = \mathbf{Mitigative}$ (reduces event consequences)		serious effects, or or acu		acute injury that is	or acute injury that is	C	Ν	IV	IV	IV	IV	
Acronyms		symptoms which	i	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.										
	Μ	C <sup>3</sup> Mild, transient C		<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;							
			hos	pitalization required.	hospitalization required.							
	L	Mild, transient Mi		Minor injuries; no	Minor injuries; no							
		adverse effects $> C$ hos		ospitalization > C	hospitalization $> C$							
	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 22.26 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, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	$\mathbf{I} = \text{situation (event) of major concern}$				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern		1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	Π	III	IV	
Control(s) Type	С	Offsite (MOI) Onsite-2 (c		e-2 (co-located worker)	Onsite-1 (facility worker)	edu	т		ш	117	13.7	
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	H C <sup>3</sup> Irreversible, other C <sup>3</sup> Pron		rompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	ш	ш	IV	IV	
$\mathbf{M} = \mathbf{Mitigative}$ (reduces event consequences)		serious effects, or or acu		acute injury that is	or acute injury that is	C	Ν	IV	IV	IV	IV	
Acronyms		symptoms which	i	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.										
	Μ	C <sup>3</sup> Mild, transient C		<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;							
			hos	pitalization required.	hospitalization required.							
	L	Mild, transient Mi		Minor injuries; no	Minor injuries; no							
		adverse effects $> C$ hos		ospitalization > C	hospitalization $> C$							
	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 22.27 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, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk					
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	$\mathbf{I}$ = situation (event) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{O}\mathbf{P}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}O$		$\mathbf{II} = \text{situation}$ (even	ent) of concern		1	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (ev	vent) of minor concern	ses	Н	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	П	ш	IV
Control(s) Type	С	Offsite (MOI) Onsite-2 (c		e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	т	TIT	ш	TV.	117
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> Irreversible, other	<b>C</b> <sup>3</sup> P	Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	ш	ш	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or or ac		acute injury that is	or acute injury that is	C	Ν	IV	IV	IV	IV
Acronyms		symptoms which	i	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.									
	Μ	C <sup>3</sup> Mild, transient	C	<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 Mi		Minor injuries; no	Minor injuries; no						
	adverse effects $> C$ ho		ospitalization > C	hospitalization > C							
	Ν	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	C	onsequence (C, of event)	)/year	Risk (R, Qualitative	Ranking)	Risk Matrix							
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	ent) of major concern				Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern		1	A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = $ Negligible		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV		
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə							
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C 3 P	Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	SUO	L	Ш	ш	IV	IV		
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	or	acute injury that is	or acute injury that is	ũ	Ν	IV	IV	IV	IV		
Acronyms		symptoms which	i	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		U	1 2 2								
		action.											
	М	C <sup>3</sup> Mild, transient	C	<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;								
			hospit		hospitalization required.								
	L	Mild, transient	Ν	Minor injuries; no	Minor injuries; no								
		adverse effects $> C$ hosp		ospitalization $> C$	hospitalization > C								
	Ν	Consequences less Conse		nsequences less than	Consequences less than								
		than those for Low those for L		for 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:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	C	onsequence (C, of event)	)/year	Risk (R, Qualitative	Ranking)	Risk	Matri	x			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{d}\mathbf{e}\mathbf{r}\mathbf{a}\mathbf{t}\mathbf{e}$		$\mathbf{II} = \text{situation}$ (ev	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	IV = situation (event) of minimal concern		М	II	II	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	Ŧ				
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	<b>C</b> <sup>3</sup> P	rompt worker fatality	C <sup>3</sup> Prompt worker fatality	suo	L	III	- 111	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	or	acute injury that is	or acute injury that is	С	Ν	IV	IV	IV	IV
Acronyms		symptoms which	i	immediately life-	immediately life-					•	
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	threatening or							
		individual's ability to		disabling.	permanently disabling.						
		take protective		C							
		action.									
	Μ	C <sup>3</sup> Mild, transient	C	<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	Mild, transient M		Minor injuries; no						
		adverse effects $> C$ hos		ospitalization > C	hospitalization > C						
	Ν	Consequences less	Consequences less Conse		Consequences less than						
		than those for Low	than those for Low those for Low		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:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year		Consequence (C, of event)/year		Risk (R, Qualitative Ranking)		Risk Matrix						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$		$\mathbf{H} = \text{High}$		$\mathbf{I}$ = situation (event) of major concern					Likelihood			
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	s	Н	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = $ Negligible		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV	
Control(s) TypeCP = Preventive (reduce event occurrence likelihood)HM = Mitigative (reduces event consequences)HAcronymsMOI = Maximally-exposed Offsite Individual		Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	•						
		C <sup>3</sup> Irreversible, other	C 3 P	rompt worker fatality	C <sup>3</sup> Prompt worker fatality	SUO	L	Ш	ш	IV	IV	
		serious effects, or	or	acute injury that is	or acute injury that is	Ν	IV	IV	IV	IV		
		symptoms which	j	immediately life-	immediately life-							
		could impair an	threat	tening or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective		U	1 2 2							
		action.										
	Μ	C <sup>3</sup> Mild, transient	С	<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;							
			hos	pitalization required.	hospitalization required.							
	L	Mild, transient	N	Minor injuries; no	Minor injuries; no							
		adverse effects $> C$	h	ospitalization $> C$	hospitalization > C							
	Ν	Consequences less	Cor	nsequences less than	Consequences less than							
		than those for Low	those	for Low Consequence	those for Low							
		Consequence Level		Level	Consequence Level							

#### Table 22.31 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: