Table 20. Summary of Baseline and Residual Risks - Switchyard

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

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

NOTE:

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

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

Table 20.1 Radiological – Onsite-1 Facility Worker

Hazard	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	L: BEU
Activation	activation.	C: H	areas where excessive residual radiation exists.	C: L
		R: I	 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. 	R: IV
Groundwater Activation	construction activities, (e.g., earthmoving).		 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
Surface Water Activation	Hazard: Radionuclides in surface water exceeding regulatory levels.	L: A C: N R: IV	 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: N R: IV

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Contamination	Hazard: Personnel are exposed to	L: A	P — Radiation Survey of areas to measure and detect contamination	L: EU
	ionizing radiation beyond regulatory	C: H	hazards.	C: L
	levels.	R: I	P – Postings intended to caution workers of area hazard.	R: IV
			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.	
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	Consequence (C, of event)/year	Risk (R, Qualitative Ranking)									
A = Anticipated (L > 1.0E-02)	H = High	Risk Matrix		Likelihood							
U = Unlikely (1.0E-02> L >1.0E-04)	M = Moderate	II = 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	Оф	1	ī	II	III				
BEU = Beyond Extremely Unlikely (1.0E-06> L)	N = Negligible	IV = situation (event) of minimal concern		'	•	.,					

Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	М	П	П	III
P = Preventive (reduce event occurrence likelihood)	Н	C ³ 25.0 rem	C ³ 100 rem	C ³ 100 rem	1	Ш	Ш	IV
M = Mitigative (reduces event consequences)	М	25.0 rem > C ³ 5 rem	100 rem > C ³ 25 rem	100 rem > C ³ 25 rem		""	•••	- ' '
Acronyms	L	5 rem > C	25 rem > C	25 rem > C	N	IV	IV	IV
MOI = Maximally-exposed Offsite Individual	N	0.5 rem > C	5 rem > C	5 rem > C				
rem = Roentgen equivalent man								

IV IV

Table 20.2 Radiological – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual	Hazard: Exposure to residual	L: A	P – Radiological Work Permit prevents unauthorized personnel form	L: BEU
Activation	activation.	C: H	areas 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 groundwater	L: A	P – Sump Pumps ensure water does not remain in the enclosure for	L: EU
Activation	exceeding regulatory levels.	C: H	extended periods of time.	C: M
		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. 	R: III
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

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Contamination	Hazard: Personnel are exposed to	L: A	P - Radiation Survey of areas to measure and detect contamination	L: EU
	ionizing radiation beyond regulatory	C: H	hazards.	C: L
	levels.	R: I	 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	L: A	⁷ Be isn't hazardous in this pattern of use by facility.	L: A
	to ⁷ Be (uptake/committed dose).	C: N R: IV		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 – 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. 	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 Figure	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)													
A = Anticipated (L > 1.0E-02)		H = High		I = situation (event) of major concern		NISK IVIALITA							
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = 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		Ι,	2 9	Н	- 1	1	Ш	Ш	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (event) of minimal concern		8	5 5		- 11			157	
Control(s) Type	С	Offsite (MOI)	Onsit	te-2 (co-located worker)	Onsite-1 (facility worker)		_]	М	- 11	- 11	III	IV	

P = Preventive (reduce event occurrence likelihood)	= Preventive (reduce event occurrence likelihood) H C ³ 25.0 rem C ³ 100 rem C ³ 100 rem		C ³ 100 rem	L	III	III	IV	IV	
M = Mitigative (reduces event consequences)	М	25.0 rem > C ³ 5 rem	100 rem > C ³ 25 rem	100 rem > C ³ 25 rem					
Acronyms	L	5 rem > C	25 rem > C	25 rem > C	N	IV	IV	IV	IV
MOI = Maximally-exposed Offsite Individual	N	0.5 rem > C	5 rem > C	5 rem > C					
rem = Roentgen equivalent man									

Table 20.3 Radiological – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual	Hazard: Exposure to residual	L: 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 groundwater	L: A	P – Sump Pumps ensure water does not remain in the enclosure for	L: EU
Activation	exceeding regulatory levels.	C: H	extended periods of time.	C: M
		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. 	R: III
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 – 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: 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
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. 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 	R: IV

Radiological Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	Cor	sequence (C, of event)/	year	Risk (R, Qualitative Ra	nking)	Risk Matrix					
A = Anticipated (L > 1.0E-02)		H = High		I = situation (even	t) of major concern			Likelihood			
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (ever	nt) of concern	l		Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (eve	III = situation (event) of minor concern			- 1	- I	Ш	Ш
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (event) of minimal concern		lenc	М	П	П	III	IV
Control(s) Type	С	Offsite (MOI)	Onsit	te-2 (co-located worker)	Onsite-1 (facility worker)	sedi	1	Ш	Ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	C ³ 25.0 rem		C ³ 100 rem	C ³ 100 rem	i o					
M = Mitigative (reduces event consequences)	М	25.0 rem > C ³ 5 rem	1	.00 rem > C ³ 25 rem	100 rem > C 3 25 rem	ال	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 20.4 Toxic Materials – Onsite 1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Lead	Hazard: Potential exposure to lead	L:	See Section I Chapter 04	L:
	during manual handling of un-	C:		C:
	encased lead bricks, lead shot, lead	R:		R:
	sheets, 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	Co	nsequence (C, of event)	/year	Risk (R, Qualitative R	anking)	Risk	Matri	(
A = Anticipated (L > 1.0E-02)		H = High		I = situation (ever	nt) of major concern							
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (eve	ent) of concern		1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (ev	ent) of minor concern	Ses	Н	- 1	- 1	Ш	Ш	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	lenc	М	Ш	Ш	Ш	IV	
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edn	1	III	Ш	IV	IV	
P = Preventive (reduce event occurrence likelihood)	Н	C ³ PAC-2		C ³ PAC-3	C 3 IDLH	l io	-					
M = Mitigative (reduces event consequences)	М	PAC-2 > C ³ PAC-1	ı	PAC-3 > C ³ PAC-2	IDLH > C 3 PEL or TLVc		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	Con	sequences less than	Consequences less than							
MOI = Maximally-exposed Offsite Individual		•		for Low Consequence	those for Low							
PAC = Protective Action Criteria		Consequence Level		Level	Consequence Level							
PEL = Permissible Exposure Limit		Consequence Level		20.0.	33334431166 26461							
TLV _c = Threshold Limit Value (ceiling)												

Table 20.5 Toxic Materials – Onsite 2 Co-located Worker

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

Chemical Hazard Consequences, derived from Figure C-	·1, "E	xample Qualitative Conso	equenc	ce Matrix", DOE-HDBK-	1163-2020.						
Likelihood (L, of event)/year	Co	onsequence (C, of event)/year		Risk (R, Qualitative Ranking)			Matrix	(
A = Anticipated (L > 1.0E-02)		H = High		I = situation (eve	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (eve	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (ev	ent) of minor concern	e	Н	- 1	I	Ш	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	N = Negligible		ent) of minimal concern	lence	М	П	Ш	III	IV
Control(s) Type	С	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 ³ PAC-2	C ³ PAC-2		C ³ IDLH	l si					
M = Mitigative (reduces event consequences)	М	PAC-2 > C ³ PAC-1	F	PAC-3 > C ³ PAC-2 IDLH > C ³ PEL or TLV			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 PAC = Protective Action Criteria	N	Consequences less than those for Low		sequences less than for Low Consequence	Consequences less than those for Low						
PEL = Permissible Exposure Limit TLVc = Threshold Limit Value (ceiling)		Consequence Level		Level	Consequence Level						

Table 20.6 Toxic Materials – MOI Offsite

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

Chemical 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)	/year	Risk (R, Qualitative Ranking)			Matrix	1				
A = Anticipated (L > 1.0E-02)		H = High		I = situation (eve	nt) of major concern				Like	ihood		
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (eve	ent) of concern		1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (ev	ent) of minor concern	ses	Н	- 1	- 1	Ш	Ш	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	iences	М	Ш	Ш	Ш	IV	
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	sedı	1	III	III	IV	IV	
P = Preventive (reduce event occurrence likelihood)	Н	C ³ PAC-2		C ³ PAC-3	C 3 IDLH	Cons	<u> </u>					
M = Mitigative (reduces event consequences)	М	PAC-2 > C ³ PAC-1	F	PAC-3 > C ³ PAC-2	IDLH > C 3 PEL or TLVc		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			Consequences less than							
PAC = Protective Action Criteria		than those for Low Consequence Level		for Low Consequence Level	those for Low Consequence Level							
PEL = Permissible Exposure Limit TLV _c = Threshold Limit Value (ceiling)		,			·							

Table 20.7 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, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.													
Likelihood (L, of event)/year	Co	onsequence (C, of event)/	/year Ri	isk (R, Qualitative R	anking)	Risk	Matrix	1					
A = Anticipated (L > 1.0E-02)		H = High		I = situation (eve	nt) of major concern				Like	lihood	ı		
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (eve	ent) of concern		1	Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (ev	ent) of minor concern	nces	Н	- 1	- 1	П	Ш		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		<pre>IV = situation (ev</pre>	ent) of minimal concern	nen	M	Ш	П	Ш	IV		
Control(s) Type	С	Offsite (MOI)	Onsite-2 (d	co-located worker)	Onsite-1 (facility worker)	lbəs	- 1	III	Ш	IV	IV		
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Prom	pt worker fatality	C ³ Prompt worker fatality	Cons	_						
M = Mitigative (reduces event consequences)		serious effects, or		ite injury that is	or acute injury that is		N	IV	IV	IV	IV		
Acronyms		symptoms which		nediately life-	immediately life-								
MOI = Maximally-exposed Offsite Individual		could impair an	thr	reatening or	threatening or								
		individual's ability to	permar	permanently disabling. permanently disabling.									
		take protective											
		action.											
	М	C ³ Mild, transient	C ³ Sei	rious injury, no	C ³ Serious injury, no								
		adverse effects.	immedia	ate loss of life no	immediate loss of life no								
			permar	nent disabilities;	permanent disabilities;								
			hospital	lization required.	hospitalization required.								
	L	Mild, transient Mi		or injuries; no	Minor injuries; no								
		adverse effects > C	hosp	oitalization > C	hospitalization > C								
	N	Consequences less	Conseq	uences less than	Consequences less than								
		than those for Low	those for	Low Consequence	those for Low								
		Consequence Level		Level	Consequence Level								

Table 20.8 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, "	Exar	nple Qualitative Consequ	ience Matrix", DOE-HDBK-11	63-2020.						
Likelihood (L, of event)/year	Co	onsequence (C, of event),	/year Risk (R, Qualitative I	Ranking)	Risk	Matrix	(
A = Anticipated (L > 1.0E-02)		H = High	I = situation (ev	ent) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate	II = situation (ev	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	es	Н	- 1	- 1	Ш	Ш
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (e	vent) of minimal concern	lenc	М	П	П	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sednences	-	Ш	III	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Prompt worker fatality	C ³ Prompt worker fatality	Cons					
M = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	ا ا	N	IV	IV	IV	IV
Acronyms		symptoms which	immediately life-	immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or	threatening or						
		individual's ability to	permanently disabling.	permanently disabling.						
		take protective								
		action.								
	М	C ³ Mild, transient	C ³ Serious injury, no	C ³ 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 20.9 Flammable and Combustible Materials – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-1, "	Exar	nple Qualitative Consequ	ence Matrix", DOE	-HDBK-116	53-2020.						
Likelihood (L, of event)/year	Co	onsequence (C, of event),	year Risk (R, Qu	alitative R	anking)	Risk	Matrix				
A = Anticipated (L > 1.0E-02)		H = High	I = situ	uation (eve	nt) of major concern				Like	lihood	ı
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate	II = sit	uation (eve	ent) of concern	l —	1	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low	III = sit	tuation (ev	ent) of minor concern	ses	Н	- 1	- 1	Ш	Ш
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = si	tuation (ev	ent) of minimal concern	nences	М	Ш	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located	l worker)	Onsite-1 (facility worker)	sedı		Ш	Ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Prompt worke	er fatality	C ³ Prompt worker fatality	Cons					
M = Mitigative (reduces event consequences)		serious effects, or	or acute injury	-	or acute injury that is		N	IV	IV	IV	IV
Acronyms		symptoms which	immediately	life-	immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	threatening	or	threatening or						
		individual's ability to	permanently dis	sabling.	permanently disabling.						
		take protective									
		action.									
	М	C ³ Mild, transient	C ³ Serious inju	ıry, no	C ³ Serious injury, no						
		adverse effects.	immediate loss o	of life no	immediate loss of life no						
			permanent disa	bilities;	permanent disabilities;						
			hospitalization re	equired.	hospitalization required.						
	L	Mild, transient	Minor injurie	s; no	Minor injuries; no						
		adverse effects > C	hospitalizatio	n > C	hospitalization > C						
	N	Consequences less	Consequences le	ess than	Consequences less than						
		than those for Low	those for Low Con	sequence	those for Low						
		Consequence Level	Level		Consequence Level						

Table 20.10 Electrical Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
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:

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:
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:

Likelihood (L, of event)/year	Co	onsequence (C, of event)/ye	ar Risk (R, Qualitative I	Ranking)	В	ick N	Matrix				
A = Anticipated (L > 1.0E-02)		H = High	I = situation (eve	ent) of major concern	, n	isk iv	viatrix		Liko	ihood	
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate	II = situation (ev	ent) of concern				Α	II.	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low	III = situation (e	vent) of minor concern	l 🗆 .		н	1	ı	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (e	vent) of minimal concern		ono.					
Control(s) Type	С	Offsite (MOI)	nsite-2 (co-located worker)	Onsite-1 (facility worker)	٦Ľ	,	М	II	II	Ш	IV

P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Prompt worker fatality	C ³ Prompt worker fatality	1	Ш	III	IV	IV
M = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is					
Acronyms		symptoms which	immediately life-	immediately life-	N	IV	IV	IV	IV
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or	threatening or					
		individual's ability to	permanently disabling.	permanently disabling.					
		take protective							
		action.							
	М	C ³ Mild, transient	C 3 Serious injury, no	C 3 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 20.11 Electrical Energy 1 Onsite-2 Co-located Worker

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

Likelihood (L, of event)/year	Co	nsequence (C, of event)/	year	Risk (R, Qualitative R	anking)	Risl	(Matrix	ĭ			
A = Anticipated (L > 1.0E-02)		H = High		I = situation (ever	nt) of major concern				Likel	ihood	
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (eve	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (ev	ent) of minor concern	es	Н	- 1	- 1	Ш	Ш
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	enc	М	Ш	Ш	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	ledu	1	III	Ш	IV	IV
 P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual 	Н	C ³ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	or i	ompt worker fatality acute injury that is mmediately life-threatening or manently disabling.	C ³ Prompt worker fatality or acute injury that is immediately life- threatening or permanently disabling.	Cons	N	IV	IV	IV	IV
	М	C ³ Mild, transient adverse effects.	imm peri	Serious injury, no ediate loss of life no manent disabilities; bitalization required.	C ³ Serious injury, no immediate loss of life no permanent disabilities; 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 20.12 Electrical Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Stored Energy	Hazard: Shock hazard, >50V, Arc	L:	See Section I Chapter 04	L:
	Flash	C:		C:
		R:		R:
High Voltage	Hazard: Shock Hazard, >50V, Arc	L:	See Section I Chapter 04	L:
Exposure	Flash outside	C:		C:
		R:		R:
		1.		
Low Voltage, High	Hazard: N/A	L:		L:
Current Exposure		C:		C:
		R:		R:

Likelihood (L, of event)/year	Co	onsequence (C, of event)/	year Risk (R, Qualitative R	anking)	Risk	Matrix						
A = Anticipated (L > 1.0E-02)		H = High		nt) of major concern				Like	lihood			
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate	II = situation (eve				Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low	III = situation (ev	ent) of minor concern	S	Н	- 1	- 1	П	Ш		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	•	ent) of minimal concern	seduences	М	П	П	Ш	IV		
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	nba				1) /	11.7		
P = Preventive (reduce event occurrence likelihood)	н	C ³ Irreversible, other	C ³ Prompt worker fatality	C ³ Prompt worker fatality	Cons	L	III	III	IV	IV		
M = Mitigative (reduces event consequences)	l''	serious effects, or	or acute injury that is	or acute injury that is	٥	N	IV	IV	IV	IV		
Acronyms		symptoms which	immediately life-	immediately life-								
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or	threatening or permanently disabling.								
		individual's ability to	permanently disabling.									
		take protective	p eg.	permanenta, escalaring								
		action.										
	М	C ³ Mild, transient	C ³ Serious injury, no	C ³ Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.	1							
	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 20.13 Thermal Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
	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	C: R:		C: R:
	can add to the fuel load of a potential fire. The exposure of the hazard to the facility worker is of major concern.			

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	Co	onsequence (C, of event)/	year	Risk (R, Qualitative Ra	anking)	Risk Matrix					
A = Anticipated (L > 1.0E-02)		H = High		I = situation (ever	nt) of major concern						
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (eve	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (ev	ent) of minor concern	es	Н	- 1	- 1	П	Ш
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	ences	М	Ш	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	edno	ı	111	Ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Pro	mpt worker fatality	C ³ Prompt worker fatality	Su					
M = Mitigative (reduces event consequences)		serious effects, or	or a	cute injury that is	or acute injury that is		N	IV	IV	IV	IV
Acronyms		symptoms which	im	nmediately life-	immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	t	threatening or	threatening or						
		individual's ability to	perm	nanently disabling.	permanently disabling.						
		take protective									
		action.									
	М	C ³ Mild, transient	C ³ S	Serious injury, no	C ³ Serious injury, no						
		adverse effects.	imme	diate loss of life no	immediate loss of life no						
			perm	nanent disabilities;	permanent disabilities;						
			hospit	talization required.	hospitalization required.						
	L	Mild, transient N		inor injuries; no	Minor injuries; no						
		adverse effects > C	<u>'</u>		hospitalization > C						
	N	Consequences less			Consequences less than						
		than those for Low	those fo	or Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 20.14 Thermal Energy – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
	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	C: R:		C: R:
	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.			

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	Co	onsequence (C, of event)/	/year	Risk (R, Qualitative Ra	Ranking) Risk Matrix						
A = Anticipated (L > 1.0E-02)		H = High		I = situation (ever	nt) of major concern						
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		<pre>II = situation (eve</pre>	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (ev	ent) of minor concern	ses	Н	- 1	- 1	Ш	Ш
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	ences	М	П	H	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	nbə	ı	Ш	III	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Pro	ompt worker fatality	C ³ Prompt worker fatality	Cons					
M = Mitigative (reduces event consequences)		serious effects, or	or a	acute injury that is	or acute injury that is		N	IV	IV	IV	IV
Acronyms		symptoms which	in	mmediately life-	immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	1	threatening or	threatening or						
		individual's ability to	perm	nanently disabling.	permanently disabling.						
		take protective									
		action.									
	М	C ³ Mild, transient	C ³	Serious injury, no C ³ Serious injury, no							
		adverse effects.	imme	ediate loss of life no	immediate loss of life no						
			perm	nanent disabilities;	permanent disabilities;						
			hospi	italization required.	hospitalization required.						
	L	Mild, transient N		linor injuries; no	Minor injuries; no						
		adverse effects > C	<u>'</u>		hospitalization > C						
	N	Consequences less			Consequences less than						
		than those for Low	those f	or Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 20.15 Thermal Energy – MOI Offsite

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

Likelihood (L, of event)/year	Co	onsequence (C, of event),	/year R	Risk (R, Qualitative Ranking)			Matrix							
A = Anticipated (L > 1.0E-02)		H = High		I = situation (event) of major concern										
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (eve			•	Α	U	EU	BEU			
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (eve	ent) of minor concern	nces	Н	- 1	- 1	П	Ш			
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	enc	М	П	Ш	Ш	IV			
Control(s) Type	С	Offsite (MOI)	Onsite-2 ((co-located worker)	Onsite-1 (facility worker)	nbəs		Ш	III	IV	IV			
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Pron	mpt worker fatality	C ³ Prompt worker fatality	Cons								
M = Mitigative (reduces event consequences)		serious effects, or		ute injury that is	or acute injury that is		N	IV	IV	IV	IV			
Acronyms		symptoms which	immediately life-		immediately life-									
MOI = Maximally-exposed Offsite Individual		could impair an		nreatening or	threatening or									
		individual's ability to		anently disabling.	permanently disabling.									
		take protective		, ,	, ,									
		action.												
	М	C 3 Mild, transient	C ³ Se	erious injury, no	C ³ 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	adverse effects > C ho		nor injuries; no	Minor injuries; no									
				pitalization > C	hospitalization > C									
	N			quences less than	Consequences less than									
		than those for Low	those for	r Low Consequence	those for Low									
		Consequence Level		Level	Consequence Level									

Table 20.16 Kinetic Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power Tools	Hazard: Personnel injury due to	L:	See Section I Chapter 04	L:
1 OWEI 10013	improper use of power tools.	C:		C:
		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 pinch	L:	See Section I Chapter 04	L:
	points, tip-overs, caught in between.	C:		C:
		R:		R:

Other Hazard Consequences, derived from Figure C-1,	Exan	nple Qualitative Conseque	ence Matrix", DOE-HDBK	(-116	3-2020.									
Likelihood (L, of event)/year	Co	onsequence (C, of event)/	year Risk (R, Qualitati	ive Ra	anking)	Risk	Matrix							
A = Anticipated (L > 1.0E-02)		H = High	I = situation	(ever	nt) of major concern				Like	lihood				
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate	II = situation	ı (eve	ent) of concern		1	Α	U	EU	BEU			
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low	III = situation	n (eve	ent) of minor concern	ses	Н	I	I	П	Ш			
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation	n (eve	ent) of minimal concern	lenc	М	Ш	Ш	Ш	IV			
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worke	er)	Onsite-1 (facility worker)	seduences	ı	III	III	IV	IV			
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Prompt worker fatal	lity	C ³ Prompt worker fatality	Cons	_							
M = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	-	or acute injury that is	L	N	IV	IV	IV	IV			
Acronyms		symptoms which	immediately life-		immediately life-									
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or		threatening or									
		individual's ability to	permanently disabling	g.	permanently disabling.									
		take protective												
		action.												
	М	C ³ Mild, transient	C ³ Serious injury, no	C ³ Serious injury, no C ³ Serious injury										
		adverse effects.	immediate loss of life r	no	immediate loss of life no									
			permanent disabilities	s;	permanent disabilities;									
			hospitalization require	d.	hospitalization required.									
	L	Mild, transient	Minor injuries; no		Minor injuries; no									
		adverse effects > C	hospitalization > C		hospitalization > C									
	N Consequences less Consequ		Consequences less tha	an	Consequences less than									
		than those for Low	those for Low Conseque	nce	those for Low									
		Consequence Level	Level		Consequence Level									

Table 20.17 Kinetic Energy – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power Tools	Hazard: Personnel injury due to	L:	See Section I Chapter 04	L:
1 OWEI 10013	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, "	Exar	nple Qualitative Consequ	ence N	/latrix", DOE-HDBK-116	3-2020.								
Likelihood (L, of event)/year	Co	onsequence (C, of event)/	year	Risk (R, Qualitative R	anking)	Risk	Matri	x					
A = Anticipated (L > 1.0E-02)		H = High		I = situation (eve	nt) of major concern				Likelihood				
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (eve	ent) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (ev	ent) of minor concern	ces	Н	- 1	1	П	Ш		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	l e	М	П	П	III	IV		
Control(s) Type	С	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	sedn	L	III	Ш	IV	IV		
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual		C ³ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	or i	rompt worker fatality acute injury that is immediately life- threatening or manently disabling.	C ³ Prompt worker fatality or acute injury that is immediately life- threatening or permanently disabling.	Con	N	IV	IV	IV	IV		
	M C ³ Mild, transient C ³ adverse effects. imm per hosp L Mild, transient N		Serious injury, no nediate loss of life no manent disabilities; pitalization required. Minor injuries; no nospitalization > C	C ³ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no hospitalization > C									

Table 20.18 Kinetic Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power Tools	N/A	L:	Public is prevented from having access to work areas.	L:
1 0 W C1 1 0 0 13		C:		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, "	Exan	nple Qualitative Consequ	ence N	/latrix", DOE-HDBK-116	53-2020.						
Likelihood (L, of event)/year	Co	onsequence (C, of event),	/year	Risk (R, Qualitative R	anking)	Risk Matrix					
A = Anticipated (L > 1.0E-02)		H = High		I = situation (eve	nt) of major concern						
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (eve	ent) of concern		1	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (ev	ent) of minor concern	ces	Н	ı	1	П	Ш
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	lenc	М	П	П	111	IV
Control(s) Type	С	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	sedr	L	Ш	III	IV	IV
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual		C ³ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	or i	rompt worker fatality acute injury that is immediately life- threatening or manently disabling.	C ³ Prompt worker fatality or acute injury that is immediately life- threatening or permanently disabling.	Con	N	IV	IV	IV	IV
		C ³ Mild, transient adverse effects. Mild, transient adverse effects > C	imm per hosp	Serious injury, no nediate loss of life no manent disabilities; pitalization required. Winor injuries; no no pospitalization > C	C ³ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no hospitalization > C						

Table 20.19 Potential Energy – Onsite-1 Facility Worker

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

Other Hazard Consequences, derived from Figure C-1, "	Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	Co	onsequence (C, of event),	/year	Risk (R, Qualitative R	anking)	Risk	Matrix						
A = Anticipated (L > 1.0E-02)		H = High		I = situation (event) of major concern					Like	lihood			
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (eve	ent) of concern		1	Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		<pre>III = situation (ev</pre>	ent) of minor concern	ses	Н	- 1	- 1	II	Ш		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		<pre>IV = situation (ev</pre>	ent) of minimal concern	nences	М	Ш	П	Ш	IV		
Control(s) Type	С	Offsite (MOI)	Offsite (MOI) Onsite-2		Onsite-1 (facility worker)	sedı	1	Ш	III	IV	IV		
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Irreversible, other C ³ Pro		C ³ Prompt worker fatality	Cons							
M = Mitigative (reduces event consequences)		serious effects, or			or acute injury that is		N	IV	IV	IV	IV		
Acronyms		symptoms which	′		immediately life-								
MOI = Maximally-exposed Offsite Individual		' '		threatening or	threatening or								
		individual's ability to	perm	nanently disabling.	permanently disabling.								
		take protective											
		action.											
	М	C ³ Mild, transient	C 3 5	Serious injury, no	C 3 Serious injury, no								
		adverse effects.	imme	ediate loss of life no	immediate loss of life no								
			perm	nanent 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 Conseq		equences less than	Consequences less than									
than those for Low those			those fo	e for Low Consequence those for Low									
		Consequence Level		Level	Consequence Level								

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

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

Likelihood (L, of event)/year	Co	onsequence (C, of event),	year Risk (R, Qualitative R	tanking)	Risk	Matrix	(
A = Anticipated (L > 1.0E-02)		H = High		I = situation (event) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate	II = situation (eve				Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low	III = situation (ev	vent) of minor concern	es	Н	- 1	1	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	enc	М	П	- 11	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sednences		Ш	III	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Prompt worker fatality	C ³ Prompt worker fatality	Cons		111	""	IV	IV
M = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is		N	IV	IV	IV	IV
Acronyms		symptoms which	immediately life-	immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or	threatening or						
		individual's ability to	permanently disabling.	permanently disabling.						
		take protective	, , ,	, ,						
		action.								
	М	C ³ Mild, transient	C ³ Serious injury, no	C ³ 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						
	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 20.21 Potential Energy – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-1, "	Exan	nple Qualitative Consequ	ience Matr	rix", DOE-HDBK-116	3-2020.								
Likelihood (L, of event)/year	Co	onsequence (C, of event)/	/year Ri	isk (R, Qualitative R	anking)	Risk	Matrix	1					
A = Anticipated (L > 1.0E-02)		H = High		I = situation (event) of major concern					Like	lihood	ı		
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (eve	ent) of concern		1	Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (ev	ent) of minor concern	nces	Н	- 1	- 1	П	Ш		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		<pre>IV = situation (ev</pre>	ent) of minimal concern	nen	M	Ш	II	Ш	IV		
Control(s) Type	С	Offsite (MOI)	Onsite-2 (d	co-located worker)	Onsite-1 (facility worker)	lbəs	- 1	III	Ш	IV	IV		
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Prom	pt worker fatality	C ³ Prompt worker fatality	Cons	_						
M = Mitigative (reduces event consequences)		serious effects, or		ite injury that is	or acute injury that is		N	IV	IV	IV	IV		
Acronyms		symptoms which		nediately life-	immediately life-								
MOI = Maximally-exposed Offsite Individual		' '		reatening or	threatening or								
		individual's ability to	permar	nently disabling.	permanently disabling.								
		take protective											
		action.											
	М	C ³ Mild, transient	C ³ Sei	rious injury, no	C ³ Serious injury, no								
		adverse effects.	immedia	ate loss of life no	immediate loss of life no								
			permar	nent disabilities;	permanent disabilities;								
			hospital	lization required.	hospitalization required.								
	L	· ·		or injuries; no	Minor injuries; no								
		adverse effects > C hosp		oitalization > C	hospitalization > C								
	N Consequences less Con		Conseq	uences less than	Consequences less than								
		than those for Low	those for	Low Consequence	those for Low								
		Consequence Level		Level	Consequence Level								

Table 20.22 Magnetic Fields – Onsite-1 Facility Worker

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

Other Hazard Consequences, derived from Figure C-1, "	_	· · · · · · · · · · · · · · · · · · ·		-		Dick	Matrix	,			
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year	Risk (R, Qualitative Ra	.	NISK	IVIALIIX	` 	Liles	lihood	
A = Anticipated (L > 1.0E-02)		H = High		•	nt) of major concern			A	U	EU	BEU
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		<pre>II = situation (eve</pre>	•			A			
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		•	ent) of minor concern	uces	Н	- 1	ı	Ш	Ш
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	ē	M	П	H	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	sedu	-	III	Ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Pro	ompt worker fatality	C ³ Prompt worker fatality	Cons					
M = Mitigative (reduces event consequences)		serious effects, or	or a	acute injury that is	or acute injury that is	L	N	IV	IV	IV	IV
Acronyms		symptoms which	in	nmediately life-	immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	1	threatening or	threatening or						
		individual's ability to	pern	manently disabling.	permanently disabling.						
		take protective									
		action.									
	М	C ³ Mild, transient	C ³	Serious injury, no	C ³ Serious injury, no						
		adverse effects.	imme	ediate loss of life no	immediate loss of life no						
			pern	nanent disabilities;	permanent disabilities;						
			hospi	italization required.	hospitalization required.						
	L	Mild, transient	М	linor injuries; no	Minor injuries; no						
		adverse effects > C	ho	ospitalization > C	hospitalization > C						
	N	Consequences less	Cons	sequences less than	Consequences less than						
		than those for Low	those f	for Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 20.23 Magnetic Fields – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields	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, "	Exan	nple Qualitative Consequ	ience Matr	rix", DOE-HDBK-116	3-2020.						
Likelihood (L, of event)/year	Co	onsequence (C, of event)/	/year Ri	isk (R, Qualitative R	anking)	Risk	Matrix	1			
A = Anticipated (L > 1.0E-02)		H = High		I = situation (eve	situation (event) of major concern				Like	lihood	ı
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (eve	ent) of concern		1	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (ev	ent) of minor concern	nces	Н	- 1	- 1	П	Ш
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		<pre>IV = situation (ev</pre>	ent) of minimal concern	nen	M	Ш	II	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (d	co-located worker)	Onsite-1 (facility worker)	lbəs	- 1	III	Ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Prom	pt worker fatality	C ³ Prompt worker fatality	Cons	_				
M = Mitigative (reduces event consequences)		serious effects, or		ite injury that is	or acute injury that is		N	IV	IV	IV	IV
Acronyms		symptoms which		nediately life-	immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	thr	reatening or	threatening or						
		individual's ability to	permar	nently disabling.	permanently disabling.						
		take protective									
		action.									
	М	C ³ Mild, transient	C ³ Sei	rious injury, no	C ³ Serious injury, no						
		adverse effects.	immedia	ate loss of life no	immediate loss of life no						
			permar	nent disabilities;	permanent disabilities;						
			hospital	lization required.	hospitalization required.						
	L	Mild, transient	Mino	or injuries; no	Minor injuries; no						
		adverse effects > C	hosp	oitalization > C	hospitalization > C						
	N	Consequences less	Conseq	uences less than	Consequences less than						
		than those for Low	those for	Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 20.24 Magnetic Fields – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields	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, "	Exan	nple Qualitative Consequ	ience M	latrix", DOE-HDBK-116	53-2020.						
Likelihood (L, of event)/year	Co	onsequence (C, of event),	/year	Risk (R, Qualitative R	anking)	Risk	Matrix				
A = Anticipated (L > 1.0E-02)		H = High		I = situation (ever	situation (event) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		<pre>II = situation (eve</pre>	ent) of concern		1	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low			ent) of minor concern	es	Н	- 1	- 1	П	Ш
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	enc	М	П	H	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-	·2 (co-located worker)	Onsite-1 (facility worker)	seduences	ı	III	III	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Pro	ompt worker fatality	C ³ Prompt worker fatality	Ç	<u> </u>				
M = Mitigative (reduces event consequences)		serious effects, or	or a	acute injury that is	or acute injury that is		N	IV	IV	IV	IV
Acronyms		symptoms which		mmediately life-	immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an		threatening or	threatening or						
		individual's ability to	perr	manently disabling.	permanently disabling.						
		take protective									
		action.									
	М	C ³ Mild, transient	C ³	Serious injury, no	C ³ Serious injury, no						
		adverse effects.	imme	ediate loss of life no	immediate loss of life no						
			perr	manent disabilities;	permanent disabilities;						
			hosp	italization required.	hospitalization required.						
	L	Mild, transient	N	linor injuries; no	Minor injuries; no						
		adverse effects > C	ho	ospitalization > C	hospitalization > C						
	N	Consequences less	Cons	sequences less than	Consequences less than						
		than those for Low	those	for Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 20.25 Other hazards – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	Hazard: Limited egress	L: A C: H R: I	 P - Confined Space training informs workers of hazard and process for working in the confined space. 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. 	L: BEU C: M 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:
Working at Heights	Hazard: Falls, dropped items.	L: A C: H R: I	 P – Fall protection program P – Training for ladders, scaffolds, mobile elevating work platforms P – Guard Rails or tie off points. M – PPE – PFAS, including approved anchor points, hard hats 	L: BEU C: M R: IV

Other Hazard Consequences, derived from Figure C-1, "	Exan	nple Qualitative Conseque	ence Ma	atrix", DOE-HDBK-116	53-2020.						
Likelihood (L, of event)/year	Co	onsequence (C, of event)/	/year	Risk (R, Qualitative R	anking)	Risk	Matrix				
A = Anticipated (L > 1.0E-02)		H = High		I = situation (event) of major concern					Like	lihood	
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		<pre>II = situation (eve</pre>	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (ev	ent) of minor concern	es	Н	- 1	- 1	П	Ш
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	ences	М	Ш	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	edno	ı	111	Ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Pro	ompt worker fatality	C ³ Prompt worker fatality	Su					
M = Mitigative (reduces event consequences)		serious effects, or	or a	acute injury that is	or acute injury that is		N	IV	IV	IV	IV
Acronyms		symptoms which	in	nmediately life-	immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	t	threatening or	threatening or						
		individual's ability to	perm	nanently disabling.	permanently disabling.						
		take protective									
		action.									
	М	C ³ Mild, transient	C ³ :	Serious injury, no	C ³ Serious injury, no						
		adverse effects.	imme	ediate loss of life no	immediate loss of life no						
			perm	nanent disabilities;	permanent disabilities;						
			hospi	italization required.	hospitalization required.						
	L	Mild, transient	М	linor injuries; no	Minor injuries; no						
		adverse effects > C	ho	ospitalization > C	hospitalization > C						
	N	Consequences less	Cons	equences less than	Consequences less than						
		than those for Low	those f	or Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	Hazard: Accidental entry	L: BEU	P — Work practice procedure requires use of an attendant, outside of	L: BEU
		C: H	the 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, "	Exar	nple Qualitative Consequ	ience Matrix", DOE-HDBK-11	163-2020.						
Likelihood (L, of event)/year	Co	onsequence (C, of event),	/year Risk (R, Qualitative	Ranking)	Risk	Matrix	(
A = Anticipated (L > 1.0E-02)		H = High	I = situation (ev	I = situation (event) of major concern				Like	lihood	•
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate	II = situation (e	vent) of concern	l .		Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low	III = situation (e	event) of minor concern	ies .	Н	- 1	- 1	П	Ш
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (e	event) of minimal concern	lenc	М	Ш	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sednences	-	Ш	III	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Prompt worker fatality	C ³ Prompt worker fatality	Cons					
M = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	الت	N	IV	IV	IV	IV
Acronyms		symptoms which	immediately life-	immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or	threatening or						
		individual's ability to	permanently disabling.	permanently disabling.						
		take protective								
		action.								
	М	C ³ Mild, transient	C ³ Serious injury, no	C ³ 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 20.27 Other hazards – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	Hazard: Accidental entry	L: BEU	P – Work practice procedure requires use of an attendant, outside of	L: BEU
		C: H	the 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:		

Likelihood (L, of event)/year	Co	onsequence (C, of event),	year Risk (R, Qualitative R	tanking)	Risk	Matrix	(
A = Anticipated (L > 1.0E-02)		H = High		I = situation (event) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate	II = situation (eve				Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low	III = situation (ev	vent) of minor concern	es	Н	- 1	1	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	enc	М	П	- 11	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sednences		Ш	III	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Prompt worker fatality	C ³ Prompt worker fatality	Cons		111	""	IV	IV
M = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is		N	IV	IV	IV	IV
Acronyms		symptoms which	immediately life-	immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or	threatening or						
		individual's ability to	permanently disabling.	permanently disabling.						
		take protective	, , ,	, ,						
		action.								
	М	C ³ Mild, transient	C ³ Serious injury, no	C ³ 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 20.28 Access & Egress – Onsite-1 Facility Worker

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

Likelihood (L, of event)/year	Co	nsequence (C, of event)/	year/	Risk (R, Qualitative Ra	anking)	Risk Matrix					
A = Anticipated (L > 1.0E-02)		H = High		I = situation (ever	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (eve	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (eve	ent) of minor concern	ses	Н	- 1	- 1	П	Ш
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	enc	М	П	Ш	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	nbəs		Ш	Ш	IV	IV
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Н	C ³ Irreversible, other serious effects, or		ompt worker fatality	C ³ Prompt worker fatality or acute injury that is	Cons	N	IV	IV	IV	IV
Acronyms		symptoms which		nmediately life-	immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	· ·		threatening or						
		individual's ability to		nanently disabling.	permanently disabling.						
		take protective									
		action.									
	М	C ³ Mild, transient	C 3 5	Serious injury, no	C ³ Serious injury, no						
		adverse effects.	imme	ediate loss of life no	immediate loss of life no						
			perm	nanent disabilities;	permanent disabilities;						
			hospit	talization required.	hospitalization required.						
		Mild, transient	Mi	inor injuries; no	Minor injuries; no						
		adverse effects > C	ho	spitalization > C	hospitalization > C						
		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 20.29 Access & Egress – Onsite-2 Co-located Worker

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	Co	onsequence (C, of event)	/year F	Risk (R, Qualitative Ra	anking)	Risk Matrix					
\mathbf{A} = Anticipated (L > 1.0E-02)		H = High		I = situation (ever	nt) of major concern						
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		<pre>II = situation (eve</pre>	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (ev	ent) of minor concern	es	Н	- 1	I	Ш	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	lenc	М	П	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2	(co-located worker)	Onsite-1 (facility worker)	sednences	ı	III	Ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Pror	mpt worker fatality	C ³ Prompt worker fatality	Cons					
M = Mitigative (reduces event consequences)		serious effects, or	or ac	cute injury that is	or acute injury that is	ا ا	N	IV	IV	IV	IV
Acronyms		symptoms which	im	mediately life-	immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an thre		hreatening or	threatening or						
		individual's ability to	perma	anently disabling.	permanently disabling.						
		take protective									
		action.									
	М	C ³ Mild, transient	C ³ S	Serious injury, no	C ³ 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	hos	spitalization > C	hospitalization > C						
	N	Consequences less	Conse	quences less than	Consequences less than						
		than those for Low	those fo	or Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 20.30 Access & Egress – MOI Offsite

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

Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	year I	Risk (R, Qualitative Ranking)		Risk Matrix					
A = Anticipated (L > 1.0E-02)		H = High		I = situation (ever	nt) of major concern			Likelihood			
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (eve	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (ev	ent) of minor concern	l s	Η	- 1	- 1	П	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible			ent) of minimal concern	enc	М	Ш	П	≡	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	Consequences	1	III	Ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Pro	mpt worker fatality	C ³ Prompt worker fatality	l si					
M = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is		or acute injury that is immediately life-	اك	N	IV	IV	IV	IV
Acronyms		symptoms which		nmediately life-							
MOI = Maximally-exposed Offsite Individual		could impair an		threatening or threatening or							
		individual's ability to	permanently disabling.		permanently disabling.						
		take protective									
		action.									
	М	C ³ Mild, transient	C ³ S	Serious injury, no	C ³ Serious injury, no						
		adverse effects.	immed	diate loss of life no	immediate loss of life no						
			perm	nanent 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 20.31 Environmental

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