	Risk Tables Description	Baseline Risk	Residual Risk
20.1	Radiological – Onsite-1 Facility Worker	R: I	R: IV
20.2	Radiological – Onsite-2 Co-located Worker	R: I	R: IV
20.3	Radiological – MOI Offsite	R: I	R: III
20.4*	Toxic Materials – Onsite 1 Facility Worker	R: *	R: *
20.5*	Toxic Materials – Onsite 2 Co-located Worker	R: *	R: *
20.6*	Toxic Materials – MOI Offsite	R: *	R: *
20.7*	Flammable & Combustible Materials – Onsite-1 Facility Worker	R: *	R: *
20.8*	Flammable & Combustible Materials – Onsite-2 Co-located worker	R: *	R: *
20.9*	Flammable & Combustible Materials – MOI Offsite	R: *	R: *
20.10*	Electrical Energy – Onsite-1 Facility Worker	R: *	R: *
20.11*	Electrical Energy – Onsite-2 Co-located Worker	R: *	R: *
20.12*	Electrical Energy – MOI Offsite	R: *	R: *
20.13*	Thermal Energy – Onsite-1 Facility Worker	R: *	R: *
20.14*	Thermal Energy – Onsite-2 Co-located Worker	R: *	R: *
20.15*	Thermal Energy – MOI Offsite	R: *	R: *
20.16*	Kinetic Energy – Onsite-1 Facility Worker	R: *	R: *
20.17*	Kinetic Energy – Onsite-2 Co-located Worker	R: *	R: *
20.18*	Kinetic Energy – MOI Offsite	R: *	R: *
20.19*	Potential Energy- Onsite-1 Facility Worker	R: *	R: *
20.20*	Potential Energy – Onsite-2 Co-located Worker	R: *	R: *
20.21*	Potential Energy – MOI Offsite	R: *	R: *
20.22*	Magnetic Fields – Onsite-1 Facility Worker	R: *	R: *
20.23*	Magnetic Fields – Onsite-2 Co-located Worker	R: *	R: *
20.24*	Magnetic Fields – MOI Offsite	R: *	R: *
20.25	Other Hazards – Onsite-1 Facility Worker	R: I	R: IV
20.26	Other Hazards – Onsite-2 Co-located Worker	R: III	R: III
20.27	Other Hazards – MOI Offsite	R: III	R: III
20.28*	Access & Egress – Onsite-1 Facility Worker	R: *	R: *
20.29*	Access & Egress – Onsite-2 Co-located Worker	R: *	R: *
20.30*	Access & Egress – MOI Offsite	R: *	R: *
20.31*	Environmental Hazards	R: *	R: *

#### Table 20. Summary of Baseline and Residual Risks - Switchyard

\* 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 20.1 Radiological – Onsite-1 Facility Worker

Hazard	azard Hazard Description Ris (with contr		Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual	Hazard: Exposure to residual	L: A	P – Radiological Work Permit prevents unauthorized personnel form areas	L: BEU
Activation	activation.	C: H	where excessive residual radiation exists.	C: L
		R: I	P – Postings intended to caution workers of area hazard.	R: IV
			P – Training for workers to identify and respond to the hazard.	
			M – Run Conditions to ensure total radiation levels are within expected parameters.	
			M – Shielding increases distance from the source of residual activation, minimizing exposure.	
Groundwater	Hazard: Potential exposure due to	L: A	P – Sump water is evaluated to determine the presence of tritium or other	L: EU
Activation	construction activities, (e.g.,	C: N	activation products to prevent personnel exposure.	C: N
	earthmoving).	R: IV	P – Sump pits/enclosures capture activated water to prevent releases exceeding allowed discharge limits.	R: IV
			M – Facility designs employ shielding to mitigate the production of activation products in groundwater.	
Surface Water	Hazard: Radionuclides in surface	L: A	P – Sump Pumps ensure water does not remain in the enclosure for	L: EU
Activation	water exceeding regulatory levels.	C: N	extended periods of time.	C: N
		R: IV	P – Sump Monitoring Program samples the water discharged by the sump pumps.	R: IV
			M – Run Conditions to ensure total radiation levels are within expected	
			<ul> <li>parameters.</li> <li>M – Shielding ensures the distance from source to surface is maximized to reduce total dose.</li> </ul>	

Hazard Hazard Description		Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)	
Radioactive	Hazard: Personnel exposed to	L: A	P – Postings intended to caution workers of area hazard.	L: BEU	
Water (RAW)	radioactive water exceeding	C: H	P – Radiological Work Permit prevents unauthorized personnel form areas	C: M	
Systems	regulatory levels.	R: I	where excessive residual radiation exists. P - Training for workers to identify and respond to the hazard.	R: IV	
			M – Run Conditions to ensure total radiation levels are within expected parameters.		
Air Activation	Hazard: Radionuclides in air	L: A	M – Engineered Air Flow ensures the air activation remains within the	L: A	
	exceeding regulatory levels.	C: H	enclosure for more than the half-life of radionuclides before exiting.	C: L	
		R: I	M – Run Conditions to ensure total radiation levels are within expected parameters.	R: III	
Soil Interactions	Hazard: Radionuclides are produced,	L: A	P – No excavation work allowed without an RWP.	L: U	
	which may contaminate groundwater.	C: H	M – Engineered Beam Dump designed to contain the radiation produced	C: N	
		R: I	by absorbing the deposited energy.	R: IV	
			M – Beamline Design ensures beam is transported through areas without interacting with soil.		
			M – Run Conditions to ensure total radiation levels are within expected parameters.		
Radioactive	Hazard: Personnel are exposed to	L: A	P – Locked Gates prevent access to areas where radiation waste is stored.	L: BEU	
Waste	ionizing radiation beyond regulatory	C: H	P – Key Control Program ensures access to these areas is managed.	C: N	
	levels.	R: I	P – Postings intended to caution workers of area hazard.	R: IV	
			M – Run Conditions to ensure total radiation levels are within expected parameters.		
			M – Distance to Stored Materials reduces total exposure risk to personnel.		
			M – Material survey and release program ensures radioactive waste is not stored in unauthorized areas.		

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Contamination	Hazard: Personnel are exposed to	L: A	P – Radiation Survey of areas to measure and detect contamination	L: EU
	ionizing radiation beyond regulatory	C: H	hazards.	C: L
	levels.	R: I	<ul> <li>P – Postings intended to caution workers of area hazard.</li> <li>M – PPE Specified by the RWP to protect workers in a contamination area.</li> <li>M – Training to ensure workers understand the risks and can prepare for the job accordingly.</li> </ul>	R: IV
<sup>7</sup> Be	<i>Hazard:</i> Potential radiation exposure to <sup>7</sup> Be (uptake/committed dose).	L: A C: N R: IV	<sup>7</sup> Be isn't hazardous in this pattern of use by facility.	L: A C: N R: IV
Radioactive	Hazard: Personnel are exposed to	L: A	P – Training for workers to identify and respond to the hazard.	L: EU
Sources	ionizing radiation beyond regulatory	C: H	P – Postings intended to caution workers of area hazard.	C: L
	levels.	R: I	<ul> <li>M – Source Handling Storage Requirements ensure radioactive sources are secured when not in use.</li> <li>M – Source Handling "In-Use" Requirements ensure the area where the radioactive source is used is tightly controlled.</li> </ul>	R: IV

Radiological Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	Cor	Consequence (C, of event)/year Risk (R, Qualitative Ranking)			Ris	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				Like	lihood	
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = situation$ (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	e	Н	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (eve	ent) of minimal concern	edn	ам	п	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsi	te-2 (co-located worker)	Onsite-1 (facility worker)	ons	5 <sup>111</sup>		m		
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	$C \ge 25.0 \text{ rem}$		$\mathbf{C} \ge 100 \text{ rem}$	<b>C</b> ≥ 100 rem	Ŭ	L	III	III	IV	IV

$\mathbf{M} = $ Mitigative (reduces event consequences)	Μ	25.0 rem > $\mathbf{C} \ge 5$ rem	100 rem > $\mathbf{C} \ge 25$ rem	100 rem > $\mathbf{C} \ge 25$ rem		Ν	IV	IV	IV	IV
Acronyms	L	5 rem > C	25 rem > C	25 rem > C	<b></b>					
<b>MOI</b> = Maximally-exposed Offsite Individual	Ν	0.5 rem > C	5 rem > C	5 rem > C						
<b>rem</b> = Roentgen equivalent man										

#### Table 20.2 Radiological – Onsite-2 Co-located Worker

Hazard	Hazard Hazard Description		Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual	Hazard: Exposure to residual	L: A	P – Radiological Work Permit prevents unauthorized personnel form areas	L: BEU
Activation	activation.	C: H	where excessive residual radiation exists.	C: M
		R: I	P – Postings intended to caution workers of areas of residual activation.	R: IV
			P – Training for workers to identify and respond to the hazard.	
			M – Run Conditions to ensure total radiation levels are within expected parameters.	
			M – Shielding increases distance from the source of residual activation, minimizing exposure.	
Groundwater	Hazard: Radionuclides in	L: A	P – Sump Pumps ensure water does not remain in the enclosure for	L: EU
Activation	groundwater exceeding regulatory	C: H	extended periods of time.	C: M
	levels.	R: I	P – Sump Monitoring Program samples the water discharged by the sump	R: III
			pumps. M – Run Conditions to ensure total radiation levels are within expected	
			parameters.	
Surface Water	Hazard: Radionuclides in surface	L: A	P – Sump Pumps ensure water does not remain in the enclosure for	L: EU
Activation	water exceeding regulatory levels.	C: H	extended periods of time.	C: L
		R: I	P – Sump Monitoring Program samples the water discharged by the sump pumps.	R: IV
			M – Run Conditions to ensure total radiation levels are within expected parameters.	
			M – Shielding ensures the distance from source to surface is maximized to reduce total dose.	
Radioactive	Hazard: Personnel exposed to	L: A	P – Postings intended to caution workers of area hazard.	L: BEU
Water (RAW)	radioactive water exceeding	C: H	P – Radiological Work Permit prevents unauthorized personnel form areas	C: M
Systems	regulatory levels.	R: I	where excessive residual radiation exists.	R: IV
			P – Training for workers to identify and respond to the hazard.	
			M – Run Conditions to ensure total radiation levels are within expected parameters.	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Air Activation	Hazard: Radionuclides in air exceeding regulatory levels.	L: A C: H R: I	<ul> <li>M – Engineered Air Flow ensures the air activation remains within the enclosure for more than the half-life of radionuclides before exiting.</li> <li>M – Run Conditions to ensure total radiation levels are within expected parameters.</li> </ul>	L: A C: L R: III
Soil Interactions	Hazard: Radionuclides are produced, which may contaminate groundwater.	L: A C: H R: I	<ul> <li>P – No excavation work allowed without an RWP.</li> <li>M – Engineered Beam Dump designed to contain the radiation produced by absorbing the deposited energy.</li> <li>M – Beamline Design ensures beam is transported through areas without interacting with soil.</li> <li>M – Run Conditions to ensure total radiation levels are within expected parameters.</li> </ul>	L: U C: N R: IV
Radioactive Waste	Hazard: Personnel are exposed to ionizing radiation beyond regulatory levels.	L: A C: H R: I	<ul> <li>P – Locked Gates prevent access to areas where radiation waste is stored.</li> <li>P – Key Control Program ensures access to these areas is managed.</li> <li>P – Postings intended to caution workers of area hazard.</li> <li>M – Run Conditions to ensure total radiation levels are within expected parameters.</li> <li>M – Distance to Stored Materials reduces total exposure risk to personnel.</li> <li>M – Material survey and release program ensures radioactive waste is not stored in unauthorized areas.</li> </ul>	L: BEU C: N R: IV
Contamination	Hazard: Personnel are exposed to ionizing radiation beyond regulatory levels.	L: A C: H R: I	<ul> <li>P – Radiation Survey of areas to measure and detect contamination hazards.</li> <li>P – Postings intended to caution workers of area hazard.</li> <li>M – PPE Specified by the RWP to protect workers in a contamination area.</li> <li>M – Training to ensure workers understand the risks and can prepare for the job accordingly.</li> </ul>	L: EU C: L R: IV
<sup>7</sup> Be	Hazard: Potential radiation exposure to <sup>7</sup> Be (uptake/committed dose).	L: A C: N R: IV	<sup>7</sup> Be isn't hazardous in this pattern of use by facility.	L: A C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive	Hazard: Personnel are exposed to	L: A	P – Training for workers to identify and respond to the hazard.	L: EU
Sources	ionizing radiation beyond regulatory	C: H	P – Postings intended to caution workers of area hazard.	C: L
	levels.	R: I	<ul> <li>M – Engineered Beam Dump designed to contain the radiation produced by absorbing the deposited energy.</li> <li>M – Engineered Beam Dump designed to contain the radiation produced by absorbing the deposited energy.</li> </ul>	R: IV
			<ul> <li>M – Source Handling Storage Requirements ensure radioactive sources are secured when not in use.</li> <li>M – Source Handling "In-Use" Requirements ensure the area where the radioactive source is used is tightly controlled.</li> </ul>	

Likelihood (L, of event)/year	Co	nsequence (C, of event)/y	year	Risk (R, Qualitative R	lanking)	Risk	Risk Matrix				
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \text{High}$		$\mathbf{I} = \text{situation}$ (even	t) of major concern				Like	lihood	
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		<b>II</b> = situation (even	nt) of concern	<u> </u>	1	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		III = 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 (eve	ent) of minimal concern	enc	М	II	Π	III	IV
Control(s) Type	С	Offsite (MOI)	Onsit	te-2 (co-located worker)	Onsite-1 (facility worker)	edn	Ŧ				
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	$C \ge 25.0$ rem		$C \ge 100 \text{ rem}$	$C \ge 100 \text{ rem}$	suo	L	III	III	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)	Μ	$25.0 \text{ rem} > \mathbb{C} \ge 5 \text{ rem}$	10	$00 \text{ rem} > \mathbf{C} \ge 25 \text{ rem}$	100 rem > C ≥ 25 rem		Ν	IV	IV	IV	IV
Acronyms MOL Maximally annead Officia Individual	L	5 rem > <b>C</b>		25 rem > C	25 rem > C						
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	Ν	0.5 rem > C		5 rem > C	5 rem > C	1					

### Table 20.3 Radiological – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual Activation	Hazard: Exposure to residual activation.	L: A C: H R: I	<ul> <li>P – Locked building prevents unauthorized access by public.</li> <li>P – Locked enclosure prevents unauthorized access by public.</li> <li>M – Run Conditions limit total beam through the area to limit the creation of activation.</li> </ul>	L: EU C: M R: III
Groundwater Activation	Hazard: Radionuclides in groundwater exceeding regulatory levels.	L: A C: H <b>R: I</b>	<ul> <li>P - Sump Pumps ensure water does not remain in the enclosure for extended periods of time.</li> <li>P - Sump Monitoring Program samples the water discharged by the sump pumps.</li> <li>M - Run Conditions to ensure total radiation levels are within expected parameters.</li> </ul>	L: EU C: M <b>R: III</b>
Surface Water Activation	Hazard: Radionuclides in surface water exceeding regulatory levels.	L: A C: H R: I	<ul> <li>P – Sump Pumps ensure water does not remain in the enclosure for extended periods of time.</li> <li>P – Sump Monitoring Program samples the water discharged by the sump pumps.</li> <li>M – Run Conditions to ensure total radiation levels are within expected parameters.</li> <li>M – Shielding ensures the distance from source to surface is maximized to reduce total dose.</li> </ul>	L: EU C: L R: IV
Radioactive Water (RAW) Systems	Hazard: Personnel exposed to radioactive water exceeding regulatory levels.	L: A C: H R: I	<ul> <li>P – Locked building prevents unauthorized access by public.</li> <li>P – Locked enclosure gate prevents access to the RAW system.</li> <li>M – Run Conditions limit total beam through the area to limit the creation of activation.</li> </ul>	L: EU C: M R: III
Air Activation	Hazard: Radionuclides in air exceeding regulatory levels.	L: A C: H R: I	<ul> <li>M – Engineered Air Flow ensures the air activation remains within the enclosure for more than the half-life of radionuclides before exiting.</li> <li>M – Run Conditions to ensure total radiation levels are within expected parameters.</li> </ul>	L: A C: L R: III

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Soil Interactions	Hazard: Radionuclides are produced,	L: A	M – Engineered Beam Dump designed to contain the radiation produced	L: A
	which may contaminate groundwater	C: H	by absorbing the deposited energy.	C: N
		R: I	<ul> <li>M – Beamline Design ensures beam is transported through areas without interacting with soil.</li> <li>M – Run Conditions to ensure total radiation levels are within expected parameters.</li> </ul>	R: IV
Radioactive	Hazard: Personnel are exposed to	L: A	P – Locked Gates prevent access to areas where radiation waste is stored.	L: EU
Waste	ionizing radiation beyond regulatory	C: H	P – Key Control Program ensures access to these areas is managed.	C: N
	levels.	R: I	<ul> <li>M – Run Conditions to ensure total radiation levels are within expected parameters.</li> <li>M – Distance to Stored Materials reduces total exposure.</li> <li>M – Material survey and release program ensures radioactive waste is not stored in unauthorized areas.</li> </ul>	R: IV
Contamination	Hazard: Personnel are exposed to	L: A	P – Locked building prevents unauthorized access by public.	L: EU
	ionizing radiation beyond regulatory	C: H	P – Locked enclosure prevents unauthorized access by public.	C: L
	levels.	R: I	<ul> <li>M – Shielding increases distance to stored materials reduces total exposure.</li> <li>M – Material survey and release program ensures radioactive waste is not stored in unauthorized areas.</li> </ul>	R: IV
<sup>7</sup> Be	Hazard: Potential radiation exposure	L: A	<sup>7</sup> Be isn't hazardous in this pattern of use by facility.	L: A
	to 7Be (uptake/committed dose).	C: N		C: N
		R: IV		R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive	Hazard: Personnel are exposed to	L: A	P – Locked building prevents unauthorized access by public.	L: EU
Sources	ionizing radiation beyond regulatory	C: H	P – Sources locked and inventoried by ES&H always ensuring positive	C: L
	levels.	R: I	<ul> <li>control of radioactive source.</li> <li>M – Engineered Beam Dump designed to contain the radiation produced by absorbing the deposited energy.</li> <li>M – Engineered Beam Dump designed to contain the radiation produced by absorbing the deposited energy.</li> </ul>	R: IV
			<ul> <li>M – Source Handling Storage Requirements ensure radioactive sources are secured when not in use.</li> <li>M – Source Handling "In-Use" Requirements ensure the area where the radioactive source is used is tightly controlled.</li> </ul>	

Radiological Hazard Consequences, derived from Figu	re C	-1, "Example Qualitative	e Con	sequence Matrix", DOI	E-HDBK-1163-2020.								
Likelihood (L, of event)/year	Consequence (C, of event)/year			Risk (R, Qualitative R	itative Ranking)			x					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (even	t) of major concern								
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	nt) of concern	-	1	Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathrm{Low}$		<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 (eve	ent) of minimal concern	duence	М	II	II	III	IV		
Control(s) Type	С	Offsite (MOI)	Onsi	te-2 (co-located worker)	Onsite-1 (facility worker)	edn	T	ш		TV.			
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	$C \ge 25.0$ rem		$C \ge 100 \text{ rem}$	$C \ge 100 \text{ rem}$	ous	L	III	III	IV	IV		
$\mathbf{M} = $ Mitigative (reduces event consequences)	Μ	25.0 rem > $\mathbf{C} \ge 5$ rem	10	$00 \text{ rem} > \mathbf{C} \ge 25 \text{ rem}$	100 rem > $\mathbf{C} \ge 25$ rem	0	Ν	IV	IV	IV	IV		
Acronyms	L	$5 \text{ rem} > \mathbf{C}$		25  rem > C	25  rem > C								
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	N	$0.5 \text{ rem} > \mathbf{C}$		$5 \text{ rem } > \mathbf{C}$	5  rem  > C								

## Table 20.4 Toxic Materials – Onsite 1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Lead	Hazard: Potential exposure to lead	L:	See Section I Chapter 04	L:
	during manual handling of un-encased	C:		C:
	lead bricks, lead shot, lead sheets,	R:		R:
	lead paint, and soldering operations.			

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)		$\mathbf{M} = \mathbf{M}$ 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	vent) of minimal concern	duences	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)	H	$C \ge PAC-2$		$C \ge PAC-3$	C≥IDLH	Cons	L	III	III	IV	IV
$\mathbf{M} = \mathbf{M}$ itigative (reduces event consequences)	М	$PAC-2 > C \ge PAC-1$	P/	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$	U U	Ν	IV	IV	IV	IV
Acronyms	L	PAC-1 > C	11	$\frac{10.57 \text{ C} = 1100 \text{ Z}}{\text{PAC-2} > \text{C}}$	PEL or $TLV_c > C$						
<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>TLVc = Threshold Limit Value (ceiling)</li> </ul>	N	Consequences less than those for Low Consequence Level		nsequences less than for Low Consequence Level	Consequences less than those for Low Consequence Level						

#### Table 20.5 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: Potential exposure to lead	L:	See Section I Chapter 04	L:
	during manual handling of un-encased	C:		C:
	lead bricks, lead shot, lead sheets,	R:		R:
	lead paint, and soldering operations.			

C	onsequence (C, of event)	)/year	Risk (R, Qualitative	itative Ranking)			x			
	$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Like	lihood	
	$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (ev	ent) of concern			Α	U	EU	BEU
	$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III
	$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	Π	Ш	IV
С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	Ŧ			11.7	
Н	C > PAC-2		C > PAC-3	C > IDLH	suo	L	III	III	IV	IV
М		PA		-	U U	Ν	IV	IV	IV	IV
L	PAC-1 > C		$\frac{10.57.02}{\text{PAC-2} > C}$	PEL or $TLV_c > C$						
N	Consequences less than those for Low Consequence Level		1	Consequences less than those for Low Consequence Level						
	C H L				$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	H = High $M = Moderate$ $L = Low$ $N = Negligible$ $I = situation (event) of major concern$ $II = situation (event) of concern$ $III = situation (event) of minor concern$ $IV = situation (event) of minor concernIV = situation (event) of minor concernIII = IIIIII = IIIIII = IIIIII = IIIIII = IIIIIII = IIIIIII = IIIIIII = IIIIIII = IIIIIII = IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII$	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $

### Table 20.6 Toxic Materials – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Lead	Hazard: Potential exposure to lead.	L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:

Likelihood (L, of event)/year	C	onsequence (C, of event	)/year	Risk (R, Qualitative	litative Ranking)			х			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<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	ences	М	Π	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	$\mathbf{C} \ge PAC-2$		$\mathbf{C} \ge \mathbf{PAC} \cdot 3$	C ≥ IDLH	suo	L	Ш	III	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)	М	$PAC-2 > C \ge PAC-1$	PA	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$	5	Ν	IV	IV	IV	IV
Acronyms	T	PAC-1 > C	17	$\frac{10-5 \times C}{PAC-2 > C}$	$\frac{10EHV}{PEL \text{ or } TLV_c} > C$						
<b>IDLH</b> = Immediately Dangerous to Life and Health			0								
MOI = Maximally-exposed Offsite Individual	Ν	Consequences less		nsequences less than	Consequences less than						
<b>PAC</b> = Protective Action Criteria		than those for Low	those	for Low Consequence	those for Low						
<b>PEL</b> = Permissible Exposure Limit		Consequence Level		Level	Consequence Level						
$TLV_c$ = Threshold Limit Value (ceiling)											

# Table 20.7 Flammable and Combustible Materials – Onsite -1 Facility Worker Baseline Qualitative **Preventative (P)**/

Hazard	Hazard Description	Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Qualitative Risk (with controls)
Combustible materials (cables, Boxes, Paper, wood cribbing, etc.)	Hazard: This hazard is a potential facility fire. The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices. This hazard can add to the fuel load of a potential facility fire. Poor housekeeping can also lead to life safety concerns, such as egress obstructions and tripping hazards. The exposure of the hazard to the facility worker is of major concern.	L: C: R:	See Section I Chapter 04	L: C: R:
Flammable Materials (Flammable gas, cleaning materials, etc.)	Hazard: The presence of flammable gases in cylinders or storage containers pose an inherent hazard due to their flammability/combustibility properties. Exposure to hot work provides a dangerous situation where flammable liquids will ignite. Unmitigated this could lead to an explosion and subsequent fire. The exposure of the hazard to the facility worker is of major concern.	L: C: R:	See Section I Chapter 04	L: C: R:

Residual

Other Hazard Consequences, derived from Figure C-	1, "E	Example Qualitative Conse	quence Matrix", DOE-HD	BK-1163-2020.									
Likelihood (L, of event)/year	C	onsequence (C, of event)/ye	ear Risk (R, Qualitative	Ranking)	Risk	Matr	ix						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = situation$ (eve	nt) of major concern				Like	lihood				
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = \text{situation}$ (ev	ent) of concern		1	Α	U	EU	BEU			
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$	<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	ences	М	П	П	Ш	IV			
Control(s) Type	С	Offsite (MOI) 0	onsite-2 (co-located worker)	Onsite-1 (facility worker)	Conseque	т	ш	ш	TV.	TV/			
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	н	$\mathbf{C} \geq$ Irreversible, <b>C</b>	$C \ge$ Prompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	suo	L	III	III	IV	IV			
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	C	Ν	IV	IV	IV	IV			
Acronyms		or symptoms which	immediately life-	is immediately life-									
<b>MOI</b> = Maximally-exposed Offsite Individual			hreatening or permanently	threatening or									
		individual's ability to	disabling.	permanently disabling.									
		take protective											
		action.											
	Μ	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$C \ge$ Serious injury, no									
		adverse effects.	immediate loss of life no	immediate loss of life no									
			permanent disabilities;	permanent disabilities;									
			hospitalization required.	hospitalization required.									
	L	Mild, transient	Minor injuries; no	Minor injuries; no									
		adverse effects > C	hospitalization > C	hospitalization > C									
	Ν	Consequences less	Consequences less than	Consequences less than									
		than those for Low the	nose for Low Consequence	those for Low									
		Consequence Level	Level	Consequence Level									

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Combustible	Hazard: The presence of excessive	L:	See Section I Chapter 04	L:
materials (cables,	combustible materials can pose a	C:		C:
Boxes, Paper,	hazard stemming from inadequate	R:		R:
wood cribbing,	housekeeping practices. This hazard			
etc.)	can add to the fuel load of a potential			
	fire. Poor housekeeping can also			
	lead to life safety concerns, such as			
	egress obstructions and tripping			
	hazards. The exposure of the hazard			
	to the co-located worker is of			
Flammable	concern. Hazard: The presence of flammable	L:	See Section I Chapter 04	L:
Materials	gases in cylinders or storage	C:	See Section 1 Chapter 04	C:
(Flammable gas,	containers pose an inherent hazard	R:		R:
cleaning	due to their	K.		K.
materials, etc.)	flammability/combustibility			
	properties. Exposure to hot work			
	provides a dangerous situation where			
	flammable liquids will ignite.			
	Unmitigated this could lead to an			
	explosion and subsequent fire. The			
	exposure of the hazard to the co-			
	located worker is of concern.			

#### Table 20.8 Flammable and Combustible Materials – Onsite -2 Co-located Worker

Other Hazard Consequences, derived from Figure C-	1, "E	Example Qualitative Conse	quence Matrix", DOE-HD	BK-1163-2020.									
Likelihood (L, of event)/year	C	onsequence (C, of event)/ye	ear Risk (R, Qualitative	Ranking)	Risk	Matr	ix						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = \text{situation}$ (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		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	ences	М	П	П	Ш	IV			
Control(s) Type	С	Offsite (MOI) 0	onsite-2 (co-located worker)	Onsite-1 (facility worker)	Conseque	т	ш	ш	TV.	TV/			
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	н	$\mathbf{C} \geq$ Irreversible, <b>C</b>	$C \ge$ Prompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	suo	L	III	III	IV	IV			
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	C	Ν	IV	IV	IV	IV			
Acronyms		or symptoms which	immediately life-	is immediately life-									
<b>MOI</b> = Maximally-exposed Offsite Individual			hreatening or permanently	threatening or									
		individual's ability to	disabling.	permanently disabling.									
		take protective											
		action.											
	Μ	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$C \ge$ Serious injury, no									
		adverse effects.	immediate loss of life no	immediate loss of life no									
			permanent disabilities;	permanent disabilities;									
			hospitalization required.	hospitalization required.									
	L	Mild, transient	Minor injuries; no	Minor injuries; no									
		adverse effects > C	hospitalization > C	hospitalization > C									
	Ν	Consequences less	Consequences less than	Consequences less than									
		than those for Low the	nose for Low Consequence	those for Low									
		Consequence Level	Level	Consequence Level									

#### Table 20.9 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: The presence of excessive	L:	See Section I Chapter 04	L:
materials (cables,	combustible materials can pose a	C:		C:
Boxes, Paper,	hazard stemming from inadequate	R:		R:
wood cribbing,	housekeeping practices. This hazard			
etc.)	can add to the fuel load of a potential			
	fire. Poor housekeeping can also			
	lead to life safety concerns, such as			
	egress obstructions and tripping			
	hazards. The exposure of the hazard			
	to the public is of minimal concern.	-		-
Flammable	Hazard: The presence of flammable	L:	See Section I Chapter 04	L:
Materials	gases in cylinders or storage	C:		C:
(Flammable gas,	containers pose an inherent hazard due to their	R:		R:
cleaning materials, etc.)	flammability/combustibility			
materials, etc.)	properties. Exposure to hot work			
	provides a dangerous situation where			
	flammable liquids will ignite.			
	Unmitigated this could lead to an			
	explosion and subsequent fire. The			
	exposure of the hazard to the public			
	is of minor concern.			

Other Hazard Consequences, derived from Figure C-	Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.										
Likelihood (L, of event)/year	C	onsequence (C, of event)/ye	ear Risk (R, Qualitative	Ranking)	Risk	Matri	ix				
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = \text{situation}$ (even	ent) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$	<b>III</b> = situation (ev	vent) of minor concern	ses	Η	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	ences	М	П	П	Ш	IV	
Control(s) Type	С	Offsite (MOI) 0	nsite-2 (co-located worker)	Onsite-1 (facility worker)	Conseque	T	ш	ш	IV	IV	
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	$\mathbf{C} \geq$ Irreversible, <b>C</b>	$C \ge$ Prompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	suo	L	ш	ш	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	С	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	immediately life-	is immediately life-							
<b>MOI</b> = Maximally-exposed Offsite Individual			hreatening or permanently	threatening or							
		individual's ability to	disabling.	permanently disabling.							
		take protective									
		action.									
	М	$\mathbf{C} \ge \mathbf{Mild}$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$C \ge$ Serious injury, no							
		adverse effects.	immediate loss of life no	immediate loss of life no							
			permanent disabilities;	permanent disabilities;							
			hospitalization required.	hospitalization required.							
	L	Mild, transient	Minor injuries; no	Minor injuries; no							
		adverse effects > C	hospitalization > C	hospitalization > C							
	Ν	Consequences less	Consequences less than	Consequences less than							
		than those for Low the	ose for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

## Table 20.10 Electrical Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
	Hazards:	_		_
	Shock Hazard, >50V, Interlocked	L:		L:
	enclosure area	C:		C:
<b>a</b> 15		R:		R:
Stored Energy			See Section I Chapter 04	
	Arc Flash, Interlocked enclosure	L:		L:
	area	C:		C:
		R:		R:
High Voltage	Hazards:			
Exposure	Shock hazard voltage $> 50V$ ,	L:	See Section I Chapter 04	L:
	Interlocked enclosures	C:		C:
		R:		R:
	Arc Flash, Interlocked enclosures	L:		L:
		C:		C:
		R:		R:
Low Voltage,	Hazards:			
High Current	Arc Flash, Non-interlocked	L:	See Section I Chapter 04	L:
Exposure	enclosures	C:		C:
		R:		R:
	Fire hazard from high current	L:		L:
	causing smoke inhalation and burns.	C:		C:
	causing smoke innutation and burns.	R:		R:
		1.		1.

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	C	onsequence (C, of event)/y	ear Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = situation$ (eve	ent) of major concern					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)		$\mathbf{L} = Low$	$\mathbf{III} = \text{situation}$ (e	vent) of minor concern	s	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	п	II	Ш	IV	
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	ш	ш	IV	IV	
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	H	$\mathbf{C} \geq$ Irreversible,	$\mathbf{C} \geq \text{Prompt worker fatality}$	$C \ge Prompt worker$	ons	L	m	- 111	1V	1 V	
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	0	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	immediately life-	is immediately life-							
<b>MOI</b> = Maximally-exposed Offsite Individual			threatening or permanently	threatening or							
		individual's ability to	disabling.	permanently disabling.							
		take protective									
		action.									
	М	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$C \ge$ Serious injury, no							
		adverse effects.	immediate loss of life no	immediate loss of life no							
			permanent disabilities;	permanent disabilities;							
			hospitalization required.	hospitalization required.							
	L	Mild, transient	Minor injuries; no	Minor injuries; no							
		adverse effects $> C$	hospitalization > C	hospitalization > C							
	Ν	Consequences less	Consequences less than	Consequences less than							
		than those for Low t	hose for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

## Table 20.11 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	Hazards:			
	Shock Hazard, >50V, Non-	L:	See Section I Chapter 04	L:
	interlocked enclosures	C:		C:
		R:		R:
	Arc Flash, Non-interlocked enclosures			
		L:		L:
		C:		C:
		R:		R:
High Voltage	Hazards:		See Section I Chapter 04	
Exposure	Shock hazard, voltage > 50V,	L:		L:
	Interlocked enclosures	C:		C:
		R:		R:
	Arc Flash, Interlocked enclosures			
		L:		L:
		C:		C:
		R:		R:
Low Voltage,	Hazards:		See Section 1, Chapter 04	
High Current	Arc Flash, Non-interlocked	L:		L:
Exposure	enclosures	C:		C:
		R:		R:
	Fire hazard from high current	T		T
	causing smoke inhalation and burns.	L:		L:
		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)/ye	ear Risk (R, Qualitative	Ranking)	Risk Matrix							
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Like	lihood			
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = \text{situation}$ (ev	ent) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	<b>III</b> = situation (ev	vent) of minor concern	ses	Н	Ι	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = $ Negligible	IV = situation (ev	vent) of minimal concern	ienc	М	Π	II	III	IV		
Control(s) Type	С	Offsite (MOI) 0	nsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	ш	ш	IV	IV		
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	$\mathbf{C} \geq$ Irreversible, <b>(</b>	$C \ge$ Prompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	suo	L	III	ш	1V	IV		
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	0	Ν	IV	IV	IV	IV		
Acronyms		or symptoms which	immediately life-	is immediately life-								
<b>MOI</b> = Maximally-exposed Offsite Individual			hreatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective										
		action.										
	Μ	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$\mathbf{C} \ge \mathbf{Serious}$ injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization > C								
	Ν	Consequences less	Consequences less than	Consequences less than								
		than those for Low the	ose for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

### Table 20.12 Electrical Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Stored Energy	Hazard: Shock hazard, >50V, Arc	L:	See Section I Chapter 04	L:
	Flash	C:		C:
		R:		R:
High Voltage	Hazard: Shock Hazard, >50V, Arc	L:	See Section I Chapter 04	L:
Exposure	Flash outside	C:		C:
		R:		R:
Low Voltage,	Hazard: N/A	L:		L:
High Current		C:		C:
Exposure		R:		R:

Other Hazard Consequences, derived from Figure C-	Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.										
Likelihood (L, of event)/year	C	onsequence (C, of event)/ye	ear Risk (R, Qualitative	Ranking)	Risk	Matri	ix				
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = \text{situation}$ (even	ent) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$	<b>III</b> = situation (ev	vent) of minor concern	ses	Η	I	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	ences	М	П	П	Ш	IV	
Control(s) Type	С	Offsite (MOI) 0	Insite-2 (co-located worker)	Onsite-1 (facility worker)	Conseque	T	ш	ш	TV.	TV/	
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	$\mathbf{C} \geq$ Irreversible, <b>C</b>	$C \ge$ Prompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	ons	L	III	Ш	IV	IV	
$\mathbf{M} = \mathbf{Mitigative}$ (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	С	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	immediately life-	is immediately life-							
<b>MOI</b> = Maximally-exposed Offsite Individual			hreatening or permanently	threatening or							
		individual's ability to	disabling.	permanently disabling.							
		take protective									
		action.									
	М	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$C \ge$ Serious injury, no							
		adverse effects.	immediate loss of life no	immediate loss of life no							
			permanent disabilities;	permanent disabilities;							
			hospitalization required.	hospitalization required.							
	L	Mild, transient	Minor injuries; no	Minor injuries; no							
		adverse effects $> C$	hospitalization > C	hospitalization > C							
	Ν	Consequences less	Consequences less than	Consequences less than							
		than those for Low the	nose for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

## Table 20.13 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: Hot work will cause elevated temperatures. If hot work is not supervised, there is a potential for combustibles in the surrounding area to be ignited due to exposure to slag or elevated temperatures. This could lead to excessive heat and burning, which could potentially lead to a fire. The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices. This hazard can add to the fuel load of a potential fire. The exposure of the hazard to the facility worker is of major concern.	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-	Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.										
Likelihood (L, of event)/year	C	onsequence (C, of event)/ye	ear 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)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = \text{situation}$ (even	ent) of concern			А	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	Η	Ι	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	ences	М	II	II	Ш	IV	
Control(s) Type	С	Offsite (MOI) 0	onsite-2 (co-located worker)	Onsite-1 (facility worker)	Conseque	т	ш	ш	IV	IV	
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	$\mathbf{C} \geq$ Irreversible, <b>C</b>	$C \ge$ Prompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	ons	L	ш	- 111	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	С	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	immediately life-	is immediately life-							
<b>MOI</b> = Maximally-exposed Offsite Individual			hreatening or permanently	threatening or							
		individual's ability to	disabling.	permanently disabling.							
		take protective									
		action.									
	Μ	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$\mathbf{C} \ge \mathbf{Serious}$ injury, no							
		adverse effects.	immediate loss of life no	immediate loss of life no							
			permanent disabilities;	permanent disabilities;							
			hospitalization required.	hospitalization required.							
	L	Mild, transient	Minor injuries; no	Minor injuries; no							
		adverse effects > C	hospitalization > C	hospitalization > C							
	Ν	Consequences less	Consequences less than	Consequences less than							
		than those for Low the	nose for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

## Table 20.14 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: Hot work will cause elevated temperatures. If hot work is not supervised, there is a potential for combustibles in the surrounding area to be ignited due to exposure to slag or elevated temperatures. This could lead to excessive heat and burning, which could potentially lead to a fire. The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices. This hazard can add to the fuel load of a potential fire. The exposure of the hazard to the co-located worker is of minor concern.	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-	Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.										
Likelihood (L, of event)/year	C	onsequence (C, of event)/ye	ear Risk (R, Qualitative	Ranking)	Risk	Matri	ix				
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = \text{situation}$ (even	ent) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	$\mathbf{III} = \text{situation}$ (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	ences	М	П	П	Ш	IV	
Control(s) Type	С	Offsite (MOI) 0	onsite-2 (co-located worker)	Onsite-1 (facility worker)	Conseque	т	ш	ш	TV.	TV/	
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	н	$\mathbf{C} \geq$ Irreversible, <b>C</b>	$C \ge$ Prompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	ons	L	III	III	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	С	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	immediately life-	is immediately life-							
<b>MOI</b> = Maximally-exposed Offsite Individual			hreatening or permanently	threatening or							
		individual's ability to	disabling.	permanently disabling.							
		take protective									
		action.									
	Μ	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$\mathbf{C} \ge \mathbf{Serious}$ injury, no							
		adverse effects.	immediate loss of life no	immediate loss of life no							
			permanent disabilities;	permanent disabilities;							
			hospitalization required.	hospitalization required.							
	L	Mild, transient	Minor injuries; no	Minor injuries; no							
		adverse effects > C	hospitalization > C	hospitalization > C							
	Ν	Consequences less	Consequences less than	Consequences less than							
		than those for Low the	nose for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

### Table 20.15 Thermal Energy – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.													
Likelihood (L, of event)/year	C	onsequence (C, of event)/y	ear Risk (R, Qualitative	Risk (R, Qualitative Ranking)			Risk Matrix						
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$	$\mathbf{H} = \mathbf{High}$		$\mathbf{I} = situation$ (eve	ent) of major concern			Likelihood						
U = Unlikely (1.0E-02>L>1.0E-04)	$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = situation (ev$	$\mathbf{II} = \text{situation (event) of concern}$			Α	U	EU	BEU			
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)	$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (e	<b>III</b> = situation (event) of minor concern		Н	Ι	I	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	П	II	Ш	IV			
Control(s) Type	C Offsite (MOI) Onsite-		Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	ш	ш	IV	IV			
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	H	$\mathbf{C} \geq$ Irreversible,	$\mathbf{C} \geq \text{Prompt worker fatality}$	$\mathbf{C} \geq \text{Prompt worker}$	suo	L	III	ш	IV	IV			
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	0	Ν	IV	IV	IV	IV			
Acronyms	· · · · · · · · · · · · · · · · · · ·		immediately life-										
<b>MOI</b> = Maximally-exposed Offsite Individual			threatening or permanently	threatening or									
		individual's ability to											
		take protective	-										
		action.											
	М	$C \ge Mild$ , transient	$C \ge$ Serious injury, no	$C \ge$ Serious injury, no									
		adverse effects.	immediate loss of life no	immediate loss of life no									
		pe	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 t	hose for Low Consequence	those for Low									
		Consequence Level	Level	Consequence Level									

## Table 20.16 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: Personnel injury due to improper use of power tools.	L: C:	See Section I Chapter 04	L: C:
Pumps and Motors	Hazard: Personal injury due to entrapment/entanglement.	R: L: C: R:	See Section I Chapter 04	R: L: C: R:
Motion Tables	Hazard: Personnel injury due to pinch points, tip-overs, caught in between.	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.													
Likelihood (L, of event)/year	C	onsequence (C, of event)/ye	ear Risk (R, Qualitative	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	$\mathbf{II} = \text{situation (event) of concern}$			Α	U	EU	BEU			
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	<b>III</b> = situation (ev	<b>III</b> = situation (event) of minor concern		Η	Ι	Ι	II	III			
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	<b>IV</b> = situation (event) of minimal concern		М	П	П	Ш	IV			
Control(s) Type		Offsite (MOI) Onsite-2 (co-located worker)		Onsite-1 (facility worker)	Conseque	т	ш	ш	IV	IV			
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	$\mathbf{C} \geq$ Irreversible, <b>(</b>	$C \ge$ Prompt worker fatality	$\mathbf{C} \ge \text{Prompt worker}$ fatality or acute injury that	ons	L	ш	ш	IV	IV			
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is		C	Ν	IV	IV	IV	IV			
Acronyms		or symptoms which	immediately life-										
<b>MOI</b> = Maximally-exposed Offsite Individual			hreatening or permanently	threatening or									
		individual's ability to	disabling.	permanently disabling.									
		take protective											
		action.											
	Μ	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$\mathbf{C} \ge \mathbf{Serious}$ injury, no									
		adverse effects.	immediate loss of life no	immediate loss of life no									
			permanent disabilities;	permanent disabilities;									
			hospitalization required.	hospitalization required.									
	L	Mild, transient	Minor injuries; no	Minor injuries; no									
		adverse effects > C	hospitalization > C	hospitalization > C									
		Consequences less	Consequences less than	Consequences less than									
		than those for Low the	nose for Low Consequence	those for Low									
		Consequence Level	Level	Consequence Level									

#### Table 20.17 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: Personnel injury due to power tool use (flying debris, struck	L: C:	See Section I Chapter 04	L: C:
	by object).	R:		R:
Pumps and Motors	Hazard: Personal injury due to entrapment/entanglement.	L: C: R:	See Section I Chapter 04	L: C: R:
Motion Tables	Hazard: Personnel injury due to tip- overs, caught in between, crushing.	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year		onsequence (C, of event)/y	year	Risk (R, Qualitative Ranking)			x Matı	ix	<u>r</u>			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation (event) of major concern}$					Likelihood			
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation (event) of concern}$			1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (event) 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 (event) of minimal concern		enc	М	П	II	ш	IV	
Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual		COffsite (MOI)OnsitH $C \ge Irreversible$ $C \ge I$		2 (co-located worker)	Onsite-1 (facility worker)	Consequences	L	ш	ш	IV	IV	
		other serious effects, or symptoms which	or ac in	ompt worker fatality cute injury that is nmediately life- ning or permanently disabling.	C ≥ Prompt worker fatality or acute injury that is immediately life- threatening or permanently disabling.	Con	N	IV	IV	IV	IV	
	M L	C ≥ Mild, transient adverse effects. Mild, transient adverse effects > C	imme perm hospit Mi	Serious injury, no diate loss of life no nanent disabilities; talization required. inor injuries; no spitalization > C	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no hospitalization > C							

# Table 20.18 Kinetic Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power Tools	N/A	L: C:	Public is prevented from having access to work areas.	L: C:
Pumps and Motors	N/A	R: L: C:	Public is prevented from having access to work areas.	R: L: C:
Motion Tables	N/A	R: L: C: R:	Public is prevented from having access to work areas.	R: L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	С	onsequence (C, of event)/y	year	Risk (R, Qualitative	Ranking)	Risk	x Matı	ix				
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (even	nt) of major concern				Likelihood			
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (eve	ent) of concern		-	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06>L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	П	II	Ш	IV	
Control(s) Type	С	Offsite (MOI)	Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	Consequences	L	III	ш	IV	IV	
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual	Η	other serious effects, or symptoms which	or ac in	ompt worker fatality acute injury that is nmediately life- ening or permanently disabling.	C ≥ Prompt worker fatality or acute injury that is immediately life- threatening or permanently disabling.	Con	N	IV	IV	IV	IV	
	M L	C ≥ Mild, transient adverse effects. Mild, transient adverse effects > C	imme perm hospit Mi	Serious injury, no diate loss of life no nanent disabilities; italization required. inor injuries; no spitalization > C	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no hospitalization > C							

# Table 20.19 Potential Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane Operations	Hazard: personnel injury due to improper crane operations.	L: C: R:	See Section I Chapter 04	L: C: R:
Compressed Gasses	Hazard: Personnel injury due to unexpected release, or unsecure tanks.	L: C: R:	See Section I Chapter 04	L: C: R:
Vacuum Pumps	Hazard: Personnel injury due to entrapment/entanglement.	L: C: R:	See Section I Chapter 04	L: C: R:
Material Handling	Hazard: Personnel injury due to improper operation of Powered Industrial Trucks and their attachments (rollovers, crush, etc.).	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	C	onsequence (C, of event)/ye	ear Risk (R, Qualitative	Ranking)	Risk	Matri	ix				
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = \text{situation}$ (eve	$\mathbf{I}$ = situation (event) of major concern				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = \text{situation}$ (even	ent) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	<b>III</b> = situation (ev	vent) of minor concern	ses	Н	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	ences	М	П	П	Ш	IV	
Control(s) Type	С	Offsite (MOI) 0	onsite-2 (co-located worker)	Onsite-1 (facility worker)	Conseque	т	тт	ш	TV.	TV/	
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	$\mathbf{C} \geq$ Irreversible, <b>C</b>	$C \ge$ Prompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	ons	L	III	III	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	С	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	immediately life-	is immediately life-							
<b>MOI</b> = Maximally-exposed Offsite Individual			hreatening or permanently	threatening or							
		individual's ability to	disabling.	permanently disabling.							
		take protective									
		action.									
	Μ	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$\mathbf{C} \ge \mathbf{Serious}$ injury, no							
		adverse effects.	immediate loss of life no	immediate loss of life no							
			permanent disabilities;	permanent disabilities;							
			hospitalization required.	hospitalization required.							
	L	Mild, transient	Minor injuries; no	Minor injuries; no							
		adverse effects > C	hospitalization > C	hospitalization > C							
	Ν	Consequences less	Consequences less than	Consequences less than							
		than those for Low the	nose for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

# Table 20.20 Potential Energy – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane Operations	Hazard: Struck by falling, swinging	L:	See Section I Chapter 04	L:
	loads.	C:		C:
		R:		R:
Compressed	Hazard: Collocated personnel injury	L:	See Section I Chapter 04	L:
Gasses	due to unexpected release, or	C:		C:
	unsecure tanks.	R:		R:
Vacuum Pumps	Hazard: Personnel injury due to	L:	See Section I Chapter 04	L:
	interaction with existing vacuum.	C:		C:
		R:		R:
Material Handling	Hazard: Collocated personnel injury	L:	See Section I Chapter 04	L:
	due to moving/handing material	C:		C:
	(rollovers, crush, etc.)	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)/ye	ear Risk (R, Qualitative	Ranking)	Risk	Matri	ix				
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = \text{situation}$ (eve	$\mathbf{I} = $ situation (event) of major concern				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = \text{situation}$ (even	ent) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$	<b>III</b> = situation (ev	vent) of minor concern	ses	Η	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	ences	М	П	П	Ш	IV	
Control(s) Type	С	Offsite (MOI) 0	onsite-2 (co-located worker)	Onsite-1 (facility worker)	Conseque	т	ш	ш	TV.	TV/	
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	$\mathbf{C} \geq$ Irreversible, <b>C</b>	$C \ge$ Prompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	ons	L	III	III	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	С	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	immediately life-	is immediately life-							
<b>MOI</b> = Maximally-exposed Offsite Individual			hreatening or permanently	threatening or							
		individual's ability to	disabling.	permanently disabling.							
		take protective									
		action.									
	Μ	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$\mathbf{C} \ge \mathbf{Serious}$ injury, no							
		adverse effects.	immediate loss of life no	immediate loss of life no							
			permanent disabilities;	permanent disabilities;							
			hospitalization required.	hospitalization required.							
	L	Mild, transient	Minor injuries; no	Minor injuries; no							
		adverse effects > C	hospitalization > C	hospitalization > C							
	Ν	Consequences less	Consequences less than	Consequences less than							
		than those for Low the	nose for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

# Table 20.21 Potential Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane Operations	Hazard: N/A	L:		L:
		C:		C:
		R:		R:
Compressed	Hazard: Injury due to unexpected	L:	See Section I Chapter 04	L:
Gasses	release, or unsecure tanks outside of	C:		C:
	buildings.	R:		R:
Vacuum Pumps	Hazard: N/A	L:		L:
		C:		C:
		R:		R:
Material Handling	Hazard: N/A	L:		L:
		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)/ye	ear 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	$\mathbf{I} = \text{situation (event) of major concern}$				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	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	ences	М	П	П	Ш	IV		
Control(s) Type	С	Offsite (MOI) 0	Insite-2 (co-located worker)	Onsite-1 (facility worker)	Conseque	т	ш	ш	IV	IV		
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	н	$\mathbf{C} \geq$ Irreversible, <b>(</b>	$C \ge$ Prompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	suo	L	ш	ш	IV	IV		
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	C	Ν	IV	IV	IV	IV		
Acronyms		or symptoms which	immediately life-	is immediately life-								
<b>MOI</b> = Maximally-exposed Offsite Individual			hreatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective										
		action.										
	Μ	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$C \ge$ Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization > C								
	Ν	Consequences less	Consequences less than	Consequences less than								
		than those for Low the	nose for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

### Table 20.22 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	Hazards: Exposure to fringe fields beyond allowable limits (worker <b>with</b> ferromagnetic or electronic medical device(s))	L: C: R:	See Section I Chapter 04	L: C: R:
	Exposure to fringe fields beyond allowable limits (worker <b>without</b> ferromagnetic or electronic medical device(s))	L: C: R:		L: C: R:
	Exposure to flying metallic objects causing potential injury.	L: C: R:		L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	C	onsequence (C, of event)/ye	ear Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = situation$ (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	$\mathbf{II} = \text{situation}$ (ev	ent) of concern		1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$	<b>III</b> = situation (ev	vent) of minor concern	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	ences	М	П	П	Ш	IV	
Control(s) Type	С	Offsite (MOI) 0	onsite-2 (co-located worker)	Onsite-1 (facility worker)	Conseque	т	ш	ш	TV.	TV/	
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	н	$\mathbf{C} \geq$ Irreversible, <b>C</b>	$C \ge$ Prompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	suo	L	III	III	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	C	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	immediately life-	is immediately life-							
<b>MOI</b> = Maximally-exposed Offsite Individual			hreatening or permanently	threatening or							
		individual's ability to	disabling.	permanently disabling.							
		take protective									
		action.									
	Μ	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$C \ge$ Serious injury, no							
		adverse effects.	immediate loss of life no	immediate loss of life no							
			permanent disabilities;	permanent disabilities;							
			hospitalization required.	hospitalization required.							
	L	Mild, transient	Minor injuries; no	Minor injuries; no							
		adverse effects > C	hospitalization > C	hospitalization > C							
	Ν	Consequences less	Consequences less than	Consequences less than							
		than those for Low the	nose for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

### Table 20.23 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	<ul> <li>Hazards:</li> <li>Exposure to fringe fields beyond allowable limits (worker with ferromagnetic or electronic medical device(s))</li> <li>Exposure to fringe fields beyond allowable limits (worker without ferromagnetic or electronic medical device(s))</li> <li>Exposure to flying metallic objects causing potential injury.</li> </ul>	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.													
Likelihood (L, of event)/year	C	onsequence (C, of event)/ye	ear Risk (R, Qualitative	Ranking)	Risk	Matri	ix	K					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$		$\mathbf{H} = \text{High}$	$\mathbf{I} = \text{situation}$ (even	vent) of major concern				Like	lihood				
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = situation (even$	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	I	I	II	III			
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$	IV = situation (ev	vent) of minimal concern	ences	М	П	Π	III	IV			
Control(s) Type	С	Offsite (MOI) 0	nsite-2 (co-located worker)	Onsite-1 (facility worker)	Conseque	т	ш	ш	TV.	TV/			
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	$\mathbf{C} \geq$ Irreversible, $\mathbf{C}$	$C \ge$ Prompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	ons	L	III	Ш	IV	IV			
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	С	Ν	IV	IV	IV	IV			
Acronyms		or symptoms which	immediately life-	is immediately life-									
<b>MOI</b> = Maximally-exposed Offsite Individual			hreatening or permanently	threatening or									
		individual's ability to	disabling.	permanently disabling.									
		take protective											
		action.											
	Μ	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$C \ge$ Serious injury, no									
		adverse effects.	immediate loss of life no	immediate loss of life no									
			permanent disabilities;	permanent disabilities;									
			hospitalization required.	hospitalization required.									
	L	Mild, transient	Minor injuries; no	Minor injuries; no									
		adverse effects $> C$	hospitalization > C	hospitalization > C									
	Ν	Consequences less	Consequences less than	Consequences less than									
		than those for Low the	ose for Low Consequence	those for Low									
		Consequence Level	Level	Consequence Level									

# Table 20.24 Magnetic Fields – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields	<ul> <li>Hazards: Exposure to fringe fields beyond allowable limits (worker with ferromagnetic or electronic medical device(s))</li> <li>Exposure to fringe fields beyond allowable limits (worker without ferromagnetic or electronic medical device(s))</li> <li>Exposure to flying metallic objects causing potential injury.</li> </ul>	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.										
Likelihood (L, of event)/year	C	onsequence (C, of event)/ye	ear Risk (R, Qualitative	Ranking)	Risk	Matri	ix			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$		$\mathbf{H} = \text{High}$	$\mathbf{I} = \text{situation}$ (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	$\mathbf{II} = situation (even$	$\mathbf{II} = \text{situation (event) of concern}$			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	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$	IV = situation (ev	vent) of minimal concern	ences	М	П	Π	III	IV
Control(s) Type	С	Offsite (MOI) 0	nsite-2 (co-located worker)	Onsite-1 (facility worker)	Conseque	т	ш	ш	TV.	TV/
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	$\mathbf{C} \geq$ Irreversible, $\mathbf{C}$	$C \ge$ Prompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	ons	L	III	Ш	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	С	Ν	IV	IV	IV	IV
Acronyms		or symptoms which	immediately life-	is immediately life-						
<b>MOI</b> = Maximally-exposed Offsite Individual			hreatening or permanently	threatening or						
		individual's ability to	disabling.	permanently disabling.						
		take protective								
		action.								
	Μ	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$C \ge$ Serious injury, no						
		adverse effects.	immediate loss of life no	immediate loss of life no						
			permanent disabilities;	permanent disabilities;						
			hospitalization required.	hospitalization required.						
	L	Mild, transient	Minor injuries; no	Minor injuries; no						
		adverse effects $> C$	hospitalization > C	hospitalization > C						
		Consequences less	Consequences less than	Consequences less than						
		than those for Low the	ose for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

# Table 20.25 Other hazards – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	Hazard: Limited egress	L: A	P – Confined Space training informs workers of hazard and process for	L: BEU
		C: H	working in the confined space.	C: M
		R: I	P – Work practice procedure requires use of an attendant, outside of the enclosure.	R: IV
			P – "Permit Required Access" and "Reclassification" require ES&H	
			approval on every access.	
			M – Mechanical ventilation active, when required.	
Noise	Hazard:	L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:
Ergonomics	Hazard:	L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:
Working at	Hazard: Falls, dropped items.	L: A	P – Fall protection program	L: BEU
Heights		C: H	P – Training for ladders, scaffolds, mobile elevating work platforms	C: M
		R: I	P – Guard Rails or tie off points.	R: IV
			M – PPE – PFAS, including approved anchor points, hard hats	

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.										
Likelihood (L, of event)/year	C	onsequence (C, of event)/ye	ear Risk (R, Qualitative	Ranking)	Risk	Matri	ix			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = \text{situation}$ (eve	$\mathbf{I}$ = situation (event) of major concern				Like	lihood	
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = \text{situation}$ (even	$\mathbf{II} = \text{situation (event) of concern}$			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	ses	Η	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	ences	М	П	П	Ш	IV
Control(s) Type	С	Offsite (MOI) 0	nsite-2 (co-located worker)	Onsite-1 (facility worker)	Conseque	T	ш	ш	IV	IV
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	$\mathbf{C} \geq$ Irreversible, <b>C</b>	$C \ge$ Prompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	ons	L	ш	ш	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	С	Ν	IV	IV	IV	IV
Acronyms		or symptoms which	immediately life-	is immediately life-						
<b>MOI</b> = Maximally-exposed Offsite Individual			hreatening or permanently	threatening or						
		individual's ability to	disabling.	permanently disabling.						
		take protective								
		action.								
	М	$\mathbf{C} \ge \mathbf{Mild}$ , transient	$\mathbf{C} \geq$ Serious injury, no	$C \ge$ Serious injury, no						
		adverse effects.	immediate loss of life no	immediate loss of life no						
			permanent disabilities;	permanent disabilities;						
			hospitalization required.	hospitalization required.						
	L	Mild, transient	Minor injuries; no	Minor injuries; no						
adverse e		adverse effects > C	hospitalization > C	hospitalization > C						
	Ν	Consequences less	Consequences less than	Consequences less than						
		than those for Low the	ose for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

#### Table 20.26 Other hazards – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	Hazard: Accidental entry	L: BEU	P – Work practice procedure requires use of an attendant, outside of the	L: BEU
		C: H	enclosure to warn of hazard.	C: H
		R: III		R: III
Noise		L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:
Ergonomics		L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:
Work from	Hazard: Struck by dropped	L: A	P – Fall protection program	L: EU
Heights	tool/material.	C: H	P – WPC	C: M
		R: I	M – PPE-Hard Hats	R: III

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.										
Likelihood (L, of event)/year	C	onsequence (C, of event)/ye	ear Risk (R, Qualitative	Ranking)	Risk	Matri	ix			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = \text{situation}$ (eve	$\mathbf{I}$ = situation (event) of major concern				Like	lihood	
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = \text{situation}$ (ev	$\mathbf{II} = \text{situation (event) of concern}$			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	ses	Η	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	ences	М	П	П	Ш	IV
Control(s) Type	С	Offsite (MOI) 0	Insite-2 (co-located worker)	Onsite-1 (facility worker)	Conseque	т	ш	ш	TV.	TV/
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	н	$\mathbf{C} \geq$ Irreversible, <b>C</b>	$C \ge$ Prompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	ons	L	III	III	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	С	Ν	IV	IV	IV	IV
Acronyms		or symptoms which	immediately life-	is immediately life-						
<b>MOI</b> = Maximally-exposed Offsite Individual			hreatening or permanently	threatening or						
		individual's ability to	disabling.	permanently disabling.						
		take protective								
		action.								
	Μ	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$\mathbf{C} \ge \mathbf{Serious}$ injury, no						
		adverse effects.	immediate loss of life no	immediate loss of life no						
			permanent disabilities;	permanent disabilities;						
			hospitalization required.	hospitalization required.						
	L	Mild, transient	Minor injuries; no	Minor injuries; no						
		adverse effects > C	hospitalization > C	hospitalization > C						
	Ν	Consequences less	Consequences less than	Consequences less than						
		than those for Low the	nose for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

# Table 20.27 Other hazards – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	Hazard: Accidental entry	L: BEU	P – Work practice procedure requires use of an attendant, outside of the	L: BEU
		C: H	enclosure.	C: H
		R: III		R: III
Noise		L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:
Ergonomics		L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:
Work from	N/A	L:		
Heights		C:		
		R:		

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.													
Likelihood (L, of event)/year	C	onsequence (C, of event)/ye	ear Risk (R, Qualitative	Ranking)	Risk	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)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{d}\mathbf{e}\mathbf{r}\mathbf{a}\mathbf{t}\mathbf{e}$	$\mathbf{II} = situation (even$	$\mathbf{II} = \text{situation (event) of concern}$			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	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	ences	М	П	Π	III	IV			
Control(s) Type	С	Offsite (MOI) 0	nsite-2 (co-located worker)	Onsite-1 (facility worker)	Conseque	T	ш	ш	TV.	TV/			
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	$\mathbf{C} \geq$ Irreversible, <b>C</b>	$C \ge$ Prompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	ons	L	III	Ш	IV	IV			
$\mathbf{M} = \mathbf{Mitigative}$ (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	С	Ν	IV	IV	IV	IV			
Acronyms		or symptoms which	immediately life-	is immediately life-									
<b>MOI</b> = Maximally-exposed Offsite Individual			hreatening or permanently	threatening or									
		individual's ability to	disabling.	permanently disabling.									
		take protective											
		action.											
	Μ	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$C \ge$ Serious injury, no									
		adverse effects.	immediate loss of life no	immediate loss of life no									
			permanent disabilities;	permanent disabilities;									
			hospitalization required.	hospitalization required.									
	L	Mild, transient	Minor injuries; no	Minor injuries; no									
	adverse effects $> C$		hospitalization > C	hospitalization > C									
N Conse		Consequences less	Consequences less than	Consequences less than									
		than those for Low the	ose for Low Consequence	those for Low									
		Consequence Level	Level	Consequence Level									

# Table 20.28 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 Egress		L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.										
Likelihood (L, of event)/year	Co	onsequence (C, of event)/	year Risk (R, Qualitative	e Ranking)	Risk	Matri	x			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = situation (ev$	ent) of major concern			Likelihood			
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{O}\mathbf{P}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}O$	$\mathbf{II} = situation (e^{-1})$	$\mathbf{I}$ = situation (event) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	$\mathbf{III} = \text{situation} (\mathbf{e})$	event) of minor concern	ses	Н	Ι	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (e	event) of minimal concern	enc	М	п	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	ш	ш	IV	IV
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	H	$\mathbf{C} \geq$ Irreversible,	$\mathbf{C} \geq \text{Prompt worker fatality}$	$\mathbf{C} \ge \mathbf{Prompt}$ worker	ous	L	III		IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	0	Ν	IV	IV	IV	IV
Acronyms		or symptoms which	immediately life-	is immediately life-						
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or						
		individual's ability to	disabling.	permanently disabling.						
		take protective								
		action.								
	Μ	$C \ge Mild$ , transient	$\mathbf{C} \ge \mathbf{Serious}$ injury, no	$\mathbf{C} \ge $ 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 $> C$	adverse effects $> C$ 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 20.29 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 Egress		L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	Co	onsequence (C, of event)/	year Risl	k (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	ation (event) of major concern				Likelihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	ses	Η	I	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = $ Negligible		IV = situation (ev	vent) of minimal concern	ienc	М	II	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co	o-located worker)	Onsite-1 (facility worker)	Consequences	т	ш	ш	IV	IV
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	H	$\mathbf{C} \geq$ Irreversible,	$\mathbf{C} \ge \operatorname{Promp}$	ot worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	suo	L	m	ш	1V	1 V
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	-	e injury that is	fatality or acute injury that	С	Ν	IV	IV	IV	IV
Acronyms		or symptoms which		diately life-	is immediately life-						
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatening	g or permanently	threatening or						
		individual's ability to	dis	sabling.	permanently disabling.						
		take protective									
		action.									
	Μ	$C \ge Mild$ , transient	$\mathbf{C} \ge \text{Seri}$	ious injury, no	$\mathbf{C} \ge $ Serious injury, no						
		adverse effects.	immediate	e loss of life no	immediate loss of life no						
			permane	ent disabilities;	permanent disabilities;						
			hospitaliz	zation required.	hospitalization required.						
	L	Mild, transient	Minor	injuries; no	Minor injuries; no						
		adverse effects $> C$ hose		alization > C	hospitalization $> C$						
	Ν	Consequences less Cons		ences less than	Consequences less than						
		than those for Low	those for Lo	ow Consequence	those for Low						
		Consequence Level	]	Level	Consequence Level						

# Table 20.30 Access & Egress – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety Egress	N/A	L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	ear Risk (R, Qualitative	Ranking)	Risk Matrix						
A = Anticipated (L > 1.0E-02) U = Unlikely (1.0E-02> L >1.0E-04)		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = \text{situation}$ (even	I = situation (event) of major concern II = situation (event) of concern				Likelihood			
		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = \text{situation}$ (eve					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	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	П	II	ш	IV	
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	Ŧ	TTT	ш	11/	13.7	
<ul> <li>P = Preventive (reduce event occurrence likelihood)</li> <li>M = Mitigative (reduces event consequences)</li> <li>Acronyms</li> <li>MOI = Maximally-exposed Offsite Individual</li> </ul>		$\mathbf{C} \geq$ Irreversible.	$C \ge Prompt$ worker fatality	$C \ge Prompt worker$		L	III	ш	IV	IV	
		other serious effects,	or acute injury that is	fatality or acute injury that	C	Ν	IV	IV	IV	IV	
		or symptoms which	immediately life-	is immediately life-							
			hreatening or permanently	threatening or							
		individual's ability to	disabling.	permanently disabling.							
		take protective	-								
		action.									
	Μ	$\mathbf{C} \ge $ Mild, transient	$C \ge$ Serious injury, no	$C \ge$ Serious injury, no							
		adverse effects.	immediate loss of life no	immediate loss of life no							
			permanent disabilities;	permanent disabilities;							
			hospitalization required.	hospitalization required.							
	L	Mild, transient	Minor injuries; no	Minor injuries; no							
		adverse effects $> C$	hospitalization > C	hospitalization > C							
	N	Consequences less	Consequences less than	Consequences less than							
		than those for Low the	hose for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

#### Table 20.31 Environmental

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Airborne	Hazards: Airborne release of radionuclides beyond permitted limits. Discharge of chemicals into onsite surface waters beyond permitted limits.	L: C: R:	See Section I Chapter 04	L: C: R:
Water	<ul> <li>Hazards:</li> <li>Discharge of radionuclides into onsite surface waters beyond permitted limits.</li> <li>Discharge of chemicals into onsite surface waters beyond permitted limits.</li> </ul>	L: A C: N R: IV	See Section I Chapter 04	L: C: R:
Soil	<ul> <li>Hazards: Radioactive soil in beam loss areas beyond allowable concentrations of radionuclides beyond calculated Fermilab limits.</li> <li>Discharge of chemicals into onsite soils beyond permitted limits.</li> </ul>	L: C: R:	See Section I Chapter 04	L: C: R: