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

Table 2. Summary of Baseline and Residual Risks (Muon Campus)

* See Section I Chapter 04

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; 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	Hazard: Accelerator components can	L: A	M – Shielding to reduce activation	L: EU
activation	become activated from beam loss.	С: Н	M – Proper dosimetry	C: L
	Exposure to these activated	R: I	P – Employee Rad Worker training	R: IV
	components is possible.		P – ALARA plan	
Groundwater Activation	Hazard: Scattered beam has potential to activate ground water at low levels calculated in the shield assessment.	L: A C: N R: IV	M – Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment.	L: A C: N R: IV
Surface Water Activation	Hazard: Potential exposure to activated surface water due to beam loss leakage from beam enclosures,	L: A C: N R: IV	 P – Beam loss monitors (in enclosures) prevent excessive beam loss. M – Shielding (soil, concrete, and/or steel) reduces surface water activation. 	L: U C: N R: IV
	located under the surface water impoundment.			
	Potential exposure to activated		P – Off-site discharge limit is applied to any water mixed into onsite surface water. This prevents surface water concentrations from	
	surface water due to mixing surface	L: A	approaching the Derived Concentration Standard.	L: U
	water with a captured groundwater	C: N	M - In situations where surface water activation is higher than expected	C: N
	source.	R: IV	(discovered by monitoring), facility stops operation until facility upset condition is resolved.	R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive	Hazard: RAW water system is used to	L: A	P – Locked cage containing water equipment is controlled by the RSO who	L: EU
Water (RAW)	cool the Lithium Lens, Pulsed Magnet	C: M	only grants access once radiation rates have dropped to safe levels.	C: N
Systems	and the beam absorber in the APO	R: II	P – Radiation training required to access the water cage.	R: IV
	target hall.		M – Radiation Technician coverage required for water cage access M – Dosimetry as required by the relevant RWP	
Air Activation	Hazard: The 8 GeV protons interacting with the target and immediate air volume can radioactivate the air	L: A C: H R: I	 P – Interlock system preventing access to beam enclosure while beam is present. D – Enclosure and convice building keys linked to radiological and 	L: BEU C: M R: IV
	which could then migrate to accessible areas.	K: 1	 P – Enclosure and service building keys linked to radiological and controlled access training to enter enclosure P – Activated air monitor is installed in the service building. M – Air flow controlled to route air through HEPA filter and decay path to allow activation to decay before being released. 	K: IV
Soil Interactions	Hazard: Scattered beam has potential	L: A	M - Sensing equipment (chipmunks) to shut off beam if it exceeds the	L: A
	to activate soil at low levels calculated in the shield assessment.	C: N R: IV	operating parameters (defense in depth) determined by the shield assessment.	C: N R: IV
Radioactive	Hazard: Persons are exposed to	L: A	P – Radiological worker training	L: BEU
waste	ionizing radiation beyond regulatory levels	C: H R: I	 P – Any item in a beam enclosure during beam-on conditions is removed and surveyed by radiological workers and classified appropriately (typically class 0 at these facilities). P – Any item identified for disposal is surveyed and processed by Radiological Control organization personnel in accordance with FRCM chapter 4. M – Labeling required by material survey and release process. 	C: M R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Contamination	Hazard: Activated dust or debris could	L: A	P – Radiation surveys of areas before work.	L: BEU
	be ingested by worker or removed	С: Н	P – Contamination wipes taken regularly in areas of likely contamination.	C: H
	from radiation area unintentionally.	R: I	P – RWP specifies PPE	R: III
			P – training – frisking upon exit	
⁷ Be	Hazard: Potential radiation exposure	L: A	Not Applicable. No prevention or mitigation is required. ⁷ Be isn't	L: A
	to 7Be (uptake/committed dose).	C: N	hazardous in this pattern of use by facility.	C: N
		R: IV		R: IV
Non-ionizing		L:	See Section I Chapter 04	L:
Radiation		C:		C:
Hazards		R:		R:

Likelihood (L, of event)/year	Con	sequence (C, of event)/y	/ear	Risk (R, Qualitative Ra	nking)	Risk Matrix					
A = Anticipated (L > 1.0E-02)		H = High		I = situation (even	t) of major concern	Likeliho			lihood	ihood	
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (ever	nt) of concern			А	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (event) of minor concern			Н	1	1	П	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (event) of minimal concern		enc	М	Ш	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsit	e-2 (co-located worker)	Onsite-1 (facility worker)	seau	L	ш	ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	C ³ 25.0 rem		C ³ 100 rem	C ³ 100 rem	l ö					
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		N	IV	IV	IV	IV
Acronyms	L	5 rem > C		25 rem > C	25 rem > C	1					

MOI = Maximally-exposed Offsite Individual	Ν	0.5 rem > C	5 rem > C	5 rem > C	
rem = Roentgen equivalent man					

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)	
Residual	Hazard: Accelerator components can	L: A	M – Shielding to reduce activation	L: EU	
Activation	become activated from beam loss.	C: N	M – Proper dosimetry	C: L	
	Exposure to these activated	R: IV	P – Employee Rad Worker training	R: IV	
	components is possible.		P – ALARA plan		
Groundwater	Hazard: Scattered beam has potential	L: A	M – Sensing equipment (chipmunks) to shut off beam if it exceeds the	L: A	
Activation	to activate ground water at low levels	C: N	operating parameters (defense in depth) determined by the shield	C: N	
	calculated in the shield assessment.	R: IV	assessment.	R: IV	
Surface Water	Hazard: Potential exposure to	L: A	P – Beam loss monitors (in enclosures) prevent excessive beam loss.	L: U	
Activation	activated surface water due to beam	C: N	M – Shielding (soil, concrete, and/or steel) reduces surface water	C: N	
	loss leakage from beam enclosures, located under the surface water impoundment.	R: IV	activation.	R: IV	
			P – Off-site discharge limit is applied to any water mixed into onsite surface water. This prevents surface water concentrations from		
	Potential exposure to activated	L: A	approaching the Derived Concentration Standard.	L: U	
	surface water due to mixing surface water with a captured groundwater source.	C: N R: IV	 M – In situations where surface water activation is higher than expected (discovered by monitoring), facility stops operation until facility upset condition is resolved. 	C: N R: IV	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive	Hazard: RAW water system is used to	L: A	P – Locked cage containing water equipment is controlled by the RSO who	L: EU
Water (RAW)	cool the Lithium Lens, Pulsed Magnet	C: M	only grants access once radiation rates have dropped to safe levels.	C: N
Systems	and the beam absorber in the APO target hall.	R: II	 P – Radiation training required to access the water cage. M – Radiation Technician coverage required for water cage access M – Dosimetry as required by the relevant RWP M – PPE as required by the relevant RWP 	R: IV
Air Activation	Hazard: The 8 GeV protons interacting with the target and immediate air	L: A C: H	P – Interlock system preventing access to beam enclosure while beam is present.	L: BEU C: M
	volume can radioactivate the air which could then migrate to accessible areas.	R: I	 P – Enclosure and service building keys linked to radiological and controlled access training to enter enclosure P – Activated air monitor is installed in the service building. M – Air flow controlled to route air through HEPA filter and decay path to allow activation to decay before being released. 	R: IV
Soil Interactions	Hazard: Scattered beam has potential to activate soil at low levels calculated in the shield assessment.	L: A C: N R: IV	M – Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment.	L: A C: N R: IV
Radioactive waste	Hazard: Persons are exposed to ionizing radiation beyond regulatory levels	L: A C: H R: I	 P – Radiological worker training P – Any item in a beam enclosure during beam-on conditions that is removed is surveyed by radiological workers and classified appropriately. P – Any item identified for disposal is surveyed and processed by Radiological Control organization personnel in accordance with FRCM chapter 4. M – Labeling required by material survey and release process. 	L: BEU C: M R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Contamination	Hazard: Activated dust or debris could	L: A	P – Radiation surveys of areas before work.	L: BEU
	be ingested by worker or removed	С: Н	P – Contamination wipes taken regularly in areas of likely contamination.	С: Н
	from radiation area unintentionally.	R: I	P – RWP specifies PPE	R: III
			P – training – frisking upon exit	
⁷ Be	Hazard: Potential radiation exposure	L: A	Not Applicable. No prevention or mitigation is required. ⁷ Be isn't	L: A
	to 7Be (uptake/committed dose).	C: N	hazardous in this pattern of use by facility.	C: N
		R: IV		R: IV
Non-ionizing		L:	See Section I Chapter 04	L:
Radiation		C:		C:
Hazards		R:		R:

Radiological Hazard Consequences, derived from Figure	C-1, '	'Example Qualitative Cor	nseque	nce Matrix", DOE-HDB	K-1163-2020.						
Likelihood (L, of event)/year	Cor	sequence (C, of event)/y	year	Risk (R, Qualitative Ra	nking)	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 (event) of concern		_	1	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (eve	event) of minor concern		Н	1	1	Ш	Ш
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (event) of minimal concern		ienc	М	П	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	nbəş		ш	ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	н	C ³ 25.0 rem		C ³ 100 rem	C ³ 100 rem	Suc					
M = Mitigative (reduces event consequences)	м	25.0 rem > C ³ 5 rem	10	0 rem > C ³ 25 rem	100 rem > C ³ 25 rem		N	IV	IV	IV	IV
Acronyms	L	5 rem > C		25 rem > C	25 rem > C						
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	N	0.5 rem > C		5 rem > C	5 rem > C						

Table 2.3 Radiological – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual	Hazard: Accelerator components can	L: A	M – Shielding to reduce activation	L: EU
Activation	become activated from beam loss.	C: N	M – Proper dosimetry	C: L
	Exposure to these activated	R: IV	P – Employee Rad Worker training	R: IV
	components is possible.		P – ALARA plan	
Groundwater	Hazard: Scattered beam has potential	L: A	P – Public screening at Fermi site boundary	L: EU
Activation	to activate ground water at low levels	C: N	P – Facility is locked preventing unescorted access	C: N
	calculated in the shield assessment.	R: IV	 M – Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment. 	R: IV
Surface Water	Hazards: Potential exposure to	L: A	P – Beam loss monitors (in enclosures) prevent excessive beam loss.	L: U
Activation	activated surface water due to beam	C: N	M – Shielding (soil, concrete, and/or steel) reduces surface water	C: N
	loss leakage from beam enclosures, located under the surface water impoundment.	R: IV	activation.	R: IV
			 P – Off-site discharge limit is applied to any water mixed into onsite surface water. This prevents surface water concentrations from 	
	Potential exposure to activated	L: A	approaching the Derived Concentration Standard.	L: U
	surface water due to mixing surface	C: N	M – In situations where surface water activation is higher than expected	C: N
	water with a captured groundwater source.	R: IV	(discovered by monitoring), facility stops operation until facility upset condition is resolved.	R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive	Hazard: RAW water system is used to	L: A	P – Public screening at Fermi site boundary	L:BEU
Water (RAW)	cool the Lithium Lens, Pulsed Magnet	C: M	P – Facility is locked preventing unescorted access	C: N
Systems	and the beam absorber in the AP0 target hall.	R: II	 P – Locked cage containing water equipment is controlled by the RSO who only grants access once radiation rates have dropped to safe levels. P – Radiation training required to access the water cage. M – Radiation Technician coverage required for water cage access M – Dosimetry as required by the relevant RWP 	R: IV
Air Activation	<i>Hazard:</i> The 8 GeV protons interacting with the target and immediate air volume can radioactivate the air which could then migrate to accessible areas.	L: A C: H R: I	 P – Interlock system preventing access to beam enclosure while beam is present. P – Enclosure and service building keys linked to radiological and controlled access training to enter enclosure P – Activated air monitor is installed in the service building. M – Air flow controlled to route air through HEPA filter and decay path to allow activation to decay before being released. 	L: BEU C: M R: IV
Soil Interactions	<i>Hazard:</i> Scattered beam has potential to activate soil at low levels calculated in the shield assessment.	L: A C: N R: IV	 P – Public screening at Fermi site boundary M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment. 	L: U C: N R: IV
Radioactive	Hazard: persons are exposed to	L: A	P – Public screening at Fermi site boundary	L: BEU
waste	ionizing radiation beyond regulatory levels	C: H R: I	 P – Facility is locked preventing unescorted access P – Any item identified for disposal is surveyed and processed by Radiological Control organization personnel in accordance with FRCM chapter 4. M – Labeling required by material survey and release process. 	C: H R: III

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Contamination	<i>Hazard:</i> Activated dust or debris could be encountered if it were unintentionally removed from radiation area.	L: A C: H R: I	 P – Radiation surveys of areas before work. P – Contamination wipes taken regularly in areas of likely contamination. P – RWP specifies PPE P – training – frisking upon exit 	L: BEU C: H R: III
⁷ Be	Hazard: Potential radiation exposure to 7Be (uptake/committed dose).	L: BEU C: N R: IV	Not Applicable. No prevention or mitigation is required. ⁷ Be isn't hazardous in this pattern of use by facility.	L: BEU C: N R: IV
Non-ionizing Radiation Hazards	<i>Hazard:</i> Laser tracker equipment used by metrology personnel could cause eye injuries.	L: EU C: N R: IV	P – Metrology group is trained in safe use of laser tracker equipment.	L: BEU C: N R: IV

Likelihood (L, of event)/year	Cor	sequence (C, of event)/ye	ar Risk (R, Qualitative Ra	Risk (R, Qualitative Ranking)			Risk Matrix						
\mathbf{A} = Anticipated (L > 1.0E-02)		H = High	I = situation (ever	it) of major concern				Like	lihood				
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate	II = situation (eve	nt) of concern			Α	U	EU	BEL			
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low	III = situation (eve	ent) of minor concern	es	Н	1	1	Ш	III			
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (eve	ent) of minimal concern	ienc	М	П	П	Ш	IV			
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	begu	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	Cons								
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		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)
Fluorinert & Its	Hazard: Potential exposure to	L: A	Not Applicable	L: A
byproducts	Fluorinert	C: N		C: N
		R: IV		R: IV
	Potential exposure to Fluorinert decomposition products (HF, PFIB).	L: A C: H	P – Fluorinert and decomposition products are contained in a closed system.	L: EU C: L
		R: I	 P – Maintenance Program identifies and implements appropriate controls to prevent exposure if system is to be breached. M – Fluorinert handling procedures exist for workers dealing with devices containing Fluorinert. M – Enclosure circulation and ventilation fans would disperse any released Fluorinert byproducts. 	R: IV

Likelihood (L, of event)/year	Со	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	nt) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (ev	ent) of minor concern	es	Н	I	I	Ш	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	nences	М	П	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	sedr	1	ш	ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	н	C ³ PAC-2		C ³ PAC-3	C ³ IDLH	Cons					
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 _c		Ν	IV	IV	IV	IV
Acronyms	L	PAC-1 > C		PAC-2 > C	PEL or TLV _c > C						
IDLH = Immediately Dangerous to Life and Health	Ν	Consequences less	Con	sequences less than	Consequences less than						
MOI = Maximally-exposed Offsite Individual		than those for Low	those	for Low Consequence	those for Low						
PAC = Protective Action Criteria PEL = Permissible Exposure Limit		Consequence Level		Level	Consequence Level						

	TLV _c = Threshold Limit Value (ceiling)					
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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)
Fluorinert & Its	Hazard : Potential exposure to	L: U	Evaluated as non-hazardous through pattern of use.	L: U
byproducts	Fluorinert	C: N		C: N
		R: IV		R: IV
	Potential exposure to Fluorinert decomposition products (HF, PFIB).	L: U C: H	P – Fluorinert and decomposition products are contained in a closed system.	L: BEU C: L
		R: I	 P – Maintenance Program identifies and implements appropriate controls to prevent exposure if system is to be breached. M – Filtration installed to remove hazardous byproducts reduces consequences of exposure. M – Fluorinert handling procedures exist for workers dealing with devices containing Fluorinert. 	R: IV

Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	year	Risk (R, Qualitative R	anking)	Risk	Matrix	۲ <u>ــــــــــــــــــــــــــــــــــــ</u>			
A = Anticipated (L > 1.0E-02)		H = High		I = situation (even	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (eve				А	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	ll I	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	ienc	М	П	Ш	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	nbə		ш	ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	н	C ³ PAC-2		C ³ PAC-3	C ³ IDLH	Sons					
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 _c		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	Ν	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			
TLV _c = Threshold Limit Value (ceiling)			

Table 2.6 Toxic Materials – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fluorinert & Its	Hazard: Potential exposure to	L: EU	Evaluated as non-hazardous through pattern of use.	L: EU
byproducts	Fluorinert	C: N		C: N
		R: IV		R: IV
	Potential exposure to Fluorinert	L: EU	P – Access to systems containing Fluorinert is prevented.	L: BEU
	decomposition products (HF, PFIB).	С: Н	P – Fluorinert and decomposition products are contained in a closed	C: M
		R: II	system.	R: IV
			M – Filtration installed to remove hazardous byproducts reduces	
			consequences of exposure.	

Likelihood (L, of event)/year	Со	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	nt) 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	ces	Н	1	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (eve	ent) of minimal concern	duenc	М	Ш	Ш	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	nbə	1	ш	ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	н	C ³ PAC-2		C ³ PAC-3	C ³ IDLH	Cons					
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 _c	•	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 PEL = Permissible Exposure Limit TLV _c = Threshold Limit Value (ceiling)	N	Consequences less than those for Low Consequence Level		sequences less than for Low Consequence Level	Consequences less than those for Low 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		L:	See Section I Chapter 04	L:
materials		C:		C:
(cables, Boxes,		R:		R:
Paper, wood				
cribbing, etc.)				
Flammable		L:	See Section I Chapter 04	L:
Materials		C:		C:
(Flammable gas,		R:		R:
cleaning				
materials, etc.)				

Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	ear Risk (R, Qualitative Ra	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	ent) of concern			А	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low	III = situation (eve	ent) of minor concern	es	н	1	- I	П	- 111
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	ent) of minimal concern	enc	М	Ш	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	1	ш	Ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	н	C ³ Irreversible, other	C ³ Prompt worker fatality	C ³ Prompt worker fatality	Suo	-				
M = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	0	Ν	IV	IV	IV	١V
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						
	Ν	Consequences less	Consequences less than	Consequences less than						
		than those for Low 1	hose 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		L:	See Section I Chapter 04	L:
materials		C:		C:
(cables, Boxes,		R:		R:
Paper, wood				
cribbing, etc.)				
Flammable		L:	See Section I Chapter 04	L:
Materials		C:		C:
(Flammable gas,		R:		R:
cleaning				
materials, etc.)				

Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	ear Risk (R, Qualitative R	anking)	Risk I	Matrix				
A = Anticipated (L > 1.0E-02)		H = High	I = situation (even	I = situation (event) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate	II = situation (eve	II = situation (event) 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	Ι	Ш	- 111
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		ent) of minimal concern	enc	М	Π	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	nbə	1	ш	Ш	IV	IV
 P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) 	н	C ³ Irreversible, other serious effects, or	C ³ Prompt worker fatality or acute injury that is	C ³ Prompt worker fatality or acute injury that is	Consequences	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	permanentiy disabiling.	permanentiy disabiling.						
		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						
	Ν	Consequences less	Consequences less than	Consequences less than						
		than those for Low	hose 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.)				
Flammable		L:	See Section I Chapter 04	L:
Materials		C:		C:
(Flammable gas,		R:		R:
cleaning				
materials, etc.)				

Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	ear Risk (R, Qualitative Ra	anking)	Risk	Matrix				
A = Anticipated (L > 1.0E-02)		H = High	I = situation (ever	I = situation (event) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate	II = situation (eve	II = situation (event) of concern			А	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low	III = situation (eve	ent) of minor concern	sa	н	1	- I	П	- 111
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	ent) of minimal concern	enc	М	Ш	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	1	ш	Ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	н	C ³ Irreversible, other	C ³ Prompt worker fatality	C ³ Prompt worker fatality	Suo	-				
M = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	0	Ν	IV	IV	IV	١V
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.						
		Mild, transient	Minor injuries; no	Minor injuries; no						
		adverse effects > C	hospitalization > C	hospitalization > C						
	Ν	Consequences less	Consequences less than	Consequences less than						
		than those for Low t	hose for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

Table 2.10 Electrical Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Stored Energy		L:	See Section I Chapter 04	L:
Exposure		C:		C:
		R:		R:
High Voltage		L:	See Section I Chapter 04	L:
Exposure		C:		C:
-		R:		R:

Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	/ear	Risk (R, Qualitative Ra	anking)	Risk	Matrix	K			
A = Anticipated (L > 1.0E-02)		H = High		I = situation (event) of major concern					Like	lihood	T
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (eve	nt) of concern		1	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (eve	ent) of minor concern	ces	Н	I.	I.	П	Ш
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	enc	М	П	П	Ш	IV
Control(s) Type	С	C ³ Irreversible, other C ³ Prompt worker fatality		Onsite-1 (facility worker)	Consequen	L	ш	ш	IV	IV	
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	н			• •	C ³ Prompt worker fatality	Con	N	IV	IV	IV	IV
 M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual 		serious effects, or symptoms which could impair an individual's ability to take protective action.	ir	acute injury that is mmediately life- threatening or manently disabling.	or acute injury that is immediately life- threatening or permanently disabling.		1		I		
		C ³ Mild, transient adverse effects.	imme perr	Serious injury, no ediate loss of life no manent disabilities; italization required.	C ³ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.						
	L	Mild, transient adverse effects > C		1inor injuries; no ospitalization > C	Minor injuries; no hospitalization > C						

Ν	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 2.11 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		L:	See Section I Chapter 04	L:
Exposure		C:		C:
		R:		R:
High Voltage		L:	See Section I Chapter 04	L:
Exposure		C:		C:
		R:		R:

Other Hazard Consequences, derived from Figure C-1, "	Exan	npie Qualitative Consequ	ience N	/latrix", DOE-HDBK-116	3-2020.						
Likelihood (L, of event)/year	Co	onsequence (C, of event),	/year	Risk (R, Qualitative Ranking)			Matrix	د <u></u>			
A = Anticipated (L > 1.0E-02)		H = High		I = situation (even	nt) 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		III = situation (ev	ent) of minor concern	es	Н	I	I	П	Ш
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	lenc	м	Ш	П	Ш	IV
Control(s) Type	С	Offsite (MOI) Onsite-2 (e-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	L	ш	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	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.	Cons	N	IV	IV	IV	IV
	М	C ³ Mild, transient adverse effects.	imm per	³ Serious injury, no nediate loss of life no manent disabilities; pitalization 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
Ν	1	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 2.12 Electrical Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Stored Energy		L:	See Section I Chapter 04	L:
Exposure		C:		C:
		R:		R:
High Voltage		L:	See Section I Chapter 04	L:
Exposure		C:		C:
		R:		R:

Other Hazard Consequences, derived from Figure C-1, "	Exan	nple Qualitative Conseque	ence N	latrix", DOE-HDBK-116	3-2020.						
Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	/ear	Risk (R, Qualitative R	anking)	Risk	Matri	ĸ			
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			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	I	П	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	edneuc	М	П	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Offsite (MOI) Onsite-2 (co-located w		Onsite-1 (facility worker)		L	Ш	ш	IV	IV
 P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) 	н			ompt worker fatality acute injury that is	C ³ Prompt worker fatality or acute injury that is	Conse	N	IV	IV	IV	IV
Acronyms MOI = Maximally-exposed Offsite Individual		symptoms which could impair an	i	mmediately life- threatening or	immediately life- threatening or						
		individual's ability to take protective action.	per	manently disabling.	permanently disabling.						
	м	C ³ Mild, transient	C ³	³ Serious injury, no	C ³ Serious injury, no						
		adverse effects.	imm	ediate loss of life no	immediate loss of life no						
			peri	manent disabilities;	permanent disabilities;						
			hosp	italization required.	hospitalization required.						
	L	Mild, transient	Ν	/linor injuries; no	Minor injuries; no						
		adverse effects > C	h	ospitalization > C	hospitalization > C						

Ν	Ν	Consequences less	Consequences less than	Consequences less than	
		than those for Low	those for Low Consequence	those for Low	
		Consequence Level	Level	Consequence Level	

Table 2.13 Thermal Energy – Onsite-1 Facility Worker

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

Other Hazard Consequences, derived from Figure C-1, "I	Exan	nple Qualitative Consequer	ence Mat	trix", DOE-HDBK-116	3-2020.							
Likelihood (L, of event)/year	Co	onsequence (C, of event)/ye	/ear R	Risk (R, Qualitative Ranking)			Matri	x				
A = Anticipated (L > 1.0E-02)		H = High		I = situation (event) of major concern					Likelihood			
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (eve	ent) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (eve	ent) of minor concern	es.	Н	1	I.	П	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	enc	М	П	П	Ш	IV	
Control(s) Type	С	Offsite (MOI)	Onsite-2	(co-located worker)	Onsite-1 (facility worker)	Consequences	L	ш	ш	IV	IV	
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Pron	mpt worker fatality	C ³ Prompt worker fatality	l log	<u> </u>					
M = Mitigative (reduces event consequences)		serious effects, or	or act	ute injury that is	or acute injury that is		Ν	IV	IV	IV	IV	
Acronyms		symptoms which	imr	mediately life-	immediately life-							
MOI = Maximally-exposed Offsite Individual		could impair an	th	nreatening or	threatening or							
		individual's ability to	perma	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	liate loss of life no	immediate loss of life no							
			perma	anent disabilities;	permanent disabilities;							
			hospita	alization required.	hospitalization required.							
	L	Mild, transient	Min	nor injuries; no	Minor injuries; no	1						
		adverse effects > C	hos	pitalization > C	hospitalization > C							

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

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

Other Hazard Consequences, derived from Figure C-1, "I	Exam	nple Qualitative Consequ	uence Ma	atrix", DOE-HDBK-116	3-2020.							
Likelihood (L, of event)/year	Со	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					Likelihood			
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (eve	ent) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (ev	ent) of minor concern	se	Н	1	I	ll –	Ш	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	ienc	М	Ш	П	Ш	IV	
Control(s) Type	С	Offsite (MOI)	Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	Consequences	L	ш	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	Con						
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	1	threatening or	threatening or							
		individual's ability to	pern	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							
			pern	nanent disabilities;	permanent disabilities;							
			hospi	italization required.	hospitalization required.							
	L	Mild, transient	Μ	linor injuries; no	Minor injuries; no							
		adverse effects > C	hc	ospitalization > C	hospitalization > C							
	Ν	Consequences less	Cons	equences less than	Consequences less than							
		than those for Low	those f	for Low Consequence	those for Low							
		Consequence Level		Level	Consequence Level							

Table 2.15 Thermal Energy – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-1, "I	Exan	nple Qualitative Conseque	ence Matrix", DOE-HDBK-116	3-2020.						
Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	year Risk (R, Qualitative R	anking)	Risk	Matrix	(
A = Anticipated (L > 1.0E-02)		H = High	I = situation (eve	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			A	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	ll –	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	ent) of minimal concern	ienc	М	Ш	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	L	ш	ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Prompt worker fatality	C ³ Prompt worker fatality	Con					
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						
	Ν	Consequences less	Consequences less than	Consequences less than						
		than those for Low	those for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

Table 2.16 Kinetic Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power tools		L: C: R:	See Section I Chapter 04	L: C: R:
Pumps and Motors		L: C: R:	See Section I Chapter 04	L: C: R:
Motion Tables		L: C: R:	See Section I Chapter 04	L: C: R:
Mobile Shielding		L: C: R:	See Section I Chapter 04	L: C: R:

Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	ear Risk (R, Qualitative R	anking)	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			А	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	П	- 111
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	ent) of minimal concern	enc	М	Ш	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	1	ш	Ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	н	C ³ Irreversible, other	C ³ Prompt worker fatality	C ³ Prompt worker fatality	Suos	-				
M = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	0	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						
	Ν	Consequences less	Consequences less than	Consequences less than						
		than those for Low 1	hose for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

Table 2.17 Kinetic Energy – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power tools		L: C: R:	See Section I Chapter 04	L: C: R:
Pumps and Motors		L: C: R:	See Section I Chapter 04	L: C: R:
Motion Tables		L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "		ipie Quantative Conseque		55-2020.						
Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	ear Risk (R, Qualitative R	anking)	Risk	Matri	ĸ			
A = Anticipated (L > 1.0E-02)		H = High	I = situation (eve	I = situation (event) of major concern					lihood	
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate	II = situation (eve	ent) of concern		r	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	vent) of minimal concern	E S	М	П	П	- 111	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Conseque	L	Ш	Ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	н	C ³ Irreversible, other	C ³ Prompt worker fatality	C ³ Prompt worker fatality	Con					
M = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is		Ν	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						

Table 2.18 Kinetic Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power tools		L:	See Section I Chapter 04	L:
FOWER LOOIS		C:		C:
		R:		R:
Pumps and		L:	See Section I Chapter 04	L:
Motors		C:		C:
		R:		R:
Motion Tables		L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:

Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	ear Risk (R, Qualitative R	anking)	Risk	Matrix	۲ <u>ــــــــــــــــــــــــــــــــــــ</u>			
A = Anticipated (L > 1.0E-02)		H = High	I = situation (eve	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	III = situation (ev	ent) of minor concern	ces	Н	1	- I	II	- 111
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	ent) of minimal concern		М	Ш	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequen	L	Ш	ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Prompt worker fatality	C ³ Prompt worker fatality	Con					
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						

Table 2.19 Potential Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane		L:	See Section I Chapter 04	L:
Operations		C:		C:
		R:		R:
Compressed		L:	See Section I Chapter 04	L:
Gasses		C:		C:
		R:		R:
Vacuum/		L:	See Section I Chapter 04	L:
Pressure Vessels		C:		C:
		R:		R:
Vacuum Pumps		L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:
Material		L:	See Section I Chapter 04	L:
Handling		C:		C:
-		R:		R:

Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	ear Risk (R, Qualitative R	anking)	Risk	Risk Matrix					
A = Anticipated (L > 1.0E-02)		H = High	I = situation (even	nt) of major concern				Like	lihood		
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate	II = situation (eve	II = situation (event) of concern			А	U	EU	BE	
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low	III = situation (ev	ent) of minor concern	es	Н	1	Ι	Ш	- 111	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		ent) of minimal concern	enc	М	Π	П	Ш	IV	
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	1	ш	Ш	IV	IV	
P = Preventive (reduce event occurrence likelihood)	н	C ³ Irreversible, other	C ³ Prompt worker fatality	C ³ Prompt worker fatality	Consequences	N	IV	IV	IV	IV	
M = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is		IN	IV	IV	IV	IV	
Acronyms		symptoms which	immediately life-	immediately life-							
MOI = Maximally-exposed Offsite Individual	mally-exposed Offsite Individual could impa			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							
	1	adverse effects > C	hospitalization > C	hospitalization > C							
	Ν	Consequences less	Consequences less than	Consequences less than							
	1	than those for Low	hose for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

Table 2.20 Potential Energy – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane		L:	See Section I Chapter 04	L:
Operations		C:		C:
		R:		R:
Compressed		L:	See Section I Chapter 04	L:
Gasses		C:		C:
		R:		R:
Vacuum/		L:	See Section I Chapter 04	L:
Pressure Vessels		C:		C:
		R:		R:
Vacuum Pumps		L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:
Material		L:	See Section I Chapter 04	L:
Handling		C:		C:
-		R:		R:

Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	ear Risk (R, Qualitative R	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	II = situation (event) of concern			А	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low	III = situation (ev	III = situation (event) of minor concern		н	1	- I	П	- 111
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	IV = situation (event) of minimal concern		М	Ш	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	1	ш	Ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	н	C ³ Irreversible, other	C ³ Prompt worker fatality	C ³ Prompt worker fatality	Suo	-				
M = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	0	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						
	Ν	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 2.21 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:
Compressed		L:	See Section I Chapter 04	L:
Gasses		C:		C:
		R:		R:
Vacuum/		L:	See Section I Chapter 04	L:
Pressure Vessels		C:		C:
		R:		R:
Vacuum Pumps		L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:
Material		L:	See Section I Chapter 04	L:
Handling		C:		C:
		R:		R:

Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	ear Risk (R, Qualitative R	anking)	Risk	Risk Matrix					
A = Anticipated (L > 1.0E-02)		H = High	I = situation (even	nt) of major concern				Like	lihood		
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate	II = situation (eve	II = situation (event) of concern			А	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low	III = situation (ev	(event) of minor concern		Н	1	Ι	Ш	- 111	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		ent) of minimal concern	enc	М	Ш	П	Ш	IV	
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	1	ш	Ш	IV	IV	
 P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) 	н	serious effects, or	C ³ Prompt worker fatality or acute injury that is	C ³ Prompt worker fatality or acute injury that is	Consequences	N	IV	IV	IV	IV	
Acronyms MOI = Maximally-exposed Offsite Individual		symptoms which could impair an	immediately life- threatening or	immediately life- threatening or							
		individual's ability to take protective action.	permanently disabling.	permanently disabling.							
	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							
	Ν	Consequences less	Consequences less than	Consequences less than							
		than those for Low 1	hose for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

Table 2.22 Magnetic Fields – Onsite-1 Facility Worker

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

Other Hazard Consequences, derived from Figure C-1, "	Exan	nple Qualitative Consequ	uence Ma	atrix", DOE-HDBK-116	3-2020.						
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 (even	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (event) of concern				A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low		III = situation (ev	ent) of minor concern	es	Н	1	I	II	Ш
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	enc	М	П	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Offsite (MOI) Onsite-2 (c		Onsite-1 (facility worker)	Consequences	1	ш	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		cute injury that is	or acute injury that is	Ŭ	Ν	IV	IV	IV	IV
Acronyms		symptoms which		nmediately life-	immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	t	hreatening or	threatening or						
		individual's ability to			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	Mi	inor injuries; no	Minor injuries; no						
				spitalization > C	hospitalization > C						
	Ν			equences less than	Consequences less than						
		than those for Low	those fo	or Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 2.23 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		L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:

Other Hazard Consequences, derived from Figure C-1, "	Exan	nple Qualitative Consequ	uence Ma	atrix", DOE-HDBK-116	3-2020.						
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 (even	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate		II = situation (eve	ent) of concern			A	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	II	Ш
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ent) of minimal concern	enc	М	П	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	Consequences	1	ш	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		cute injury that is	or acute injury that is	Ŭ	Ν	IV	IV	IV	IV
Acronyms		symptoms which		nmediately life-	immediately life-						
MOI = Maximally-exposed Offsite Individual		could impair an	t	hreatening 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	Mi	inor injuries; no	Minor injuries; no						
		adverse effects > C	hos	spitalization > C	hospitalization > C						
	Ν	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 2.24 Magnetic Fields – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-1, "I	Exan	nple Qualitative Conseque	ence Matrix", DOE-HDBK-11	63-2020.						
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	ent) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate	II = situation (ev	vent) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low	III = situation (e	vent) of minor concern	es	Н	1	1	ll –	Ш
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (e	vent) of minimal concern	enc	М	П	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	1	ш	ш	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	-	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						
	Ν	Consequences less	Consequences less than	Consequences less than						
		than those for Low	those for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

Table 2.25 Other hazards – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces		L: C: R:	See Section I Chapter 04	L: C: R:
Noise		L: C: R:	See Section I Chapter 04	L: C: R:
Silica		L: C: R:	See Section I Chapter 04	L: C: R:
Ergonomics		L: C: R:	See Section I Chapter 04	L: C: R:
Working at heights		L: C: R:	See Section I Chapter 04	L: C: R:
Lithium	Hazard: Lithium is used in the focusing lens in the APO target station. Lithium itself is reactive and flammable. Contact with moisture produces lithium hydroxide which is caustic.	L: A C: H R: I	 P – The lithium in the lens is completely encased and there are conductivity interlocks that are an early indicator of a containment breach. P – Spare lithium is kept in an oil container to avoid contact with air or moisture. P – The container for spare lithium is kept in a flammable material cabinet in the APO service building. M – A fire extinguisher suitable for lithium is maintained in APO M – The Fermilab fire department is trained on the lithium hazard at APO and the response to an incident. 	L: BEU C: L R: IV

Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	ear 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	nt) of concern			А	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low	III = situation (eve	ent) of minor concern	sa	н	1	I.	П	- 111
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	ent) of minimal concern	enc	М	Ш	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	1	ш	Ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	н	C ³ Irreversible, other	C ³ Prompt worker fatality	C ³ Prompt worker fatality	Suo	-				
M = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	U	N	IV	IV	IV	١V
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						
	Ν	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 2.26 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		L: C: R:	See Section I Chapter 04	L: C: R:
Noise		L: C: R:	See Section I Chapter 04	L: C: R:
Silica		L: C: R:	See Section I Chapter 04	L: C: R:
Ergonomics		L: C: R:	See Section I Chapter 04	L: C: R:
Working at heights		L: C: R:	See Section I Chapter 04	L: C: R:
Lithium	Hazard: Lithium is used in the focusing lens in the APO target station. Lithium itself is reactive and flammable. Contact with moisture produces lithium hydroxide which is caustic.	L: A C: H R: I	 P – The lithium in the lens is completely encased and there are conductivity interlocks that are an early indicator of a containment breach. P – Spare lithium is kept in an oil container to avoid contact with air or moisture. P – The container for spare lithium is kept in a flammable material cabinet in the APO service building. M – A fire extinguisher suitable for lithium is maintained in APO M – The Fermilab fire department is trained on the lithium hazard at APO and the response to an incident. 	L: BEU C: L R: IV

Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	ear 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			А	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low	III = situation (eve	ent) of minor concern	es	н	1	- I	П	- 111
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	ent) of minimal concern	enc	М	Ш	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	1	ш	Ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	н	C ³ Irreversible, other	C ³ Prompt worker fatality	C ³ Prompt worker fatality	Suo	-				
M = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	0	Ν	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						
	Ν	Consequences less	Consequences less than	Consequences less than						
		than those for Low 1	hose for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

Table 2.27 Other hazards – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces		L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:
Noise		L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:
Silica		L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:
Ergonomics		L:	See Section I Chapter 04	L:
-		C:		C:
		R:		R:
Working at		L:	See Section I Chapter 04	L:
heights		C:		C:
-		R:		R:
Lithium	Hazard: Lithium is used in the	L: A	P – Lithium is confined to the APO target service building which is away	L: BEU
	focusing lens in the APO target	С: Н	from any publicly accessible area.	C: L
	station. Lithium itself is reactive and	R: I	P – The lithium in the lens is completely encased and there are	R: IV
	flammable. Contact with moisture		conductivity interlocks that are an early indicator of a containment	
	produces lithium hydroxide which is		breach.	
	caustic.		P – Spare lithium is kept in an oil container to avoid contact with air or	
			moisture.	
			P – The container for spare lithium is kept in a flammable material cabinet	
			in the APO service building.	
			M – A fire extinguisher suitable for lithium is maintained in APO	

	M – The Fermilab fire department is trained on the lithium hazard at APO and the response to an incident.	
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Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	ear Risk (R, Qualitative R	anking)	Risk	Matrix				
A = Anticipated (L > 1.0E-02)		H = High	I = situation (even	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate	II = situation (eve	ent) of concern			А	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.	П	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	ent) of minimal concern	enc	М	П	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Insite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	1	ш	ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	C ³ Irreversible, other	C ³ Prompt worker fatality	C ³ Prompt worker fatality	Suo	_				
M = Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	0	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						
	Ν	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 2.28 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		L:	See Section I Chapter 04	L:
Egress		C:		C:
_		R:		R:

Other Hazard Consequences, derived from Figure C-1, "I	Exan	nple Qualitative Conseque	ence 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 (eve	I = situation (event) of major concern				Like	lihood	
U = Unlikely (1.0E-02> L >1.0E-04)		M = 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	ses	Н	1	I.	II	Ш
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (e	vent) of minimal concern	lenc	М	Ш	П	Ш	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	L	ш	ш	IV	IV
P = Preventive (reduce event occurrence likelihood)	н	C ³ Irreversible, other	C ³ Prompt worker fatality	C ³ Prompt worker fatality	Con					
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						
	Ν	Consequences less	Consequences less than	Consequences less than						
		than those for Low	those for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

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

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

Other Hazard Consequences, derived from Figure C-1, "	Exan	nple Qualitative Conseque	nce Matrix", DOE-HDBK-116	3-2020.							
Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	ear Risk (R, Qualitative R	anking)	Risk Matrix						
A = Anticipated (L > 1.0E-02)		H = High	I = situation (even	I = situation (event) of major concern				Likelihood			
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate	II = situation (eve	II = situation (event) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)		L = Low	III = situation (even	ent) of minor concern	es	Н	1	1	ll I	Ш	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	ent) of minimal concern	iences	М	П	Ш	Ш	IV	
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Conseque	L	ш	ш	IV	IV	
P = Preventive (reduce event occurrence likelihood)	н	C ³ Irreversible, other	C ³ Prompt worker fatality	C ³ Prompt worker fatality	Ö						
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							
	Ν	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 2.30 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, "I	Exan	nple Qualitative Conseque	ence Matrix", DOE-HDBK-11	53-2020.							
Likelihood (L, of event)/year	Со	onsequence (C, of event)/	year Risk (R, Qualitative R	anking)	Risk Matrix						
A = Anticipated (L > 1.0E-02)	H = High		I = situation (eve	I = situation (event) of major concern				Likelihood			
U = Unlikely (1.0E-02> L >1.0E-04)		M = Moderate	II = situation (ev	II = situation (event) of concern			А	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	П	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	enc	М	Ш	П	Ш	IV	
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	1	ш	ш	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	•	Ν	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							
	Ν	Consequences less	Consequences less than	Consequences less than							
		than those for Low	those for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

Table 2.31 Environmental

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Airborne		L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:
<u>Water</u>		L:	See Section I Chapter 04	L:
		C:		C:
		R:		R:
Soil		L:	See Section I Chapter 04	L:
		C:		C:
		R:		R: