Table 2. Summary of Baseline and Residual Risks - Switchyard

	Risk Tables Description	Baseline	Residual
		Risk	Risk
2.1	Radiological – Onsite-1 Facility Worker	R: I	R: IV
2.2	Radiological – Onsite-2 Co-located Worker	R: I	R: IV
2.3	Radiological – MOI Offsite	R: I	R: III
2.4*	Toxic Materials – Onsite 1 Facility Worker	R: *	R: *
2.5*	Toxic Materials – Onsite 2 Co-located Worker	R: *	R: *
2.6*	Toxic Materials – MOI Offsite	R: *	R: *
2.7*	Flammable & Combustible Materials – Onsite-1 Facility Worker	R: *	R: *
2.8*	Flammable & Combustible Materials – Onsite-2 Co-located worker	R: *	R: *
2.9*	Flammable & Combustible Materials – MOI Offsite	R: *	R: *
2.10*	Electrical Energy – Onsite-1 Facility Worker	R: *	R: *
2.11*	Electrical Energy – Onsite-2 Co-located Worker	R: *	R: *
2.12*	Electrical Energy – MOI Offsite	R: *	R: *
2.13*	Thermal Energy – Onsite-1 Facility Worker	R: *	R: *
2.14*	Thermal Energy – Onsite-2 Co-located Worker	R: *	R: *
2.15*	Thermal Energy – MOI Offsite	R: *	R: *
2.16*	Kinetic Energy – Onsite-1 Facility Worker	R: *	R: *
2.17*	Kinetic Energy – Onsite-2 Co-located Worker	R: *	R: *
2.18*	Kinetic Energy – MOI Offsite	R: *	R: *
2.19*	Potential Energy- Onsite-1 Facility Worker	R: *	R: *
2.20*	Potential Energy – Onsite-2 Co-located Worker	R: *	R: *
2.21*	Potential Energy – MOI Offsite	R: *	R: *
2.22*	Magnetic Fields – Onsite-1 Facility Worker	R: *	R: *
2.23*	Magnetic Fields – Onsite-2 Co-located Worker	R: *	R: *
2.24*	Magnetic Fields – MOI Offsite	R: *	R: *
2.25	Other Hazards – Onsite-1 Facility Worker	R: I	R: IV
2.26	Other Hazards – Onsite-2 Co-located Worker	R: III	R: III
2.27	Other Hazards – MOI Offsite	R: III	R: III
2.28*	Access & Egress – Onsite-1 Facility Worker	R: *	R: *
2.29*	Access & Egress – Onsite-2 Co-located Worker	R: *	R: *
2.30*	Access & Egress – MOI Offsite	R: *	R: *
2.31*	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 2.1 Radiological – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Prompt Ionizing Radiation	Hazard: Exposure to ionizing radiation.	L: A C: H R: I	 P - Radiation Safety Interlock System (RSIS) prevents beam from entering an enclosure when that area is on access. P - Fencing prevents access to areas where beam could be running. P - Training for workers to identify operating enclosures vs. enclosures ready for access. M - Shielding between operating enclosures to minimize exposure to radiation. M - Run Conditions to ensure total radiation levels are within expected parameters. M - Radiation Detectors disable beam to protect personnel. 	L: BEU C: N R: IV
Residual Activation	Hazard: Exposure to residual activation.	L: A C: H R: I	 M – Radiation Detectors disable beam to protect personnel. P – Radiological Work Permit prevents unauthorized personnel form areas where excessive residual radiation exists. P – Postings intended to caution workers of area hazard. 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: Potential exposure due to construction activities, (e.g., earthmoving).	L: A C: N R: IV	 P – Sump water is evaluated to determine the presence of tritium or other activation products to prevent personnel exposure. P – Sump pits/enclosures capture activated water to prevent releases exceeding allowed discharge limits. M – Facility designs employ shielding to mitigate the production of activation products in groundwater. 	L: EU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Surface Water	Hazard: Radionuclides in surface	L: A	P – Sump Pumps ensure water does not remain in the enclosure for	L: EU
Activation	water exceeding regulatory levels.	C: N	extended periods of time.	C: N
		R: IV	 P – Sump Monitoring Program samples the water discharged by the sump pumps. 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. 	R: IV
Radioactive	Hazard: Personnel exposed to	L: A	P – Postings intended to caution workers of area hazard.	L: BEU
Water (RAW)	radioactive water exceeding	C: H	P – Radiological Work Permit prevents unauthorized personnel form areas	C: M
Systems	regulatory levels.	R: I	where excessive residual radiation exists. P - Training for workers to identify and respond to the hazard. M - Run Conditions to ensure total radiation levels are within expected parameters.	R: IV
Air Activation	Hazard: Radionuclides in air	L: A	M – Engineered Air Flow ensures the air activation remains within the	L: A
	exceeding regulatory levels.	C: H	enclosure for more than the half-life of radionuclides before exiting.	C: L
		R: I	M – Run Conditions to ensure total radiation levels are within expected parameters.	R: III
Soil Interactions	Hazard: Radionuclides are produced,	L: A	P – No excavation work allowed without an RWP.	L: U
	which may contaminate groundwater.	C: H	M – Engineered Beam Dump designed to contain the radiation produced	C: N
		R: I	 by absorbing the deposited energy. 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. 	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 Gates prevent access to areas where radiation waste is stored.	L: BEU
Waste	ionizing radiation beyond regulatory	C: H	P - Key Control Program ensures access to these areas is managed.	C: N
	levels.	R: I	 P – Postings intended to caution workers of area hazard. M – Run Conditions to ensure total radiation levels are within expected parameters. 	R: IV
			 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. 	
Contamination	Hazard: Personnel are exposed to	L: A	P – Radiation Survey of areas to measure and detect contamination	L: EU
	ionizing radiation beyond regulatory	C: H	hazards.	C: L
	levels.	R: I	 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. 	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
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. M – Source Handling "In-Use" Requirements ensure the area where the radioactive source is used is tightly controlled. 	R: IV

Likelihood (L, of event)/year	Co	nsequence (C, of event)/y	year Risk (R, Qualitative	Ranking)	Risk Matrix					
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (even	I = situation (event) of major concern				Likelihood		
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (ev	ent) of concern	l ——	1	A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situation (e	vent) of minor concern	ences	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (e	IV = situation (event) of minimal concern		M	II	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 ≥ 25.0 rem	C ≥ 100 rem	C ≥ 100 rem	ous	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						
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	N	0.5 rem > C	5 rem > C	5 rem > C	•					

Table 2.2 Radiological – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Prompt Ionizing	Hazard: Exposure to ionizing	L: A	P - Radiation Safety Interlock System prevents beam from entering an	L: BEU
Radiation	radiation.	C: H	enclosure when that area is on access.	C: N
		R: I	P – Fencing prevents access to areas where beam could be running.	R: IV
			P – Training for workers to identify operating enclosures vs. enclosures	
			ready for access.	
			M – Shielding between operating enclosures to minimize exposure to	
			radiation.	
			M – Run Conditions to ensure total radiation levels are within expected	
			parameters.	
			M – Radiation Detectors disable beam to protect personnel.	
Residual	Hazard: Exposure to residual	L: A	P – Radiological Work Permit prevents unauthorized personnel form areas	L: BEU
Activation	activation.	C: H	where excessive residual radiation exists.	C: M
		R: I	P – Postings intended to caution workers of areas of residual activation.	R: IV
			P – Training for workers to identify and respond to the hazard.	
			M – Run Conditions to ensure total radiation levels are within expected	
			parameters.	
			M – Shielding increases distance from the source of residual activation,	
			minimizing exposure.	
Groundwater	Hazard: Radionuclides in	L: A	P – Sump Pumps ensure water does not remain in the enclosure for	L: EU
Activation	groundwater exceeding regulatory	C: H	extended periods of time.	C: M
	levels.	R: I	P – Sump Monitoring Program samples the water discharged by the sump	R: III
			pumps.	
			M – Run Conditions to ensure total radiation levels are within expected	
			parameters.	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Surface Water	Hazard: Radionuclides in surface	L: A	P – Sump Pumps ensure water does not remain in the enclosure for	L: EU
Activation	water exceeding regulatory levels.	C: H	extended periods of time.	C: L
		R: I	 P – Sump Monitoring Program samples the water discharged by the sump pumps. 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. 	R: IV
Radioactive	Hazard: Personnel exposed to	L: A	P – Postings intended to caution workers of area hazard.	L: BEU
Water (RAW)	radioactive water exceeding	C: H	P – Radiological Work Permit prevents unauthorized personnel form areas	C: M
Systems	regulatory levels.	R: I	 where excessive residual radiation exists. P - Training for workers to identify and respond to the hazard. M - Run Conditions to ensure total radiation levels are within expected parameters. 	R: IV
Air Activation	Hazard: Radionuclides in air	L: A	M – Engineered Air Flow ensures the air activation remains within the	L: A
	exceeding regulatory levels.	C: H	enclosure for more than the half-life of radionuclides before exiting.	C: L
		R: I	M – Run Conditions to ensure total radiation levels are within expected parameters.	R: III
Soil Interactions	Hazard: Radionuclides are produced,	L: A	P – No excavation work allowed without an RWP.	L: U
	which may contaminate groundwater.	C: H	M – Engineered Beam Dump designed to contain the radiation produced	C: N
		R: I	 by absorbing the deposited energy. 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. 	R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
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
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
Radioactive Sources	Hazard: Personnel are exposed to ionizing radiation beyond regulatory levels.	L: A C: H R: I	 P - Training for workers to identify and respond to the hazard. P - Postings intended to caution workers of area hazard. M - Engineered Beam Dump designed to contain the radiation produced by absorbing the deposited energy. M - Engineered Beam Dump designed to contain the radiation produced by absorbing the deposited energy. 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. 	L: EU C: L R: IV

Likelihood (L, of event)/year		Consequence (C, of event)/year		Risk (R, Qualitative R	Ranking)	Risk Matrix					
A = 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)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern				Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low				S	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible				enc	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsit	te-2 (co-located worker)	Onsite-1 (facility worker)	edn	_	TTT	TTT	17.7	17.7
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 rem > C ≥ 25 rem	C	N	IV	IV	IV	IV
Acronyms MOI = Manipus lla supposed Officia 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						

Table 2.3 Radiological – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Prompt Ionizing	Hazard: Exposure to ionizing	L: A	P – Locked building prevents unauthorized access by public.	L: EU
Radiation	radiation.	C: H	P – Interlocked gates prevent unauthorized access by public with beam on.	C: L
		R: I	M – Shielding reduces potential for exposure.	R: IV
			M – Interlocked Radiation Detectors prevent beam from exceeding predetermined radiation limits.	
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	R: III
			of activation.	
Groundwater	Hazard: Radionuclides in	L: A	P – Sump Pumps ensure water does not remain in the enclosure for	L: EU
Activation	groundwater exceeding regulatory	C: H	extended periods of time.	C: M
	levels.	R: I	P – Sump Monitoring Program samples the water discharged by the sump	R: III
			pumps.	
			M – Run Conditions to ensure total radiation levels are within expected	
G C W	II 1 D 1: 1:1 : C	T 4	parameters.	T DII
Surface Water	Hazard: Radionuclides in surface	L: A	P – Sump Pumps ensure water does not remain in the enclosure for	L: EU
Activation	water exceeding regulatory levels.	C: H	extended periods of time.	C: L
		R: I	P – Sump Monitoring Program samples the water discharged by the sump	R: IV
			pumps. M. Dyn Conditions to an area total rediction levels one within associated	
			M – Run Conditions to ensure total radiation levels are within expected	
			parameters. M. Shialding ensures the distance from source to surface is maximized to	
			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 - Locked building prevents unauthorized access by public. P - Locked enclosure gate prevents access to the RAW system. M - Run Conditions limit total beam through the area to limit the creation of activation. 	L: EU C: M R: III
Air Activation	Hazard: Radionuclides in air exceeding regulatory levels.	L: A C: H R: I	 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: A C: L R: III
Soil Interactions	Hazard: Radionuclides are produced, which may contaminate groundwater	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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
⁷ Be	Hazard: Potential radiation exposure	L: A	⁷ Be isn't hazardous in this pattern of use by facility.	L: A
	to 7Be (uptake/committed dose).	C: N		C: N
		R: IV		R: IV
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 – Engineered Beam Dump designed to contain the radiation produced by absorbing the deposited energy.	
			M – Engineered Beam Dump designed to contain the radiation produced	
			by absorbing the deposited energy.	
			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	Co	nsequence (C, of event)/	(R, Qualitative Ranking) Risk Ma					ıtrix					
A = 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		1	A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (eve	ent) of minor concern	es	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (eve	ent) of minimal concern	ences	M	II	II	Ш	IV		
Control(s) Type	C	Offsite (MOI)	Onsi	te-2 (co-located worker)	Onsite-1 (facility worker)	edn		TTT	TTT	13.7	13.7		
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 rem > C ≥ 25 rem	100 rem > C ≥ 25 rem		N	IV	IV	IV	IV		
Acronyms MOI = Maximally-exposed Offsite Individual	L	5 rem > C		25 rem > C	25 rem > C								
rem = Roentgen equivalent man	N	0.5 rem > C		5 rem > C	5 rem > C								

Table 2.4 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.			

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)	Risk Matrix										
A = 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)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ev	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	es	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)	edn	· ·	TTT	777	13.7	13.7		
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)	M	$PAC-2 > C \ge PAC-1$	P	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$		N	IV	IV	IV	IV		
Acronyms	Τ.	PAC-1 > C		$\frac{PAC-2 > C}{PAC-2 > C}$	PEL or $TLV_c > C$								
IDLH = Immediately Dangerous to Life and Health	N	Consequences less	Cor	nsequences less than	Consequences less than								
MOI = Maximally-exposed Offsite Individual	1	than those for Low		•	those for Low								
PAC = Protective Action Criteria			tnose	for Low Consequence									
PEL = Permissible Exposure Limit		Consequence Level		Level	Consequence Level								
TLV_c = Threshold Limit Value (ceiling)													

Table 2.5 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.			

Chemical Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event))/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
A = 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)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ev	ent) of concern	l —			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ev	vent) of minor concern	i	es	Η	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	e-2 (co-located worker)	Onsite-1 (facility worker)		- bed	T	Ш	III	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ PAC-2		C ≥ PAC-3	C≥IDLH		Suo:	L	111	111	1 V	1 V
M = Mitigative (reduces event consequences)	M	$PAC-2 > C \ge PAC-1$	P.A	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$		ر	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	N	Consequences less	Cor	nsequences less than	Consequences less than							
MOI = Maximally-exposed Offsite Individual	1	than those for Low		for Low Consequence	those for Low							
PAC = Protective Action Criteria			uiosc	Level								
PEL = Permissible Exposure Limit		Consequence Level		LEVEI	Consequence Level							
TLV_c = Threshold Limit Value (ceiling)												

Table 2.6 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:

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	Risk (R, Qualitative Ranking)			Risk Matrix					
A = 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)		$\mathbf{M} = \mathbf{Moderate}$		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	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	П	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edn	т .	III	III	IV	IV		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ PAC-2		C ≥ PAC-3	C ≥ IDLH	Suo	L	111	111	1 V	1 V		
M = Mitigative (reduces event consequences)	M	$PAC-2 > C \ge PAC-1$	P.A	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$		N	IV	IV	IV	IV		
Acronyms IDLH = Immediately Dangerous to Life and Health	L	PAC-1 > C		PAC-2 > C	PEL or $TLV_c > C$								
MOI = Maximally-exposed Offsite Individual PAC = Protective Action Criteria PEL = Permissible Exposure Limit	N	Consequences less than those for Low Consequence Level		nsequences less than for Low Consequence Level	Consequences less than those for Low Consequence Level								
TLV _c = Threshold Limit Value (ceiling)													

Table 2.7 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:
Flammable Materials (Flammable gas, cleaning materials, etc.)	Hazard: The presence of flammable gases in cylinders or storage containers pose an inherent hazard due to their flammability/combustibility properties. Exposure to hot work provides a dangerous situation where flammable liquids will ignite. Unmitigated this could lead to an explosion and subsequent fire. The exposure of the hazard to the facility worker is of major concern.	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-	1, "F	Example Qualitative Conse	equence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year A = Anticipated (L > 1.0E-02)	C	onsequence (C, of event)/y H = High	I = situation (eve	ent) of major concern	Risk	Matri		Like	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)		M = ModerateL = LowN = Negligible	III = situation (ev	II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern		Н	I II	I II	EU II	III IV
Control(s) Type P = Preventive (reduce event occurrence likelihood)	C H	Offsite (MOI)	Onsite-2 (co-located worker) $C \ge \text{Prompt worker fatality}$	Onsite-1 (facility worker) C ≥ Prompt worker	Consequences	L	III	III	IV	IV
M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual		other serious effects, or symptoms which	or acute injury that is immediately life-threatening or permanently disabling.	fatality or acute injury that is immediately life- threatening or permanently disabling.		N	IV	IV	IV	IV
	M L	C ≥ Mild, transient adverse effects. Mild, transient	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no						
	N	adverse effects > C Consequences less than those for Low Consequence Level	hospitalization > C Consequences less than hose for Low Consequence Level	hospitalization > C Consequences less than those for Low Consequence Level						

Table 2.8 Flammable and Combustible Materials – Onsite -2 Co-located Worker

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

Other Hazard Consequences, derived from Figure C-1	l, "F	Example Qualitative Cons	sequence Matrix", DOE-HD	DBK-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)		$\mathbf{H} = \mathbf{High}$	I = situation (eve	ent) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (ev	vent) 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	nces	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (e	vent) of minimal concern		M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	_	777	TTT	77.7	77.7
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	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		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	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 $> C$						
	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 2.9 Flammable and Combustible Materials – MOI Offsite

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

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

Table 2.10 Electrical Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Stored Energy	Hazards: Shock Hazard, >50V, Interlocked enclosure area	L: C: R:	See Section I Chapter 04	L: C: R:
	Arc Flash, Interlocked enclosure area	L: C: R:		L: C: R:
High Voltage Exposure	Hazards: 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	Hazards: 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:

Other Hazard Consequences, derived from Figure C-	1, "E	Example Qualitative Conse	quence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year A = Anticipated (L > 1.0E-02)	C	onsequence (C, of event)/yo H = High	,	Ranking) nt) of major concern	Risk	Matri	ix	Like	lihood	
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) BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{L} = \text{Low}$ $\mathbf{N} = \text{Negligible}$	-	vent) of minor concern vent) of minimal concern	saoua	H M	II	II	III	III IV
Control(s) Type	C		nsite-2 (co-located worker)	Onsite-1 (facility worker)	sedne	I	III	III	IV	IV
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Н	C ≥ Irreversible, other serious effects,	C ≥ Prompt worker fatality or acute injury that is	C ≥ Prompt worker fatality or acute injury that	Con	N	IV	IV	IV	IV
Acronyms MOI = Maximally-exposed Offsite Individual		or symptoms which	immediately life- hreatening or permanently disabling.	is immediately life- threatening or permanently disabling.						
	M	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.						
	L	Mild, transient	Minor injuries; no	Minor injuries; no						
	N		hospitalization > C Consequences less than nose for Low Consequence	hospitalization > C Consequences less than those for Low						
	1	Consequence Level	Level	Consequence Level						

Table 2.11 Electrical Energy 1 Onsite-2 Co-located Worker

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	C	onsequence (C, of event))/year Ri	isk (R, Qualitative	Ranking)	Risk Matrix					
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern					lihood		
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ev	ent) of concern		1	A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ev	vent) of minor concern	uces	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-2 (c	co-located worker)	Onsite-1 (facility worker)	edn	r	111	TIT	137	137
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,		te injury that is	fatality or acute injury that	0	N	IV	IV	IV	IV
Acronyms		or symptoms which		nediately life-	is immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	threatenir	ng or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective									
		action.									
	M	C ≥ Mild, transient	C ≥ Se	rious 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 > C						
	N	Consequences less	Conseq	uences less than	Consequences less than						
		than those for Low	those for l	Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 2.12 Electrical Energy – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-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	ix			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (even	nation (event) of major concern						
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (ev	vent) 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	seou	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (e	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)	nbəs	-	***	***	***	***
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	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	Ö	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	8							
		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 2.13 Thermal Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Hot Work	Hazard: Hot work will cause elevated temperatures. If hot work is not supervised, there is a potential for combustibles in the surrounding area to be ignited due to exposure to slag or elevated temperatures. This could lead to excessive heat and burning, which could potentially lead to a fire. The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices. This hazard can add to the fuel load of a potential fire. The exposure of the hazard to the facility worker is of major concern.	L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-	1, "F	Example Qualitative Conse	equence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year A = Anticipated (L > 1.0E-02)	C	onsequence (C, of event)/y H = High	I = situation (eve	ent) of major concern	Risk	Matri		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)		 M = Moderate L = Low N = Negligible 	,	ent) of concern vent) of minor concern vent) of minimal concern		Н	I	I	EU II	III
Control(s) Type P = Preventive (reduce event occurrence likelihood)	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	M L	III	III	III IV	IV IV
 P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms 		other serious effects,	C ≥ Prompt worker fatality or acute injury that is	$C \ge Prompt worker$ fatality or acute injury that	Co	N	IV	IV	IV	IV
- '		or symptoms which could impair an individual's ability to take protective action.	immediately life- threatening or permanently disabling.	is immediately life- threatening or permanently disabling.						
	M	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.						
	L	Mild, transient adverse effects > C	Minor injuries; no hospitalization > C	Minor injuries; no hospitalization > C						
	N	Consequences less than those for Low Consequence Level	Consequences less than hose for Low Consequence Level	Consequences less than those for Low Consequence Level						

Table 2.14 Thermal Energy – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
	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	C: R:		C: R:
	fire. The exposure of the hazard to the co-located worker is of minor concern.			

Other Hazard Consequences, derived from Figure C-	1, "F	Example Qualitative Conse	equence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year A = Anticipated (L > 1.0E-02)	C	onsequence (C, of event)/y H = High	I = situation (eve	ent) of major concern	Risk	Matri		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)		 M = Moderate L = Low N = Negligible 	,	event) of minor concern		Н	I	I	EU II	III
Control(s) Type P = Preventive (reduce event occurrence likelihood)	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	M L	III	III	III IV	IV IV
 P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms 		other serious effects,	C ≥ Prompt worker fatality or acute injury that is	$C \ge Prompt worker$ fatality or acute injury that	Co	N	IV	IV	IV	IV
- '		or symptoms which could impair an individual's ability to take protective action.	immediately life- threatening or permanently disabling.	is immediately life- threatening or permanently disabling.						
	M	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.						
	L	Mild, transient adverse effects > C	Minor injuries; no hospitalization > C	Minor injuries; no hospitalization > C						
	N	Consequences less than those for Low Consequence Level	Consequences less than hose for Low Consequence Level	Consequences less than those for Low 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		L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year Consequence (C, of			y)/year Risk (R, Qualitative Ranking)		Risk Matrix							
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (ever	I = situation (event) of major concern				Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (evolution)	ent) of concern	_	ı	A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = 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	П	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 ≥ Prompt worker fatality	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	C	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	Z .	, , ,								
		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 t	those for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

Table 2.16 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, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year A = Anticipated (L > 1.0E-02) L = Likelihood (L > 0.2) L > 1.0E-04)	C	onsequence (C, of event)/y H = High M = Moderate	I = situation (eve	Risk (R, Qualitative Ranking) I = situation (event) of major concern		Matri	A	Likelihood			
U = Unlikely (1.0E-02> L >1.0E-04) EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		$\mathbf{L} = \mathbf{Low}$ $\mathbf{N} = \mathbf{Negligible}$	III = situation (e	II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern		Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L) Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual	C H	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	M L	III	III	III	IV IV	
		other serious effects,	C ≥ Prompt worker fatality or acute injury that is	$C \ge Prompt worker$ fatality or acute injury that		N	IV	IV	IV	IV	
		or symptoms which could impair an individual's ability to take protective action.	immediately life- threatening or permanently disabling.	is immediately life- threatening or permanently disabling.							
		C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.							
		Mild, transient adverse effects > C	Minor injuries; no hospitalization > C	Minor injuries; no hospitalization > C							
		Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level							

Table 2.17 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 OWEL TOOLS	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	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Ris	k Ma	trix				
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (eve	ent) of major concern					Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ev	ent) of concern				A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ex	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	ences	M	í .	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	L		III	III	IV	IV
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms	Н	C ≥ Irreversible, other serious effects,	or	Prompt worker fatality acute injury that is	C ≥ Prompt worker fatality or acute injury that	Con	N		IV	IV	IV	IV
MOI = Maximally-exposed Offsite Individual		or symptoms which could impair an individual's ability to take protective		mmediately life- tening or permanently disabling.	is immediately life- threatening or permanently disabling.							
	M	action. C ≥ Mild, transient adverse effects.	imm per hosp	≥ Serious injury, no lediate loss of life no manent disabilities; bitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.							
	L	Mild, transient adverse effects > C		Minor injuries; no ospitalization > C	Minor injuries; no hospitalization > C							

Table 2.18 Kinetic Energy – MOI Offsite

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

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

Table 2.19 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:	See Section I Chapter 04	L: C:
Compressed	Hazard: Personnel injury due to	R: L:	See Section I Chapter 04	R: L:
Gasses	unexpected release, or unsecure tanks.	C: R:	See seemen 1 enapter 0 1	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	l, "F	Example Qualitative Cons	equence Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/y	vear Risk (R, Qualitative	Ranking)	Risk	Matri	ix					
A = Anticipated (L > 1.0E-02)		$\hat{\mathbf{H}} = \mathbf{High}$		nt) of major concern				Likelihood				
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 (ex	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	ences	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	-	***	***	***	***		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	_	L	III	III	IV	IV		
M = Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	Co	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	8	, , , , , , , , , , , , , , , , , , ,								
		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 2.20 Potential Energy – Onsite-2 Co-located Worker

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

Other Hazard Consequences, derived from Figure C-	1, "F	Example Qualitative Cons	equence Matrix", DOE-HD	DBK-1163-2020.						
Likelihood (L, of event)/year A = Anticipated (L > 1.0E-02) L = U-1/2-1-(1.0E-02) L > 1.0E-04)	C	onsequence (C, of event)/y H = High M = Moderate	I = situation (eve	ent) of major concern	Risk	Matri	ix A	Likelihood		
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)		$\mathbf{L} = \mathbf{Low}$ $\mathbf{N} = \mathbf{Negligible}$	•	event) of concern event) of minor concern event) of minimal concern	ences	Н	I	I	II	BEU
Control(s) Type P = Preventive (reduce event occurrence likelihood)	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	nbəsı	M L	III	III	IV	IV IV
M = Mitigative (reduces event consequences) Acronyms	11	other serious effects,	C ≥ Prompt worker fatality or acute injury that is	$C \ge Prompt worker$ fatality or acute injury that	Cor	N	IV	IV	IV	IV
Acronyms MOI = Maximally-exposed Offsite Individual		or symptoms which could impair an individual's ability to take protective action.	immediately life- threatening or permanently disabling.	is immediately life- threatening or permanently disabling.						
	M	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.						
	L	Mild, transient adverse effects > C	Minor injuries; no hospitalization > C	Minor injuries; no hospitalization > C						
	N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level						

Table 2.21 Potential Energy – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-	1, "F	Example Qualitative Cons	equence Matrix", DOE-HD	DBK-1163-2020.						
Likelihood (L, of event)/year A = Anticipated (L > 1.0E-02) L = U-1/2-1-(1.0E-02) L > 1.0E-04)	C	onsequence (C, of event)/y H = High M = Moderate	I = situation (eve	ent) of major concern	Risk	Matri	ix A	Likelihood		
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)		$\mathbf{L} = \mathbf{Low}$ $\mathbf{N} = \mathbf{Negligible}$	•	event) of concern event) of minor concern event) of minimal concern	ences	Н	I	I	II	BEU
Control(s) Type P = Preventive (reduce event occurrence likelihood)	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	nbəsı	M L	III	III	IV	IV IV
M = Mitigative (reduces event consequences) Acronyms	11	other serious effects,	C ≥ Prompt worker fatality or acute injury that is	$C \ge Prompt worker$ fatality or acute injury that	Cor	N	IV	IV	IV	IV
Acronyms MOI = Maximally-exposed Offsite Individual		or symptoms which could impair an individual's ability to take protective action.	immediately life- threatening or permanently disabling.	is immediately life- threatening or permanently disabling.						
	M	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.						
	L	Mild, transient adverse effects > C	Minor injuries; no hospitalization > C	Minor injuries; no hospitalization > C						
	N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level						

Table 2.22 Magnetic Fields – Onsite-1 Facility Worker

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

Other Hazard Consequences, derived from Figure C-	1, "F	Example Qualitative Conse	equence Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year A = Anticipated (L > 1.0E-02)	C	onsequence (C, of event)/y H = High	I = situation (eve	ent) of major concern	Risk	Matri		Likelihood				
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)		M = ModerateL = LowN = Negligible	•	ent) of concern vent) of minor concern vent) of minimal concern	ences	Н	I II	I II	II	BEU III IV		
Control(s) Type P = Preventive (reduce event occurrence likelihood)	C H	Offsite (MOI)	Onsite-2 (co-located worker) $C \ge \text{Prompt worker fatality}$	Onsite-1 (facility worker) C ≥ Prompt worker	Conseque	L	III	III	IV	IV		
M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual		other serious effects, or symptoms which	or acute injury that is immediately life-threatening or permanently disabling.	fatality or acute injury that is immediately life- threatening or permanently disabling.		N	IV	IV	IV	IV		
	M L	C ≥ Mild, transient adverse effects. Mild, transient	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no								
	N	adverse effects > C Consequences less than those for Low Consequence Level	hospitalization > C Consequences less than hose for Low Consequence Level	hospitalization > C Consequences less than those for Low Consequence Level								

Table 2.23 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	Hazards: 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	l, "F	Example Qualitative Cons	sequence Matrix", DOE-HD	DBK-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)		$\mathbf{H} = \mathbf{High}$	I = situation (eve	ent) of major concern				Likelihood		
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (ev	vent) of concern	l .		A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situation (e	vent) of minor concern	nces	Н	I	I	II	III
BEU = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible	IV = situation (e	vent) of minimal concern		M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	_	777	TTT	77.7	77.7
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	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	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 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	1					
		adverse effects > C	hospitalization > C	hospitalization > C						
	N	Consequences less	Consequences less than	Consequences less than	1					
		than those for Low	those for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

Table 2.24 Magnetic Fields – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields	Hazards: Exposure to fringe fields beyond allowable limits (worker 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	l, "F	Example Qualitative Cons	sequence Matrix", DOE-HD	DBK-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)		$\mathbf{H} = \mathbf{High}$	I = situation (eve	ent) of major concern				Likelihood		
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (ev	vent) of concern	l .		A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situation (e	vent) of minor concern	nces	Н	I	I	II	III
BEU = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible	IV = situation (e	vent) of minimal concern		M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	_	777	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
M = 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 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	1					
		adverse effects > C	hospitalization > C	hospitalization > C						
	N	Consequences less	Consequences less than	Consequences less than	1					
		than those for Low	those for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

Table 2.25 Other hazards – Onsite-1 Facility Worker

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

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

Table 2.26 Other hazards – Onsite-2 Co-located Worker

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

Other Hazard Consequences, derived from Figure C-1	l, "F	Example Qualitative Conse	equence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year A = Anticipated (L > 1.0E-02)	C	onsequence (C, of event)/y H = High	I = situation (eve	ent) of major concern	Risk	Matri			lihood EU	DEII
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)		 M = Moderate L = Low N = Negligible 	,	vent) of concern vent) of minor concern vent) of minimal concern	ences	Н	I II	I II	II	BEU III IV
Control(s) Type P = Preventive (reduce event occurrence likelihood)	C H	Offsite (MOI)	Onsite-2 (co-located worker) $C \ge \text{Prompt worker fatality}$	Onsite-1 (facility worker) C ≥ Prompt worker	Conseque	L	III	III	IV	IV
M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual		other serious effects, or symptoms which	or acute injury that is immediately life-threatening or permanently disabling.	fatality or acute injury that is immediately life- threatening or permanently disabling.	Ö	N	IV	IV	IV	IV
	M L	C ≥ Mild, transient adverse effects. Mild, transient	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no						
	N	adverse effects > C Consequences less than those for Low Consequence Level	hospitalization > C Consequences less than hose for Low Consequence Level	hospitalization > C Consequences less than those for Low Consequence Level						

Table 2.27 Other hazards – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-	1, "F	Example Qualitative Cons	equence Matrix", DOE-HD	DBK-1163-2020.						
Likelihood (L, of event)/year A = Anticipated (L > 1.0E-02) L = U-1/2-1-(1.0E-02) L > 1.0E-04)	C	onsequence (C, of event)/y H = High M = Moderate	I = situation (eve	ent) of major concern	Risk	Matri		X Likelihood A U EU		
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)		$\mathbf{L} = \mathbf{Low}$ $\mathbf{N} = \mathbf{Negligible}$	•	event) of concern event) of minor concern event) of minimal concern	ences	Н	I	I	II	BEU
Control(s) Type P = Preventive (reduce event occurrence likelihood)	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	nbəsı	M L	III	III	IV	IV IV
M = Mitigative (reduces event consequences) Acronyms	11	other serious effects,	C ≥ Prompt worker fatality or acute injury that is	$C \ge Prompt worker$ fatality or acute injury that	Cor	N	IV	IV	IV	IV
MOI = Maximally-exposed Offsite Individual		or symptoms which could impair an individual's ability to take protective action.	immediately life- threatening or permanently disabling.	is immediately life- threatening or permanently disabling.						
	M	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.						
	L	Mild, transient adverse effects > C	Minor injuries; no hospitalization > C	Minor injuries; no hospitalization > C						
	N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level						

Table 2.28 Access & Egress – Onsite-1 Facility Worker

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.										
Likelihood (L, of event)/year	C	onsequence (C, of event)/y	vear Risk (R, Qualitative	Ranking)	Risk	Matri	ix			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (ever	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (evolution)	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	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	П	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sednences	_	***	***	***	***
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	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	C	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	S	, , ,						
		action.								
	M	C ≥ Mild, transient	C ≥ Serious injury, no	$C \ge Serious injury, no$						
		adverse effects.	immediate loss of life no	immediate loss of life no						
			permanent disabilities;	permanent disabilities;						
			hospitalization required.	hospitalization required.						
	L	Mild, transient	Minor injuries; no	Minor injuries; no						
		adverse effects > C	hospitalization > C	hospitalization > C						
	N	Consequences less	Consequences less than	Consequences less than						
		than those for Low t	those for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

Table 2.29 Access & Egress – Onsite-2 Co-located Worker

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.										
Likelihood (L, of event)/year	Consequence (C, of event)/year Risk (R, Qualitative Ranking) Risk Matrix									
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (ever	nt) of major concern				Likelihood		
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (evolution)	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	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	П	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sednences	_	***	***	***	***
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	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	C	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	S	, , ,						
		action.								
	M	C ≥ Mild, transient	C ≥ Serious injury, no	$C \ge Serious injury, no$						
		adverse effects.	immediate loss of life no	immediate loss of life no						
			permanent disabilities;	permanent disabilities;						
			hospitalization required.	hospitalization required.						
	L	Mild, transient	Minor injuries; no	Minor injuries; no						
		adverse effects > C	hospitalization > C	hospitalization > C						
	N	Consequences less	Consequences less than	Consequences less than						
		than those for Low t	those for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

Table 2.30 Access & Egress – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	Consequence (C, of event)/year Risk (R, Qualitative Ranking) Risk Matrix										
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (ever	nt) of major concern			Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (evolution)	ent) of concern	_	ı	A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = 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	П	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 ≥ Prompt worker fatality	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	C	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	Z .	1 3							
		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 t	those for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

Table 2.31 Environmental

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