Table 13. Summary of Baseline and Residual Risks Meson

	Risk Tables Description	Baseline Risk	Residual Risk
13,1	Radiological – Onsite-1 Facility Worker	R: I	R: IV
13.2	Radiological – Onsite-2 Co-located Worker	R: I	R: IV
13.3	Radiological – MOI Offsite	R: I	R: III
13.4*	Toxic Materials – Onsite 1 Facility Worker	R: *	R: *
13.5*	Toxic Materials – Onsite 2 Co-located Worker	R: *	R: *
13.6*	Toxic Materials – MOI Offsite	R: *	R: *
13.7*	Flammable & Combustible Materials – Onsite-1 Facility Worker	R: *	R: *
13.8*	Flammable & Combustible Materials – Onsite-2 Co-located worker	R: *	R: *
13.9*	Flammable & Combustible Materials – MOI Offsite	R: *	R: *
13.10*	Electrical Energy – Onsite-1 Facility Worker	R: *	R: *
13.11*	Electrical Energy – Onsite-2 Co-located Worker	R: *	R: *
13.12*	Electrical Energy – MOI Offsite	R: *	R: *
13.13*	Thermal Energy – Onsite-1 Facility Worker	R: *	R: *
13.14*	Thermal Energy – Onsite-2 Co-located Worker	R: *	R: *
13.15*	Thermal Energy – MOI Offsite	R: *	R: *
13.16*	Kinetic Energy – Onsite-1 Facility Worker	R: *	R: *
13.17*	Kinetic Energy – Onsite-2 Co-located Worker	R: *	R: *
13.18*	Kinetic Energy – MOI Offsite	R: *	R: *
13.19*	Potential Energy - Onsite-1 Facility Worker	R: *	R: *
13.20*	Potential Energy – Onsite-2 Co-located Worker	R: *	R: *
13.21*	Potential Energy – MOI Offsite	R: *	R: *
13.22*	Magnetic Fields – Onsite-1 Facility Worker	R: *	R: *
13.23*	Magnetic Fields – Onsite-2 Co-located Worker	R: *	R: *
13.24*	Magnetic Fields – MOI Offsite	R: *	R: *
13.25	Other Hazards – Onsite-1 Facility Worker	R: I	R: IV
13.26	Other Hazards – Onsite-2 Co-located Worker	R: III	R: III
13.27	Other Hazards – MOI Offsite	R: III	R: III
13.28*	Access & Egress – Onsite-1 Facility Worker	R: *	R: *
13.29*	Access & Egress – Onsite-2 Co-located Worker	R: *	R: *
13.30*	Access & Egress – MOI Offsite	R: *	R: *
13.31*	Environmental Hazards	R: *	R: *

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

NOTE

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

"Events with an unmitigated risk value of III or IV would not require additional control assignments to provide reasonable assurance of adequate protection. Whereas, for events with an unmitigated risk value of I or II, controls would need to be assigned to either reduce the likelihood or the consequence, and therefore the overall mitigated risk. Generally, preventive controls are applied prior to a loss event – reflecting a likelihood reduction and mitigative controls are applied after a loss event – reflecting a consequence reduction. Each control is credited for a single "bin drop" either in likelihood or consequence; not both. Following a standard hierarchy of controls, controls are applied until the residual risk is acceptable – reflecting a mitigated risk value of III or IV. After controls are credited, events with a remaining unacceptable residual risk (i.e., I or II) are candidates for additional analyses and additional controls, often quantitative in nature." For Fermilab, these controls for accelerator-specific hazards are identified as Credited Controls and further summarized in the Accelerator Safety Envelope (ASE).

Table 13.1 Radiological – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual	Hazard: Exposure to residual	L: A	P: Radiological Work Permit prevents unauthorized personnel form areas	L: BEU
activation	activation.	C: H	where excessive residual radiation exists.	C: L
		R: I	P: Postings intended to caution workers of area hazard.	R: IV
			P: Training for workers to identify and respond to the hazard.	
			M: Run Conditions to ensure total radiation levels are within expected parameters.	
			M: Shielding increases distance from the source of residual activation, minimizing exposure.	
Groundwater	Hazard: Radionuclides in	L: A	P: Sump Pumps ensure water does not remain in the enclosure for extended	L: BEU
Activation	groundwater exceeding regulatory	C: H	periods of time.	C: M
	levels.	R: I	P: Sump Monitoring Program samples the water discharged by the sump pumps.	R: IV
			P: Sump Pump Hatches are locked.	
			M: Run Conditions to ensure total radiation levels are within expected parameters.	
Surface Water	Hazard: Radionuclides in surface	L: A	P: Sump Pumps ensure water does not remain in the enclosure for extended	L: EU
Activation	water exceeding regulatory levels.	C: H	periods of time.	C: L
		R: I	P: Sump Monitoring Program samples the water discharged by the sump pumps.	R: IV
			M: Run Conditions to ensure total radiation levels are within expected	
			parameters.	
			M: Shielding ensures the distance from source to surface is maximized to reduce total dose.	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)	
Radioactive Water (RAW) Systems	Hazard: Personnel exposed to radioactive water exceeding regulatory levels.	L: A C: H R: I	P: Postings intended to caution workers of area hazard. P: Radiological Work Permit prevents unauthorized personnel form areas where excessive residual radiation exists. P: Training for workers to identify and respond to the hazard. M: Run Conditions to ensure total radiation levels are within expected parameters.	L: BEU C: M R: IV	
Air Activation	Hazard: Radionuclides in air exceeding regulatory levels.	L: A C: N R: IV	P: Measured air release documented in 2003 Shielding Assessment for the Switchyard 120 Project indicated 0 Ci per year under similar beam conditions. M: Engineered Air Flow ensures the air activation remains within the enclosure for more than the half-life of radionuclides before exiting. M: Run Conditions to ensure total radiation levels are within expected parameters.	L: U C: N R: IV	
Soil Interactions	Hazard: Radionuclides are produced, which may contaminate groundwater.	L: A C: H R: I	P: No excavation work allowed without an RWP. M: Engineered Beam Dump designed to contain the radiation produced by absorbing the deposited energy. M: Beamline Design ensures beam is transported through areas without interacting with soil. M: Run Conditions to ensure total radiation levels are within expected parameters.	L: U C: N R: IV	
Radioactive waste	Hazard: Personnel are exposed to ionizing radiation beyond regulatory levels.	L: A C: H R: I	P: Locked Gates prevent access to areas where radiation waste is stored. P: Key Control Program ensures access to these areas is managed. P: Postings intended to caution workers of area hazard. M: Run Conditions to ensure total radiation levels are within expected parameters. M: Distance to Stored Materials reduces total exposure risk to personnel. M: Material survey and release program ensures radioactive waste is not stored in unauthorized areas.	L: BEU C: N R: IV	

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

Radiological Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.													
Likelihood (L, of event)/year	Cor	nsequence (C, of event)/y	year	Risk (R, Qualitative Ranking)			Matri	X					
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \text{High}$		I = situation (even	t) of major concern				Like	lihood			
U = Unlikely (1.0E-02> L > 1.0E-04)	$\mathbf{M} = \mathbf{Moderate}$			$\mathbf{H} = \text{situation (even}$	situation (event) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (event) of minor concern		es	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (event) of minimal concern		enc	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsit	te-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	т т	III	III	IV	IV		
P = Preventive (reduce event occurrence likelihood)M = Mitigative (reduces event consequences)		C ≥ 25.0 rem		C ≥ 100 rem	C ≥ 100 rem	ons	L		111		- '		
		$25.0 \text{ rem} > \mathbf{C} \ge 5 \text{ rem}$	10	00 rem > C ≥ 25 rem	100 rem > C ≥ 25 rem		N	IV	IV	IV	IV		

Acronyms	L	5 rem > C	25 rem > C	25 rem > C
MOI = Maximally-exposed Offsite Individual	N	$0.5 \text{ rem} > \mathbf{C}$	5 rem > C	5 rem > C
rem = Roentgen equivalent man				

Table 13.2 Radiological – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual activation	Hazard: Exposure to residual activation.	L: A C: H R: I	P: Radiological Work Permit prevents unauthorized personnel form areas where excessive residual radiation exists. P: Postings intended to caution workers of areas of residual activation. P: Training for workers to identify and respond to the hazard. M: Run Conditions to ensure total radiation levels are within expected parameters. M: Shielding increases distance from the source of residual activation, minimizing exposure.	L: BEU C: L R: IV
Groundwater Activation	Hazard: Radionuclides in groundwater exceeding regulatory levels.	L: A C: H R: I	P: Sump Pumps ensure water does not remain in the enclosure for extended periods of time. P: Sump Monitoring Program samples the water discharged by the sump pumps. P: Sump Pump pit workers inform co-located workers of hazard. M: Run Conditions to ensure total radiation levels are within expected parameters.	L: BEU C: M R: IV
Surface Water Activation	Hazard: Radionuclides in surface water exceeding regulatory levels.	L: A C: H R: I	P: Sump Pumps ensure water does not remain in the enclosure for extended periods of time. P: Sump Monitoring Program samples the water discharged by the sump pumps. M: Run Conditions to ensure total radiation levels are within expected parameters. M: Shielding ensures the distance from source to surface is maximized to reduce total dose.	L: EU C: L R: IV
Radioactive Water (RAW) Systems	Hazard: Personnel exposed to radioactive water exceeding regulatory levels.	L: A C: H R: I	P: Postings to caution workers of area hazard. P: Radiological Work Permit prevents unauthorized personnel form areas where excessive residual radiation exists. P: Training for workers to identify and respond to the hazard. M: Run Conditions to ensure total radiation levels are within expected parameters.	L: BEU C: M R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Air Activation	Hazard: Radionuclides in air exceeding regulatory levels.	L: A C: N R: IV	 P: Measured air release documented in 2003 Shielding Assessment for the Switchyard 120 Project indicated 0 Ci per year under similar beam conditions. M: Engineered Air Flow ensures the air activation remains within the enclosure for more than the half-life of radionuclides before exiting. M: Run Conditions to ensure total radiation levels are within expected parameters. 	L: U C: N R: IV
Soil Interactions	Hazard: Radionuclides are produced, which may contaminate groundwater	L: A C: H R: I	P: No excavation work allowed without an RWP. M: Engineered Beam Dump designed to contain the radiation produced by absorbing the deposited energy. M: Beamline Design ensures beam is transported through areas without interacting with soil. M: Run Conditions to ensure total radiation levels are within expected parameters.	L: U C: N R: IV
Radioactive waste	Hazard: Personnel are exposed to ionizing radiation beyond regulatory levels.	L: A C: H R: I	P: Locked Gates prevent access to areas where radioactive waste is stored. P: Key Control Program ensures access to these areas is managed. P: Postings intended to caution workers of area hazard. M: Run Conditions to ensure total radiation levels are within expected parameters. M: Distance to Stored Materials reduces total exposure risk to personnel. M: Material survey and release program ensures radioactive waste is not stored in unauthorized areas.	L: BEU C: N R: IV
Contamination	Hazard: Personnel are exposed to ionizing radiation beyond regulatory levels.	L: A C: H R: I	 P: Radiation Survey of areas to measure and detect contamination hazards. P: Postings intended to caution workers of area hazard. M: PPE Specified by the RWP to protect workers in a contamination area. M: Training to ensure workers understand the risks and can prepare for the job accordingly. 	L: EU C: L R: IV
⁷ Be	Hazard: Potential radiation exposure to ⁷ Be (uptake/committed dose).	L: A C: N R: IV	⁷ Be isn't hazardous in this pattern of use by facility.	L: A C: N R: IV

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

adiological Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	event)/year Consequence (C, of event)/year Risk (R, Qualitative Ranking) Risk Matrix										
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (even	t) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (event) of concern				A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (eve	ent) of minor concern	S	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (eve	ent) of minimal concern	enc	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsi	te-2 (co-located worker)	Onsite-1 (facility worker)	edn		777	***	TX /	***
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ 25.0 rem		C ≥ 100 rem	C ≥ 100 rem	ons	L	III	III	IV	IV
M = Mitigative (reduces event consequences)	M	$25.0 \text{ rem} > \mathbf{C} \ge 5 \text{ rem}$	10	$00 \text{ rem} > \mathbf{C} \ge 25 \text{ rem}$	$100 \text{ rem} > \mathbf{C} \ge 25 \text{ rem}$		N	IV	IV	IV	IV
Acronyms MOI Manimally annual Office Individual	L	5 rem > C		25 rem > C	25 rem > C						
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	N	0.5 rem > C		5 rem > C	5 rem > C	1					

Table 13.3 Radiological – MOI Offsite

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Air Activation	Hazard: Radionuclides in air exceeding regulatory levels.	L: A C: N R: IV	 P: Measured air release documented in 2003 Shielding Assessment for the Switchyard 120 Project indicated 0 Ci per year under similar beam conditions. M: Engineered Air Flow ensures the air activation remains within the enclosure for more than the half-life of radionuclides before exiting. M: Run Conditions to ensure total radiation levels are within expected parameters. 	L: U C: N R: IV
Soil Interactions	Hazard: Radionuclides are produced, which may contaminate the soil.	L: A C: H R: I	 M: Engineered Beam Dump designed to contain the radiation produced by absorbing the deposited energy. M: Beamline Design ensures beam is transported through areas without interacting with soil. M: Run Conditions to ensure total radiation levels are within expected parameters. 	L: A C: N R: IV
Radioactive waste	Hazard: Personnel are exposed to ionizing radiation beyond regulatory levels.	L: A C: H R: I	P: Locked Gates prevent access to areas where radiation waste is stored. P: Key Control Program ensures access to these areas is managed. M: Run Conditions to ensure total radiation levels are within expected parameters. M: Distance to Stored Materials reduces total exposure. M: Material survey and release program ensures radioactive waste is not stored in unauthorized areas.	L: EU C: N R: IV
Contamination	Hazard: Personnel are exposed to ionizing radiation beyond regulatory levels.	L: A C: H R: I	P: Locked building prevents unauthorized access by public. P: Locked enclosure prevents unauthorized access by public. M: Shielding increases distance to stored materials reduces total exposure. M: Material survey and release program ensures radioactive waste is not stored in unauthorized areas.	L: EU C: L R: IV
⁷ Be	Hazard: Potential radiation exposure to 7Be (uptake/committed dose).	L: A C: N R: IV	⁷ Be isn't hazardous in this pattern of use by facility.	L: A C: N R: IV

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

Radiological Hazard Consequences, derived from Figu	Radiological Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year Consequence (C, of event)/year Risk (R, Qualitative Ranking) Risk Matrix													
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (even)	t) of major concern				Like	lihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ever	nt) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		III = situation (eve	ent) of minor concern	e	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (eve	ent) of minimal concern	nbə	M M	II	TT	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsi	te-2 (co-located worker)	Onsite-1 (facility worker)	ons	٠٠٠	11					
P = Preventive (reduce event occurrence likelihood)	Н	H $C \ge 25.0 \text{ rem}$		C ≥ 100 rem	C ≥ 100 rem	ر ت	L	III	III	IV	IV		

M = Mitigative (reduces event consequences)	M	$25.0 \text{ rem} > \mathbf{C} \ge 5 \text{ rem}$	100 rem > C ≥ 25 rem	100 rem > C ≥ 25 rem	N	IV	IV	IV	IV
Acronyms	L	5 rem > C	25 rem > C	25 rem > C				ı	
MOI = Maximally-exposed Offsite Individual	N	0.5 rem > C	5 rem > C	5 rem > C					ļ
rem = Roentgen equivalent man									ļ

Table 13.4 Toxic Materials – Onsite 1 Facility Worker

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

Chemical Hazard Consequences, derived from Figure	C-1	, "Example Qualitative	Conseq	quence Matrix", DOE-	HDBK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk Matrix					
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern						
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (even	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (e	vent) of minor concern	S	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	M	II	II	Ш	IV
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edn	,	Ш	Ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ PAC-2		C ≥ PAC-3	C ≥ IDLH	ons	L	Ш	Ш	1 V	17
M = Mitigative (reduces event consequences)	M	PAC-2 > C ≥ PAC-1	P/	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$	0	N	IV	IV	IV	IV
Acronyms	L	PAC-1 > C		PAC-2 > C	PEL or TLV $_{c} > C$						
IDLH = Immediately Dangerous to Life and Health MOI = Maximally-exposed Offsite Individual	N	Consequences less	Cor	nsequences 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 13.5 Toxic Materials – Onsite 2 Co-located Worker

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

Chemical Hazard Consequences, derived from Figure	C-1	, "Example Qualitative	Conseq	quence Matrix", DOE-	HDBK-1163-2020.						
Likelihood (L, of event)/year	Co	onsequence (C, of event))/year	Risk (R, Qualitative	Ranking)	Risk Matrix					
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern						
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ev	ent) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (e	vent) of minor concern	ક	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Offsite (MOI) Onsite-		Onsite-1 (facility worker)	edn	,	777	TTT	13.7	13.7
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ PAC-2		C ≥ PAC-3	C ≥ IDLH	Suo	L	III	III	IV	IV
$\mathbf{M} = \text{Mitigative (reduces event consequences)}$	М	$PAC-2 > C \ge PAC-1$	P.A	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$	1 5	N	IV	IV	IV	IV
Acronyms	T	$PAC-1 > \mathbf{C}$	- 11	PAC-2 > C	PEL or TLV $_{c} > C$						
IDLH = Immediately Dangerous to Life and Health	N		C								
MOI = Maximally-exposed Offsite Individual	11	Consequences less		nsequences 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 13.6 Toxic Materials – MOI Offsite

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

Chemical Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.													
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk	Matri	x					
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern				Like	lihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (ev}$	ent) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ex	vent) of minor concern	ន	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	ences	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edno				***	***		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ PAC-2		C ≥ PAC-3	C ≥ IDLH	ons	L	III	III	IV	IV		
M = Mitigative (reduces event consequences)	М	$PAC-2 > C \ge PAC-1$	P/	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$	၁	N	IV	IV	IV	IV		
Acronyms	T.	$PAC-1 > \mathbf{C}$		PAC-2 > C	PEL or TLV $_{c} > C$								
IDLH = Immediately Dangerous to Life and Health MOI = Maximally-exposed Offsite Individual PAC = Protective Action Criteria PEL = Permissible Exposure Limit TLV _c = Threshold Limit Value (ceiling)	N	Consequences less than those for Low Consequence Level		nsequences less than for Low Consequence Level	Consequences less than those for Low Consequence Level								

 ${\bf Table~13.7~Flammable~and~Combustible~Materials-Onsite~-1~Facility~Worker}$

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Combustible materials (cables, Boxes, Paper, wood cribbing, etc.)	Hazard: This hazard is a potential facility fire. The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices. This hazard can add to the fuel load of a potential facility fire. Poor housekeeping can also lead to life safety concerns, such as egress obstructions and tripping hazards. The exposure of the hazard to the facility worker is of major concern.	L: C: R:	See Section I Chapter 04.	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020. Likelihood (L, of event)/year Risk (R, Qualitative Ranking) F											
Likelihood (L, of event)/year	C	onsequence (C, of event)/	Risk	Matri	ix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern					Like	lihood	
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (even}$	ent) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ev	vent) of minor concern	nces	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern		M	П	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2	(co-located worker)	Onsite-1 (facility worker)	sedn	_	***	***	77.7	77.7
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Pro	ompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV
M = Mitigative (reduces event consequences)		other serious effects,		cute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV
Acronyms		or symptoms which			is immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an			threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective		-							
		action.									
	M	$C \ge Mild$, transient	$C \ge S$	Serious injury, no	C ≥ Serious injury, no						
		adverse effects.	immed	liate loss of life no	immediate loss of life no						
			perma	anent disabilities;	permanent disabilities;						
			hospita	alization required.	hospitalization required.						
	L	Mild, transient	Mir	nor injuries; no	Minor injuries; no						
		adverse effects > C	hosp	pitalization > C	hospitalization > C						
	N	Consequences less	Conse	equences less than	Consequences less than						
		than those for Low	those for	r Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 13.8 Flammable and Combustible Materials – Onsite -2 Co-located Worker

Combustible materials (cables, Boxes, Paper, wood cribbing, etc.) 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 co-located worker is of concern.	Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
	materials (cables, Boxes, Paper, wood	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	C:	See Section I Chapter 04.	C:

Other Hazard Consequences, derived from Figure C-1	, "F	xample Qualitative Cons	sequence Mat	trix", DOE-HD	BK-1163-2020.							
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year Risk ((R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$	I	= situation (eve	nt) of major concern							
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	I	II = situation (event) of concern				A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$	I	$\mathbf{II} = \text{situation (ev}$	vent) of minor concern	nces	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	Г	$\mathbf{V} = \text{situation (ev}$	vent) of minimal concern	- E	M	П	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-lo	ocated worker)	Onsite-1 (facility worker)	sedno	_	***	777	77.7	77.7	
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt v	worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV	
M = Mitigative (reduces event consequences)		other serious effects,	_	njury that is	fatality or acute injury that	C	N	IV	IV	IV	IV	
Acronyms		or symptoms which		ately life-	is immediately life-			•		•		
MOI = Maximally-exposed Offsite Individual		could impair an		or permanently	threatening or							
		individual's ability to	_	disabling. permanently disabling.								
		take protective		J								
		action.										
	M	C ≥ Mild, transient	C ≥ Seriou	ıs injury, no	C ≥ Serious injury, no							
		adverse effects.	immediate l	loss of life no	immediate loss of life no							
			permanent	disabilities;	permanent disabilities;							
			hospitalizat	ion required.	hospitalization required.							
	L	Mild, transient	Minor in	njuries; no	Minor injuries; no							
		adverse effects > C	hospitaliz	zation > C	hospitalization $> \mathbf{C}$							
	N	Consequences less	Consequen	ces less than	Consequences less than							
		than those for Low	those for Low	v Consequence	those for Low							
		Consequence Level	Le	evel	Consequence Level							

Table 13.9 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.)	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 I Chapter 04.	L: C: R:

Other Hazard Consequences, derived from Figure C-1	, "F	xample Qualitative Cons	sequence	e Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year F	Risk (R, Qualitative	Ranking)	Risk	Matri	ix			
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	ent) of major concern						
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (event) of concern				A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ev	vent) of minor concern	nces	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	event) of minimal concern		M	П	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2	(co-located worker)	Onsite-1 (facility worker)	edn	_	***	***	77.7	77.7
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Pro	ompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV
M = Mitigative (reduces event consequences)		other serious effects,		cute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV
Acronyms		or symptoms which		mediately life-	is immediately life-	-		•	•	•	<u> </u>
MOI = Maximally-exposed Offsite Individual		could impair an		ning or permanently	threatening or						
		individual's ability to		disabling. permanently disabling.							
		take protective		· ·							
		action.									
	M	C ≥ Mild, transient	$C \ge S$	Serious injury, no	C ≥ Serious injury, no						
		adverse effects.	immed	diate loss of life no	immediate loss of life no						
			perma	anent disabilities;	permanent disabilities;						
			hospita	alization required.	hospitalization required.						
	L	Mild, transient	Mir	nor injuries; no	Minor injuries; no						
		adverse effects > C	hosp	pitalization > C	hospitalization $> \mathbf{C}$						
	N	Consequences less	Conse	equences less than	Consequences less than						
		than those for Low	those for	or Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 13.10 Electrical Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
High Voltage Exposure	Hazard: • Shock hazard voltage > 50V, Non-interlocked enclosures	L: C: R:	See Section I, Chapter 04.	L: C: R:
	• Arc Flash, Non- interlocked enclosures	L: C: R:		L: C: R:
High Voltage Exposure	Hazard: • Shock hazard voltage > 50V, Interlocked enclosures	L: C: R:	See Section I, Chapter 04.	L: C: R:
	Arc Flash, Interlocked enclosures	L: C: R:		L: C: R:
Low Voltage, High Current Exposure	Hazard: • Arc Flash, Non- interlocked enclosures	L: C: R:	See Section I, Chapter 04.	L: C: R:
	 Fire hazard from high current causing smoke inhalation and burns. 	L: C: R:		L: C: R:

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Low Voltage,	Hazard:	L:	See Section I, Chapter 04.	L:
High Current	• Arc Flash, Interlocked	C:		C:
Exposure	enclosures	R:		R:
	Fire hazard from high current	L:		L:
	causing smoke inhalation and	C:		C:
	burns.	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 R	Risk (R, Qualitative	Ranking)	Risk	Matri	X			
$\mathbf{A} = \text{Anticipated (L} > 1.0\text{E}-02)$		$\mathbf{H} = \text{High}$		I = situation (eve	nt) of major concern						
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = situation (evolution (evolution for evolution $	ent) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (ev	vent) of minor concern	es	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2	(co-located worker)	Onsite-1 (facility worker)	sedneuces		***		***	
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Pro	mpt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV
M = Mitigative (reduces event consequences)		other serious effects,		cute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV
Acronyms		or symptoms which		mediately life-	is immediately life-				•	•	
MOI = Maximally-exposed Offsite Individual		could impair an		ning or permanently	threatening or						
		individual's ability to	disabling.		permanently disabling.						
		take protective		C							
		action.									
	M	C ≥ Mild, transient	$C \ge S$	Serious injury, no	C ≥ Serious injury, no						
		adverse effects.	immed	liate loss of life no	immediate loss of life no						
			perma	anent disabilities;	permanent disabilities;						
			hospita	alization required.	hospitalization required.						
	L	Mild, transient	Mir	nor injuries; no	Minor injuries; no						
		adverse effects > C	hosp	pitalization > C	hospitalization $> \mathbf{C}$						
	N	Consequences less	Conse	equences less than	Consequences less than						
		than those for Low	those for	r Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 13.11 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)
High Voltage	Hazard:	_	See Section I, Chapter 04.	
Exposure	 Shock hazard, voltage > 50 V, Non-interlocked enclosures 	L: C: R:		L: C: R:
	• Arc Flash, Non-			
	interlocked enclosures	L: C: R:		L: C: R:
High Voltage	Hazard:		See Section I, Chapter 04.	
Exposure	• Shock hazard, voltage > 50V, Interlocked enclosures	L: C: R:		L: C: R:
	Arc Flash, Interlocked	L:		L:
	enclosures	C: R:		C: R:
Low Voltage,	Hazard:		See Section 1, Chapter 04.	
High Current	Arc Flash, Non-interlocked	L:		L:
Exposure	enclosures	C: R:		C: R:
	Fire hazard from high	L:		L:
	current causing smoke inhalation and burns.	C:		C:
	invalence and ouries.	R:		R:

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Low Voltage,	Hazard:		See Section 1, Chapter 04.	
High Current	• Arc Flash, Interlocked	L:		L:
Exposure	enclosures	C:		C:
		R:		R:
	Fire hazard from high			
	current causing smoke	L:		L:
	inhalation and burns.	C:		C:
		R:		R:

Other Hazard Consequences, derived from Figure C-1	1, "E	Example Qualitative Cons	sequence Matrix", DOE-HI	DBK-1163-2020.						
Likelihood (L, of event)/year A = Anticipated (L > 1.0E-02)	C	onsequence (C, of event)/y H = High	I = situation (even	ent) of major concern	Risk	Matri	A	Like U	lihood EU	BEU
U = Unlikely (1.0E-02> L >1.0E-04) EU = Extremely Unlikely (1.0E-04 > L >1.0E-06) BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{M} = \mathbf{Moderate}$ $\mathbf{L} = \mathbf{Low}$ $\mathbf{N} = \mathbf{Negligible}$,	event) of concern event) of minor concern event) of minimal concern	iences	H M	I II	I	II III	III
Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual	C H	C ≥ Irreversible, other serious effects, or symptoms which	Onsite-2 (co-located worker) C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	Onsite-1 (facility worker) C ≥ Prompt worker fatality or acute injury that is immediately life- threatening or permanently disabling.	Conseque	L N	III IV	III IV	IV IV	IV IV
	L N	C ≥ Mild, transient adverse effects. Mild, transient adverse effects > C Consequences less	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	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 13.12 Electrical Energy – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-1	l, "F	Example Qualitative Cons	equence Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year Risk (R, Qualitative	Ranking)	Risk	Matri	X					
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (eve	ent) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{H} = \text{situation (ev}$	ent) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situation (ex	vent) of minor concern	sə	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	ences	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sedne		TTT	***	77.7	TX /		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
$\mathbf{M} = \text{Mitigative (reduces event consequences)}$		other serious effects,	or acute injury that is	fatality or acute injury that	5	N	IV	IV	IV	IV		
Acronyms		or symptoms which	immediately life-	is immediately life-					•			
MOI = Maximally-exposed Offsite Individual			threatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective	C									
		action.										
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization $> \mathbf{C}$								
	N	Consequences less	Consequences less than	Consequences less than								
		than those for Low	those for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

Table 13.13 Thermal Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Hot Work	Hazard: Hot work will cause elevated temperatures. If hot work is not supervised, there is a potential for combustibles in the surrounding area to be ignited due to exposure to slag or elevated temperatures. This could lead to excessive heat and burning, which could potentially lead to a fire. The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices. This hazard can add to the fuel load of a potential fire. The exposure of the hazard to the facility worker is of major concern.	L: C: R:	See Section I Chapter 4.	L: C: R:

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Cryogenics	Cryogenics are inherently a low risk on their own as they are non-flammable and non-toxic. However, if exposed to the cryogenic liquids, they have the potential of burning skin and creating an oxygen deficient atmosphere which can lead to death. The exposure of the hazard to the facility worker is of major concern.	L: C: R:	See Section I 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 F	Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	ent) of major concern				lihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		\mathbf{H} = situation (evo	ent) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ev	vent) of minor concern	nces	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern		M	П	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-2	(co-located worker)	Onsite-1 (facility worker)	sedn	_	***	***	77.7	77.7	
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Pro	Prompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV	
M = Mitigative (reduces event consequences)		other serious effects,		cute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV	
Acronyms		or symptoms which		mediately life-	is immediately life-							
MOI = Maximally-exposed Offsite Individual		could impair an	threaten	ning or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective		_								
		action.										
	M	$C \ge Mild$, transient	$C \ge S$	Serious injury, no	C ≥ Serious injury, no							
		adverse effects.	immed	diate loss of life no	immediate loss of life no							
			perma	anent disabilities;	permanent disabilities;							
			hospita	alization required.	hospitalization required.							
	L	Mild, transient	Mir	nor injuries; no	Minor injuries; no							
		adverse effects > C	hosp	pitalization > C	hospitalization $> \mathbf{C}$							
	N	Consequences less	Conse	equences less than	Consequences less than							
		than those for Low	those for	or Low Consequence	those for Low							
		Consequence Level		Level	Consequence Level							

Table 13.14 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	Hot work will cause elevated temperatures. If hot work is not supervised, there is a potential for combustibles in the surrounding area to be ignited due to exposure to slag or elevated temperatures. This could lead to excessive heat and burning, which could potentially lead to a fire. The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices. This hazard can add to the fuel load of a potential fire. The exposure of the hazard to the co-located worker is of minor concern.	L: C: R:	See Section I Chapter 04.	L: C: R:

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	C	onsequence (C, of event)/y	year Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$	I = situation (eve	ent) of major concern							
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situation (ev}$	vent) of concern		ı	A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$	III = situation (e	vent) of minor concern	ses	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely $(1.0E-06>L)$		N = Negligible	IV = situation (e	vent) of minimal concern	enc	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	_	TTT		TX /	13.7	
P = Preventive (reduce event occurrence likelihood)	H	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	ous	L	III	III	IV	IV	
$\mathbf{M} = \mathbf{Mitigative}$ (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	5	N	IV	IV	IV	IV	
Acronyms		or symptoms which	immediately life-	is immediately life-						<u> </u>	
MOI = Maximally-exposed Offsite Individual		could impair an threatening or permanently		threatening or							
		individual's ability to	disabling.	permanently disabling.							
		take protective	C								
		action.									
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no							
		adverse effects.	immediate loss of life no	immediate loss of life no							
			permanent disabilities;	permanent disabilities;							
			hospitalization required.	hospitalization required.							
	L	Mild, transient	Minor injuries; no	Minor injuries; no							
		adverse effects > C	hospitalization > C	hospitalization $> \mathbf{C}$							
	N	Consequences less	Consequences less than	Consequences less than							
		than those for Low	those for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

Table 2.15 Thermal Energy – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year Risk (R, Qualitative	Ranking)	Risk Matrix						
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \text{High}$	I = situation (eve	ent) of major concern							
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situation (ev}$	ent) of concern		1	A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situation (e	vent) of minor concern	es	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ex	vent) of minimal concern	ences	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sedne		***	***	77.7	***	
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV	
$\mathbf{M} = \text{Mitigative (reduces event consequences)}$		other serious effects,	or acute injury that is	fatality or acute injury that	ت ا	N	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.									
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no							
		adverse effects.	immediate loss of life no	immediate loss of life no							
			permanent disabilities;	permanent disabilities;							
			hospitalization required.	hospitalization required.							
	L	Mild, transient	Minor injuries; no	Minor injuries; no							
		adverse effects > C	hospitalization > C	hospitalization $> C$							
	N	Consequences less	Consequences less than	Consequences less than							
		than those for Low	those for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

Table 13.16 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 I Chapter 04.	L: C: R:
Pumps and Motors	Hazard: Personal injury due to entrapment/entanglement.	L: C: R:	See Section I Chapter 04.	L: C: R:
Motion Tables	Hazard: Personnel injury due to pinch points, tip-overs, caught in between.	L: C: R:	See Section I Chapter 04.	L: C: R:

Other Hazard Consequences, derived from Figure C-1	l, "F	Example Qualitative Cons	equence Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year Risk (R, Qualitative	Ranking)	Risk	Matri	ix					
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \text{High}$	I = situation (eve	ent) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situation (ev}$	vent) of concern		1	A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situation (e	vent) of minor concern	es	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ex	vent) of minimal concern	ences	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sedne		***	***	77.7	TX /		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
$\mathbf{M} = \text{Mitigative (reduces event consequences)}$		other serious effects,	or acute injury that is	fatality or acute injury that	ت ا	N	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.										
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization $> C$								
	N	Consequences less	Consequences less than	Consequences less than								
		than those for Low	those for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

Table 13.17 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	L:	See Section I Chapter 04.	L:
1 OWEI tOOIS	power tool use (flying debris, struck	C:		C:
	by object).	R:		R:
Pumps and	Hazard: Personal injury due to	L:	See Section I Chapter 04.	L:
Motors	entrapment/entanglement.	C:		C:
		R:		R:
Motion Tables	Hazard: Personnel injury due to tip-	L:	See Section I Chapter 04.	L:
	overs, caught in between, crushing.	C:		C:
		R:		R:

Other Hazard Consequences, derived from Figure C-1	l, "F	Example Qualitative Con	sequer	nce Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	1 ()										
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern						
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (even	vent) of concern		1	A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (ev	vent) of minor concern	nces	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern		M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	sedn	T	III	III	IV	IV
 P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual 	H	C ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	or i	Prompt worker fatality acute injury that is immediately lifetening or permanently disabling.	C ≥ Prompt worker fatality or acute injury that is immediately lifethreatening or permanently disabling.	Cons	N	IV	IV	IV	IV
	M L	C ≥ Mild, transient adverse effects. Mild, transient adverse effects > C	imm per hosp	≥ Serious injury, no lediate loss of life no manent disabilities; pitalization required. Minor injuries; no ospitalization > C	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no hospitalization > C						

Table 13.18 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:	Public is prevented from having access to work areas.	L: C: R:
Pumps and Motors	Hazard: N/A	L: C: R:	Public is prevented from having access to work areas.	L: C: R:
Motion Tables	Hazard: N/A	L: C: R:	Public is prevented from having access to work areas.	L: C: R:

Other Hazard Consequences, derived from Figure C-1	l, "F	Example Qualitative Con	sequer	nce Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	1 ()										
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern						
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (even	vent) of concern		1	A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (ev	vent) of minor concern	nces	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern		M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	sedn	T	III	III	IV	IV
 P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual 	H	C ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	or i	Prompt worker fatality acute injury that is immediately lifetening or permanently disabling.	C ≥ Prompt worker fatality or acute injury that is immediately lifethreatening or permanently disabling.	Cons	N	IV	IV	IV	IV
	M L	C ≥ Mild, transient adverse effects. Mild, transient adverse effects > C	imm per hosp	≥ Serious injury, no lediate loss of life no manent disabilities; pitalization required. Minor injuries; no ospitalization > C	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no hospitalization > C						

Table 13.19 Potential Energy – Onsite-1 Facility Worker

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

Other Hazard Consequences, derived from Figure C-1	, "F	xample Qualitative Cons	sequence	Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	Risk	Matri	ix								
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (ever	nt) of major concern						
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (even}$	ent) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (ev	event) of minor concern	nces	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern		M	П	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 ((co-located worker)	Onsite-1 (facility worker)	sedn	_	***	***	77.7	77.7
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Pror	mpt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV
M = Mitigative (reduces event consequences)				ute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV
Acronyms		or symptoms which		mediately life-	is immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	threateni	ing or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective		-							
		action.									
	M	C ≥ Mild, transient	$C \ge Se$	Serious injury, no	C ≥ Serious injury, no						
		adverse effects.	immedi	liate loss of life no	immediate loss of life no						
			perma	anent disabilities;	permanent disabilities;						
			hospita	alization required.	hospitalization required.						
	L	Mild, transient	Min	nor injuries; no	Minor injuries; no						
		adverse effects > C	hosp	pitalization > C	hospitalization $> \mathbf{C}$						
	N	Consequences less	Consec	quences less than	Consequences less than						
		than those for Low	those for	r Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 13.20 Potential Energy – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane Operations	Hazard: Struck by falling, swinging	L:	See Section I Chapter 04.	L:
	loads.	C:		C:
		R:		R:
Compressed	Hazard: Collocated personnel injury	L:	See Section I Chapter 04.	L:
Gasses	due to unexpected release, or	C:		C:
	unsecure tanks.	R:		R:
Vacuum Pumps	Hazard: Personnel injury due to	L:	See Section I Chapter 04.	L:
	interaction with existing vacuum.	C:		C:
		R:		R:
Material Handling	Hazard: Collocated personnel	L:	See Section I Chapter 04.	L:
	injury due to moving/handing	C:		C:
	material (rollovers, crush, etc.)	R:		R:

Other Hazard Consequences, derived from Figure C-1	, "F	xample Qualitative Cons	sequence	e Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	Risk	Matri	ix								
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	ent) of major concern						
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H} = \text{situation (even}$	ent) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ev	event) of minor concern	nces	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern		M	П	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2	(co-located worker)	Onsite-1 (facility worker)	sedn	_	***	***	77.7	77.7
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Pro	ompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV
M = Mitigative (reduces event consequences)		other serious effects,		cute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV
Acronyms		or symptoms which		mediately life-	is immediately life-	-		•	•	•	<u> </u>
MOI = Maximally-exposed Offsite Individual		could impair an		ning or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective		· ·							
		action.									
	M	C ≥ Mild, transient	$C \ge S$	Serious injury, no	C ≥ Serious injury, no						
		adverse effects.	immed	diate loss of life no	immediate loss of life no						
			perma	anent disabilities;	permanent disabilities;						
			hospita	alization required.	hospitalization required.						
	L	Mild, transient	Mir	nor injuries; no	Minor injuries; no						
		adverse effects > C	hosp	pitalization > C	hospitalization $> \mathbf{C}$						
	N	Consequences less	Conse	equences less than	Consequences less than						
		than those for Low	those for	or Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 13.21 Potential Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane	Hazard: N/A	L:		L:
Operations		C:		C:
•		R:		R:
Compressed	Hazard: Injury due to unexpected	L:	See Section I Chapter 04.	L:
Gasses	release, or unsecure tanks outside	C:		C:
	of buildings.	R:		R:
Vacuum Pumps	Hazard: N/A	L:		L:
_		C:		C:
		R:		R:
Material	Hazard: N/A	L:		L:
Handling		C:		C:
		R:		R:

Other Hazard Consequences, derived from Figure C-1	, "F	xample Qualitative Cons	sequence 1	Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	Risk	Matri	ix								
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern						
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (even	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ev	event) of minor concern event) of minimal concern	nces	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev		- E	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 ((co-located worker)	Onsite-1 (facility worker)	sedn	_	***	777	77.7	77.7
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prom	npt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV
M = Mitigative (reduces event consequences)		other serious effects,		ite injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV
Acronyms		or symptoms which		nediately life-	is immediately life-					•	<u> </u>
MOI = Maximally-exposed Offsite Individual		could impair an		ing or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective		· ·							
		action.									
	M	C ≥ Mild, transient	C ≥ Se	erious injury, no	C ≥ Serious injury, no						
		adverse effects.	immedia	ate loss of life no	immediate loss of life no						
			perman	nent disabilities;	permanent disabilities;						
			hospital	lization required.	hospitalization required.						
	L	Mild, transient	Mino	or injuries; no	Minor injuries; no						
		adverse effects > C	hospi	italization > C	hospitalization $> \mathbf{C}$						
	N	Consequences less	Conseq	quences less than	Consequences less than						
		than those for Low	those for	Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 13.22 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	 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 I, Chapter 04.	L: C: R:

Other Hazard Consequences, derived from Figure C-1	, "F	xample Qualitative Cons	sequence N	Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year Ris	sk (R, Qualitative	Ranking)	Risk	Matri	ix			
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern						
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (even}$	ent) of concern		ı	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (ev	event) of minor concern event) of minimal concern	nces	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev			M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co	co-located worker)	Onsite-1 (facility worker)	sedn	_	***	777	77.7	77.7
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Promi	pt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV
M = Mitigative (reduces event consequences)		other serious effects,	-	te injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV
Acronyms		or symptoms which		ediately life-	is immediately life-	-				•	<u> </u>
MOI = Maximally-exposed Offsite Individual		could impair an		ng or permanently	threatening or						
		individual's ability to		lisabling.	permanently disabling.						
		take protective		· ·							
		action.									
	M	C ≥ Mild, transient	C ≥ Ser	rious injury, no	C ≥ Serious injury, no						
		adverse effects.	immediat	nte loss of life no	immediate loss of life no						
			permane	ent disabilities;	permanent disabilities;						
			hospitali	ization required.	hospitalization required.						
	L	Mild, transient	Minor	or injuries; no	Minor injuries; no						
		adverse effects > C	hospit	talization > C	hospitalization $> \mathbf{C}$						
	N	Consequences less	Consequ	uences less than	Consequences less than						
		than those for Low	those for L	Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 13.23 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	 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 I, Chapter 04.	L: C: R:

Other Hazard Consequences, derived from Figure C-1	, "F	xample Qualitative Cons	sequence	e Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year l	Risk (R, Qualitative	Ranking)	Risk	Matri	ix					
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (even}$	event) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (ev	vent) of minor concern	nces	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern		M	П	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	sedn	_	***	777	77.7	77.7		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Pro	ompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
M = Mitigative (reduces event consequences)		other serious effects,		cute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV		
Acronyms		or symptoms which		mediately life-	is immediately life-								
MOI = Maximally-exposed Offsite Individual		could impair an	threaten	ning or permanently	threatening or								
		individual's ability to		disabling.	permanently disabling.								
		take protective		_									
		action.											
	M	$C \ge Mild$, transient	C ≥ S	Serious injury, no	C ≥ Serious injury, no								
		adverse effects.	immed	diate loss of life no	immediate loss of life no								
			perma	anent disabilities;	permanent disabilities;								
			hospit	talization required.	hospitalization required.								
	L	Mild, transient	Mi	inor injuries; no	Minor injuries; no								
		adverse effects > C	hos	spitalization > C	hospitalization > C								
	N	Consequences less	Conse	equences less than	Consequences less than								
		than those for Low	those fo	or Low Consequence	those for Low								
		Consequence Level		Level	Consequence Level								

Table 13.24 Magnetic Fields – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields	 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 I, Chapter 04.	L: C: R:

Other Hazard Consequences, derived from Figure C-1	, "F	xample Qualitative Cons	sequence Mat	trix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year Risk ((R, Qualitative	Ranking)	Risk	Matri	ix					
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$	I	= situation (eve	nt) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	I	$\mathbf{I} = \text{situation (evolution } \mathbf{I} = \mathbf{I} \mathbf{I} \mathbf{I}$	event) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$	I	$\mathbf{II} = \text{situation (ev}$	vent) of minor concern	səəu	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	Г	$\mathbf{V} = \text{situation (ev}$	vent) of minimal concern	- E	M	П	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-lo	ocated worker)	Onsite-1 (facility worker)	sedn	_	***	777	77.7	77.7		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt v	worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
M = Mitigative (reduces event consequences)		other serious effects,	_	njury that is	fatality or acute injury that	C	N	IV	IV	IV	IV		
Acronyms		or symptoms which		ately life-	is immediately life-			•		•			
MOI = Maximally-exposed Offsite Individual		could impair an		or permanently	threatening or								
		individual's ability to	_	bling.	permanently disabling.								
		take protective		J									
		action.											
	M	C ≥ Mild, transient	C ≥ Seriou	ıs injury, no	C ≥ Serious injury, no								
		adverse effects.	immediate l	loss of life no	immediate loss of life no								
			permanent	disabilities;	permanent disabilities;								
			hospitalizat	ion required.	hospitalization required.								
	L	Mild, transient	Minor in	njuries; no	Minor injuries; no								
		adverse effects > C	hospitaliz	zation > C	hospitalization $> \mathbf{C}$								
	N	Consequences less	Consequen	ces less than	Consequences less than								
		than those for Low	those for Low	v Consequence	those for Low								
		Consequence Level	Le	evel	Consequence Level								

 $Table\ 13.25\ Other\ hazards-Onsite-1\ Facility\ Worker$

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined	Hazard:	L: A	P: Confined Space training informs workers of hazard and process for	L: BEU
Spaces	• Limited egress	C: H	working in the confined space.	C: M
		R: I	P: Work practice procedure requires use of an attendant, outside of the enclosure. P: "Permit Required Access" and "Reclassification" require ES&H approval on every access. M: Mechanical ventilation active, when required.	R: IV
Noise	Hazard:	L: C: R:	See Section I, Chapter 04.	L: C: R:
Ergonomics	Hazard:	L: C: R:	See Section I, Chapter 04.	L: C: R:

Other Hazard Consequences, derived from Figure C-1	, "F	xample Qualitative Cons	sequence 1	Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year Ri	isk (R, Qualitative	Ranking)	Risk	Matri	ix			
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern						
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (even	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ev	event) of minor concern	seou	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	- E	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 ((co-located worker)	Onsite-1 (facility worker)	sedn	_	***	777	77.7	77.7
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prom	npt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV
M = Mitigative (reduces event consequences)		other serious effects,		ite injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV
Acronyms		or symptoms which		nediately life-	is immediately life-					•	<u> </u>
MOI = Maximally-exposed Offsite Individual		could impair an		ing or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective		· ·							
		action.									
	M	C ≥ Mild, transient	C ≥ Se	erious injury, no	C ≥ Serious injury, no						
		adverse effects.	immedia	ate loss of life no	immediate loss of life no						
			perman	nent disabilities;	permanent disabilities;						
			hospital	lization required.	hospitalization required.						
	L	Mild, transient	Mino	or injuries; no	Minor injuries; no						
		adverse effects > C	hospi	italization > C	hospitalization $> \mathbf{C}$						
	N	Consequences less	Conseq	quences less than	Consequences less than						
		than those for Low	those for	Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 13.26 Other hazards – Onsite-2 Co-located Worker

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

Other Hazard Consequences, derived from Figure C-1	, "F	xample Qualitative Cons	sequence	e Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year l	Risk (R, Qualitative	Ranking)	Risk	Matri	ix					
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	ent) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (even}$	ent) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (ev	vent) of minor concern	seou	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	- E	M	П	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	nbəs	_	***	***	77.7	***		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Pro	ompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
M = Mitigative (reduces event consequences)		other serious effects,		cute injury that is	fatality or acute injury that	5	N	IV	IV	IV	IV		
Acronyms		or symptoms which		mediately life-	is immediately life-								
MOI = Maximally-exposed Offsite Individual		could impair an	threater	ning or permanently	threatening or								
		individual's ability to		disabling.	permanently disabling.								
		take protective		-									
		action.											
	M	$C \ge Mild$, transient	C ≥ S	Serious injury, no	C ≥ Serious injury, no								
		adverse effects.	immed	diate loss of life no	immediate loss of life no								
			perma	anent disabilities;	permanent disabilities;								
			hospit	talization required.	hospitalization required.								
	L	Mild, transient	Mi	inor injuries; no	Minor injuries; no								
		adverse effects > C	hos	spitalization > C	hospitalization $> \mathbf{C}$								
	N	Consequences less	Conse	equences less than	Consequences less than								
		than those for Low	those fo	or Low Consequence	those for Low								
		Consequence Level		Level	Consequence Level								

Table 13.27 Other hazards – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-1	, "F	xample Qualitative Cons	sequence	e Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year F	Risk (R, Qualitative	Ranking)	Risk	Matri	ix					
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	ent) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H} = \text{situation (even}$	ent) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ev	event) of minor concern	nces	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern		M	П	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2	(co-located worker)	Onsite-1 (facility worker)	sedn	_	***	***	77.7	77.7		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Pro	ompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
M = Mitigative (reduces event consequences)		other serious effects,		cute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV		
Acronyms		or symptoms which		mediately life-	is immediately life-	-		•	•	•	<u> </u>		
MOI = Maximally-exposed Offsite Individual		could impair an		ning or permanently	threatening or								
		individual's ability to		disabling.	permanently disabling.								
		take protective		· ·									
		action.											
	M	C ≥ Mild, transient	$C \ge S$	Serious injury, no	C ≥ Serious injury, no								
		adverse effects.	immed	diate loss of life no	immediate loss of life no								
			perma	anent disabilities;	permanent disabilities;								
			hospita	alization required.	hospitalization required.								
	L	Mild, transient	Mir	nor injuries; no	Minor injuries; no								
		adverse effects > C	hosp	pitalization > C	hospitalization $> \mathbf{C}$								
	N	Consequences less	Conse	equences less than	Consequences less than								
		than those for Low	those for	or Low Consequence	those for Low								
		Consequence Level		Level	Consequence Level								

Table 13.28 Access & Egress – Onsite-1 Facility Worker

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year Risk (R, Qualita	ative l	Ranking)	Risk Matrix					
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$	I = situation	I = situation (event) of major concern							
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situatio}$	n (eve	ent) of concern		ı	A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situati	on (ev	vent) of minor concern	səc	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation	on (ev	vent) of minimal concern	enc	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located work	er)	Onsite-1 (facility worker)	Consequences	_	***	***	77.7	77.7
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fata	lity	C ≥ Prompt worker	suo	L	III	III	IV	IV
$\mathbf{M} = \mathbf{Mitigative}$ (reduces event consequences)		other serious effects,	or acute injury that is		fatality or acute injury that	C	N	IV	IV	IV	IV
Acronyms		or symptoms which	immediately life-	-	is immediately life-	_					
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or permaner	ntly	threatening or						
		individual's ability to	disabling.	,	permanently disabling.						
		take protective	C								
		action.									
	M	C ≥ Mild, transient	C ≥ Serious injury, n	0	C ≥ Serious injury, no						
		adverse effects.	immediate loss of life	no	immediate loss of life no						
			permanent disabilities	s;	permanent disabilities;						
			hospitalization require	ed.	hospitalization required.						
	L	Mild, transient	Minor injuries; no		Minor injuries; no						
		adverse effects > C	hospitalization > C		hospitalization $> \mathbf{C}$						
	N	Consequences less	Consequences less that	an	Consequences less than						
		than those for Low	those for Low Conseque	ence	those for Low						
		Consequence Level	Level		Consequence Level						

Table 13.29 Access & Egress – Onsite-2 Co-located Worker

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

Other Hazard Consequences, derived from Figure C-1	l, "E	xample Qualitative Con	sequence Matrix", DOE	-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year Risk (R, Qualita	tive 1	Ranking)	Risk	Matr	ix			
$\mathbf{A} = \text{Anticipated (L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathbf{High}$	I = situation	I = situation (event) of major concern							
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation	n (eve	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situatio	on (ev	vent) of minor concern	nces	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situatio	IV = situation (event) of minimal concern			M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located work	er)	Onsite-1 (facility worker)	nbəs	-	***	***	***	77.7
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatal	lity	C ≥ Prompt worker	Cons	L	III	III	IV	IV
M = Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	-	fatality or acute injury that	ت	N	IV	IV	IV	IV
Acronyms		or symptoms which	immediately life-		is immediately life-					•	
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or permanen	ıtlv	threatening or						
		individual's ability to	disabling.	,	permanently disabling.						
		take protective	Č								
		action.									
	M	C ≥ Mild, transient	C ≥ Serious injury, no)	C ≥ Serious injury, no						
		adverse effects.	immediate loss of life r	10	immediate loss of life no						
			permanent disabilities	;	permanent disabilities;						
			hospitalization required	d.	hospitalization required.						
	L	Mild, transient	Minor injuries; no		Minor injuries; no						
		adverse effects > C	hospitalization > C		hospitalization $> \mathbf{C}$						
	N	Consequences less	Consequences less tha	n	Consequences less than						
		than those for Low	those for Low Conseque	nce	those for Low						
		Consequence Level	Level		Consequence Level						

Table 13.30 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:	L: C: R:	See Section I, Chapter 04.	L: C: R:

Other Hazard Consequences, derived from Figure C-	l, "F	xample Qualitative Con	sequence Matrix", DO	E-HD	BK-1163-2020.	•				•	
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year Risk (R, Quali	tative	Ranking)	Risk	Matri	ix			
$\mathbf{A} = \text{Anticipated (L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathbf{High}$	$\mathbf{I} = \text{situation}$	I = situation (event) of major concern							
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = situati$	on (eve	ent) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situat	tion (ev	vent) of minor concern	uces	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situat	IV = situation (event) of minimal concern			M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located wor	rker)	Onsite-1 (facility worker)	nbəs		***		***	
P = Preventive (reduce event occurrence likelihood)	H	C ≥ Irreversible,	C ≥ Prompt worker fa	tality	C ≥ Prompt worker	Cons	L	III	III	IV	IV
M = Mitigative (reduces event consequences)		other serious effects,	or acute injury that	-	fatality or acute injury that	ŭ	N	IV	IV	IV	IV
Acronyms		or symptoms which	immediately life-		is immediately life-				•		
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or perman		threatening or						
		individual's ability to	disabling.		permanently disabling.						
		take protective	Č								
		action.									
	M	C ≥ Mild, transient	C ≥ Serious injury,	no	C ≥ Serious injury, no						
		adverse effects.	immediate loss of life	e no	immediate loss of life no						
			permanent disabiliti	es;	permanent disabilities;						
			hospitalization requir	red.	hospitalization required.						
	L	Mild, transient	Minor injuries; no)	Minor injuries; no						
		adverse effects > C	hospitalization > (\mathbb{C}	hospitalization $> \mathbf{C}$						
	N	Consequences less	Consequences less th	nan	Consequences less than						
		than those for Low	those for Low Consequ	ience	those for Low						
		Consequence Level	Level		Consequence Level						

Table 13.31 Environmental

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Airborne	 Hazard: Airborne release of radionuclides beyond permitted limits. Discharge of chemicals into onsite surface waters beyond permitted limits. 	L: C: R:	See Section I, Chapter 04.	L: C: R:
Water	 Discharge of radionuclides into onsite surface waters beyond permitted limits. Discharge of chemicals into onsite surface waters beyond permitted limits. 	L: C: R:	See Section I, Chapter 04.	L: C: R:

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Soil	 Radioactive soil in beam loss areas beyond allowable concentrations of radionuclides beyond calculated Fermilab limits. Discharge of chemicals into onsite soils beyond permitted limits. 	L: C: R:	See Section I, Chapter 04.	L: C: R: