Table 11. Summary of Baseline and Residual Risks Main Injector / Recycler

	Risk Tables Description	Baseline Risk	Residual Risk
11.1	Radiological – Onsite-1 Facility Worker	R: I*	R: IV, *
11.2	Radiological – Onsite-2 Co-located Worker	R: I*	R: IV, *
11.3	Radiological – MOI Offsite	R: NA*	R: NA, *
11.4	Toxic Materials – Onsite 1 Facility Worker	R: *	R: *
11.5	Toxic Materials – Onsite 2 Co-located Worker	R: *	R: *
11.6	Toxic Materials – MOI Offsite	R:NA *	R: NA*
11.7	Flammable & Combustible Materials – Onsite-1 Facility Worker	R: *	R: *
11.8	Flammable & Combustible Materials – Onsite-2 Co-located worker	R: *	R: *
11.9	Flammable & Combustible Materials – MOI Offsite	R: NA*	R: NA*
11.10	Electrical Energy – Onsite-1 Facility Worker	R: *	R: *
11.11	Electrical Energy – Onsite-2 Co-located Worker	R: *	R: *
11.12	Electrical Energy – MOI Offsite	R: NA*	R: NA*
11.13	Thermal Energy – Onsite-1 Facility Worker	R: *	R: *
11.14	Thermal Energy – Onsite-2 Co-located Worker	R: *	R: *
11.15	Thermal Energy – MOI Offsite	R: NA*	R: NA*
11.16	Kinetic Energy – Onsite-1 Facility Worker	R: *	R: *
11.17	Kinetic Energy – Onsite-2 Co-located Worker	R: *	R: *
11.18	Kinetic Energy – MOI Offsite	R: NA*	R: NA*
11.19	Potential Energy- Onsite-1 Facility Worker	R: *	R: *
11.20	Potential Energy – Onsite-2 Co-located Worker	R: *	R: *
11.21	Potential Energy – MOI Offsite	R: NA*	R: NA*
11.22	Magnetic Fields – Onsite-1 Facility Worker	R: *	R: *
11.23	Magnetic Fields – Onsite-2 Co-located Worker	R: *	R: *
11.24	Magnetic Fields – MOI Offsite	R: NA*	R: NA*
11.25	Other Hazards – Onsite-1 Facility Worker	R: *	R: *
11.26	Other Hazards – Onsite-2 Co-located Worker	R: *	R: *
11.27	Other Hazards – MOI Offsite	R: NA*	R: NA*
11.28	Access & Egress – Onsite-1 Facility Worker	R: *	R: *
11.29	Access & Egress – Onsite-2 Co-located Worker	R: *	R: *
11.30	Access & Egress – MOI Offsite	R: NA*	R: NA*
11.31	Environmental Hazards	R: *	R: *
*	accord has been evaluated within the common Disk Matrix table inclu	dad: - CAD C	

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

NOTE:

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

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

specific hazards are identified as Credited Controls and further summarized in the Accelerator Safety Envelope (ASE).

Table 11.1 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: exposure to residual activation	L: A C: H R: I	 P – Locked Gates: Barriers to entrances of areas that contain radioactive material. Keys are required to open these gates. P – Key Control Program: A program that checks the worker's training prior to issuing them a key to the accelerator enclosure. Also keeps track of worker accountability. P – Radiological Work Permit: A permit written by Safety that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure. P – Postings: Signs located in various places throughout the accelerator warning of various hazards and occupancy restrictions. P – Training: An educational system managed by ES&H that establishes basic worker knowledge through presentations and testing. P – Beam Loss Monitoring: Electronic Beam Loss Monitors are used to convert radiation created by prompt dose due to beam loss into electrical signals. This information is then made available to the accelerator control system where the data can be logged and monitored with alarms and limits. Losses can be reduced or eliminated with adjustment to the accelerators to prevent activation of tunnel components. M – Machine Protection System: An accelerator system that monitors devices such as beam loss monitors, power supplies, vacuum valves, etc. If these devices are not within their specified limits, the beam is aborted and further injections into the accelerator are inhibited until the system is reset by an operator. M – Local Component Shielding: Material placed between the local component and the area to be protected. The material is used to attenuate the radiation flux by a factor related to the radiation length of the material. 	L: BEU C: N R: IV

			M – Run Conditions: Operating parameters that reduce residual activation by limiting the total amount of beam that could be delivered.	
Groundwater Activation	Hazard: radionuclides in ground water exceed regulatory levels	L: C: R:	See section I Chapter IV	L: C: R:
Surface Water Activation	Hazard: radionuclides in surface water exceed regulatory levels	L: C: R:	See section I Chapter IV	L: C: R:

Radioactive	Hazard: Exposure to activated water	L: A	P – Locked Gates: Barriers to entrances of areas that contain radioactive	L: BEU
Water (RAW)		C: H	material. Keys are required to open these gates.	C: L
Systems		R: I	 P – Key Control Program: A program that checks the worker's training prior to issuing them a key to the accelerator enclosure. Also keeps track of worker accountability. P – Radiological Work Permit: A permit written by Safety that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure P – Postings: Signs located in various places throughout the accelerator warning of various hazards and occupancy restrictions. P – Training: An educational system managed by ES&H that establishes basic worker knowledge through presentations and testing. M – Volume Monitoring: Reservoir of closed loop water is monitored for the total volume. When a leak occurs in this closed loop system, the 	R: IV
			system will report an alarm and shut down if the volume becomes too low. M – Engineered Containment: Containment in the area around the RAW system to prevent the RAW from spreading in the case of a leak.	
Air Activation	Hazard: radionuclides in air exceed	L: A	P – Air Monitoring: Air sampled from the enclosure for activation	L: EU
	regulatory levels	C: H R: I	 M – Run Conditions: Operating parameters that reduce residual activation by limiting the total amount of beam that could be delivered. P – Beam loss Monitoring: Electronic Beam Loss Monitors are used to convert radiation created by prompt dose due to beam loss into electrical signals. This information is then made available to the accelerator control system where the data can be logged and monitored with alarms and limits. Losses can be reduced or eliminated with adjustment to the accelerators to prevent activation of tunnel components. M – Machine Protection System: An accelerator system that monitors devices such as beam loss monitors, power supplies, vacuum valves, etc. If these devices are not within their specified limits, the beam is aborted and further injections into the accelerator are inhibited until the system is reset by an operator. M – Engineered Air Flow: Enclosure air flow design to give the activated 	C: N R: IV

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Soil Interactions	Hazard: radionuclides are produced	L: A	P – Beam Loss Monitoring: Electronic Beam Loss Monitors are used to	L: U
	which may contaminate ground water	C: H	convert radiation created by prompt dose due to beam loss into	C: N
		R: I	electrical signals. This information is then made available to the	R: IV
			accelerator control system where the data can be logged and	
			monitored with alarms and limits. Losses can be reduced or	
			eliminated with adjustment to the accelerators to prevent activation of	
			tunnel components.	
			M – Machine Protection System: An accelerator system that monitors	
			devices such as beam loss monitors, power supplies, vacuum valves,	
			etc. If these devices are not within their specified limits, the beam is	
			aborted and further injections into the accelerator are inhibited until	
			the system is reset by an operator.	
			M – Engineered Beam Dump: Design of a beam absorber that minimizes	
			the radiological leakage through the used of shielding.	
			M – Beamline Design: Design of beamline optics to ensure that the actual	
			beam size is smaller than the beam pipe to prevent scraping, beam	
			loss, prompt dose, and residual activation.	
			M – Run Conditions: Operating parameters that reduce residual activation	
			by limiting the total amount of beam that could be delivered	
Radioactive	Hazard: persons are exposed to	L: A	P – Locked Gates: Barriers to entrances of areas that contain radioactive	L: BEU
waste	ionizing radiation beyond regulatory	C: H	material. Keys are required to open these gates.	C: N
	levels	R: I	P – Key Control Program: A program that checks the worker's training	R: IV
			prior to issuing them a key to the accelerator enclosure. Also keeps	
			track of worker accountability.	
			P – Postings: Signs located in various places throughout the accelerator	
			warning of various hazards and occupancy restrictions	
			M – Run Conditions: Operating parameters that reduce residual activation	
			by limiting the total amount of beam that could be delivered.	
			M – Distance to Stored Material: Barriers, such as ropes, that are used to	
			increase the distance between the activated material and personnel.	
			M – Material survey and release process	

Contamination	Hazard: persons are exposed to	L: A	P – Locked Gates: Barriers to entrances of areas that contain radioactive	L:EU
	ionizing radiation beyond regulatory	C: H	material. Keys are required to open these gates.	C: L
	levels	R: I	 P – Key Control Program: A program that checks the worker's training prior to issuing them a key to the accelerator enclosure. Also keeps track of worker accountability. M – Radiological Work Permit: A permit written by Safety that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure. M – Training: An educational system managed by ES&H that establishes basic worker knowledge through presentations and testing. 	R: IV
⁷ Be	Hazard: Potential radiation exposure to 7Be (uptake/committed dose).	L: A 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: A C: N R: IV
Non-ionizing Radiation Hazards	Hazard: Exposure to high power RF and Lasers	L: C: R:	See section I Chapter IV Class 1 and 2 lasers only	L: C: R:

Radiological Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year Consequence (C, of event)/year		year	Risk (R, Qualitative R	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 (even)	nt) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		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		ences	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsi	te-2 (co-located worker)	Onsite-1 (facility worker)	edn		777	TTT	IV	IV	
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ 25.0 rem		C ≥ 100 rem	C ≥ 100 rem	ons	L	III	III	IV	IV	
M = Mitigative (reduces event consequences)	M	$25.0 \text{ rem} > \mathbf{C} \ge 5 \text{ rem}$	10	00 rem > C ≥ 25 rem	100 rem > C ≥ 25 rem		N	IV	IV	IV	IV	
Acronyms	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 11.2 Radiological – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual activation	Hazard: exposure to residual activation	L: A C: H R: I	 P – Locked Gates: Barriers to entrances of areas that contain radioactive material. Keys are required to open these gates. P – Key Control Program: A program that checks the worker's training prior to issuing them a key to the accelerator enclosure. Also keeps track of worker accountability. P – Radiological Work Permit: A permit written by Safety that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure. P – Postings: Signs located in various places throughout the accelerator warning of various hazards and occupancy restrictions. P – Training: An educational system managed by ES&H that establishes basic worker knowledge through presentations and testing. P – Beam Loss Monitoring: Electronic Beam Loss Monitors are used to convert radiation created by prompt dose due to beam loss into electrical signals. This information is then made available to the accelerator control system where the data can be logged and monitored with alarms and limits. Losses can be reduced or eliminated with adjustment to the accelerators to prevent activation of tunnel components. M – Machine Protection System: An accelerator system that monitors devices such as beam loss monitors, power supplies, vacuum valves, etc. If these devices are not within their specified limits, the beam is aborted and further injections into the accelerator are inhibited until the system is reset by an operator. M – Local Component Shielding: Material placed between the local component and the area to be protected. The material is used to attenuate the radiation flux by a factor related to the radiation length of the material. 	L: BEU C: N R: IV

			M – Run Conditions: Operating parameters that reduce residual activation by limiting the total amount of beam that could be delivered.	
Groundwater Activation	Hazard: radionuclides in ground water exceed regulatory levels	L: C: R:	See section I Chapter IV	L: C: R:
Surface Water Activation	Hazard: radionuclides in surface water exceed regulatory levels	L: C: R:	See section I Chapter IV	L: C: R:
Radioactive Water (RAW) Systems	Hazard: Exposure to activated water	L: A C: H R: I	 P – Locked Gates: Barriers to entrances of areas that contain radioactive material. Keys are required to open these gates. P – Key Control Program: A program that checks the worker's training prior to issuing them a key to the accelerator enclosure. Also keeps track of worker accountability. P – Radiological Work Permit: A permit written by Safety that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure P – Postings: Signs located in various places throughout the accelerator warning of various hazards and occupancy restrictions. P – Training: An educational system managed by ES&H that establishes basic worker knowledge through presentations and testing. M – Volume Monitoring: Reservoir of closed loop water is monitored for the total volume. When a leak occurs in this closed loop system, the system will report an alarm and shut down if the volume becomes too low. M – Engineered Containment: Containment in the area around the RAW system to prevent the RAW from spreading in the case of a leak 	L: BEU C: L R: IV
Air Activation	Hazard: radionuclides in air exceed regulatory levels	L: A C: H R: I	P – Air Monitoring: Air sampled from the enclosure for activation M – Run Conditions: Operating parameters that reduce residual activation by limiting the total amount of beam that could be delivered. P – Beam Loss Monitoring: Electronic Beam Loss Monitors are used to convert radiation created by prompt dose due to beam loss. This information is then made available to the accelerator control system where the data can be logged and monitored with alarms and limits.	L: EU C: N R: IV

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			Losses can be reduced or eliminated whit adjustment to the	
			accelerators to prevent activation of tunnel components.	
			M – Machine Protection System: An accelerator system that monitors	
			devices such as beam loss monitors, power supplies, vacuum valves,	
			etc. If these devices are not within their specified limits, the beam is	
			aborted and further injections into the accelerator are inhibited until	
			the system is reset by an operator.	
			M – Engineered Air Flow: Enclosure air flow design to give the activated	
			air time to decay before exiting the enclosure.	
Soil Interactions	Hazard: radionuclides are produced	L: A	P – Beam Loss Monitoring: Electronic Beam Loss Monitors are used to	L: U
	which may contaminate ground water	C: H	convert radiation created by prompt dose due to beam loss. This	C: N
	_	R: I	information is then made available to the accelerator control system	R: IV
			where the data can be logged and monitored with alarms and limits.	
			Losses can be reduced or eliminated whit adjustment to the	
			accelerators to prevent activation of tunnel components.	
			M – Machine Protection System: : An accelerator system that monitors	
			devices such as beam loss monitors, power supplies, vacuum valves,	
			etc. If these devices are not within their specified limits, the beam is	
			aborted and further injections into the accelerator are inhibited until	
			the system is reset by an operator.	
			M – Engineered Beam Dump: Design of a beam absorber that minimizes	
			the radiological leakage through the used of shielding.	
			M – Beamline Design: Design of beamline optics to ensure that the actual	
			beam size is smaller than the beam pipe to prevent scraping, beam	
			loss, prompt dose, and residual activation.	
			M – Run conditions: Operating parameters that reduce residual activation	
			by limiting the total amount of beam that could be delivered	
Radioactive	Hazard: persons are exposed to	L: A	P – Locked Gates: Barriers to entrances of areas that contain radioactive	L: BEU
waste	ionizing radiation beyond regulatory	C: H	material. Keys are required to open these gates.	C: L
	levels	R: I	P – Key Control Program: A program that checks the worker's training	R: IV
			prior to issuing them a key to the accelerator enclosure. Also keeps	
			track of worker accountability.	
			P – Postings: Signs located in various places throughout the accelerator	
			warning of various hazards and occupancy restrictions	
			M – Run Conditions: Operating parameters that reduce residual activation	
			by limiting the total amount of beam that could be delivered.	

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Non-ionizing Radiation Hazards	Hazard: Exposure to high power RF and Lasers	L: C: R:	See section I Chapter IV. Class 1 and 2 lasers only	L: BEU C: M R: IV
⁷ Be	Hazard: Potential radiation exposure to 7Be (uptake/committed dose).	L: A 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: A C: N R: IV
Contamination	Hazard: persons are exposed to ionizing radiation beyond regulatory levels	L: A C: H R: I	 M – Distance to Stored Material: Barriers, such as ropes, that are used to increase the distance between the activated material and personnel. P – Locked Gates: Barriers to entrances of areas that contain radioactive material. Keys are required to open these gates. P – Key Control Program: A program that checks the worker's training prior to issuing them a key to the accelerator enclosure. Also keeps track of worker accountability. M – Radiological Work Permit: A permit written by Safety that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure. M – Training: An educational system managed by ES&H that establishes basic worker knowledge through presentations and testing. 	L:EU C: L R: IV

Radiological Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	Cor	nsequence (C, of event)/y	year	Risk (R, Qualitative Ranking)			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 (even)	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	ક	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (event) of minimal concern		ences	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsit	te-2 (co-located worker)	Onsite-1 (facility worker)	edn		***	***	77.7	77.7	
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ 25.0 rem		C ≥ 100 rem	C ≥ 100 rem	ons	L	III	III	IV	IV	
M = Mitigative (reduces event consequences)	M	$25.0 \text{ rem} > \mathbf{C} \ge 5 \text{ rem}$	10	00 rem > C ≥ 25 rem	100 rem > C ≥ 25 rem		N	IV	IV	IV	IV	
Acronyms MOL Manipully and a difficient distribution	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 11.3 Radiological – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual activation	Hazard: exposure to residual activation	L: BEU C: N R: IV	Not Applicable. No prevention or mitigation is required. The area is located beyond the public access gate.	L: BEU C: N R: IV
Groundwater Activation	Hazard: radionuclides in ground water exceed regulatory levels	L: C: R:	See section I Chapter IV	L: C: R:
Surface Water Activation	Hazard: radionuclides in surface water exceed regulatory levels	L: C: R:	See section I Chapter IV	L: C: R:
Radioactive Water (RAW) Systems	Hazard: Exposure to activated water	L: BEU C: N R: IV	Not Applicable. No prevention or mitigation is required. The area is located beyond the public access gate.	L: BEU C: N R: IV
Air Activation	Hazard: radionuclides in air exceed regulatory levels	L: BEU C: N R: IV	Not Applicable. No prevention or mitigation is required. The area is located beyond the public access gate.	L: BEU C: N R: IV
Soil Interactions	Hazard: radionuclides are produced which may contaminate ground water	L: BEU C: N R: IV	Not Applicable. No prevention or mitigation is required. The area is located beyond the public access gate.	L: BEU C: N R: IV
Radioactive waste	Hazard: persons are exposed to ionizing radiation beyond regulatory levels	L: BEU C: N R: IV	Not Applicable. No prevention or mitigation is required. The area is located beyond the public access gate.	L: BEU C: N R: IV

Contamination	Hazard: persons are exposed to ionizing radiation beyond regulatory levels	L: BEU C: N R: IV	Not Applicable. No prevention or mitigation is required. The area is located beyond the public access gate.	L: BEU C: N R: IV
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	Hazard: Exposure to high power RF	L: BEU C: N R: IV	Not Applicable. No prevention or mitigation is required. The area is located beyond the public access gate.	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 R	Risk (R, Qualitative Ranking)			Risk Matrix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern				Likelihood						
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		\mathbf{II} = situation (even	nt) of concern			A	U	EU	BEU			
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		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 (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)	edn		***	777	***	TX /			
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ 25.0 rem		C ≥ 100 rem	C ≥ 100 rem	ous	L	III	III	IV	IV			
M = Mitigative (reduces event consequences)	M	$25.0 \text{ rem} > \mathbf{C} \ge 5 \text{ rem}$	10	00 rem > C ≥ 25 rem	100 rem > C ≥ 25 rem		N	IV	IV	IV	IV			
Acronyms MOI Manimally annual Office Individual	L	5 rem > C		25 rem > C	25 rem > C									
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	N	0.5 rem > C		5 rem > C	5 rem > C									

Table 11.4 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 IV	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 IV	L: C: R:
Fluorinert byproducts	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:

Chemical Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

Likelihood (L, of event)/year	Co	onsequence (C, of event))/year	Risk (R, Qualitative	Ranking)	Risk Matrix					
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern					Likelihood		
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (ev}$	II = situation (event) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (ex	vent) of minor concern	ences	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	IV = situation (event) of minimal concern		M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edn	_	TTT	111	13.7	TS 7
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ PAC-2		C ≥ PAC-3	C ≥ IDLH	ous	L	III	III	IV	IV
M = Mitigative (reduces event consequences)	М	$PAC-2 > C \ge PAC-1$	P/	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$	5	N	IV	IV	IV	IV
Acronyms	L	PAC-1 > C	17	PAC-2 > C	PEL or TLV _c > \mathbf{C}						_
IDLH = Immediately Dangerous to Life and Health	N		C								
MOI = Maximally-exposed Offsite Individual	1	Consequences less		nsequences less than	Consequences less than						
PAC = Protective Action Criteria		than those for Low	those	for Low Consequence	those for Low						
PEL = Permissible Exposure Limit		Consequence Level		Level	Consequence Level						
TLV _c = Threshold Limit Value (ceiling)											

Table 11.5 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 dust during manual handling of unencased lead bricks, lead shot, and lead sheets.	L: C: R:	See section I Chapter IV	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 IV	L: C: R:
Fluorinert byproducts	Hazard: Potential exposure to fluorinert decomposition products (HF, PFIB).	L: A C: H R: I	See section I Chapter IV	L: EU C: L R: IV

Chemical Hazard Consequences, derived from Figure	Chemical Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year /	Risk (R, Qualitative	Ranking)	Risl	Risk Matrix					
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \text{High}$		I = situation (event) of major concern					Likelihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (ev}$	ent) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (ex	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			M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə —	_	TTT	TIT	13.7	IV	
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ PAC-2		C ≥ PAC-3	C≥IDLH	ons	L	III	III	IV	IV	
M = Mitigative (reduces event consequences)	M	$PAC-2 > C \ge PAC-1$	PA	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$		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	N	Consequences less	Consequences 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		Consequence Level	Level	Consequence Level
PEL = Permissible Exposure Limit				
TLV_c = Threshold Limit Value (ceiling)				

Table 11.6 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 IV	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 IV	L: C: R:
Fluorinert byproducts	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:

Chemical Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year	Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern					Likelihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		\mathbf{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	(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	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	T	Ш	Ш	IV	IV	
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ PAC-2		C ≥ PAC-3	C ≥ IDLH	ons	L	111	111	1 V		
M = Mitigative (reduces event consequences)	M	$PAC-2 > C \ge PAC-1$	P/	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$		N	IV	IV	IV	IV	
Acronyms	L	PAC-1 > C		PAC-2 > C	PEL or TLV _c > C							

IDLH = Immediately Dangerous to Life and Health	N	Consequences less	Consequences 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		Consequence Level	Level	Consequence Level
PEL = Permissible Exposure Limit				
TLV_c = Threshold Limit Value (ceiling)				

 ${\bf Table~11.7~Flammable~and~Combustible~Materials-Onsite~-1~Facility~Worker}$

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Combustible	Hazard: N/A	L:	See section I Chapter IV	L:
materials		C:		C:
(cables, Boxes,		R:		R:
Paper, wood				
cribbing, etc.)				
Flammable	Hazard: N/A	L:	See section I Chapter IV	L:
Materials		C:		C:
(Flammable gas,		R:		R:
cleaning				
materials, etc.)				

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							
$\mathbf{A} = \text{Anticipated (L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	ent) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (ev}$	ent) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (e	vent) of minor concern	es	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	ences	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	т.	III	III	IV	IV		
 P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual 	Н	C ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective	or	Prompt worker fatality cacute injury that is immediately life- itening or permanently disabling.	C ≥ Prompt worker fatality or acute injury that is immediately lifethreatening or permanently disabling.	Cons	N	IV	IV	IV	IV		
	M	$\label{eq:constraint} \begin{split} & \text{action.} \\ & \textbf{C} \geq \text{Mild, transient} \\ & \text{adverse effects.} \end{split}$		≥ Serious injury, no nediate loss of life no	C ≥ Serious injury, no immediate loss of life no								

			permanent disabilities;	permanent disabilities;
			hospitalization required.	hospitalization required.
Ī	L	Mild, transient	Minor injuries; no	Minor injuries; no
		adverse effects > C	hospitalization $> \mathbf{C}$	hospitalization $> \mathbf{C}$
<u> </u>	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 2.8 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: N/A	L:	See section I Chapter IV	L:
materials		C:		C:
(cables, Boxes,		R:		R:
Paper, wood				
cribbing, etc.)				
Flammable	Hazard: N/A	L:	See section I Chapter IV	L:
Materials		C:		C:
(Flammable gas,		R:		R:
cleaning				
materials, etc.)				

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.													
Likelihood (L, of event)/year	Co	onsequence (C, of event))/year	Risk (R, Qualitative	Ranking)	Risk Matrix							
$\mathbf{A} = \text{Anticipated } (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (even)	nt) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (eve	ent) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (ev	vent) of minor concern	es	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	sedn	Τ.	III	Ш	IV	IV		
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms	Н	C ≥ Irreversible, other serious effects, or symptoms which	or	Prompt worker fatality acute injury that is immediately life-	C ≥ Prompt worker fatality or acute injury that is immediately life-	Con	N	IV	IV	IV	IV		
MOI = Maximally-exposed Offsite Individual		could impair an individual's ability to take protective		tening or permanently disabling.	threatening or permanently disabling.								
		action.											
	M	$C \ge Mild$, transient	C :	≥ Serious injury, no	$C \ge Serious injury, no$								
		adverse effects.	imm	nediate loss of life no	immediate loss of life no								

			permanent disabilities;	permanent disabilities;
			hospitalization required.	hospitalization required.
Ī	L	Mild, transient	Minor injuries; no	Minor injuries; no
		adverse effects > C	hospitalization $> \mathbf{C}$	hospitalization $> \mathbf{C}$
<u> </u>	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 11.9 Flammable and Combustible Materials – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Combustible	Hazard: N/A	L:	See section I Chapter IV	L:
materials		C:		C:
(cables, Boxes,		R:		R:
Paper, wood				
cribbing, etc.)				
Flammable	Hazard: N/A	L:	See section I Chapter IV	L:
Materials		C:		C:
(Flammable gas,		R:		R:
cleaning				
materials, etc.)				

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.													
Likelihood (L, of event)/year	C	onsequence (C, of event))/year	Risk (R, Qualitative	Ranking)	Risk	Matri	X					
$\mathbf{A} = \text{Anticipated (L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (ev}$	ent) of concern		ı	A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (e	vent) of minor concern	es	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	N = Negligible		vent) of minimal concern	ences	M	II	II	Ш	IV		
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	ī	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	Prompt worker fatality racute injury that is immediately life- itening or permanently disabling.	C ≥ Prompt worker fatality or acute injury that is immediately lifethreatening or permanently disabling.	Cons	N	IV	IV	IV	IV		
	M	C ≥ Mild, transient	C	≥ Serious injury, no	C ≥ Serious injury, no								
		adverse effects.	imm	nediate loss of life no	immediate loss of life no								

			permanent disabilities;	permanent disabilities;
			hospitalization required.	hospitalization required.
Ī	L	Mild, transient	Minor injuries; no	Minor injuries; no
		adverse effects > C	hospitalization $> \mathbf{C}$	hospitalization $> \mathbf{C}$
<u> </u>	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 11.10 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 Exposure	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
High Voltage Exposure	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
Low Voltage, High Current Exposure.	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	year	Risk (R, Qualitative	Ranking)	Ris	k Matr	ix				
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern					Like	lihood		
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (ev}$	ent) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (ev	vent) of minor concern		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	()		-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	L	Ш	III	IV	IV	
 P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual 	ces) other serious effects, or symptoms which		or a	rompt worker fatality acute injury that is mmediately life- ening or permanently disabling.	C ≥ Prompt worker fatality or acute injury that is immediately life- threatening or permanently disabling.	Consequ	N	IV	IV	IV	IV	
	M	C ≥ Mild, transient adverse effects.	imme perr	e Serious injury, no ediate loss of life no manent disabilities; pitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.							

L	,	Mild, transient	Minor injuries; no	Minor injuries; no
		adverse effects $> \mathbf{C}$	hospitalization $> C$	hospitalization $> \mathbf{C}$
N	ſ	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 11.11 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 Exposure	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
High Voltage Exposure	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
Low Voltage, High Current Exposure.	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	Co	onsequence (C, of event)/y	year	Risk (R, Qualitative	Ranking)	Risk	Matri	X				
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern					Like	lihood		
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = situation (evolution (evolution for evolution $	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	es	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = $ Negligible		IV = situation (ev	vent) of minimal concern	enc	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI) Onsite-2 (d		2 (co-located worker)	Onsite-1 (facility worker)	sednences	ī	III	III	IV	IV	
P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Н	C ≥ Irreversible, other serious effects,	C ≥ Prompt worker fatality or acute injury that is immediately life- threatening or permanently disabling.		C ≥ Prompt worker fatality or acute injury that	Cons	N	IV	IV	IV	IV	
Acronyms MOI = Maximally-exposed Offsite Individual		or symptoms which			is immediately life- 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	ediate loss of life no	immediate loss of life no							
			perm	nanent disabilities;	permanent disabilities;							
			hospi	italization required.	hospitalization required.							

L	,	Mild, transient	Minor injuries; no	Minor injuries; no
		adverse effects $> \mathbf{C}$	hospitalization $> C$	hospitalization $> \mathbf{C}$
N	ſ	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 11.12 Electrical Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Stored Energy Exposure	Hazard: NA	L: C: R:	See section I Chapter IV	L: C: R:
High Voltage Exposure	Hazard: NA	L: C: R:	See section I Chapter IV	L: C: R:
Low Voltage, High Current Exposure.	Hazard: NA	L: C: R:	See section I Chapter IV	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)/y	year Risk (R, Qualitative	Ranking)	Risk	Matri	X					
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$	I = situation (eve	I = situation (event) of major concern				Like	lihood			
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situation (ev}$	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	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)	nbəs	ī	Ш	III	IV	IV		
P = Preventive (reduce event occurrence likelihood)	H	C ≥ Irreversible,	$C \ge Prompt$ worker fatality	$C \ge Prompt worker$	juo,							
$\mathbf{M} = \mathbf{M}$ itigative (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 ≥ 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 $> \mathbf{C}$	hospitalization $> C$	hospitalization $> \mathbf{C}$
N	ſ	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 11.13 Thermal Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Magnet Bakeouts	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
Hot Work	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year	Risk (R, Qualitative	Ranking)	Risk	Matri	X				
$\mathbf{A} = \text{Anticipated (L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	I = situation (event) of major concern				Like	lihood		
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (ev}$	ent) of concern		T	A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ev	vent) of minor concern	səc	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	$C \ge Irreversible, \qquad C \ge Pr$		2 (co-located worker)	Onsite-1 (facility worker)	sedneuces	,	***	777	TX /	TX /	
P = Preventive (reduce event occurrence likelihood)	Н			rompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV	
M = Mitigative (reduces event consequences)				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		ening or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective		8	T a series of the series of th							
		action.										
	M	C ≥ Mild, transient	C ≥	Serious injury, no	C ≥ 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	M	linor injuries; no	Minor injuries; no							
		adverse effects > C	ho	spitalization > C	hospitalization $> \mathbf{C}$							

N	Cor	nsequences less	Consequences less than	Consequences less than
	thar	n those for Low	those for Low Consequence	those for Low
	Con	nsequence Level	Level	Consequence Level

Table 11.14 Thermal Energy – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Magnet Bakeouts	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
Hot Work	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year	Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern					Like	lihood		
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ev	II = situation (event) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		$III = situation (e^{-1})$	vent) of minor concern	ces	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	en	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI) Onsite-2		e-2 (co-located worker)	Onsite-1 (facility worker)	edn	,	***	***	***	***	
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ P	Prompt worker fatality	ty $C \ge Prompt worker$	Cons	L	III	III	IV	IV	
M = Mitigative (reduces event consequences)		other serious effects, or ac		acute injury that is	fatality or acute injury that	5	N	IV	IV	IV	IV	
Acronyms				mmediately life-	is immediately life-		•					
MOI = Maximally-exposed Offsite Individual		J 1		tening or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective		C								
		action.										
	M	C ≥ Mild, transient	C ≥	≥ Serious injury, no	C ≥ Serious injury, no							
		adverse effects.	imm	ediate loss of life no	immediate loss of life no							
			per	manent disabilities;	permanent disabilities;							
			hosp	pitalization required.	hospitalization required.							
	L	Mild, transient	N	Minor injuries; no	Minor injuries; no							
		adverse effects > C	ho	ospitalization > C	hospitalization > C							

N	Cor	nsequences less	Consequences less than	Consequences less than
	thar	n those for Low	those for Low Consequence	those for Low
	Con	nsequence Level	Level	Consequence Level

Table 11.15 Thermal Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Magnet Bakeouts	Hazard: N/A	L: C:	See section I Chapter IV	L: C:
Hot Work	Hazard: N/A	R: L: C: R:	See section I Chapter IV	R: L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	Consequence (C, of event)/year			Risk (R, Qualitative Ranking)			Risk Matrix				
$\mathbf{A} = \text{Anticipated (L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (event) of major concern					Like	lihood	
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = situation (evolution (evolution for evolution $	ent) of concern		ı	A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ev	vent) of minor concern	sə	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	ation (event) of minimal concern			II	II	III	IV
Control(s) Type	C Offsite (MOI)		Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	Consequences		III	III	IV	IV
P = Preventive (reduce event occurrence likelihood)	Н	$C \ge Irreversible$, $C \ge F$		ompt worker fatality	C ≥ Prompt worker		L				
M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual		,		cute injury that is	fatality or acute injury that is immediately life-	C	N	IV	IV	IV	IV
		or symptoms which	immediately life-								
		could impair an		ening or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective		222422226	permanently disacting.						
		action.									
	M	C ≥ Mild, transient	C ≥	Serious injury, no	C ≥ Serious injury, no						
		adverse effects.	imme	ediate loss of life no	immediate loss of life no						
			perm	nanent disabilities;	permanent disabilities;						
			hospi	italization required.	hospitalization required.						
	L	Mild, transient	M	inor injuries; no	Minor injuries; no						
		adverse effects > C	hos	spitalization > C	hospitalization $> \mathbf{C}$						

N	Cor	nsequences less	Consequences less than	Consequences less than
	thar	n those for Low	those for Low Consequence	those for Low
	Con	nsequence Level	Level	Consequence Level

Table 11.16 Kinetic Energy – Onsite-1 Facility Worker

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern				Likelihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ev	ent) of concern	_	1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (e	vent) of minor concern	es	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \text{Negligible}$		IV = situation (e	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)	nbə						
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible.	C > F	Prompt worker fatality	C ≥ Prompt worker	ons	L	III	III	IV	IV	
M = Mitigative (reduces event consequences)	_	other serious effects,		acute injury that is	fatality or acute injury that	ŭ	N	IV	IV	IV	IV	
Acronyms		or symptoms which	· ·		is immediately life-		1					
MOI = Maximally-exposed Offsite Individual		could impair an		immediately life- tening or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective										
		action.										

M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no
	adverse effects.	immediate loss of life no	immediate loss of life no
		permanent disabilities;	permanent disabilities;
		hospitalization required.	hospitalization required.
L	Mild, transient	Minor injuries; no	Minor injuries; no
	adverse effects > C	hospitalization $> \mathbf{C}$	hospitalization $> \mathbf{C}$
N	Consequences less	Consequences less than	Consequences less than
	than those for Low	those for Low Consequence	those for Low
	Consequence Level	Level	Consequence Level

Table 11.17 Kinetic Energy – Onsite-2 Co-located Worker

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	isk (R, Qualitative Ranking)			Risk Matrix				
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern		Likelihood			lihood		
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H} = \text{situation (ev}$	ent) of concern	_		Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$ $\mathbf{N} = \mathbf{Negligible}$		III = situation (ev	vent) of minor concern	es	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)				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)	nbəs						
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible.	C > F	Prompt worker fatality	C ≥ Prompt worker	ons	L	III	III	IV	IV	
M = Mitigative (reduces event consequences)	_	other serious effects,		acute injury that is	fatality or acute injury that	ರ	N	IV	IV	IV	IV	
Acronyms		or symptoms which		immediately life-	is immediately life-					ı		
MOI = Maximally-exposed Offsite Individual		could impair an		tening or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective		J								
		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.
\mathbf{L}		Mild, transient	Minor injuries; no	Minor injuries; no
		adverse effects $> \mathbf{C}$	hospitalization $> \mathbf{C}$	hospitalization $> \mathbf{C}$

Table 11.18 Kinetic Energy – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern				Likelihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H} = \text{situation (ev}$	ent) of concern	_		Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (e	vent) of minor concern		H	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	səbuə	М	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	None	} —	***				
P = Preventive (reduce event occurrence likelihood)	Н	H $C \ge Irreversible$, $C \ge F$	Prompt worker fatality	C ≥ Prompt worker	1 5		III	III	IV	IV		
M = Mitigative (reduces event consequences)		other serious effects,		r acute injury that is	fatality or acute injury that	ರ	N	IV	IV	IV	IV	
Acronyms		or symptoms which		immediately life-	is immediately life-		1	l .				
MOI = Maximally-exposed Offsite Individual		could impair an		tening 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.
\mathbf{L}		Mild, transient	Minor injuries; no	Minor injuries; no
		adverse effects $> \mathbf{C}$	hospitalization $> \mathbf{C}$	hospitalization $> \mathbf{C}$

Table 11.19 Potential Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane	Hazard: N/A	L:	See section I Chapter IV	L:
Operations		C: R:		C: R:
Compressed Gasses	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
Vacuum/ Pressure Vessels	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
Vacuum Pumps	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
Material Handling	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: 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)	Ris	k Matr	ix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern				Likelihood					
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (ev}$	ent) of concern			Α	U	EU	BEU			
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (e	vent) of minor concern	ses	Н	I	I	II	III			
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (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	_	TTT	111	13.7	IV			
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible.	C > F	Prompt worker fatality	C ≥ Prompt worker	ous	L	III	III	IV	IV			
M = Mitigative (reduces event consequences)		other serious effects,		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		·										

		individual's ability to	threatening or permanently	threatening or
		take protective	disabling.	permanently disabling.
		action.		
M	I	$C \ge Mild$, transient	C ≥ Serious injury, no	$C \ge Serious injury, no$
		adverse effects.	immediate loss of life no	immediate loss of life no
			permanent disabilities;	permanent disabilities;
			hospitalization required.	hospitalization required.
L	[]	Mild, transient	Minor injuries; no	Minor injuries; no
		adverse effects $> \mathbf{C}$	hospitalization $> \mathbf{C}$	hospitalization $> \mathbf{C}$
N	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 11.20 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	Hazard: N/A	L:	See section I Chapter IV	L:
Operations		C: R:		C: R:
Compressed Gasses	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
Vacuum/ Pressure Vessels	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
Vacuum Pumps	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
Material Handling	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.													
Likelihood (L, of event)/year	C	onsequence (C, of event))/year	Risk (R, Qualitative	Ranking)	Risl	Risk Matrix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathrm{High}$		I = situation (eve	nt) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (ev}$	ent) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (e	vent) of minor concern	es	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	ences	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edn	-	TTT	***	77.7	77.7		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C > F	Prompt worker fatality	C ≥ Prompt worker	ons	L	III	III	IV	IV		
M = Mitigative (reduces event consequences)		other serious effects,		acute injury that is	fatality or acute injury that	S	N	IV	IV	IV	IV		
Acronyms		or symptoms which		immediately life-	is immediately life-								
MOI = Maximally-exposed Offsite Individual		could impair an											

		individual's ability to	threatening or permanently	threatening or
		take protective	disabling.	permanently disabling.
		action.		
M	I	$C \ge Mild$, transient	C ≥ Serious injury, no	$C \ge Serious injury, no$
		adverse effects.	immediate loss of life no	immediate loss of life no
			permanent disabilities;	permanent disabilities;
			hospitalization required.	hospitalization required.
L	[]	Mild, transient	Minor injuries; no	Minor injuries; no
		adverse effects $> \mathbf{C}$	hospitalization $> \mathbf{C}$	hospitalization $> \mathbf{C}$
N	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 11.21 Potential Energy – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.													
Likelihood (L, of event)/year	C	onsequence (C, of event))/year	Risk (R, Qualitative	Ranking)	Risk Matr							
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathrm{High}$		I = situation (eve	nt) of major concern								
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (ev}$	ent) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (ex	vent) of minor concern	es	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	ences	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edn		***	***	TX /	77.7		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C > F	Prompt worker fatality	C ≥ Prompt worker	ous	L	III	III	IV	IV		
M = Mitigative (reduces event consequences)		other serious effects,		acute injury that is	fatality or acute injury that	S	N	IV	IV	IV	IV		
Acronyms		or symptoms which		immediately life-	is immediately life-								
MOI = Maximally-exposed Offsite Individual		could impair an											

		individual's ability to take protective action.	threatening or permanently disabling.	threatening or permanently disabling.
N	М	$C \ge Mild$, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities;	C ≥ Serious injury, no immediate loss of life no permanent disabilities;
			hospitalization required.	hospitalization required.
I	L	Mild, transient	Minor injuries; no	Minor injuries; no
		adverse effects $> \mathbf{C}$	hospitalization $> C$	hospitalization $> \mathbf{C}$
1	Z	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 11.22 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	Hazard: Personnel with implanted medical devices	L: C: R:	See section I Chapter IV	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.															
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk	Matri	ix	X						
$\mathbf{A} = \text{Anticipated (L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (even	nt) of major concern				Like	lihood					
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = situation (evolution (evolution of the evolution of the evolut$	ent) of concern			A	U	EU	BEU				
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (evolution)	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	2 (co-located worker)	Onsite-1 (facility worker)	nba	_								
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C > Pr	ompt worker fatality	C ≥ Prompt worker	Suc	L	III	III	IV	IV				
M = Mitigative (reduces event consequences)		other serious effects,		cute injury that is	fatality or acute injury that	్త	N	IV	IV	IV	IV				
Acronyms		or symptoms which		nmediately life-	is immediately life-										
MOI = Maximally-exposed Offsite Individual		could impair an		ening or permanently	threatening or										
		individual's ability to		disabling.	permanently disabling.										
		take protective		C											
		action.													
	M	C ≥ Mild, transient	C ≥	Serious injury, no	C ≥ Serious injury, no										
		adverse effects.	imme	ediate loss of life no	immediate loss of life no										
			perm	nanent disabilities;	permanent disabilities;										
			hospi	italization required.	hospitalization required.										
	L	Mild, transient	M	inor injuries; no	Minor injuries; no										
		adverse effects > C	ho	spitalization > C	hospitalization > C										
	N	Consequences less	Cons	sequences less than	Consequences less than										
		than those for Low	those fo	or Low Consequence	those for Low										
		Consequence Level		Level	Consequence Level										

Table 11.23 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	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)/y	ear Risk (R, Qualitative	Ranking)	Risk Matrix							
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$	I = situation (eve	I = situation (event) of major concern				Like	lihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situation (ev}$	ent) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	III = situation (ex	vent) of minor concern	es	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	enc	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	,	III	ш	IV	IV		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	ous	L	111	III	1 V	1 V		
$\mathbf{M} = \text{Mitigative (reduces event consequences)}$		other serious effects,	or acute injury that is	fatality or acute injury that is immediately life- threatening or	C	N	IV	IV	IV	IV		
Acronyms		or symptoms which	immediately life-									
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or permanently									
		individual's ability to	disabling.	permanently disabling.								
		take protective										
		action.										
	M	$C \ge Mild$, transient	C ≥ Serious injury, no	$C \ge Serious injury, no$								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization $> \mathbf{C}$								
	N	Consequences less	Consequences less than	Consequences less than								
			hose for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

Table 11.24 Magnetic Fields – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year Risk (R, Qua	litative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$	I = situat	ion (eve	nt) of major concern			Likelihoo				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = situa$	tion (eve	ent) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$	III = situ	ation (ev	vent) of minor concern	səx	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situ	ation (ev	vent) of minimal concern	ienc	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located we	orker)	Onsite-1 (facility worker)	sednences	L	TTT	TIT	IV	IV	
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker f	atality	C ≥ Prompt worker	Cons	L	III	III	1 V	1 V	
M = Mitigative (reduces event consequences)		other serious effects,	or acute injury tha	•	fatality or acute injury that)	N	IV	IV	IV	IV	
Acronyms		or symptoms which			is immediately life-							
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or perma	nently	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 li	fe no	immediate loss of life no							
			permanent disabili	ties;	permanent disabilities;							
			hospitalization requ	iired.	hospitalization required.							
	L	Mild, transient	Minor injuries; r	10	Minor injuries; no							
		adverse effects > C	hospitalization >	C	hospitalization > C							
	N	Consequences less	Consequences less		Consequences less than							
		than those for Low	those for Low Consec	quence	those for Low							
		Consequence Level	Level		Consequence Level							

 $Table\ 11.25\ Other\ hazards-Onsite-1\ Facility\ Worker$

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
Noise	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
Silica	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
Ergonomics	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risl	k Matri	X	X .			
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern				Likelihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H} = \text{situation (ev}$	ent) of concern	_	1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$ $\mathbf{N} = \text{Negligible}$		III = situation (e	vent) of minor concern	es	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)				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)	nbə						
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible.	C > I	Prompt worker fatality	C ≥ Prompt worker	ons	L	III	III	IV	IV	
M = Mitigative (reduces event consequences)	_	other serious effects,		acute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV	
Acronyms		or symptoms which		immediately life-	is immediately life-		1					
MOI = Maximally-exposed Offsite Individual		could impair an		tening or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective		_								
		action.										

M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no
	adverse effects.	immediate loss of life no	immediate loss of life no
		permanent disabilities;	permanent disabilities;
		hospitalization required.	hospitalization required.
L	Mild, transient	Minor injuries; no	Minor injuries; no
	adverse effects > C	hospitalization $> \mathbf{C}$	hospitalization $> \mathbf{C}$
N	Consequences less	Consequences less than	Consequences less than
	than those for Low	those for Low Consequence	those for Low
	Consequence Level	Level	Consequence Level

Table 11.26 Other hazards – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
Noise	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
Silica	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
Ergonomics	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Ri	sk Mat	sk Matrix				
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern				Likelihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H} = \text{situation (ev}$	ent) of concern	_		Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (e	vent) of minor concern	á	H	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	soute	М	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	HUJOS	} —	***		***		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C > F	Prompt worker fatality	C ≥ Prompt worker	one		III	III	IV	IV	
M = Mitigative (reduces event consequences)		other serious effects,		acute injury that is	fatality or acute injury that	ي) N	IV	IV	IV	IV	
Acronyms		or symptoms which		immediately life-	is immediately life-		1	l .				
MOI = Maximally-exposed Offsite Individual		could impair an		tening or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective										
		action.										

M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no
	adverse effects.	immediate loss of life no	immediate loss of life no
		permanent disabilities;	permanent disabilities;
		hospitalization required.	hospitalization required.
L	Mild, transient	Minor injuries; no	Minor injuries; no
	adverse effects > C	hospitalization $> \mathbf{C}$	hospitalization $> \mathbf{C}$
N	Consequences less	Consequences less than	Consequences less than
	than those for Low	those for Low Consequence	those for Low
	Consequence Level	Level	Consequence Level

Table 11.27 Other hazards – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
Noise	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
Silica	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:
Ergonomics	Hazard: N/A	L: C: R:	See section I Chapter IV	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.													
Likelihood (L, of event)/year	Co	onsequence (C, of event)/	/year	Risk (R, Qualitative	Ranking)	Risk	Matri	X	K .				
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	ent) of major concern			Likelihood					
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{M} = \mathbf{Moderate}$		ent) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ev	vent) of minor concern	જ	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	Ш	IV		
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edn	_	***	***	TX /	***		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible.	C > F	Prompt worker fatality	C ≥ Prompt worker	ons	L	III	III	IV	IV		
M = Mitigative (reduces event consequences)		other serious effects,		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		• 1		tening 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 $> \mathbf{C}$	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 11.28 Access & Egress – Onsite-1 Facility Worker

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

Other Hazard Consequences, derived from Figure C-1	l, "E	Example Qualitative Con	sequence Matrix", DOE-	HDBK-1163-20 <mark>2</mark> 0.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/year Risk (R, Qualitative Ranking)					Risk Matrix					
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$	I = situation	event) of major concern				Like	lihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situation}$	(event) of concern		1	A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$	III = situation	(event) of minor concern	es	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation	(event) of minimal concern	ences	M	II	II	Ш	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worke	c) Onsite-1 (facility worker)	sedn	-	***	***	77.7	77.7		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatali	ty C ≥ Prompt worker	Cons	L	III	III	IV	IV		
M = Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	ت ا	N	IV	IV	IV	IV		
Acronyms		or symptoms which	immediately life-	is immediately life-								
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or permanent									
		individual's ability to	disabling.	permanently disabling.								
		take protective	C									
		action.										
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization > C								
	N	Consequences less	Consequences less than	Consequences less than								
		than those for Low	those for Low Consequen	ce those for Low								
		Consequence Level	Level	Consequence Level								

Table 11.29 Access & Egress – Onsite-2 Co-located Worker

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

Other Hazard Consequences, derived from Figure C-1	l, "E	xample Qualitative Cons	equence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/y	year Risk (R, Qualitative	Ranking)	Risk	Matri	ix			
$\mathbf{A} = \text{Anticipated } (L > 1.0\text{E}-02)$		$\mathbf{H} = \mathbf{High}$	I = situation (eve	nt) of major concern			Likelihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situation (ev}$				A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$	· ·	vent) of minor concern	ences	Н	I	1	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)	_	N = Negligible		vent) of minimal concern	nen	M	II	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	L	III	III	IV	IV
P = Preventive (reduce event occurrence likelihood)	H	$C \ge Irreversible$,	$C \ge Prompt worker fatality$	$\mathbf{C} \ge \text{Prompt worker}$	Con					
M = Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that		N	IV	IV	IV	IV
Acronyms MOI = Maximally-exposed Offsite Individual		or symptoms which	immediately life-	is immediately life-						
WIOT - Waximany-exposed Offsite individual		*	threatening or permanently	threatening or						
		individual's ability to	disabling.	permanently disabling.						
		take protective								
	M	action.	Q > Q · · · ·	0 × 0 · · · ·						
	IVI	$C \ge Mild$, transient	$C \ge Serious injury, no$	C ≥ Serious injury, no immediate loss of life no						
		adverse effects.	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						
		*	those for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

Table 11.30 Access & Egress – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-1	l, "E	Example Qualitative Con	sequence Matrix", DOE-	HDBK-1163-20 <mark>2</mark> 0.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/year Risk (R, Qualitative Ranking)					Risk Matrix					
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$	I = situation	event) of major concern				Like	lihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situation}$	(event) of concern		1	A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$	III = situation	(event) of minor concern	es	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation	(event) of minimal concern	ences	M	II	II	Ш	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worke	c) Onsite-1 (facility worker)	sedn	-	***	***	77.7	77.7		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatali	ty C ≥ Prompt worker	Cons	L	III	III	IV	IV		
M = Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	ت ا	N	IV	IV	IV	IV		
Acronyms		or symptoms which	immediately life-	is immediately life-								
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or permanent									
		individual's ability to	disabling.	permanently disabling.								
		take protective	C									
		action.										
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization > C								
	N	Consequences less	Consequences less than	Consequences less than								
		than those for Low	those for Low Consequen	ce those for Low								
		Consequence Level	Level	Consequence Level								

Table 11.31 Environmental

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

Discharge of chemicals into	
onsite soils beyond permitted limits.	
timus.	