Table 2. Summary of Baseline and Residual Risks - Proton

	Risk Tables Description	Baseline Risk	Residual 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: III	R: IV
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	Kinetic Energy – Onsite-1 Facility Worker	R: *	R: *
2.14	Kinetic Energy – Onsite-2 Co-located Worker	R: *	R: *
2.15	Kinetic Energy – MOI Offsite	R: *	R: *
2.16	Potential Energy- Onsite-1 Facility Worker	R: *	R: *
2.17	Potential Energy – Onsite-2 Co-located Worker	R: *	R: *
2.18	Potential Energy – MOI Offsite	R: *	R: *
2.19	Other Hazards – Onsite-1 Facility Worker	R: *	R: *
2.20	Other Hazards – Onsite-2 Co-located Worker	R: *	R: *
2.21	Other Hazards – MOI Offsite	R: *	R: *
2.22	Access & Egress – Onsite-1 Facility Worker	R: *	R: *
2.23	Access & Egress – Onsite-2 Co-located Worker	R: *	R: *
2.24	Access & Egress – MOI Offsite	R: *	R: *
2.25	Environmental Hazards	R: *	R: *

^{*} see SIH Table in Section I Chapter 4.

NOTE:

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

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

Table 2.1 Radiological – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual Activation	Hazard: Persons are exposed to residual activation beyond regulatory limits	L: A C: M R: II	 P – Locked Doors: Locked doors bar entrance to areas that contain radioactive material. Keys are required to open these doors. P – Key Control Program: The key control program checks the worker's training prior to issuing them a key to the Proton Area enclosure. P – Radiological Work Permit (RWP): The RWP is written by Safety and specifies the work to be performed, requirements to perform the work, and limitations of radiological exposure M – Shielding: Shielding is material placed between the irradiated component and the area to be protected. Shielding attenuates radiation flux. 	L: BEU C: M R: IV
Groundwater Activation	Hazard: radionuclides in ground water exceed regulatory limits	L: A C: N R: IV	See Section I Chapter 04	L: EU C: N R: IV
Radioactive Waste	Hazard: Persons are exposed to residual activation beyond regulatory limits	L: BEU C: N R: IV	P – The Proton Area is non-operational: Radioactive waste is not present in the Proton Area. Additional radioactive waste is not produced. This reduces the baseline likelihood to "beyond extremely unlikely".	L: BEU C: N R: IV
Contamination	Hazard: Persons are exposed to residual activation beyond regulatory limits	L: BEU C: N R: IV	 P – Radiation Survey: The radiation survey conducted August 11, 2002, found no accessible contamination. Beam has not been transported since then. This reduces the baseline likelihood to "beyond extremely unlikely"; baseline consequence is "negligible". M – The mitigative measurements, "frisk upon exit" and "survey material", remain in place. Before work is conducted, additional preventative and mitigative measures will be determined through a job-specific hazard analysis. 	L: BEU C: N R: IV

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)/	year	Risk (R, Qualitative F	sk (R, Qualitative Ranking)			Risk Matrix						
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	Α	U	EU	BEU			
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		III = situation (eve	ent) of minor concern	ences	Н	I	I	II	III			
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (eve	situation (event) of minimal concern		M	II	II	III	IV			
Control(s) Type	C	Offsite (MOI)	Onsi	te-2 (co-located worker)	Onsite-1 (facility worker)	edno	_	TTT	TTT	77.7	TX 7			
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ 25.0 rem		C ≥ 100 rem	C ≥ 100 rem	ons	L	111	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		N	IV	IV	IV	IV			
Acronyms MOI - Movimelly, averaged Offsite 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 2.2 Radiological – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Activation Persons are exposed to residual activation beyond regulatory limits Groundwater Hazard: radionuclides in ground		L: A C: M R: II	 P – Locked Doors: Locked doors bar entrance to areas that contain radioactive material. Keys are required to open these doors. P – Key Control Program: The key control program checks the worker's training prior to issuing them a key to the accelerator enclosure. P – Radiological Work Permit (RWP): The RWP is written by Safety and specifies the work to be performed, requirements to perform the work, and limitations of radiological exposure M – Shielding: Shielding is material placed between the irradiated component and the area to be protected. Shielding attenuates radiation flux. 	L: BEU C: M R: IV
Groundwater Activation	Hazard: radionuclides in ground water exceed regulatory limits	L: A C: N R: IV	Proton Area is in "stand-by"; radionuclide production has ceased. See Section I Chapter 04	L: EU C: N R: IV
Radioactive Waste	Hazard: Persons are exposed to residual activation beyond regulatory limits	L: BEU C: N R: IV	P – Proton area is non-operational. Radioactive waste is not present in the Proton Area. Additional radioactive waste is not produced. This reduces the baseline likelihood to "beyond extremely unlikely".	L: BEU C: N R: IV
Contamination	Hazard: Persons are exposed to residual activation beyond regulatory limits	L: BEU C: N R: IV	 P – Radiation Survey: The radiation survey conducted August 11, 2002, found no accessible contamination. Beam has not been transported since then. This reduces the baseline likelihood to "beyond extremely unlikely"; baseline consequence is "negligible". M – The mitigative measurements, "frisk upon exit" and "survey material", remain in place. Before work is conducted, additional preventative and mitigative measures will be determined through a job-specific hazard analysis. 	L: BEU C: N R: IV

Radiological Hazard Consequences, derived from Figu	re C	-1, "Example Qualitativ	e Con	sequence Matrix", DOI	E-HDBK-1163-2020.								
Likelihood (L, of event)/year	Co	nsequence (C, of event)/y	year	Risk (R, Qualitative Ranking)			Risk Matrix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (even	t) of major concern				Like	lihood			
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ever	II = situation (event) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		III = situation (eve	ent) of minor concern	es	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible		IV = situation (event) of minimal concern		enc	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsi	te-2 (co-located worker)	Onsite-1 (facility worker)	edn	· ·	III	III	IV	IV		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ 25.0 rem		C ≥ 100 rem	C ≥ 100 rem	Suo	L	111	Ш	1 V	1 V		
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 - Manipully and a Office Individual	L	5 rem > C		25 rem > C	25 rem > C								
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	N	0.5 rem > C		5 rem > C	5 rem > C								

Table 2.3 Radiological – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual Activation	Hazard: Persons are exposed to residual activation beyond regulatory limits	L: BEU C: H R: III	 P – Locked Doors: The doors to the access points of the Proton Area tunnels (the location of activated components) are locked. This reduces the baseline likelihood to "beyond extremely unlikely". M – Shielding: Shielding is material placed between the irradiated component and the area to be protected. Shielding attenuates radiation flux. The Proton Area tunnels (the location of the activated components) are underground; the earthen overburden provides more than sufficient shielding. 	L: BEU C: M R: IV
Groundwater Activation	Hazard: radionuclides in ground water exceed regulatory limits	L: A C: N R: IV	Proton Area is in "stand-by"; radionuclide production has ceased. See Section I Chapter 04	L: EU C: N R: IV
Radioactive Waste	Hazard: Persons are exposed to residual activation beyond regulatory limits	L: BEU C: N R: IV	P – Proton area is no longer operational. Radioactive waste is not present in the Proton Area. New radioactive waste is not produced. This reduces the baseline likelihood to "beyond extremely unlikely"; baseline consequence is "negligible".	L: BEU C: N R: IV
Contamination	Hazard: Persons are exposed to residual activation beyond regulatory limits	L: BEU C: N R: IV	P – Radiation Survey: The radiation survey conducted August 11, 2002, found no accessible contamination. Beam has not been transported since then. This reduces the baseline likelihood to "beyond extremely unlikely"; baseline consequence is "negligible".	L: BEU C: N R: IV

Likelihood (L, of event)/year	Co	nsequence (C, of event)/y	year F	Risk (R, Qualitative Ranking)			Risk Matrix					
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (even	t) of major concern			Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (event) of concern			1	A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		III = situation (eve	III = situation (event) of minor concern		Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (event) of minimal concern		enc	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-2	-2 (co-located worker)	Onsite-1 (facility worker)	nbə		***	***			
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	$25.0 \text{ rem} > \mathbf{C} \ge 5 \text{ rem}$	100	rem > C ≥ 25 rem	100 rem > C ≥ 25 rem	0	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 2.4 Toxic Materials – Onsite 1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Lead *	Hazard: Potential exposure to lead dust during manual handling of unencased lead bricks, lead shot, and lead sheets.	L: C: R:	See Section I Chapter 04	L: C: R:
Beryllium *	Hazard: Potential exposure to beryllium dust during manual handling of un-encased, or machining dusts from fabrication shop activities.	L: C: R:	See Section I Chapter 04	L: C: R:

Chemical Hazard Consequences, derived from Figure	C-1,	, "Example Qualitative	Conseq	quence Matrix", DOE-	HDBK-1163-2020.								
Likelihood (L, of event)/year	Co	onsequence (C, of event))/year	Risk (R, Qualitative	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		1	A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (e	vent) of minor concern	ses	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	N = Negligible IV		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)	edn	т	111	Ш	IV	IV		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ PAC-2	C ≥ PAC-2		C ≥ IDLH	ons	L	III	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 IDI II = Immediately Denominate Life and Health	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 PEL = Permissible Exposure Limit TLV _c = Threshold Limit Value (ceiling)	N	Consequences less than those for Low Consequence Level		nsequences less than for Low Consequence Level	Consequences less than those for Low Consequence Level								

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:
	dust during manual handling of un-	C:		C:
	encased lead bricks, lead shot, and	R:		R:
	lead sheets.			
Beryllium *	Hazard: Potential exposure to	L:	See Section I Chapter 04	L:
	beryllium dust during manual	C:		C:
	handling of un-encased, or machining	R:		R:
	dusts from fabrication shop activities.			

Chemical Hazard Consequences, derived from Figure	C-1	, "Example Qualitative	Conseq	quence Matrix", DOE-	HDBK-1163-2020.							
Likelihood (L, of event)/year	Co	onsequence (C, of event)/year	Risk (R, Qualitative Ranking)			Risk Matrix					
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$			ent) of major concern				Like	lihood	1	
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ev	ent) of concern		ı	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ev	vent) of minor concern	s	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edn	т .	TTT	777	13.7	IV	
	Н	C ≥ PAC-2		C ≥ PAC-3	C ≥ IDLH	ons	L	III	III	IV	1 V	
M = Mitigative (reduces event consequences)	M	$PAC-2 > C \ge PAC-1$	P/	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$	\sim	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 TLV _c = Threshold Limit Value (ceiling)	N	Consequences less than those for Low Consequence Level		nsequences less than for Low Consequence Level	Consequences less than those for Low Consequence Level							

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 dust during manual handling of unencased lead bricks, lead shot, and lead sheets.	L: C: R:	See Section I Chapter 04	L: C: R:
Beryllium *	Hazard: Potential exposure to beryllium dust during manual handling of un-encased, or machining dusts from fabrication shop activities.	L: C: R:	See Section I Chapter 04	L: C: 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	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			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (e	vent) of minor concern	səa	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ex	vent) of minimal concern	enc	M	II	II	Ш	IV	
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	т	III	TTT	IV	IV	
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ PAC-2		C ≥ PAC-3	C ≥ IDLH	Suo	L	111	III	1 V	17	
M = Mitigative (reduces event consequences)	M	$PAC-2 > C \ge PAC-1$	P.A	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$	С	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		nsequences less than for Low Consequence	Consequences less than those for Low							
PEL = Permissible Exposure Limit TLV _c = Threshold Limit Value (ceiling)		Consequence Level		Level	Consequence Level							

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	Hazard:	L:	See Section I Chapter 04	L:
materials		C:		C:
(cables, Boxes,		R:		R:
Paper, wood				
cribbing, etc.)				

Other Hazard Consequences, derived from Figure C-1	, "E	xample Qualitative Cons	equen	ce Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year	Risk (R, Qualitative	<u> </u>	Risk	Matri	X			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$			nt) of major concern				Like	lihood	DELL
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ev	ent) of concern		I	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		· · · · · · · · · · · · · · · · · · ·	vent) of minor concern	səs	Н	I	I	II	III
BEU = Beyond Extremely Unlikely $(1.0E-06>L)$		N = Negligible		`	vent) of minimal concern	len	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)		-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	L	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
Acronyms MOI = Maximally-exposed Offsite Individual		or symptoms which could impair an		mmediately life- ening or permanently	is immediately life- threatening or						
		individual's ability to take protective action.		disabling.	permanently disabling.						
	M	$C \ge Mild$, transient	C ≥	≥ Serious injury, no	$C \ge Serious injury, no$						
		adverse effects.	imm	ediate loss of life no	immediate loss of life no						
			peri	manent disabilities;	permanent disabilities;						
				oitalization required.	hospitalization required.						
	L	Mild, transient	N	Ainor injuries; no	Minor injuries; no						
		adverse effects > C	ho	ospitalization > C	hospitalization > C						
	N	Consequences less	Con	sequences less than	Consequences less than						
		than those for Low	those	for Low Consequence	those for Low						
		Consequence Level		Level	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	Hazard:	L:	See Section I Chapter 04	L:
materials		C:		C:
(cables, Boxes,		R:		R:
Paper, wood				
cribbing, etc.)				

Other Hazard Consequences, derived from Figure C-1	, "E	xample Qualitative Cons	equen	ce Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year	Risk (R, Qualitative	<u> </u>	Risk	Matri	X			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$			nt) of major concern				Like	lihood	DELL
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ev	ent) of concern		I	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		· · · · · · · · · · · · · · · · · · ·	vent) of minor concern	səs	Н	I	I	II	III
BEU = Beyond Extremely Unlikely $(1.0E-06>L)$		N = Negligible		`	vent) of minimal concern	len	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)		-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	L	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
Acronyms MOI = Maximally-exposed Offsite Individual		or symptoms which could impair an		mmediately life- ening or permanently	is immediately life- threatening or						
		individual's ability to take protective action.		disabling.	permanently disabling.						
	M	$C \ge Mild$, transient	C ≥	≥ Serious injury, no	$C \ge Serious injury, no$						
		adverse effects.	imm	ediate loss of life no	immediate loss of life no						
			peri	manent disabilities;	permanent disabilities;						
				oitalization required.	hospitalization required.						
	L	Mild, transient	N	Ainor injuries; no	Minor injuries; no						
		adverse effects > C	ho	ospitalization > C	hospitalization > C						
	N	Consequences less	Con	sequences less than	Consequences less than						
		than those for Low	those	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		L:	See Section I Chapter 04	L:
materials		C:		C:
(cables, Boxes,		R:		R:
Paper, wood				
cribbing, etc.)				

Other Hazard Consequences, derived from Figure C-1	l, "E	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	٥,	Risk	Matri	X	* "		1
A = Anticipated (L > 1.0E-02) U = Unlikely (1.0E-02> L >1.0E-04)		H = High M = Moderate		I = situation (eve II = situation (ev	ent) of major concern			A	Like U	lihood EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		*	vent) of minor concern	səs	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		(vent) of minimal concern	lenc	M	II	II	III	IV
Control(s) Type P = Preventive (reduce event occurrence likelihood)	C	Offsite (MOI)		-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	L	III	III	IV	IV
M = Mitigative (reduces event consequences)	Н	$C \ge Irreversible$, other serious effects,		Prompt worker fatality acute injury that is	C ≥ Prompt worker fatality or acute injury that	Coi	N	IV	IV	IV	IV
 M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual 		or symptoms which could impair an individual's ability to take protective action.		mmediately life- tening or permanently disabling.	is immediately life- threatening or permanently disabling.						
	M	C ≥ Mild, transient adverse effects.	imm per	≥ Serious injury, no nediate loss of life no manent disabilities; pitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.						
	L	Mild, transient adverse effects > C		Minor injuries; no	Minor injuries; no						
	N	Consequences less than those for Low Consequence Level	Cor	ospitalization > C nsequences less than for Low Consequence Level	hospitalization > C 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)
High Voltage		L:	See Section I Chapter 04	L:
Exposure		C:		C:
1		R:		R:
Low Voltage,		L:	See Section I Chapter 04	L:
High Current		C:		C:
Exposure.		R:		R:

Other Hazard Consequences, derived from Figure C-	l, "F	Example Qualitative Conse	equence Matrix", DOE-HD	BK-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 $(1.0\text{E}-06 > \text{L})$		$\mathbf{L} = \mathbf{Low}$ $\mathbf{N} = \mathbf{Negligible}$	1	vent) of concern vent) of minor concern vent) of minimal concern	ences	H M	I	I	II	BEU	
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker) $C \ge \text{Prompt worker fatality}$	Onsite-1 (facility worker) C ≥ Prompt worker	nbəsı	L	III	III	III	IV IV	
 P = Preventive (reduce event occurrence likelihood) 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.	Cor	N	IV	IV	IV	IV	
	M	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	hospitalization > C Consequences less than	hospitalization > C Consequences less than							
			hose for Low Consequence Level	those for Low 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)
High Voltage		L:	See Section I Chapter 04	L:
Exposure		C:		C:
•		R:		R:
Low Voltage,		L:	See Section I Chapter 04	L:
High Current		C:		C:
Exposure.		R:		R:

Other Hazard Consequences, derived from Figure C-	l, "F	Example Qualitative Conse	equence Matrix", DOE-HD	BK-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 $(1.0\text{E}-06 > \text{L})$		$\mathbf{L} = \mathbf{Low}$ $\mathbf{N} = \mathbf{Negligible}$	1	vent) of concern vent) of minor concern vent) of minimal concern	ences	H M	I	I	II	BEU	
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker) $C \ge \text{Prompt worker fatality}$	Onsite-1 (facility worker) C ≥ Prompt worker	nbəsı	L	III	III	III	IV IV	
 P = Preventive (reduce event occurrence likelihood) 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.	Cor	N	IV	IV	IV	IV	
	M	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	hospitalization > C Consequences less than	hospitalization > C Consequences less than							
			hose for Low Consequence Level	those for Low 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)
High Voltage		L:	See Section I Chapter 04	L:
Exposure		C:		C:
1		R:		R:
Low Voltage,		L:	See Section I Chapter 04	L:
High Current		C:		C:
Exposure.		R:		R:

Other Hazard Consequences, derived from Figure C-	1, "F	Example Qualitative Conse	quence Matrix", DOE-HD	BK-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	nt) of major concern	Risk	Matri	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)		$\mathbf{L} = \mathbf{Low}$ $\mathbf{N} = \mathbf{Negligible}$	-	vent) of concern vent) of minor concern vent) of minimal concern	ences	H M	I	I	II	BEU	
Control(s) Type P = Preventive (reduce event occurrence likelihood)	С	Offsite (MOI)	Onsite-2 (co-located worker) $C \ge \text{Prompt worker fatality}$	Onsite-1 (facility worker)	Conseque	L	III	III	III	IV IV	
 P = Preventive (reduce event occurrence likelihood) 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.	r acute injury that is immediately life- itening or permanently fatality or acute injury that is is immediately life- threatening or				IV	IV	IV	
	М	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							
		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 2.13 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		L:A C:H R:I	See Section I Chapter 04	L: C: R:
Pumps and Motors		L:A C:H R:I	See Section I Chapter 04	L: C: R:
Mobile Shielding		L: A C: H R: I	See Section I Chapter 04	L: BEU C: H R: III

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	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)		 M = Moderate L = Low N = Negligible 	III = situation (e	on (event) of concern ion (event) of minor concern ion (event) of minimal concern			I	I	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	Consequences	M L	III	III	IV	IV	
M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual		other serious effects, or symptoms which could impair an individual's ability to take protective action.	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	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 2.14 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		L:	See Section I Chapter 04	L:
		C: R:		C: R:
Pumps and		L:	See Section I Chapter 04	L:
Motors		C:		C:
		R:		R:
Mobile		L: A	See Section I Chapter 04	L: BEU
Shielding		C: H		C: H
8		R: I		R: III

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	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								
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	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	e-2 (co-located worker)	Onsite-1 (facility worker)	sedn	L	Ш	III	IV	IV		
M = Mitigative (reduces event consequences)	H	C ≥ Irreversible, other serious effects,		Prompt worker fatality acute injury that is	$C \ge Prompt worker$ fatality or acute injury that	Con	N	IV		IV	IV		
Acronyms MOI = Maximally-exposed Offsite Individual		or symptoms which could impair an individual's ability to take protective action.		mmediately life- tening or permanently disabling.	is immediately life- threatening or permanently disabling.								
		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 2.15 Kinetic Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power tools		L:	See Section I Chapter 04	L:
rower tools		C:		C:
		R:		R:
Pumps and		L:	See Section I Chapter 04	L:
Motors		C:		C:
		R:		R:
Mobile		L:	See Section I Chapter 04	L:
Shielding		C:		C:
-8		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)	Risk Matrix						
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern								
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	səo	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	M	II	II	III	IV	
Control(s) Type	С	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 MOI = Maximally-exposed Offsite Individual		C ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	or i	Prompt worker fatality acute injury that is immediately life-tening or permanently disabling.	C ≥ Prompt worker fatality or acute injury that is immediately lifethreatening or permanently disabling.	Con	N	IV	IV	IV	IV	
	adverse effects. imper host L Mild, transient		imm per hosp	≥ Serious injury, no nediate loss of life no manent disabilities; pitalization required. Minor injuries; no ospitalization > C	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no hospitalization > C							

Table 2.16 Potential Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane		L:	See Section I Chapter 04	L:
Operations		C:		C:
•		R:		R:
Material		L:	See Section I Chapter 04	L:
Handling		C:		C:
		R:		R:

Other Hazard Consequences, derived from Figure C-1	e Matrix", DOE-HD	BK-1163-2020.													
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year	Risk (R, Qualitative	Ranking)	Risk	Matri								
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 (even	ent) of concern		1	A	U	EU	BEU				
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		III = situation (ev	vent) of minor concern	ses	Н	I	I	II	III				
BEU = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible		IV = situation (ev	vent) of minimal concern	ienc	M	II	II	III	IV				
Control(s) Type	C	Offsite (MOI)	Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	sednences	· ·	TTT	777	13.7	13.7				
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	$C \ge Pro$	ompt worker fatality	C ≥ Prompt worker	Suo	L	III	III	IV	IV				
M = Mitigative (reduces event consequences)		other serious effects,		cute injury that is	fatality or acute injury that	0	N	IV	IV	IV	IV				
Acronyms		or symptoms which		nmediately life-	is immediately life-					•					
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or permanently disabling.		threatening or										
		individual's ability to			permanently disabling.										
		take protective													
		action.													
	M	C ≥ Mild, transient	C ≥ :	Serious injury, no	C ≥ 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 Mi		inor injuries; no	Minor injuries; no										
	adverse effects > C hos		spitalization > C	hospitalization > C											
	N Consequences less Co		Cons	equences less than	Consequences less than										
		than those for Low	those fo	or Low Consequence	those for Low										
		Consequence Level		Level	Consequence Level										

Table 2.17 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		L:	See Section I Chapter 04	L:
Operations		C:		C:
•		R:		R:
Material		L:	See Section I Chapter 04	L:
Handling		C:		C:
		R:		R:

Other Hazard Consequences, derived from Figure C-1	BK-1163-2020.														
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year l	Risk (R, Qualitative	Ranking)	Risk	Matri								
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)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H} = \text{situation (ev}$	ent) of concern		1	A	U	EU	BEU				
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		III = situation (evaluation)	vent) of minor concern	es	Н	I	I	II	III				
BEU = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	M	II	II	III	IV				
Control(s) Type	C	Offsite (MOI)	Onsite-2	(co-located worker)	Onsite-1 (facility worker)	sednences		TTT	111	13.7	13.7				
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Pro	ompt worker fatality	C ≥ Prompt worker	ous	L	III	III	IV	IV				
M = Mitigative (reduces event consequences)		other serious effects,		cute injury that is	fatality or acute injury that		N	IV	IV	IV	IV				
Acronyms		or symptoms which		mediately life-	is immediately life-					•					
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or permanently disabling.		threatening or										
		individual's ability to			permanently disabling.										
		take protective		· ·											
		action.													
	M	C ≥ Mild, transient	C ≥ S	Serious injury, no	C ≥ Serious injury, no										
		adverse effects.	immed	diate loss of life no	immediate loss of life no										
			perma	anent disabilities;	permanent disabilities;										
		hospi		talization required.	hospitalization required.										
	L			nor injuries; no	Minor injuries; no										
				spitalization > C	hospitalization > C										
	N Consequences less Cor		Conse	equences less than	Consequences less than										
		than those for Low	those for	or Low Consequence	those for Low										
		Consequence Level		Level	Consequence Level										

Table 2.18 Potential Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane		L:	See Section I Chapter 04	L:
Operations		C:		C:
•		R:		R:
Material		L:	See Section I Chapter 04	L:
Handling		C:		C:
		R:		R:

Other Hazard Consequences, derived from Figure C-1	l, "E	xample Qualitative Cons	sequenc	e Matrix", DOE-HD	BK-1163-2020.										
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year	Risk (R, Qualitative	Ranking)	Risk	Matri	ix							
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern					Like	lihood					
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (even	ent) of concern		1	A	U	EU	BEU				
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		III = situation (ev	vent) of minor concern	ses	Н	I	I	II	III				
BEU = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible		IV = situation (ev	vent) of minimal concern	ienc	M	II	II	III	IV				
Control(s) Type	C	Offsite (MOI)	Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	sednences	· ·	TTT	777	13.7	13.7				
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	$C \ge Pro$	ompt worker fatality	C ≥ Prompt worker	Suo	L	III	III	IV	IV				
M = Mitigative (reduces event consequences)		other serious effects,		cute injury that is	fatality or acute injury that	0	N	IV	IV	IV	IV				
Acronyms		or symptoms which		nmediately life-	is immediately life-					•					
MOI = Maximally-exposed Offsite Individual		could impair an		ning or permanently	threatening or										
		individual's ability to		disabling.	permanently disabling.										
		take protective													
		action.													
	M	C ≥ Mild, transient	C ≥	Serious injury, no	C ≥ Serious injury, no										
		adverse effects.	imme	diate loss of life no	immediate loss of life no										
			perm	nanent disabilities;	permanent disabilities;										
			hospi	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	Cons	equences less than	Consequences less than										
		than those for Low	those fo	or Low Consequence	those for Low										
		Consequence Level		Level	Consequence Level										

Table 2.19 Other hazards – Onsite-1 Facility Worker

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

Likelihood (L, of event)/year	C	onsequence (C, of event)/y	ear Risk (R, Qualitative	Ranking)	Risk Matrix							
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	7	nt) of major concern				Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (ev				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	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sedneuces	т	III	III	IV	IV		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	Cons	L	111	111	1 V	1 V		
M = Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	0	N	IV	IV	IV	IV		
Acronyms		or symptoms which	immediately life-	is immediately life-								
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective										
		action.										
	M	$C \ge Mild$, transient	$C \ge Serious injury, no$	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	hose for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

Table 2.20 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		L:	See Section I Chapter 04	L:
Spaces		C:		C:
•		R:		R:
Ergonomics		L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:

Other Hazard Consequences, derived from Figure C-1	l, "E	xample Qualitative Cons	sequence	e Matrix", DOE-HD	BK-1163-2020.										
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year l	Risk (R, Qualitative	Ranking)	Risk	Matri	ix							
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)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H} = \text{situation (ev}$	ent) of concern		1	A	U	EU	BEU				
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		III = situation (evaluation)	vent) of minor concern	es	Н	I	I	II	III				
BEU = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	M	II	II	III	IV				
Control(s) Type	C	Offsite (MOI)	Onsite-2	(co-located worker)	Onsite-1 (facility worker)	sednences		TTT	111	13.7	13.7				
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Pro	ompt worker fatality	C ≥ Prompt worker	ous	L	III	III	IV	IV				
M = Mitigative (reduces event consequences)		other serious effects,		cute injury that is	fatality or acute injury that		N	IV	IV	IV	IV				
Acronyms		or symptoms which		mediately life-	is immediately life-					•					
MOI = Maximally-exposed Offsite Individual		could impair an		ning or permanently	threatening or										
		individual's ability to		disabling.	permanently disabling.										
		take protective		· ·											
		action.													
	M	C ≥ Mild, transient	C ≥ S	Serious injury, no	C ≥ Serious injury, no										
		adverse effects.	immed	diate loss of life no	immediate loss of life no										
			perma	anent disabilities;	permanent disabilities;										
			hospit	talization required.	hospitalization required.										
	L	Mild, transient	Mi	nor 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 for	or Low Consequence	those for Low										
		Consequence Level		Level	Consequence Level										

Table 2.21 Other hazards – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-1	l, "E	xample Qualitative Cons	sequence	e Matrix", DOE-HD	BK-1163-2020.										
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year l	Risk (R, Qualitative	Ranking)	Risk	Matri	ix							
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern					Like						
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H} = \text{situation (ev}$	ent) of concern		1	A	U	EU	BEU				
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		III = situation (evaluation)	vent) of minor concern	es	Н	I	I	II	III				
BEU = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	M	II	II	III	IV				
Control(s) Type	C	Offsite (MOI)	Onsite-2	(co-located worker)	Onsite-1 (facility worker)	sednences		TTT	777	13.7	13.7				
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Pro	ompt worker fatality	C ≥ Prompt worker	ous	L	III	III	IV	IV				
M = Mitigative (reduces event consequences)		other serious effects,		cute injury that is	fatality or acute injury that		N	IV	IV	IV	IV				
Acronyms		or symptoms which		mediately life-	is immediately life-					•					
MOI = Maximally-exposed Offsite Individual		could impair an		ning or permanently	threatening or										
		individual's ability to		disabling.	permanently disabling.										
		take protective		· ·											
		action.													
	M	C ≥ Mild, transient	C ≥ S	Serious injury, no	C ≥ Serious injury, no										
		adverse effects.	immed	diate loss of life no	immediate loss of life no										
			perma	anent disabilities;	permanent disabilities;										
			hospit	talization required.	hospitalization required.										
	L	Mild, transient	Mi	nor 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 2.22 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		L:	See Section I Chapter 04	L:
Egress		C:		C:
		R:		R:

Other Hazard Consequences, derived from Figure C-	Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	C	onsequence (C, of event)	year Risk (R, Qualitative	Ranking)	Risk Matrix							
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (eve	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			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situation (e	vent) of minor concern	s	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	enc	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sedneuces	_	***	***	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	Č	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 2.23 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		L:	See Section I Chapter 04	L:
Egress		C:		C:
		R:		R:

Other Hazard Consequences, derived from Figure C-1	ther 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	Risk (R, Qualitative Ranking)			trix							
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (eve	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			A	U	EU	BEU				
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situation (e	vent) of minor concern	S	Н	I	I	II	III				
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (e	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)	nbə	_	777	TTT	TX 7	17.7				
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	_											
		action.												
	M	$C \ge Mild$, 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 2.24 Access & Egress – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety		L:	See Section I Chapter 04	L:
Egress		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)	Ranking)	Risk Matrix							
A = Anticipated (L > 1.0E-02)	$\mathbf{H} = \mathbf{High}$		I = situation (eve	I = situation (event) of major concern				Likelihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{H} = \text{situation (ev}$	event) of concern		1	A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situation (e	event) of minor concern	es	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (e	V = 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)	sedneuces	_	***	***	77.7	***	
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)		C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV	
		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	5								
		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 2.25 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.	L: C: R:	See Section I Chapter 04	L: C: R:
	Discharge of chemicals into onsite surface waters beyond permitted limits.		See Section I Chapter 04	
Water	Hazard: Discharge of radionuclides into onsite surface waters beyond permitted limits.	L: C: R:	See Section I Chapter 04	L: C: R:
	Discharge of chemicals into onsite surface waters beyond permitted limits.		See Section I Chapter 04	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Soil	Hazard: 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:	Standard analysis applies Standard analysis applies	L: C: R: