	Risk Tables Description	Baseline	Residual
		Risk	Risk
18.1	Radiological – Onsite-1 Facility Worker	R:I	R:III, IV
18.2	Radiological – Onsite-2 Co-located Worker	R:I	R:III, IV
18.3	Radiological – MOI Offsite	R:I	R:III, IV
18.4	Toxic Materials – Onsite 1 Facility Worker	R:*	R:*
18.5	Toxic Materials – Onsite 2 Co-located Worker	R:*	R:*
18.6	Toxic Materials – MOI Offsite	R:*	R:*
18.7	Flammable & Combustible Materials – Onsite-1 Facility Worker	R:*	R:*
18.8	Flammable & Combustible Materials – Onsite-2 Co-located worker	R:*	R:*
18.9	Flammable & Combustible Materials – MOI Offsite	R:*	R:*
18.10	Electrical Energy – Onsite-1 Facility Worker	R:*	R:*
18.11	Electrical Energy – Onsite-2 Co-located Worker	R:*	R:*
18.12	Electrical Energy – MOI Offsite	R:*	R:*
18.13	Thermal Energy – Onsite-1 Facility Worker	R:*	R:*
18.14	Thermal Energy – Onsite-2 Co-located Worker	R:*	R:*
18.15	Thermal Energy – MOI Offsite	R:*	R:*
18.16	Kinetic Energy – Onsite-1 Facility Worker	R:*	R:*
18.17	Kinetic Energy – Onsite-2 Co-located Worker	R:*	R:*
18.18	Kinetic Energy – MOI Offsite	R:*	R:*
18.19	Potential Energy- Onsite-1 Facility Worker	R:*	R:*
18.20	Potential Energy – Onsite-2 Co-located Worker	R:*	R:*
18.21	Potential Energy – MOI Offsite	R:*	R:*
18.22	Magnetic Fields – Onsite-1 Facility Worker	R:*	R:*
18.23	Magnetic Fields – Onsite-2 Co-located Worker	R:*	R:*
18.24	Magnetic Fields – MOI Offsite	R:*	R:*
18.25	Other Hazards – Onsite-1 Facility Worker	R:*	R:*
18.26	Other Hazards – Onsite-2 Co-located Worker	R:*	R:*
18.27	Other Hazards – MOI Offsite	R:*	R:*
18.28	Access & Egress – Onsite-1 Facility Worker	R:*	R:*
18.29	Access & Egress – Onsite-2 Co-located Worker	R:*	R:*
18.30	Access & Egress – MOI Offsite	R:*	R:*
18.31	Environmental Hazards	R:*	R:*

Table 18. Summary of Baseline and Residual Risks Neutrino

* See Section 1, Chapter 4

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 18.1 Radiological – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M) Credited Controls (CC) in Bold	Residual Qualitative Risk (with CCs)
Residual	Hazard: exposure to residual	L: A	P-General And/Or Job Specific RWP: A Radiological Work Permit is	L: BEU
activation	activation	C: H	written by ES&H that specifies the work that is permitted to be	C: N
		R: I	 performed, requirements to perform the work, and limitations of radiological exposure. P – Use Of A LSM: Use of a log survey monitor is specified by a RWP. The LSM allows for real time monitoring of radiation levels during work. P – Radiological Training: An educational system managed by ES&H that establishes basic worker knowledge through presentations and testing. M – Radiological Signage And Decay Time Requirements: Signs located in various places throughout the accelerator complex warn of various hazards and occupancy restrictions prior to entry. Furthermore, work may be restricted or prevented until sufficient time has passed such that radiation levels are sufficiently low to allow for safer work to proceed. This mitigation has passive and active components. M – Radiological Shielding: Material placed between radiation sources and the enclosure to be protected. This is a passive mitigation. M – Run Conditions: Operating parameters that reduce residual activation by limiting the total amount of beam that could be delivered. 	R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M) Credited Controls (CC) in Bold	Residual Qualitative Risk (with CCs)
Groundwater	Hazard: exposure to radionuclides in	L: A	P – Sump Pumps: Pumps located in the accelerator enclosure that have an	L: BEU
Activation	ground water exceed regulatory levels	C: H	underdrain network. The water is pumped to the surface, so it does not	C: L
		R: I	stagnate in the accelerator and becomes activated prior to removing	R: IV
			the water from the enclosure.	
			P – Sump Monitoring Program; Sump water samples are periodically	
			collected and measured for radiological activation. If activation is	
			found in the sump sample, we have the ability to look for the root	
			cause before additional water is pumped to the surface.	
			P– Beam Loss Monitoring Electronic Beam Loss Monitors are used to	
			convert radiation created by prompt dose due to beam loss into	
			electrical signals. This information is then made available to the	
			accelerator control system where the data can be logged and	
			monitored with alarms and limits. Losses can be reduced or	
			eliminated with adjustment to the accelerators to prevent activation of	
			unnel components.	
			M – Machine Protection System: An accelerator system that monitors	
			ate. If these devices are not within their specified limits, the beam is	
			aborted and further injections into the accelerator are inhibited until	
			the system is reset by an operator	
			M = Run Conditions: Operating parameters that reduce residual activation	
			by limiting the total amount of beam that could be delivered.	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M) Credited Controls (CC) in Bold	Residual Qualitative Risk (with CCs)
Surface Water	Hazard: exposure to radionuclides in	L: A	P – Sump Pumps: Pumps located in the accelerator enclosure that have an	L: BEU
Activation	surface water exceed regulatory levels	C: H	underdrain network. The water is pumped to the surface, so it does not	C: N
		R: I	stagnate in the accelerator and becomes activated prior to removing	R: IV
			the water from the enclosure.	
			P – Sump Monitoring Program; Sump water samples are periodically	
			collected and measured for radiological activation. If activation is	
			found in the sump sample, we have the ability to look for the root	
			cause before additional water is pumped to the surface.	
			P-Beam Loss Monitoring Electronic Beam Loss Monitors are used to	
			convert radiation created by prompt dose due to beam loss into	
			electrical signals. This information is then made available to the	
			accelerator control system where the data can be logged and	
			monitored with alarms and limits. Losses can be reduced or	
			eliminated with adjustment to the accelerators to prevent activation of	
			tunnel components.	
			M – Machine Protection System: An accelerator system that monitors	
			devices such as beam loss monitors, power supplies, vacuum valves,	
			etc. If these devices are not within their specified limits, the beam is	
			aborted and further injections into the accelerator are inhibited until	
			the system is reset by an operator.	
			M – Pond Monitoring Program: Samples taken from the ponds and measured for activation. Sump water from the tunnel is discharged	
			into these ponds.	
			M – Run Conditions: Operating parameters that reduce residual activation	
			by limiting the total amount of beam that could be delivered.	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M) Credited Controls (CC) in Bold	Residual Qualitative Risk (with CCs)
Radioactive	Hazard: Exposure, beyond regulatory	L: A	P – Interlocked Gates: Barriers at entrances to the accelerator enclosure that	L: BEU
Water (RAW)	levels, to radioactive water	C: H	are electrically monitored through the Radiation and Electrical Safety	C: M
Systems		R: I	Systems to turn off the accelerator if the gate is opened	R: IV
			P - Interlocked Key; A key tree system that captures the keys to the accelerator enclosure. These keys are electrically monitored through the Radiation and Electrical Safety Systems to turn off the accelerator if any key is removed from the key tree.	
			P – Key Control Program: A program that checks the worker's training prior to issuing them a key to the accelerator enclosure. Also keeps track of worker accountability.	
			P – Postings: Signs located in various places throughout the accelerator warning of various hazards and occupancy restrictions.	
			P – Training: An educational system managed by ES&H that establishes basic worker knowledge through presentations and testing.	
			M – Engineered Containment: Containment in the area around the RAW system to prevent the RAW from spreading in the case of a leak.	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M) Credited Controls (CC) in Bold	Residual Qualitative Risk (with CCs)
Air Activation	Hazard: radionuclides in air exceed regulatory levels	L: A C: H R: I	 P – Air Monitoring: Air sampled from the enclosure for activation P – RSIS: The Radiation Safety Interlock System uses a key tree system that captures the keys to an accelerator enclosure. These keys are electrically monitored through the Radiation and Electrical Safety Systems to turn off the accelerator enclosure if any key is removed from the key tree. P – Beam loss Monitoring: Electronic Beam Loss Monitors are used to convert radiation created by prompt dose due to beam loss into electrical signals. This information is then made available to the accelerator control system where the data can be logged and monitored with alarms and limits. Losses can be reduced or eliminated with adjustment to the accelerators to prevent activation of tunnel components. M – Engineered air flow to dilute activated air and provide cool off (decay) time prior to release. Enclosure air flow design to give the activated air time to decay before exiting the enclosure. M – Run Conditions: Operating parameters that reduce residual activation by limiting the total amount of beam that could be delivered. Specifies when MCR operators are allowed to issue keys for the enclosure. Prohibits personnel access before the appropriate amount of decay time has elapsed. 	L: BEU C: L R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M) Credited Controls (CC) in Bold	Residual Qualitative Risk (with CCs)
Soil Interactions	Hazard: radionuclides are produced by beam interactions which may contaminate ground water	L: A C: N R: IV	 P – Beam Loss Monitoring: Electronic Beam Loss Monitors are used to convert radiation created by prompt dose due to beam loss into electrical signals. This information is then made available to the accelerator control system where the data can be logged and monitored with alarms and limits. Losses can be reduced or eliminated with adjustment to the accelerators to prevent activation of tunnel components. M – Engineered Beam Dump: Design of a beam absorber that minimizes the radiological leakage through the used of shielding. M – Beamline Design: Design of beamline optics to ensure that the actual beam size is smaller than the beam pipe to prevent scraping, beam loss, prompt dose, and residual activation. M – Run Conditions: Operating parameters that reduce residual activation by limiting the total amount of beam that could be delivered. 	L: U C: N R: IV
Radioactive waste	Hazard: persons are exposed to ionizing radiation beyond regulatory levels	L: A C: H R: I	 P – Locked Gates: Barriers to entrances of areas that contain radioactive material. Keys are required to open these gates. P – Key Control Program: A program that checks the worker's training prior to issuing them a key to the accelerator enclosure. Also keeps track of worker accountability. P – Postings: Signs located in various places throughout the accelerator warning of various hazards and occupancy restrictions M – Run Conditions: Operating parameters that reduce residual activation by limiting the total amount of beam that could be delivered. M – Distance to Stored Material: Barriers, such as ropes, that are used to increase the distance between the activated material and personnel. 	L:BEU C: L R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M) Credited Controls (CC) in Bold	Residual Qualitative Risk (with CCs)
Contamination	Hazard: persons are exposed to ionizing radiation beyond regulatory levels	L: A C: H R: I	 P – Locked Gates: Barriers to entrances of areas that contain radioactive material. Keys are required to open these gates. P – Key Control Program: A program that checks the worker's training prior to issuing them a key to the accelerator enclosure. Also keeps track of worker accountability. P – Postings and Fencing: Signs located in various places throughout the accelerator warning of various hazards and occupancy restrictions M – Radiological Work Permit: A permit written by Safety that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure. M – Training: An educational system managed by ES&H that establishes basic worker knowledge through presentations and testing. M – Run Conditions: Operating parameters that reduce residual activation by limiting the total amount of beam that could be delivered. 	L:BEU C: N R: IV
⁷ Be	Hazard: Potential radiation exposure to 7Be (uptake/committed dose).	L: A C: N R: IV	No prevention or mitigation is required. ⁷ Be isn't hazardous in this pattern of use by facility.	L: A C: N R: IV
Radioactive Sources	Hazard: Persons exposed to ionizing radiation beyond regulatory levels	L: A C: H R: I	 P – Radiological Signage On Or Near Source Cabinets: Signs give warning of the presence of radioactive sources. P – Radiological Training: An educational system managed by ES&H that establishes basic worker knowledge through presentations and testing. P – Kept Under Lock-and-key: Radioactive sources are kept in locked storage, where key issuance is a controlled process. M – Kept In Storage: Unused radioactive sources are kept in storage, which prevents the close proximity of these sources and people. M – Shielded Containers: Unused high activity sources are stored within shielded containers. 	L: BEU C: L R: IV

Radiological Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year Consequence (C, of event)/year			Risk (R, Qualitative Ranking)Risk Matrix								
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		\mathbf{I} = situation (event) of major concern							
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	nt) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)	$\mathbf{L} = \mathbf{Low}$		III = situation (eve	= situation (event) of minor concern		Н	Ι	Ι	Π	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)	$\mathbf{N} = \mathbf{Negligible}$			IV = situation (event) of minimal concern		enc	М	II	II	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsi	te-2 (co-located worker)	Onsite-1 (facility worker)	nbə	т	ш	ш	TV.	IV.
\mathbf{P} = Preventive (reduce event occurrence likelihood)	Н	$C \ge 25.0 \text{ rem}$		$\mathbf{C} \ge 100 \text{ rem}$	$C \ge 100 \text{ rem}$	ons	L	ш	ш	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)	Μ	25.0 rem > $\mathbf{C} \ge 5$ rem	10	$00 \text{ rem} > \mathbb{C} \ge 25 \text{ rem}$	100 rem > $\mathbf{C} \ge 25$ rem	0	Ν	IV	IV	IV	IV
Acronyms MOI - Maximally approved Officite Individual	L	5 rem > C		25 rem > C	25 rem > C						
rem = Roentgen equivalent man	Ν	0.5 rem > C		5 rem > C	5 rem > C						

Table 18.2 Radiological – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M) Credited Controls (CC) in Bold	Residual Qualitative Risk (with CCs)
Residual	Hazard: exposure to residual	L: A	P – General And/Or Job Specific RWP: A Radiological Work Permit is written by	L: BEU
activation	activation	C: H	ES&H that specifies the work that is permitted to be performed, requirements	C: N
		R: I	to perform the work, and limitations of radiological exposure.	R: IV
			P – Use Of A LSM: Use of a log survey monitor is specified by a RWP. The LSM	
			allows for real time monitoring of radiation levels during work.	
			P – Radiological Training: An educational system managed by ES&H that	
			establishes basic worker knowledge through presentations and testing.	
			M – Radiological Signage, Fencing And Decay Time Requirements: Signs located	
			in various places throughout the accelerator complex warn of various hazards	
			and occupancy restrictions prior to entry. Furthermore, work may be	
			restricted or prevented until sufficient time has passed such that radiation	
			levels are sufficiently low to allow for safer work to proceed. This mitigation	
			has passive and active components.	
			M – Radiological Shielding: Material placed between radiation sources and the	
			enclosure to be protected. This is a passive mitigation.	
			M – Run Conditions: Operating parameters that reduce residual activation by	
			limiting the total amount of beam that could be delivered.	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M) Credited Controls (CC) in Bold	Residual Qualitative Risk (with CCs)
Groundwater	Hazard: exposure to	L: A	P – Sump Pumps: Pumps located in the accelerator enclosure that have an	L: BEU
Activation	radionuclides in ground water	C: H	underdrain network. The water is pumped to the surface, so it does not	C: L
	exceed regulatory levels	R: I	stagnate in the accelerator and becomes activated prior to removing the water	R: IV
			from the enclosure.	
			P – Sump Monitoring Program; Sump water samples are periodically collected	
			and measured for radiological activation. If activation is found in the sump	
			sample, we have the ability to look for the root cause before additional water	
			is pumped to the surface.	
			P-Beam Loss Monitoring Electronic Beam Loss Monitors are used to convert	
			radiation created by prompt dose due to beam loss into electrical signals.	
			This information is then made available to the accelerator control system	
			where the data can be logged and monitored with alarms and limits. Losses	
			can be reduced or eliminated with adjustment to the accelerators to prevent	
			activation of tunnel components.	
			M – Machine Protection System: An accelerator system that monitors devices	
			such as beam loss monitors, power supplies, vacuum valves, etc. If these	
			devices are not within their specified limits, the beam is aborted and further	
			injections into the accelerator are inhibited until the system is reset by an	
			operator.	
			M – Run Conditions: Operating parameters that reduce residual activation by	
			limiting the total amount of beam that could be delivered.	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M) Credited Controls (CC) in Bold	Residual Qualitative Risk (with CCs)
Surface Water	Hazard: exposure to	L: A	P – Sump Pumps: Pumps located in the accelerator enclosure that have an	L: BEU
Activation	radionuclides in surface water	C: H	underdrain network. The water is pumped to the surface, so it does not	C: N
	exceed regulatory levels	R: I	stagnate in the accelerator and becomes activated prior to removing the water from the enclosure.	R: IV
			P – Sump Monitoring Program; Sump water samples are periodically collected	
			and measured for radiological activation. If activation is found in the sump	
			sample, we have the ability to look for the root cause before additional water	
			is pumped to the surface.	
			P– Beam Loss Monitoring Electronic Beam Loss Monitors are used to convert	
			radiation created by prompt dose due to beam loss into electrical signals.	
			This information is then made available to the accelerator control system	
			where the data can be logged and monitored with alarms and limits. Losses	
			can be reduced or eliminated with adjustment to the accelerators to prevent activation of tunnel components.	
			M – Machine Protection System: An accelerator system that monitors devices	
			such as beam loss monitors, power supplies, vacuum valves, etc. If these	
			devices are not within their specified limits, the beam is aborted and further	
			injections into the accelerator are inhibited until the system is reset by an	
			operator.	
			M – Pond Monitoring Program: Samples taken from the ponds and measured for	
			activation. Sump water from the tunnel is discharged into these ponds.	
			M – Run Conditions: Operating parameters that reduce residual activation by	
			limiting the total amount of beam that could be delivered.	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M) Credited Controls (CC) in Bold	Residual Qualitative Risk (with CCs)
Radioactive	Hazard: Exposure, beyond	L: A	P – Interlocked Gates: Barriers at entrances to the accelerator enclosure that are	L: BEU
Water (RAW)	regulatory levels, to radioactive	C: L	electrically monitored through the Radiation and Electrical Safety Systems to	C: M
Systems	water	R: III	turn off the accelerator if the gate is opened	R: IV
	b		P - Interlocked Key; A key tree system that captures the keys to the accelerator	
			enclosure. These keys are electrically monitored through the Radiation and	
			Electrical Safety Systems to turn off the accelerator if any key is removed from the key tree.	
			P – Key Control Program: A program that checks the worker's training prior to	
			issuing them a key to the accelerator enclosure. Also keeps track of worker accountability.	
			P – Postings: Signs located in various places throughout the accelerator warning of	
			various hazards and occupancy restrictions.	
			P – Training: An educational system managed by ES&H that establishes basic	
			worker knowledge through presentations and testing.	
			M – Engineered Containment: Containment in the area around the RAW system to	
			prevent the RAW from spreading in the case of a leak.	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M) Credited Controls (CC) in Bold	Residual Qualitative Risk (with CCs)
Air Activation	Hazard: • Radionuclides in air exceed regulatory levels	L: A C: H R: I	 P – Air Monitoring: Air sampled from the enclosure for activation P – RSIS: The Radiation Safety Interlock System uses a key tree system that captures the keys to an accelerator enclosure. These keys are electrically monitored through the Radiation and Electrical Safety Systems to turn off the accelerator enclosure if any key is removed from the key tree. P– Beam loss Monitoring: Electronic Beam Loss Monitors are used to convert radiation created by prompt dose due to beam loss into electrical signals. This information is then made available to the accelerator control system where the data can be logged and monitored with alarms and limits. Losses can be reduced or eliminated with adjustment to the accelerators to prevent activation of tunnel components. M – Engineered air flow to dilute activated air and provide cool off (decay) time prior to release. Enclosure air flow design to give the activated air time to decay before exiting the enclosure. M – Run Conditions: Operating parameters that reduce residual activation by limiting the total amount of beam that could be delivered. Specifies when MCR operators are allowed to issue keys for the enclosure. Prohibits personnel access before the appropriate amount of decay time has elapsed. 	L: BEU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M) Credited Controls (CC) in Bold	Residual Qualitative Risk (with CCs)
Soil Interactions	Hazard: radionuclides are	L: A	P – Beam Loss Monitoring: Electronic Beam Loss Monitors are used to convert	L: U
	produced which may	C: H	radiation created by prompt dose due to beam loss into electrical signals.	C: N
	contaminate ground water	R: I	This information is then made available to the accelerator control system	R: IV
			where the data can be logged and monitored with alarms and limits. Losses	
			can be reduced or eliminated with adjustment to the accelerators to prevent	
			activation of tunnel components.	
			M – Engineered Beam Dump: Design of a beam absorber that minimizes the	
			radiological leakage through the used of shielding.	
			M – Beamline Design: Design of beamline optics to ensure that the actual beam	
			size is smaller than the beam pipe to prevent scraping, beam loss, prompt	
			dose, and residual activation.	
			M – Run Conditions: Operating parameters that reduce residual activation by	
			limiting the total amount of beam that could be delivered.	
Radioactive waste	Hazard: persons are exposed to	L: A	P – Locked Gates: Barriers to entrances of areas that contain radioactive material.	L: BEU
	ionizing radiation beyond	C: H	Keys are required to open these gates.	C: L
	regulatory levels	R: I	P – Key Control Program: A program that checks the worker's training prior to	R: IV
			issuing them a key to the accelerator enclosure. Also keeps track of worker accountability.	
			P – Postings: Signs located in various places throughout the accelerator warning of various hazards and occupancy restrictions	
			M – Run Conditions: Operating parameters that reduce residual activation by	
			limiting the total amount of beam that could be delivered.	
			M – Distance to Stored Material: Barriers, such as ropes, that are used to increase	
			the distance between the activated material and personnel.	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M) Credited Controls (CC) in Bold	Residual Qualitative Risk (with CCs)
Contamination	Hazard: persons are exposed to ionizing radiation beyond regulatory levels	L: BEU C: N R: IV	 P – Locked Gates: Barriers to entrances of areas that contain radioactive material. Keys are required to open these gates. P – Key Control Program: A program that checks the worker's training prior to issuing them a key to the accelerator enclosure. Also keeps track of worker accountability. P – Postings and Fencing: Signs located in various places throughout the accelerator warning of various hazards and occupancy restrictions M – Radiological Work Permit: A permit written by Safety that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure. M – Training: An educational system managed by ES&H that establishes basic worker knowledge through presentations and testing. M – Run Conditions: Operating parameters that reduce residual activation by limiting the total amount of beam that could be delivered. 	L: BEU C: N R: IV
⁷ Be	Hazard: Potential radiation exposure to 7Be (uptake/committed dose).	L: A C: N R: IV	No prevention or mitigation is required. ⁷ Be isn't hazardous in this pattern of use by facility.	L: A C: N R: IV
Radioactive Sources	<i>Hazard: Persons are</i> exposed to ionizing radiation beyond regulatory levels	L: A C: H R: I	 P – Radiological Signage On Or Near Source Cabinets: Signs give warning of the presence of radioactive sources. P – Radiological Training: An educational system managed by ES&H that establishes basic worker knowledge through presentations and testing. P – Kept Under Lock-and-key: Radioactive sources are kept in locked storage, where key issuance is a controlled process. M – Kept In Storage: Unused radioactive sources are kept in storage, which prevents the close proximity of these sources and people. M – Shielded Containers: Unused high activity sources are stored within shielded containers. 	L: BEU C: L R: IV

Radiological Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	Consequence (C, of event)/year R			Risk (R, Qualitative Ranking)			Risk Matrix					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation (even})$	t) of major concern				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	nt) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		III = situation (eve	ent) of minor concern	es	Н	Ι	Ι	Π	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (event) of minimal concern		enc	М	II	II	Ш	IV	
Control(s) Type	С	Offsite (MOI)	Onsi	te-2 (co-located worker)	Onsite-1 (facility worker)	nbə	т	ш	ш	TV.	IV.	
\mathbf{P} = Preventive (reduce event occurrence likelihood)	Н	$C \ge 25.0 \text{ rem}$		$\mathbf{C} \ge 100 \text{ rem}$	$C \ge 100 \text{ rem}$	ons	L	ш	ш	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)	Μ	25.0 rem > $\mathbf{C} \ge 5$ rem	10	$00 \text{ rem} > \mathbb{C} \ge 25 \text{ rem}$	100 rem > $\mathbf{C} \ge 25$ rem	0	Ν	IV	IV	IV	IV	
Acronyms MOI - Maximally approved Officite Individual	L	5 rem > C		25 rem > C	25 rem > C							
rem = Roentgen equivalent man	Ν	0.5 rem > C		5 rem > C	5 rem > C							

Table 18.3 Radiological – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual	Hazard: exposure to residual	L: BEU	P – Facility is locked and not accessible to the unescorted public.	L: BEU
activation	activation	C: H	P – Shielding in place around the beam line and experiment enclosures per	C: H
		R: III	the relevant shield assessments	R: III
			P – Interlock system preventing access to beam enclosure while beam is present.	
			P – Enclosure keys linked to radiological and controlled access training to enter enclosure	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Groundwater	Hazard: radionuclides in ground	L: EU	P – Monitoring Wells: Wells that are drilled near accelerator enclosures in	L: BEU
Activation	water exceed regulatory levels	C: H	areas that are sensitive to potential aquifer contamination. These wells	C: L
		R: I	are periodically sampled and analyzed by ES&H to ensure the aquifer	R: IV
			is not becoming contaminated from accelerator operations.	
			P – Sump Pumps: Pumps located in the accelerator enclosure that have an	
			underdrain network. The water is pumped to the surface, so it does not	
			stagnate in the accelerator and becomes activated.	
			P – Beam loss Monitoring: Electronic Beam Loss Monitors are used to	
			convert radiation created by prompt dose due to beam loss into	
			electrical signals. This information is then made available to the	
			accelerator control system where the data can be logged and	
			monitored with alarms and limits. Losses can be reduced or	
			eliminated with adjustment to the accelerators to prevent activation of tunnel components.	
			M – Machine Protection System: An accelerator system that monitors	
			devices such as beam loss monitors, power supplies, vacuum valves,	
			etc. If these devices are not within their specified limits, the beam is	
			aborted and further injections into the accelerator are inhibited until	
			the system is reset by an operator.	
			M – Run Conditions: Operating parameters that reduce residual activation	
			by limiting the total amount of beam that could be delivered	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Surface Water	Hazard: radionuclides in surface	L: U	P – Sump Pumps: Pumps located in the accelerator enclosure that have an	L: BEU
Activation	water exceed regulatory levels	C: H	underdrain network. The water is pumped to the surface, so it does not	C: N
		R: 1	stagnate in the accelerator and becomes activated prior to removing the water from the enclosure.	R: IV
			P – Sump Monitoring Program; Sump water samples are periodically	
			collected and measured for radiological activation. If activation is	
			found in the sump sample, we have the ability to look for the root	
			cause before additional water is pumped to the surface.	
			P- Beam Loss Monitoring Electronic Beam Loss Monitors are used to	
			electrical signals. This information is then made available to the	
			accelerator control system where the data can be logged and	
			monitored with alarms and limits. Losses can be reduced or	
			eliminated with adjustment to the accelerators to prevent activation of	
			tunnel components.	
			M – Machine Protection System: An accelerator system that monitors	
			devices such as beam loss monitors, power supplies, vacuum valves,	
			etc. If these devices are not within their specified limits, the beam is	
			the system is reset by an operator	
			M - Pond Monitoring Program (Procedure): Samples taken from the ponds	
			and measured for activation. Sump water from the tunnel is	
			discharged into these ponds.	
			M – Run Conditions: Operating parameters that reduce residual activation	
			by limiting the total amount of beam that could be delivered.	
Radioactive	Hazard: Exposure beyond regulatory	L: BEU	P – Facility is locked and not accessible to the unescorted public.	L: BEU
water (RAW)	levels, to radioactive water		P – Interiock system preventing access to beam enclosure while beam is	
Systems		K. III	P = Finctorial resonance in the stationary in the stationary interval and controlled access training to	K. 111
			enter enclosure	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Air Activation	Hazard: radionuclides in air exceed regulator levels	L: BEU C: N R: IV	 P – Facility is locked and not accessible to the unescorted public. P – Interlock system preventing access to beam enclosure while beam is present. P – Enclosure keys linked to radiological and controlled access training to enter enclosure 	L: BEU C: N R: IV
Soil Interactions	Hazard: radionuclides are produced which may contaminate ground water	L: BEU C: N R: IV	 P – Beam Loss Monitoring: Electronic Beam Loss Monitors are used to convert radiation created by prompt dose due to beam loss into electrical signals. This information is then made available to the accelerator control system where the data can be logged and monitored with alarms and limits. Losses can be reduced or eliminated with adjustment to the accelerators to prevent activation of tunnel components. M – Beamline Design: Design of beamline optics to ensure that the actual beam size is smaller than the beam pipe to prevent scraping, beam loss, prompt dose, and residual activation. M – Run Conditions: Operating parameters that reduce residual activation by limiting the total amount of beam that could be delivered. 	L: BEU C: N R: IV
Radioactive waste	Hazard: Persons are exposed to ionizing radiation beyond regulatory levels	L: BEU C: H R: III	P – Facility is locked and not accessible to the unescorted public. M – Radiological shielding to limit exposure to radioactive waste.	L: BEU C: M R: IV
Contamination	Hazard: Persons are exposed to ionizing radiation beyond regulatory levels	L: BEU C:N R: IV	 P – Facility is locked and not accessible to the unescorted public. P – Radiological control prescreens items with contamination potential prior to acceptance. If contamination exists the item is rejected. 	L: BEU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
⁷ Be	Hazard: Potential radiation exposure to 7Be (uptake/committed dose).	L: A C: N R: IV	No prevention or mitigation is required. ⁷ Be isn't hazardous in this pattern of use by facility.	L: A C: N R: IV
Radioactive Sources	Hazard: Persons are exposed to ionizing radiation beyond regulatory levels	L: BEU C: H R: III	 P – Facility is locked and not accessible to the unescorted public. P – All low activity sealed sources are kept in a lock box and registered through Radiological Control. M – Radiological training is required for source handling. 	L: BEU C: M R: IV

Radiological Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	Consequence (C, of event)/year F			Risk (R, Qualitative Ranking)			Risk Matrix					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \text{High}$		$\mathbf{I} = \text{situation (even}$	$\mathbf{I} = \text{situation (event) of major concern}$				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	nt) of concern			А	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	Π	III	
BEU = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (event) of minimal concern		enc	М	Π	II	Ш	IV	
Control(s) Type	С	Offsite (MOI)	Onsi	te-2 (co-located worker)	Onsite-1 (facility worker)	equ	т			117	11.7	
\mathbf{P} = Preventive (reduce event occurrence likelihood)	Н	$C \ge 25.0$ rem		$\mathbf{C} \ge 100 \text{ rem}$	$C \ge 100 \text{ rem}$	ons	L	ш	ш	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)	Μ	25.0 rem > $\mathbf{C} \ge 5$ rem	10	00 rem > $\mathbf{C} \ge 25$ rem	100 rem > C ≥ 25 rem	0	Ν	IV	IV	IV	IV	
Acronyms MOL Manimalla annead Officia Individual	L	5 rem > C		25 rem > C	25 rem > C							
rem = Roentgen equivalent man	Ν	0.5 rem > C		5 rem > C	5 rem > C							

Table 18.4 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 dust during manual handling of un- encased lead bricks, lead shot, and lead sheets.	L: C: R:	See Section 1, Chapter 4	L: C: R:
Beryllium *	Hazard: Potential exposure to beryllium dust during manual handling of un-encased, activities.	L: C: R:	See Section 1, Chapter 4	L: C: R:

Chemical Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk Matrix					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (even	nt) of major concern						
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)		$\mathbf{L} = Low$		Kl;kmkm;.;'/ III	I = situation (event) of	es	Н	Ι	Ι	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		minor concern		ienc	М	II	II	III	IV
				IV = situation (ev	vent) of minimal concern	nbə	-				
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	Suc	L	ш	ш	IV	IV
\mathbf{P} = Preventive (reduce event occurrence likelihood)	н	$\mathbf{C} \ge PAC-2$		$\mathbf{C} \ge PAC-3$	C≥IDLH	Ŭ	Ν	IV	IV	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)	М	PAC-2 > C > PAC-1	PA	AC-3 > C > PAC-2	$IDLH > C > PEL or TLV_c$						
Acronyms	T.	PAC-1 > C		PAC-2 > C	$\frac{PEL \text{ or } TLV_0 > C}{PEL \text{ or } TLV_0 > C}$						
IDLH = Immediately Dangerous to Life and Health	N		Cor	TAC-27C							
MOI = Maximally-exposed Offsite Individual	IN	Consequences less		isequences less than	Consequences less than						
PAC = Protective Action Criteria		than those for Low	those	for Low Consequence	those for Low						
PEL = Permissible Exposure Limit		Consequence Level		Level	Consequence Level						
TLV _c = Threshold Limit Value (ceiling)											

Table 18.5 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 dust during manual handling of un- encased lead bricks, lead shot, and lead sheets.	L: C: R:	See Section 1, Chapter 4	L: C: R:
Beryllium *	Hazard: Potential exposure to beryllium dust during manual handling of un-encased, activities.	L: C: R:	See Section 1, Chapter 4	L: C: R:

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

Table 18.6 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 dust during manual handling of un- encased lead bricks, lead shot, and lead sheets.	L: C: R:	See Section 1, Chapter 4	L: C: R:
Beryllium *	Hazard: Potential exposure to beryllium dust during manual handling of un-encased, activities.	L: C: R:	See Section 1, Chapter 4	L: C: R:

Chemical Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	Co	onsequence (C, of event))/year	Risk (R, Qualitative	Ranking)	Risk Matrix					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern						
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)		$\mathbf{L} = Low$		III = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə					
P = Preventive (reduce event occurrence likelihood)	Н	$C \ge PAC-2$		$C \ge PAC-3$	$C \ge IDLH$	suo	L	ш	ш	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)	Μ	PAC-2 > C > PAC-1	PA	AC-3 > C > PAC-2	$IDLH > C > PEL or TLV_{c}$	C	Ν	IV	IV	IV	IV
Acronyms	T.	PAC-1 > C		1000000000000000000000000000000000000	$\frac{PEL \text{ or } TLV}{PEL \text{ or } TLV} > C$						
IDLH = Immediately Dangerous to Life and Health	N	Consequences less	Cor	nnc-2 > c	$\frac{1}{1} \frac{1}{1} \frac{1}$						
MOI = Maximally-exposed Offsite Individual	1 N	the set of	41-2-2-	for Loss Conservation	these for Less than						
PAC = Protective Action Criteria		than those for Low	those	for Low Consequence	those for Low						
PEL = Permissible Exposure Limit		Consequence Level		Level	Consequence Level						
TLV _c = Threshold Limit Value (ceiling)											

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Combustible materials (cables, Boxes, Paper, wood cribbing, etc.)	 Hazard: 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 1, Chapter 4	L: C: R:

Table 18.7 Flammable and Combustible Materials – Onsite -1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Flammable Materials (e.g., 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.		See Section 1, Chapter 4	L: C: R:

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

Likelihood (L, of event)/year	C	onsequence (C, of event)/	'year	Risk (R, Qualitative	Ranking)	Risk	. Matri	X			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	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	<u></u>		Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		III = situation (ev	vent) of minor concern	es	Н	Ι	Ι	Π	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	nbə					
\mathbf{P} = Preventive (reduce event occurrence likelihood)	Н	C > Irreversible	$\mathbf{C} > \mathbf{P}$	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	Ŭ	Ν	IV	IV	IV	IV
Acronyms		or symptoms which	i	mmediately life-	is immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective		e	1 5 6						
		action.									
	Μ	$\mathbf{C} \geq \mathbf{Mild}$, transient	C 2	≥ Serious injury, no	$C \ge$ Serious injury, no						
		adverse effects.	imm	ediate loss of life no	immediate loss of life no						
			per	manent disabilities;	permanent disabilities;						
			hosp	pitalization required.	hospitalization required.						
	L	Mild, transient	Ň	Ainor injuries; no	Minor injuries; no						
		adverse effects > C	ho	ospitalization > C	hospitalization $> C$						
	Ν	Consequences less	Con	sequences less than	Consequences less than						
		than those for Low	those	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 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 1, Chapter 4	L: C: R:

Table 18.8 Flammable and Combustible Materials – Onsite -2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Flammable Materials (e.g., 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 1, Chapter 4	L: C: R:

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

Likelihood (L, of event)/year	C	onsequence (C, of event)/2	'year	Risk (R, Qualitative	Ranking)	Risk	. Matri	X			
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (even	situation (event) of major concern				Like	lihood	
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = situation (even$	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	$\mathbf{L} = \mathbf{Low}$		vent) of minor concern	es	Н	Ι	Ι	Π	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	nbə					
\mathbf{P} = Preventive (reduce event occurrence likelihood)	н	C > Irreversible	$\mathbf{C} > \mathbf{P}$	rompt worker fatality	$\mathbf{C} \ge \text{Prompt worker}$	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	Ŭ	Ν	IV	IV	IV	IV
Acronyms		or symptoms which	i	mmediately life-	is immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	threat	ening or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective		C C							
		action.									
	Μ	$C \ge Mild$, transient	C ≥	Serious injury, no	$C \ge$ Serious injury, no						
		adverse effects.	imm	ediate loss of life no	immediate loss of life no						
			peri	manent disabilities;	permanent disabilities;						
			hosp	vitalization required.	hospitalization required.						
	L	Mild, transient	Ν	linor injuries; no	Minor injuries; no						
		adverse effects > C	ho	ospitalization > C	hospitalization > C						
	Ν	Consequences less	Con	sequences less than	Consequences less than						
		than those for Low	those t	for Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 18.9 Flammable and Combustible Materials – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Combustible materials (cables, Boxes, Paper, wood cribbing, etc.)	 Hazard: 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. 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. 	L: C: R:	. See Section 1, Chapter 4	L: C: R:

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Flammable Materials (e.g., 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 public is of minor concern.	L: C: R:	See Section 1, Chapter 4	L: C: R:

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

Likelihood (L, of event)/year		Consequence (C, of event)/year		Risk (R, Qualitative Ranking)		Risk Matrix					
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		\mathbf{I} = situation (event) of major concern				Likelihood			
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation (event) of concern}$			1	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		III = situation (event) of minor concern		es	Н	Ι	Ι	Π	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (event) of minimal concern		enc	М	II	II	III	IV
Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual		Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	nbə					
		C > Irreversible	$\mathbf{C} > \mathbf{P}$	rompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	ons	L	Ш	ш	IV	IV
		other serious effects.	or	acute injury that is	fatality or acute injury that	Ŭ	Ν	IV	IV	IV	IV
		or symptoms which	i	immediately life- reatening or permanently that is immediately life- threatening or							
		could impair an	threat								
		individual's ability to		disabling.	permanently disabling.						
		take protective		C C							
		action.									
	М	$C \ge Mild$, transient	C ≥	Serious injury, no	$C \ge$ Serious injury, no						
		adverse effects.	imm	ediate loss of life no	immediate loss of life no						
			peri	manent disabilities;	permanent disabilities;						
			hosp	vitalization required.	hospitalization required.						
		Mild, transient	Ν	linor injuries; no	Minor injuries; no						
		adverse effects > C	ho	ospitalization > C	hospitalization > C						
	Ν	Consequences less	Con	sequences less than	Consequences less than						
		than those for Low	those t	for Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 18.10 Electrical Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Stored Energy Exposure	Hazard: Shock hazard, >50 V, <u>Non-interlocked enclosures</u>	L: C: R:	See Section 1, Chapter 4	L: C: R:
	Arc Flash, <u>Non-interlocked</u> <u>enclosures</u>			
Stored Energy Exposure	Hazard: Shock hazard,>50 V, <u>Interlocked</u> enclosure area	L: C: R:	See Section 1, Chapter 4	L: C: R:
High Voltage Exposure	Hazard: Shock hazard, voltage > 50 V, <u>Non-interlocked enclosures</u>	L: C: R:	See Section 1, Chapter 4	L: C: R:
	Arc Flash, <u>Non-interlocked</u> <u>enclosures</u>			
Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
---	---	--	-------------------------------------	--
High Voltage Exposure	Hazard: Shock hazard, voltage > 50 V, <u>Interlocked enclosures</u> Arc Flash, <u>Interlocked</u> <u>enclosures</u>	L: C: R:	See Section 1, Chapter 4	L: C: R:
Low Voltage, High Current Exposure.	Hazard: Arc Flash, <u>Non- interlocked enclosures</u> Fire hazard from high current causing smoke inhalation and burns.	L: C: R:	See Section 1, Chapter 4	L: C: R:
Low Voltage, High Current Exposure	Hazard: Arc Flash, <u>Interlocked</u> <u>enclosures</u> Fire hazard from high current causing smoke inhalation and burns.	L: C: R:	See Section 1, Chapter 4	L: C: R:

Other Hazard Consequences, derived from Figure C-1	, "E	xample Qualitative Cons	sequen	nce Matrix", DOE-HD	BK-1163-2020.							
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year	Risk (R, Qualitative	Ranking)	Risk	Risk Matrix					
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (even	on (event) of major concern				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (eve	ent) of concern		1	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	ses	Н	Ι	I	II	III	
BEU = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	ienc	М	Π	II	III	IV	
Control(s) Type	С	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	nbə	т	тт	ш	TV.	TV.	
\mathbf{P} = Preventive (reduce event occurrence likelihood)	H	$\mathbf{C} \geq$ Irreversible,	$\mathbf{C} \ge \mathbf{P}$	rompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	ons	L	III	ш	IV	IV	
$\mathbf{M} = \mathbf{M}$ itigative (reduces event consequences)		other serious effects,	or acute injury that is		fatality or acute injury that	C	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	i	mmediately life-	is immediately life-							
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or permanently		threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective										
		action.										
	Μ	$C \ge Mild$, transient	C ≥	≥ Serious injury, no	$\mathbf{C} \ge \mathbf{Serious}$ injury, no							
		adverse effects.	imm	ediate loss of life no	immediate loss of life no							
			per	manent disabilities;	permanent disabilities;							
			hosp	pitalization required.	hospitalization required.							
	L	Mild, transient	Ν	Ainor injuries; no	Minor injuries; no							
		adverse effects > C	h	ospitalization > C	hospitalization > C							
		Consequences less	Con	sequences less than	Consequences less than							
		than those for Low	those	for Low Consequence	those for Low							
		Consequence Level		Level	Consequence Level							

Table 18.11 Electrical Energy 1 Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Stored Energy Exposure	Hazard: Shock hazard, >50 V, <u>Non-interlocked enclosures</u> Arc Flash, <u>Non-interlocked</u> <u>enclosures</u>	L: C: R:	See Section 1, Chapter 4	L: C: R:
Stored Energy Exposure	Harard: Shock hazard, >50 V, <u>Interlocked enclosures</u> Arc Flash, <u>Interlocked enclosures</u>	L: C: R:	See Section 1, Chapter 4	L: C: R:
High Voltage Exposure	Hazard: Shock hazard, voltage > 50 V, <u>Non-interlocked enclosures</u> Arc Flash, <u>Non-interlocked</u> <u>enclosures</u>	L: C: R:	See Section 1, Chapter 4	L: C: R:

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
High Voltage Exposure	Hazard: Shock hazard, voltage > 50 V, <u>Interlocked enclosures</u> Arc Flash, <u>Interlocked enclosures</u>	L: C: R:	See Section 1, Chapter 4	L: C: R:
Low Voltage, High Current Exposure.	Hazard: Arc Flash <u>Non- interlocked enclosures</u> Fire hazard from high current causing smoke inhalation and burns service building areas.	L: C: R:	See Section 1, Chapter 4	L: C: R:
Low Voltage, High Current Exposure.	Hazard: Arc Flash, <u>Interlocked</u> <u>enclosures</u> Fire hazard from high current causing smoke inhalation and burns, beam line enclosure areas	L: C: R:	See Section 1, Chapter 4	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	Consequence (C, of event)/year	Risk (R, Qualitative Ranking)	Risk Matrix								
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$	$\mathbf{H} = \mathrm{High}$	\mathbf{I} = situation (event) of major concern			Like	lihood					
U = Unlikely (1.0E-02>L>1.0E-04)	$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = \text{situation (event) of concern}$		Α	U	EU	BEU				
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)	$\mathbf{L} = Low$	III = situation (event) of minor concern	U e H	Ι	Ι	Π	III				

BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	М	II	Π	III	IV
						L	III	III	IV	IV
						Ν	IV	IV	IV	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)					
 P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual 	Η	C ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	C ≥ H or threa	Prompt worker fatality acute injury that is immediately life- tening or permanently disabling.	C ≥ Prompt worker fatality or acute injury that is immediately life- threatening or permanently disabling.					
		C ≥ Mild, transient adverse effects. Mild, transient adverse effects > C Consequences less than those for Low Consequence Level	action. $C \ge$ Mild, transient adverse effects. $C \ge$ imm per- hospMild, transient adverse effects > Chosp hospConsequences less than those for LowCor		C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no hospitalization > C Consequences less than those for Low Consequence Level					

Table 18.12 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, >50 V,	L:	See Section 1, Chapter 4	L:
Exposure	Arc flash	C:		C:
		K:		K:
High Voltage	Hazard: Shock hazard, >50 V,	L:	See Section 1, Chapter 4	L:
Exposure	Arc flash <u>outside</u>	C:		C:
		R:		R:
Low Voltage,	Hazard: N/A	L:	No Further analysis required	L:
High Current		C:		C:
Exposure.		R:		R:

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

Likelihood (L, of event)/year	C	onsequence (C, of event)/2	year	Risk (R, Qualitative	Ranking)	Risk Matrix							
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (even	nt) of major concern				Like	lihood			
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = situation (even$	ent) of concern		1	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	Ι	Π	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	ent) of minimal concern	enc	М	II	II	III	IV		
Control(s) Type	С	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	nbə							
\mathbf{P} = Preventive (reduce event occurrence likelihood)	Н	C > Irreversible	$\mathbf{C} > \mathbf{P}$	rompt worker fatality	$\mathbf{C} \ge \text{Prompt worker}$	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	Ŭ	Ν	IV	IV	IV	IV		
Acronyms		or symptoms which	i	mmediately life-	is immediately life-								
MOI = Maximally-exposed Offsite Individual		could impair an	threat	ening or permanently	threatening or								
		individual's ability to		disabling.	permanently disabling.								
		take protective		C C									
		action.											
	Μ	$C \ge Mild$, transient	C ≥	Serious injury, no	$C \ge$ Serious injury, no								
		adverse effects.	imm	ediate loss of life no	immediate loss of life no								
			peri	manent disabilities;	permanent disabilities;								
			hosp	vitalization required.	hospitalization required.								
	L	Mild, transient	Ν	linor injuries; no	Minor injuries; no								
		adverse effects > C	ho	ospitalization > C	hospitalization > C								
N		Consequences less	Con	sequences less than	Consequences less than								
		than those for Low	those t	for Low Consequence	those for Low								
		Consequence Level		Level	Consequence Level								

Table 18.13 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: welding, brazing, grinding, and other operations which create high temperatures which can ignite a fire	L: C: R:	See Section 1, Chapter 4	L: C: R:

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

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

Table 18.14 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: welding, brazing, grinding, and other operations which create high temperatures which can ignite a fire.	L: C: R:	See Section 1, Chapter 4	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year	Risk (R, Qualitative	Ranking)	Ris	sk Ma	atrix	[
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (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				А	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		III = situation (ev	vent) of minor concern	es	ŀ	Η	Ι	Ι	Π	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	Ν	А	II	Π	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nba						
\mathbf{P} = Preventive (reduce event occurrence likelihood)	н	$\mathbf{C} > $ Irreversible	C > P	Prompt worker fatality	C > Prompt worker	Suc	1	-	Ш	ш	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects	or acute injury that is		fatality or acute injury that	Ŭ	Ν	V	IV	IV	IV	IV
Acronyms		or symptoms which	immediately life-		is immediately life-							
MOI = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or							
		individual's ability to	unou	disabling.	permanently disabling.							
		take protective		uisuo migi	permanenti y unaccinig.							
		action.										
	Μ	$\mathbf{C} \ge \mathbf{Mild}, \mathbf{transient}$	C ≥	≥ Serious injury, no	$C \ge$ Serious injury, no							
		adverse effects.	imm	rediate loss of life no	immediate loss of life no							
			per	manent disabilities;	permanent disabilities;							
			hosp	pitalization required.	hospitalization required.							

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

Table 18.15 Thermal Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Hot Work	Hazard: N/A	L:	No further analysis required.	L: 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	Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (even	nt) of major concern				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{O}\mathbf{P}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}O$		$\mathbf{II} = \text{situation}$ (eve	ent) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		III = situation (ev	vent) of minor concern	es	Η	Ι	Ι	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	$\mathbf{N} = $ Negligible		vent) of minimal concern	enc	М	II	П	ш	IV	
Control(s) Type	С	Offsite (MOI)	Offsite (MOI) Onsite-2 (co		Onsite-1 (facility worker)	nbə	Ŧ				T 1	
\mathbf{P} = Preventive (reduce event occurrence likelihood)	H	$\mathbf{C} >$ Irreversible.	$\mathbf{C} \ge $ Irreversible $\mathbf{C} \ge $ Prom		$\mathbf{C} \ge \text{Prompt worker}$	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	C	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	i	immediately life-	is immediately life-							
MOI = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective		C	1 2 2							
		action.										
	Μ	$C \ge Mild$, transient	C 2	≥ Serious injury, no	$C \ge$ Serious injury, no							
		adverse effects.	imm	ediate loss of life no	immediate loss of life no							
			per	manent disabilities;	permanent disabilities;							
			hosp	pitalization required.	hospitalization required.							
	L	Mild, transient	Ν	Ainor injuries; no	Minor injuries; no							
		adverse effects $> C$ hos		ospitalization > C	hospitalization > C							
	Ν	Consequences less	Cor	sequences less than	Consequences less than							
		than those for Low	those	for Low Consequence	those for Low							
		Consequence Level		Level	Consequence Level							

Table 18.16 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: R:	See Section 1, Chapter 4	L: C: R:
Pumps and Motors	Hazard: Personnel injury due to entrapment/entanglement.	L: C: R:	See Section 1, Chapter 4	L: C: R:
Motion Tables	Hazard: Personnel injury due to pinch points, tip-overs, caught in between.	L: C: R:	See Section 1, Chapter 4	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk	Matri	X				
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (even	nt) of major concern				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = situation (even$	$\mathbf{II} = \text{situation (event) of concern}$		1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		III = situation (ev	vent) of minor concern	s	Н	Ι	Ι	II	III	
BEU = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = \mathbf{Negligible}$	$\mathbf{N} = $ Negligible		vent) of minimal concern	enc	М	II	II	III	IV	
Control(s) Type	С	Offsite (MOI) Onsite-2		e-2 (co-located worker)	Onsite-1 (facility worker)	nbə						
\mathbf{P} = Preventive (reduce event occurrence likelihood)	Н	C > Irreversible	C > Irreversible $C > Pro$		$\mathbf{C} \ge \text{Prompt worker}$	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	Ŭ	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	i	immediately life-	is immediately life-							
MOI = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective		6	1 2 2							
		action.										
	Μ	$C \ge Mild$, transient	C 2	≥ Serious injury, no	$\mathbf{C} \ge \mathbf{Serious}$ injury, no							
		adverse effects.	imm	nediate loss of life no	immediate loss of life no							
			per	manent disabilities;	permanent disabilities;							
			hosp	pitalization required.	hospitalization required.							
	L	Mild, transient	Ν	Minor injuries; no	Minor injuries; no							
		adverse effects > C	h	ospitalization > C	hospitalization > C							
	Ν	Consequences less	Consequences less Consec		Consequences less than							
		than those for Low	those	for Low Consequence	those for Low							
		Consequence Level		Level	Consequence Level							

Table 18.17 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 by object).	L: C: R:	See Section 1, Chapter 4	L: C: R:
Pumps and Motors	Hazard: Personnel injury due to entrapment/entanglement.	L: C: R:	See Section 1, Chapter 4	L: C: R:
Motion Tables	Hazard: Personnel injury due to tip-overs, caught in between, crushing	L: C: R:	See Section 1, Chapter 4	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	ent) of major concern				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{e}\mathbf{r}\mathbf{a}\mathbf{t}\mathbf{e}$		$\mathbf{II} = \text{situation}$ (ev	ent) of concern		1	A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		III = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III	
BEU = 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	e-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	т	ш	ш	IV	IV	
\mathbf{P} = Preventive (reduce event occurrence likelihood)	Н	$\mathbf{C} \geq$ Irreversible,	$\mathbf{C} \ge \mathbf{F}$	Prompt worker fatality	$C \ge Prompt worker$	ons	L	ш	m	1 V	1 V	
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects, or ac		acute injury that is	fatality or acute injury that is immediately life-	0	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	or symptoms which im									
MOI = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective		U	1 5 6							
		action.										
	М	$C \ge Mild$, transient	C	≥ Serious injury, no	$C \ge$ Serious injury, no							
		adverse effects.	imm	nediate loss of life no	immediate loss of life no							
			per	manent disabilities;	permanent disabilities;							
			hosp	pitalization required.	hospitalization required.							
	L	Mild, transient	Ν	Minor injuries; no	Minor injuries; no							
		adverse effects $> C$	h	ospitalization $> C$	hospitalization $> C$							

Table 18.18 Kinetic Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power tools	Hazard: N/A	L: C: R:	No Further analysis required	L: C: R:
Pumps and Motors	Hazard: N/A	L: C: R:	No Further analysis required	L: C: R:
Motion Tables	Hazard: N/A	L: C: R:	No Further analysis required	L: C: R:

Other Hazard Consequences, derived from Figure C-1	l, "E	xample Qualitative Con	sequer	nce Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk Matrix					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	ent) of major concern				Like	lihood	
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{O}\mathbf{P}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}O$		II = situation (ev	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		III = situation (e	vent) of minor concern	es	Н	Ι	Ι	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV
Control(s) Type	С	Offsite (MOI) Onsite-2		e-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	т	ш	ш	IV	IV
\mathbf{P} = Preventive (reduce event occurrence likelihood)	Н	$C \ge$ Irreversible, $C \ge$ Prorother serious effects. or acu		Prompt worker fatality	$C \ge Prompt worker$	ons	L		ш	1 V	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)				acute injury that is	fatality or acute injury that	0	Ν	IV	IV	IV	IV
Acronyms		or symptoms which	i	immediately life-	is immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or permanently disabling.						
		individual's ability to		disabling.							
		take protective		Ũ							
		action.									
	М	$C \ge Mild$, transient	C 2	≥ Serious injury, no	$C \ge$ Serious injury, no						
		adverse effects.	imm	nediate loss of life no	immediate loss of life no						
			per	rmanent disabilities;	permanent disabilities;						
			hosp	pitalization required.	hospitalization required.						
	L	Mild, transient	Ν	Minor injuries; no	Minor injuries; no						
		adverse effects > C	h	ospitalization > C	hospitalization > C						

Table 18.19 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 1, Chapter 4	L: C: R:
Compressed Gasses	Hazard: Personnel injury due to unexpected release, or unsecure tanks.	L: C: R:	See Section 1, Chapter 4	L: C: R:
Vacuum/ Pressure Vessels/ Piping	Hazard: Personnel injury due to unexpected pressure release.	L: C: R:	See Section 1, Chapter 4	L: C: R:
Vacuum Pumps	Hazard: Personnel injury due to interaction with existing vacuum.	L: C: R:	See Section 1, Chapter 4	L: C: R:
Material Handling	Hazard: Personnel injury due to moving/handing material (rollovers, crush, etc.)	L: C: R:	See Section 1, Chapter 4	L: C: R:

L		

Other Hazard Consequences, derived from Figure C-1	l, "E	example Qualitative Cor	isequei	nce Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event))/year	Risk (R, Qualitative	Ranking)	Risk Matrix					
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		III = situation (ev	vent) of minor concern	ses	Н	Ι	Ι	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	Π	II	ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)		T				
\mathbf{P} = Preventive (reduce event occurrence likelihood)	Н	$\mathbf{C} >$ Irreversible.	C > F	Prompt worker fatality	$\mathbf{C} \ge \text{Prompt worker}$	suo	L	ш	ш	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects.	or	acute injury that is	fatality or acute injury that	C	Ν	IV	IV	IV	IV
Acronyms		or symptoms which	i	immediately life-	is immediately life-				•		
MOI = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective		C	1 2 2						
		action.									
	М	$C \ge Mild$, transient	C	≥ Serious injury, no	$C \ge$ Serious injury, no						
		adverse effects.	imm	nediate loss of life no	immediate loss of life no						
			per	manent disabilities;	permanent disabilities;						
			hos	pitalization required.	hospitalization required.						
	L	Mild, transient	N	Minor injuries; no	Minor injuries; no						
		adverse effects $> C$	h	ospitalization > C	hospitalization $> C$						
	Ν	Consequences less	Cor	nsequences less than	Consequences less than						
		than those for Low	those	for Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 18.20 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:_Personnel struck by falling, swinging loads	L: C: R:	See Section 1, Chapter 4	L: C: R:
Compressed Gasses	Hazard: Collocated personnel injury due to unexpected release, or unsecure tanks	L: C: R:	See Section 1, Chapter 4	L: C: R:
Vacuum/ Pressure Vessels/ Piping	Hazard: Collocated personnel injury due to unexpected pressure release Hazard: Beam pipes under vacuum	L: C: R:	See Section 1, Chapter 4	L: C: R:
Vacuum Pumps	Hazard: Hazard: Personnel injury due to interaction with existing vacuum.	L: C: R:	See Section 1, Chapter 4	L: C: R:
Material Handling	Hazard: Collocated personnel injury due to moving/handing material (rollovers, crush, etc.)	L: C: R:	See Section 1, Chapter 4	L: C: R:

Other Hazard Consequences, derived from Figure C-1	, "Е	xample Qualitative Con	sequer	nce Matrix", DOE-HD	BK-1163-2020.							
Likelihood (L, of event)/year	Co	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = situation$ (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	r		Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		III = situation (ev	vent) of minor concern	es	Η	Ι	Ι	II	III	
BEU = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	tion (event) of minimal concern		М	II	Π	Ш	IV	
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	Ŧ					
\mathbf{P} = Preventive (reduce event occurrence likelihood)	H	$\mathbf{C} >$ Irreversible.	$\mathbf{C} > \mathbf{P}$	rompt worker fatality	$\mathbf{C} \ge \text{Prompt worker}$	suo	L	111	III	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects.	or	acute injury that is	fatality or acute injury that	C	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	i	mmediately life-	is immediately life-							
MOI = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective		e	1 2 2							
		action.										
	М	$\mathbf{C} \geq \text{Mild}$, transient	C 2	≥ Serious injury, no	$C \ge$ Serious injury, no							
		adverse effects.	imm	ediate loss of life no	immediate loss of life no							
			per	manent disabilities;	permanent disabilities;							
			hosp	pitalization required.	hospitalization required.							
	L	Mild, transient	Ν	Ainor injuries; no	Minor injuries; no							
		adverse effects $> C$	h	ospitalization > C	hospitalization > C							
	N	Consequences less	Con	sequences less than	Consequences less than							
		than those for Low	those	for Low Consequence	those for Low							
		Consequence Level		Level	Consequence Level							

Table 18.21 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: C: R:	No Further analysis required	L: C: R:
Compressed Gasses	Hazard: Injury due to unexpected release, or unsecure tanks outside of buildings	L: C: R:	See Section 1, Chapter 4	L: C: R:
Vacuum/ Pressure Vessels/ Piping	Hazard: Injury due to unexpected release, or unsecure tanks outside of buildings	L: C: R:	See Section 1, Chapter 4	L: C: R:
Vacuum Pumps	Hazard: N/A	L: C: R:	No Further analysis required	L: C: R:
Material Handling	Hazard: N/A	L: C: R:	No Further analysis required	L: C: R:

Other Hazard Consequences, derived from Figure C-1	l, "E	xample Qualitative Con	sequen	nce Matrix", DOE-HD	BK-1163-2020.							
Likelihood (L, of event)/year	Co	onsequence (C, of event)/	/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = situation$ (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			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		III = situation (ev	vent) of minor concern	s	Н	Ι	Ι	II	III	
BEU = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	Π	ш	IV	
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edu	Ţ					
\mathbf{P} = Preventive (reduce event occurrence likelihood)	н	C > Irreversible	$\mathbf{C} > \mathbf{P}$	Prompt worker fatality	C > Prompt worker	suo	L	Ш	ш	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects.	or	acute injury that is	fatality or acute injury that	Ŭ	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	i	immediately life-	is immediately life-							
MOI = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective		uisuomigi	permanenti y unsuo mig.							
		action.										
	Μ	$\mathbf{C} \geq \text{Mild}, \text{transient}$	C ≥	≥ Serious injury, no	$C \ge$ Serious injury, no							
		adverse effects.	imm	nediate loss of life no	immediate loss of life no							
			per	manent disabilities;	permanent disabilities;							
			hosp	pitalization required.	hospitalization required.							
	L	Mild, transient	N	Ainor injuries; no	Minor injuries; no							
		adverse effects $> C$	ho	ospitalization $> C$	hospitalization > C							
	Ν	Consequences less	Con	sequences less than	Consequences less than							
		than those for Low	those	for Low Consequence	those for Low							
		Consequence Level		Level	Consequence Level							

Table 18.22 Magnetic Fields – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields	 Hazard: Exposure to fringe fields beyond allowable limits (worker with ferromagnetic or electronic medical device(s)) Exposure to fringe fields beyond allowable limits (worker without ferromagnetic or electronic medical device(s)) Exposure to flying metallic objects causing potential injury. 	L: C: R:	See Section 1, Chapter 4	L: C R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.										
Likelihood (L, of event)/year	Consequence (C, of event)/yea	r Risk (R, Qualitative Ranking)	Rick M	atriv						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$	$\mathbf{H} = \mathrm{High}$	\mathbf{I} = situation (event) of major concern	KISK IVI		Like	libood				
U = Unlikely (1.0E-02>L>1.0E-04)	$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = \text{situation (event) of concern}$		А	U	EU	BEU			
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)	$\mathbf{L} = \mathbf{Low}$	III = situation (event) of minor concern	s a l	I F	I	П	Ш			
BEU = Beyond Extremely Unlikely $(1.0E-06>L)$	$\mathbf{N} = \mathbf{Negligible}$	IV = situation (event) of minimal concern			-					
Control(s) Type	C Offsite (MOI) Or	site-2 (co-located worker) Onsite-1 (facility worker)		и п	11	III	IV			

P = Preventive (reduce event occurrence likelihood)	Η	$\mathbf{C} \geq$ Irreversible,	$C \ge$ Prompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	L	III	III	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that					
Acronyms		or symptoms which	immediately life-	is immediately life-	Ν	IV	IV	IV	IV
MOI = 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	$\mathbf{C} \geq$ Serious injury, no	$\mathbf{C} \ge $ Serious injury, no					
		adverse effects.	immediate loss of life no	immediate loss of life no					
			permanent disabilities;	permanent disabilities;					
			hospitalization required.	hospitalization required.					
	L	Mild, transient	Minor injuries; no	Minor injuries; no					
		adverse effects > C	hospitalization $> C$	hospitalization > C					
	Ν	Consequences less	Consequences less than	Consequences less than					
		than those for Low	those for Low Consequence	those for Low					
		Consequence Level	Level	Consequence Level					

Table 18.23 Magnetic Fields – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields	 Hazard: Exposure to fringe fields beyond allowable limits (worker with ferromagnetic or electronic medical device(s)) Exposure to fringe fields beyond allowable limits (worker without ferromagnetic or electronic medical device(s)) Exposure to flying metallic objects causing potential injury. 	L: C: R:	See Section 1, Chapter 4	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.										
Likelihood (L, of event)/year	Consequence (C, of event)/year	Risk (R, Qualitative	Ranking)	Ris	k Matri	v			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$	$\mathbf{H} = \mathbf{High}$	H = High I = situation (event) of major concern								
U = Unlikely (1.0E-02>L>1.0E-04)	$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern			А	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)	$\mathbf{L} = \mathbf{Low}$		III = situation (ev	vent) of minor concern	s	чH	T	T	П	Ш
BEU = Beyond Extremely Unlikely $(1.0E-06>L)$	$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	Con Con		-	-		
Control(s) Type	C Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)		M	11	11	ш	IV

P = Preventive (reduce event occurrence likelihood)	Η	$\mathbf{C} \geq$ Irreversible,	$C \ge$ Prompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	L	III	III	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that					
Acronyms		or symptoms which	immediately life-	is immediately life-	Ν	IV	IV	IV	IV
MOI = 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	$\mathbf{C} \geq$ Serious injury, no	$\mathbf{C} \ge $ Serious injury, no					
		adverse effects.	immediate loss of life no	immediate loss of life no					
			permanent disabilities;	permanent disabilities;					
			hospitalization required.	hospitalization required.					
	L	Mild, transient	Minor injuries; no	Minor injuries; no					
		adverse effects > C	hospitalization $> C$	hospitalization > C					
	Ν	Consequences less	Consequences less than	Consequences less than					
		than those for Low	those for Low Consequence	those for Low					
		Consequence Level	Level	Consequence Level					

Table 18.24 Magnetic Fields – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields	Hazard: N/A	L: C: R:	No further analysis required	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)/	'year	Risk (R, Qualitative	Ranking)	Risk	Matri					
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \text{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern			Likelihood				
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern		1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		III = situation (ev	vent) of minor concern	ses	Н	Ι	Ι	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	Π	III	IV	
Control(s) Type	С	C Offsite (MOI) Onsite-2		e-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	т	ш	ш	IV	IV	
\mathbf{P} = Preventive (reduce event occurrence likelihood)	Н	$\mathbf{C} \geq$ Irreversible,	$\mathbf{C} \ge \mathbf{P}$	Prompt worker fatality	$\mathbf{C} \ge \text{Prompt worker}$	Jon	L	111	m	1.4	1.4	
$\mathbf{M} = Mitigative (reduces event consequences)$		other serious effects, or		acute injury that is	fatality or acute injury that	•	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	i	mmediately life-	is immediately life-							
MOI = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective										
		action.										
	М	$C \ge Mild$, transient	C ≥	≥ Serious injury, no	$C \ge$ Serious injury, no							
		adverse effects.	imm	ediate loss of life no	immediate loss of life no							
Ī			per	manent disabilities;	permanent disabilities;							
			hosp	pitalization required.	hospitalization required.							
		Mild, transient	N	/linor injuries; no	Minor injuries; no							
		adverse effects $> C$	h	ospitalization $> C$	hospitalization > C							

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

Table 18.25 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: Exposure to toxic atmosphere , limited egress, poor quality	L: C: R:	See Section 1, Chapter 4	L: C: R:
Noise	Hazard: Exposure above OELs via use of machinery, tools, co- location w/ equipment, etc.	L: C: R:	See Section 1, Chapter 4	L: C: R:
Silica	Hazard: Airborne exposure above OEL via concrete (or similar material) machining, moving dirt or gravel	L: C: R:	See Section 1, Chapter 4	L: C: R:
Ergonomics	Hazard: Office space, Industrial space (over lifting, repetitive motion, static posture)	L: C: R:	See Section 1, Chapter 4	L: C: R:
Asbestos	Hazard: Deteriorating building materials	L: C: R:	See Section 1, Chapter 4	L: C: R:

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Working at Heights	Hazard: Falls, dropped tools/material	L: C: R:	See Section 1, Chapter 4	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event))/year	Risk (R, Qualitative	Ranking)	Risk	x Matrix					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	ent) of major concern							
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (ev	ent) of concern		1	A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		III = situation (e	vent) of minor concern	es	Н	Ι	Ι	Π	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	ienc	М	II	II	III	IV	
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edu	т	TTT	ш	TV.	IV.	
 P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual 	$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	$\mathbf{C} \geq$ Irreversible,	$C \ge$ Prompt worker fatality		$\mathbf{C} \geq \text{Prompt worker}$	Cons	L	111	III	IV	IV	
		fatality or acute injury that is immediately life- threatening or permanently disabling.		N	IV	IV	IV	IV				
	М	C ≥ Mild, transient adverse effects.	C imm	≥ Serious injury, no nediate loss of life no	$C \ge$ Serious injury, no immediate loss of life no							

			permanent disabilities;	permanent disabilities;
			hospitalization required.	hospitalization required.
I	Ĺ	Mild, transient	Minor injuries; no	Minor injuries; no
		adverse effects $> C$	hospitalization > C	hospitalization > C
Ν	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 18.26 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: Exposure to toxic atmosphere , limited egress, poor quality	L: C: R:	See Section 1, Chapter 4	L: C: R:
Noise	Hazard: Exposure above OELs via use of machinery, tools, co- location w/ equipment, etc.	L: C: R:	See Section 1, Chapter 4	L: C: R:
Silica	Hazard: Airborne exposure above OEL via concrete (or similar material) machining, moving dirt or gravel	L: C: R:	See Section 1, Chapter 4	L: C: R:
Ergonomics	Hazard: Office space, Industrial space (over lifting, repetitive motion, static posture)	L: C: R:	No Further analysis required	L: C: R:
Asbestos	Hazard: Deteriorating building materials	L: C: R:	See Section 1, Chapter 4	L: C: R:

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Working at Heights	Hazard: Struck by dropped tools/material	L: C: R:	See Section 1, Chapter 4	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	Consequence (C, of event)/year			Risk (R, Qualitative	Ranking)	Risk	x 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		r	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		III = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	lenc	М	II	II	III	IV	
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	т	ш	ш	TV.	TV.	
P = Preventive (reduce event occurrence likelihood)M = Mitigative (reduces event consequences)	H	I $\mathbf{C} \ge$ Irreversible, $\mathbf{C} \ge \mathbf{P}$		Prompt worker fatality	$\mathbf{C} \ge \text{Prompt worker}$	ons	L	ш	m	1V	1V	
		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-								
--	---	--------------------------	--------------------------------------	--								
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective										
		action.										
	М	$C \ge Mild$, transient	$\mathbf{C} \ge $ Serious injury, no	$\mathbf{C} \ge \mathbf{Serious}$ injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects $> C$	hospitalization > C	hospitalization > C								
	Ν	Consequences less	Consequences less than	Consequences less than								
		than those for Low	those for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

Table 18.27 Other hazards – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	Hazard: Exposure to toxic atmosphere , limited egress, poor quality	L: C: R:	See Section 1, Chapter 4	L: C: R:
Noise	Hazard: Exposure above OELs via use of machinery, tools, co- location w/ equipment, etc.	L: C: R:	See Section 1, Chapter 4	L: C: R:
Silica	Hazard: Airborne exposure above OEL via concrete (or similar material) machining, moving dirt or gravel	L: C: R:	See Section 1, Chapter 4	L: C: R:
Ergonomics	Hazard: N/A	L: C: R:	No Further analysis required	L: C: R:
Asbestos	Hazard: N/A	L: C: R:	No Further analysis required	L: C: R:
Working at Heights	Hazard: Struck by dropped tools/material.	L: C: R:	See Section 1, Chapter 4	L: C: R:

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

			permanent disabilities;	permanent disabilities;
			hospitalization required.	hospitalization required.
I	Ĺ	Mild, transient	Minor injuries; no	Minor injuries; no
		adverse effects $> C$	hospitalization > C	hospitalization > C
Ν	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 18.28 Access & Egress – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety	Hazard: blocked egress would be	L:	See Section 1, Chapter 4	L:
Egress	of major life safety concern.	C: R:		C: R:
	An egress might be blocked due to construction work, poor housekeeping, or faulty doors.			
	In the event of a fire or other life- threatening event, a blocked egress would be life threatening.			
	The exposure of the hazard to the facility worker is of major concern.			

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	Consequence (C, of event)/y	ear Risk (R, Qualitative	Ranking)	Rick	Matri	7					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$	$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = \text{situation}$ (eve	\mathbf{I} = situation (event) of major concern			Likelihood					
U = Unlikely (1.0E-02>L>1.0E-04)	$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = situation (ev$	$\mathbf{II} = \text{situation (event) of concern}$			А	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)	$\mathbf{L} = \mathbf{Low}$	$\mathbf{III} = \text{situation}$ (e	vent) of minor concern		н	T	T	п	ш		
BEU = Beyond Extremely Unlikely $(1.0E-06>L)$	N = Negligible	IV = situation (e)	vent) of minimal concern	uo;	- 11	1	1	- 11	m		
Control(s) Type	C Offsite (MOI)	nsite-2 (co-located worker)	Onsite-1 (facility worker)		M	II	II	III	IV		

\mathbf{P} = Preventive (reduce event occurrence likelihood)	Н	$\mathbf{C} \geq $ Irreversible,	$\mathbf{C} \geq \mathbf{Prompt}$ worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker		L	III	III	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that						
Acronyms		or symptoms which	immediately life-	is immediately life-		Ν	IV	IV	IV	IV
MOI = 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	$C \ge$ 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						
	Ν	Consequences less	Consequences less than							
		than those for Low	those for Low Consequence those for Low							
		Consequence Level	Level	Consequence Level						

Table 18.29 Access & Egress – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety	Hazard: A blocked egress would	L:	See Section 1, Chapter 4	L:
Egress	be of major life safety concern.	C: R:		C: R:
	An egress might be blocked due to			
	construction work, poor			
	housekeeping, or faulty doors.			
	In the event of a fire, a blocked egress would be life threatening.			
	The exposure of the hazard to the			
	•			

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)/2	year	Risk (R, Qualitative	Ranking)	Risk	. Matri	x			
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern		1	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		III = situation (ev	vent) of minor concern	es	Н	Ι	Ι	Π	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	nbə					
\mathbf{P} = Preventive (reduce event occurrence likelihood)	Н	C > Irreversible	$\mathbf{C} > \mathbf{P}$	rompt worker fatality	$\mathbf{C} \ge \mathbf{Prompt}$ worker	ons	L	Ш	ш	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		other serious effects.	other serious effects $c \ge 110$ mg		fatality or acute injury that	Ŭ	Ν	IV	IV	IV	IV
Acronyms		or symptoms which	i	mmediately life-	is immediately life- threatening or						
MOI = Maximally-exposed Offsite Individual		could impair an	threat	ening or permanently							
		individual's ability to		disabling.	permanently disabling.						
		take protective		0							
		action.									
	Μ	$C \ge Mild$, transient	C ≥	≥ Serious injury, no	$C \ge$ Serious injury, no						
		adverse effects.	imm	ediate loss of life no	immediate loss of life no						
			peri	manent disabilities;	permanent disabilities;						
			hosp	vitalization required.	hospitalization required.						
	L	Mild, transient	Ν	/linor injuries; no	Minor injuries; no						
		adverse effects > C	ho	ospitalization > C	hospitalization > C						
	Ν	Consequences less	Con	sequences less than	Consequences less than						
		than those for Low	those t	for Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 18.30 Access & Egress – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety Egress	Hazard: N/A	L: C: R:	No Further analysis required	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	Co	onsequence (C, of event))/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (even	ent) of concern		1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		III = situation (ev	vent) of minor concern	ses	Η	Ι	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	ш	IV	
Control(s) Type	С	Offsite (MOI) Onsite-2		e-2 (co-located worker)	Onsite-1 (facility worker)	equ	Ŧ		ш	TV /	13.7	
\mathbf{P} = Preventive (reduce event occurrence likelihood)	Н	$C \ge Irreversible$, $C \ge Prompto contact of the co$		Prompt worker fatality	$\mathbf{C} \geq \text{Prompt worker}$	ons	L	ш	111	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)				acute injury that is	fatality or acute injury that	C	Ν	IV	IV	IV	IV	
Acronyms		or symptoms which	i	immediately life-	is immediately life-							
MOI = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective		C C								
		action.										
	Μ	$C \ge Mild$, transient	C	≥ Serious injury, no	$C \ge$ Serious injury, no							
		adverse effects.	imm	nediate loss of life no	immediate loss of life no							
			per	manent disabilities;	permanent disabilities;							
			hos	pitalization required.	hospitalization required.							
	L	Mild, transient	N	Minor injuries; no	Minor injuries; no							
adve		adverse effects $> C$	h	ospitalization > C	hospitalization > C							
	Ν	Consequences less	Cor	nsequences less than	Consequences less than							
		than those for Low	those	for Low Consequence	those for Low							
		Consequence Level		Level	Consequence Level							