Table 2. Summary of Baseline and Residual Risks – PIP-II IT

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

\*See SAD Section I Chapter 04

## NOTE:

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

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

Table 2.1 Radiological – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Prompt Ionizing Radiation	Hazard: Ionizing radiation generated by operation of SRF Cavities	L: A C: M R: I	<ul> <li>P - Enclosure access is generally not allowed without amplifiers being locked out, which is controlled procedurally. Without power to the cavities, there is no prompt ionizing radiation hazard.</li> <li>P - Enclosure is locked and keys are only obtained after verifying training credentials.</li> <li>P - If a key is used to open the enclosure door, interlocks are dropped, preventing power from entering the cavities.</li> <li>M - Radiation detectors are stationed at strategic locations around the enclosure to limit dose to those outside the enclosure during operation.</li> <li>M - Enclosure has a shielding assessment and is designed to prevent dose to those outside the enclosure during operation.</li> <li>M - Entrants to the enclosure wear dosimetry and would notice dose being taken in the event all of the other steps were bypassed.</li> </ul>	L: EU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive Waste	Hazard: Possibly activated material from accelerated dark current.	L: U C: L	P – After test, all reachable surfaces of the cryomodule are surveyed for activation by the radiation safety group.	L: EU C: N
		R: III	<ul> <li>P – The PIP2IT enclosure is considered an impacted area when RF is applied. Any item in the enclosure during RF powering must be surveyed upon exit from the cave and is at minimum class 0.</li> <li>M – Class 0 material waiting to be declassified is kept in a special bin outside the enclosure.</li> <li>M – Only qualified radiation workers can enter the cave to do work and they must be wearing dosimetry. Pocket dosimeter readings would notify of a large hazard.</li> </ul>	R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radiation Generating	Hazard: Ionizing radiation generated by operation of SRF Cavities	L: A C: M	P – Enclosure is generally not allowed to be accessed without amplifiers being locked out, although this is only controlled procedurally.	L: EU C: N
Devices (RGDs)		R: I	Without power to the cavities, there is no prompt ionizing radiation hazard.	R: IV
			P – Enclosure is locked and keys are only obtained after verifying training credentials.	
			P – If a key is used to open the enclosure door, interlocks are dropped, preventing power from entering the cavities.	
			M – Radiation detectors are stationed at strategic locations around the enclosure to limit dose to those outside the enclosure during operation.	
			M – Concrete shielding in place according to the approved shielding assessment that is designed to prevent dose to those outside the enclosure during operations.	
			M – Entrants to the enclosure wear dosimetry and would notice dose being taken in the event all of the other steps were bypassed.	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Non-ionizing Radiation Hazards	Hazard: RF leakage	L: A C: M R: II	<ul> <li>P — To prepare for an access, the amplifiers which provide power to the cavities are physically locked out, this is controlled procedurally. Without power to the cavities, there is no prompt ionizing radiation hazard.</li> <li>P — If a key is used to open the enclosure door, interlocks are dropped, preventing RF power from being applied.</li> <li>P — Enclosure acts as a shield to those outside the enclosure.</li> <li>M — RF antennas are installed both in the enclosure and outside the enclosure near the amplifiers to detect stray RF. When stray RF signals received by any one of these antennas exceeds the preset threshold, the interlock system will shut off RF amplifiers. This detecting/interlocking system was tested and verified during the initial test (trial) operation of high-power RF system.</li> <li>P — RF Distribution system (Coax line and Waveguides etc.) outside the enclosure is rarely disassembled. If a distribution system needs to be opened, the amplifier connected to that system will be manually locked out first following LOTO procedure.</li> <li>P — Trained RF technicians install RF distribution system and work on amplifiers.</li> <li>P — Critical RF components (circulator, directional coupler, RF window) and amplifiers all have RF leakage specification and communicated with vendors during procurement process. The RF leakage of these components are measured and verified during acceptance tests to make sure they meet the specification.</li> <li>P — Periodic RF surveys by ESH IH group.</li> </ul>	L: BEU C: L R: IV

Likelihood (L, of event)/year	Co	nsequence (C, of event)/y	vear Risk (R, Qualitative	Ranking)	Risk	Matri	ix			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \text{High}$		nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (eve	-			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situation (ex	vent) of minor concern	es	Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	rent) of minimal concern	enc	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	nbə	_	***	***	***	***
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ 25.0 rem	<b>C</b> ≥ 100 rem	<b>C</b> ≥ 100 rem	ons	L	III	III	IV	IV
<b>M</b> = Mitigative (reduces event consequences)	M	$25.0 \text{ rem} > \mathbf{C} \ge 5 \text{ rem}$	$100 \text{ rem} > \mathbf{C} \ge 25 \text{ rem}$	$100 \text{ rem} > \mathbf{C} \ge 25 \text{ rem}$	C	N	IV	IV	IV	IV
Acronyms	L	5 rem > C	25 rem > C	25 rem > C						
<b>MOI</b> = Maximally-exposed Offsite Individual <b>rem</b> = Roentgen equivalent man	N	0.5 rem > C	5 rem > C	5 rem > C						

Table 2.2 Radiological – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Prompt Ionizing Radiation	Hazard: Ionizing radiation generated by operation of SRF Cavities	L: A C: H R: I	<ul> <li>P — To prepare for an access, the amplifiers which provide power to the cavities are physically locked out, this is controlled procedurally. Without power to the cavities, there is no prompt ionizing radiation hazard.</li> <li>P — Enclosure is locked and keys cannot be issued to those without proper training.</li> <li>P — If a key is used to open the enclosure door, interlocks are dropped, which inhibits the amplifiers from applying power if they were not properly locked out.</li> <li>M — Radiation detectors are stationed at strategic locations around the enclosure to limit dose to those outside the enclosure during operation.</li> <li>M — Concrete shielding in place according to the approved shielding assessment that is designed to prevent does to those outside the enclosure during operations.</li> </ul>	L: EU C: L R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive	Hazard: Possibly activated material	L: U	P – After test, all reachable surfaces of the cryomodule are surveyed for	L: BEU
Waste	from accelerated dark current.	C: L	activation by the radiation safety group.	C: N
		R: III		R: IV
			P – The PIP2IT enclosure is considered an impacted area when RF is	
			applied. Any item in the enclosure during RF powering must be	
			surveyed upon exit from the cave and is at minimum class 0.	
			M – Class 0 material waiting to be declassified is kept in a special bin outside the enclosure.	
			M – Only qualified radiation workers can enter the cave to do work and they must be wearing dosimetry. Pocket dosimeter readings would notify of a large hazard.	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radiation Generating Devices (RGDs)	Hazard: Ionizing radiation generated by operation of SRF Cavities	L: A C: H R: I	<ul> <li>P – To prepare for an access, the amplifiers which provide power to the cavities are physically locked out, although this is only controlled procedurally. Without power to the cavities, there is no prompt ionizing radiation hazard.</li> <li>P – Enclosure is locked and keys cannot be issued to those without proper training.</li> <li>P – If a key is used to open the enclosure door, interlocks are dropped, which inhibits the amplifiers from applying power if they were not properly locked out.</li> <li>M – Radiation detectors are stationed at strategic locations around the enclosure to limit dose to those outside the enclosure during operation.</li> <li>M – Enclosure has a shielding assessment and is designed to prevent dose to those outside the enclosure during operation.</li> </ul>	L: EU C: L R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Non-ionizing Radiation Hazards	Hazard: RF leakage	L: A C: M R: II	<ul> <li>P - Enclosure access is generally not allowed to be accessed without amplifiers being locked out, although this is only controlled procedurally. Without RF power, there is no non-ionizing radiation hazard.</li> <li>P - If a key is used to open the enclosure door, interlocks are dropped, preventing RF power from being applied.</li> <li>P - Enclosure acts as a shield to those outside the enclosure.</li> <li>M - RF antennas are installed both in the enclosure and outside the enclosure near the amplifiers to detect stray RF. When stray RF signals received by any one of these antennas exceeds the preset threshold, the interlock system will shut off RF amplifiers. This detecting/interlocking system was tested and verified during the initial test (trial) operation of high-power RF system.</li> <li>P - RF Distribution system (Coax line and Waveguides etc.) outside the enclosure is rarely disassembled. If a distribution system needs to be opened, the amplifier connected to that system will be manually locked out first following LOTO procedure.</li> <li>P - Trained RF technicians install RF distribution system and work on amplifiers.</li> <li>P - Critical RF components (circulator, directional coupler, RF window) and amplifiers all have RF leakage specification and communicated with vendors during procurement process. The RF leakage of these</li> </ul>	L: BEU C: L R: IV
			components are measured and verified during acceptance tests to make sure they meet the specification.	

Likelihood (L, of event)/year	Consequence (C, of event)/year		Risk (R, Qualitative R	lanking)	Risk Matrix						
A = Anticipated (L > 1.0E-02)	$\mathbf{H} = \text{High}$		I = situation (event) of major concern					Like	lihood		
U = Unlikely (1.0E-02 > L > 1.0E-04)	$\mathbf{M} = \mathbf{M}$ oderate $\mathbf{L} = \mathbf{Low}$		II = situation (event) of concern			1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)				<b>III</b> = situation (event) of minor concern			Н	I	I	II	III
<b>BEU</b> = 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)	Onsit	te-2 (co-located worker)	Onsite-1 (facility worker)	]    -		***	***	***	***
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ 25.0 rem		<b>C</b> ≥ 100 rem	<b>C</b> ≥ 100 rem	Ous	L	III	III	IV	IV
<b>M</b> = Mitigative (reduces event consequences)	M	$25.0 \text{ rem} > \mathbf{C} \ge 5 \text{ rem}$	10	$00 \text{ rem} > \mathbf{C} \ge 25 \text{ rem}$	$100 \text{ rem} > \mathbf{C} \ge 25 \text{ rem}$		N	IV	IV	IV	IV
Acronyms	-	5 rem > C	10	$\frac{25 \text{ rem} > \mathbf{C}}{25 \text{ rem} > \mathbf{C}}$	25 rem > C						
<b>MOI</b> = Maximally-exposed Offsite Individual	L					4					
rem = Roentgen equivalent man	N	$0.5 \text{ rem} > \mathbf{C}$		$5 \text{ rem } > \mathbf{C}$	5 rem > C						

**Table 2.3 Radiological – MOI 1 Offsite** 

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Prompt Ionizing Radiation	Hazard: Ionizing radiation generated by operation of SRF Cavities	L: U C: H R: I	<ul> <li>P - Site access is prevented through security checkpoints.</li> <li>P - Security presence on-site would identify people in non-public areas.</li> <li>P - All doors to CMTF are locked and nearly all doors are opened using key cards preventing unwanted and untracked access.</li> <li>P - Workers in the building do notice unusual guests and question why the person is in the building.</li> <li>P - Enclosure is locked and keys are only issued through a locked system opened by the main control room.</li> <li>P - If the enclosure door was to be forced open, interlocks would drop and the interlock system would inhibit power being applied to the cavities through the amplifiers.</li> <li>M - MOI is unlikely to be able to operate the controls system to apply power to cavities.</li> </ul>	L: BEU C: M R: IV
			P – Controls consoles are password protected.	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive Waste	Hazard: Possibly activated material from accelerated dark current.	L: A C: L R: III	<ul> <li>P - Site access is prevented through security checkpoints.</li> <li>P - Security presence on-site would identify people in non-public areas.</li> <li>P - All doors to CMTF are locked and nearly all doors are opened using key cards preventing unwanted and untracked access.</li> <li>P - Workers in the building do notice unusual guests and question why the person is in the building.</li> </ul>	L: BEU C: N R: IV
Radiation Generating Devices (RGDs)	Hazard: Ionizing radiation generated by operation of SRF Cavities	L: U C: H R: I	<ul> <li>P - Site access is prevented through security checkpoints.</li> <li>P - Security presence on-site would identify people in non-public areas.</li> <li>P - All doors to CMTF are locked and nearly all doors are opened using key cards preventing unwanted and untracked access.</li> <li>P - Workers in the building do notice unusual guests and question why the person is in the building.</li> <li>P - Enclosure is locked and keys are only issued through a locked system opened by the main control room.</li> <li>P - If the enclosure door was to be forced open, interlocks would drop and the interlock system would inhibit power being applied to the cavities through the amplifiers.</li> <li>M - MOI is unlikely to be able to operate the controls system to apply power to cavities.</li> <li>P - Controls consoles are password protected.</li> </ul>	L: BEU C: M R: IV

Non-ionizing	Hazard: RF leakage	L: U	P – Site access is prevented through security checkpoints.	L: BEU
Radiation		C: M	P – Security presence on-site would identify people in non-public areas.	C: L
Hazards		R: II	P – All doors to CMTF are locked and nearly all doors are opened using	R: IV
			key cards preventing unwanted and untracked access.	
			P – Workers in the building do notice unusual guests and question why	
			the person is in the building.	
			P – Enclosure is not allowed to be accessed without amplifiers being	
			locked out. Without RF power, there is no non-ionizing radiation hazard.	
			P – Enclosure is locked and keys are only obtained after verifying	
			training credentials.	
			P – If a key is used to open the enclosure door, interlocks are dropped,	
			preventing RF power from being applied.	
			P – Enclosure acts as a shield to those outside the enclosure.	
			M – RF antennas are installed both in the enclosure and outside the	
			enclosure near the amplifiers to detect stray RF. When stray RF	
			signals received by any one of these antennas exceeds the preset	
			threshold, the interlock system will shut off RF amplifiers. This	
			detecting/interlocking system was tested and verified during the	
			initial test (trial) operation of high-power RF system.	
			P – RF Distribution system (Coax line and Waveguides etc.) outside the	
			enclosure is rarely disassembled. If a distribution system needs to be	
			opened, amplifier connected to that system will be manually locked	
			out first following LOTO procedure.	
			P – Qualified RF technicians install RF distribution system and work on	
			amplifiers.	
			P – Critical RF components (circulator, directional coupler, RF window)	
			and amplifiers all have RF leakage specification and communicated	
			with vendors during procurement process. The RF leakage of these	
			components are measured and verified during acceptance tests to	
			make sure they meet the specification.	

Likelihood (L, of event)/year	Consequence (C, of event)/year		Risk (R, Qualitative R	anking)	Risk Matrix						
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \text{High}$ $\mathbf{I} = \text{situation (event) of major concern}$					Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ derate $\mathbf{II} = \mathbf{Situation}$ (event) of concern		nt) 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 (event) of minor concern IV = situation (event) of minimal concern			Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)							M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsi	te-2 (co-located worker)	Onsite-1 (facility worker)	edn	т .	TTT	TIT	IV	IV
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ 25.0 rem		C ≥ 100 rem	<b>C</b> ≥ 100 rem	Suo	L	III	III	IV	IV
<b>M</b> = Mitigative (reduces event consequences)	M	$25.0 \text{ rem} > \mathbf{C} \ge 5 \text{ rem}$	10	$00 \text{ rem} > \mathbf{C} \ge 25 \text{ rem}$	100 rem > C ≥ 25 rem		N	IV	IV	IV	IV
Acronyms  MOI - Maximally averaged Offsite Individual	L	5 rem > C		25 rem > C	25 rem > C						
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	N	$0.5 \text{ rem} > \mathbf{C}$		5 rem > C	5 rem > C						

Table 2.7 Flammable and Combustible Materials – Onsite -1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Combustible		L:	See Section I Chapter 04	L:
materials (cables,		C:		C:
Boxes, Paper,		R:		R:
wood cribbing,				
etc.)				
Flammable		L:	See Section I Chapter 04	L:
Materials		C:		C:
(Flammable gas,		R:		R:
cleaning				
materials, etc.)				

Other Hazard Consequences, derived from Figure C-	l, "E	Example Qualitative Cons	equence Matrix", DOE-HI	DBK-1163-2020.						
Likelihood (L, of event)/year  A = Anticipated (L > 1.0E-02)  U = Unlikely (1.0E-02> L > 1.0E-04)	C	onsequence (C, of event)/y H = High M = Moderate	I = situation (even	ent) of major concern	Risk	isk Matrix Likelih A U			lihood EU	BEU
EU = Extremely Unlikely $(1.0E-04 > L > 1.0E-06)$ BEU = Beyond Extremely Unlikely $(1.0E-06 > L)$		$\mathbf{L} = \mathbf{Low}$ $\mathbf{N} = \mathbf{Negligible}$	III = situation (e	II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern			I	I	II III	III IV
Control(s) Type  P = Preventive (reduce event occurrence likelihood)  M = Mitigative (reduces event consequences)  Acronyms  MOI = Maximally-exposed Offsite Individual	C H	C ≥ Irreversible, other serious effects, or symptoms which	Onsite-2 (co-located worker)  C ≥ Prompt worker fatality or acute injury that is immediately life- threatening or permanently disabling.	Onsite-1 (facility worker)  C ≥ Prompt worker fatality or acute injury that is immediately life- threatening or permanently disabling.	Consequences	L N	III IV	III IV	IV IV	IV IV
	M L	C ≥ Mild, transient adverse effects.  Mild, transient adverse effects > C	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.  Minor injuries; no hospitalization > C	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.  Minor injuries; no hospitalization > C						
	N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level						

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Combustible		L:	See Section I Chapter 04	L:
materials (cables,		C:		C:
Boxes, Paper,		R:		R:
wood cribbing,				
etc.)				
Flammable		L:	See Section I Chapter 04	L:
Materials		C:		C:
(Flammable gas,		R:		R:
cleaning				
materials, etc.)				

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

Table 2.9 Flammable and Combustible Materials – MOI 1 Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Combustible materials (cables, Boxes, Paper, wood cribbing, etc.)		L: C: R:	See Section I Chapter 04	L: C: R:
Flammable Materials (Flammable gas, cleaning materials, etc.)		L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk	Matri	ix				
A = Anticipated (L > 1.0E-02)		$\hat{\mathbf{H}} = \text{High}$		I = situation (ever	ent) of major concern				Like	lihood		
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (evolution)	ent) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		<b>III</b> = situation (ev	vent) of minor concern	S	Н	I	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible			vent) of minimal concern	Consequences	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	nba		***				
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C > P	rompt worker fatality	C ≥ Prompt worker	ous	L	III	III	IV	IV	
<b>M</b> = 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		mmediately 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								
		action.										
	M	C ≥ Mild, transient	C	≥ Serious injury, no	C ≥ Serious injury, no							
		adverse effects.		ediate loss of life no	immediate loss of life no							
			per	manent disabilities;	permanent disabilities;							
			hosp	oitalization required.	hospitalization required.							
	L	Mild, transient	N	Minor injuries; no	Minor injuries; no							
		adverse effects > C	h	ospitalization > C	hospitalization > C							
	N	Consequences less	Cor	sequences less than	Consequences less than							
		than those for Low	those	for Low Consequence	those for Low							
		Consequence Level		Level	Consequence Level							
	N	Consequences less	Cor	sequences less than	Consequences less than							
		than those for Low	those	for Low Consequence	those for Low							
		Consequence Level		Level	Consequence Level							

Table 2.10 Electrical Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitativ e Risk (with controls)
Stored Energy Exposure	Hazards: Shock hazard, >50 V, Non- interlocked enclosures	L: C: R:	See Section I Chapter 04	L: C: R:
	Arc Flash, <u>Non-interlocked</u> <u>enclosures</u>	L: C: R:	See Section I Chapter 04	L: C: R:
Stored Energy Exposure	Hazards: Shock hazard, >50 V, <u>Interlocked</u> enclosures	L: C: R:	See Section I Chapter 04	L: C: R:
	Arc Flash, <u>Interlocked enclosures</u>	L: C: R:	See Section I Chapter 04	L: C: R:
High Voltage Exposure	Hazards: Shock hazard, voltage > 50 V, <u>Non-interlocked enclosures</u>	L: C: R:	See Section I Chapter 04	L: C: R:
	Arc Flash, <u>Non-interlocked</u> enclosures	L: C: R:	See Section I Chapter 04	L: C: R:

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

Other Hazard Consequences, derived from Figure C-	1, "E	Example Qualitative Cons	sequence Matrix", DOE-HE	DBK-1163-2020.						
Likelihood (L, of event)/year  A = Anticipated (L > 1.0E-02)  U = Unlikely (1.0E-02> L > 1.0E-04)  EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)  BEU = Beyond Extremely Unlikely (1.0E-06> L)		onsequence (C, of event)/ = High i = Moderate = Low = Negligible	Yyear Risk (R, Qualitative I = situation (event) of II = situation (event) III = situation (event) IV = situation (event)	of major concern of concern ) of minor concern	Risk Matrix					
Control(s) Type	C		Onsite-2 (co-located worker)				A	U	<b>lihood</b> EU	BEU
<ul> <li>P = Preventive (reduce event occurrence likelihood)</li> <li>M = Mitigative (reduces event consequences)</li> <li>Acronyms</li> </ul>	Н	C ≥ Irreversible,	$C \ge Prompt$ worker fatality	C ≥ Prompt worker	C	Н	I	I	II	III
		other serious effects,	or acute injury that is immediately life-	fatality or acute injury that is immediately life-	o n	M	II	II	III	IV
<b>MOI</b> = Maximally-exposed Offsite Individual		or symptoms which could impair an	threatening or permanently	threatening or permanently	s e	L	III	III	IV	IV
		individual's ability to take protective action.	disabling.	disabling.	q u e					
	M	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	n c e s	N	IV	IV	IV	IV
	L	Mild, transient adverse effects > C	Minor injuries; no hospitalization > C	Minor injuries; no hospitalization > C						
		Consequences less than those for Low	Consequences less than those for Low Consequence	Consequences less than those for Low						
		Consequence Level	Level	Consequence Level						

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitativ e Risk (with controls)
Stored Energy Exposure	Hazards: Shock hazard, >50 V, <u>Non-interlocked enclosures</u>	L: C: R:	See Section I Chapter 04	L: C: R:
	Arc Flash, <u>Non-interlocked</u> <u>enclosures</u>	L: C: R:	See Section I Chapter 04	L: C: R:
Stored Energy Exposure	Hazards: Shock hazard, >50 V, <u>Interlocked</u> enclosures	L: C: R:	See Section I Chapter 04	L: C: R:
	Arc Flash, <u>Interlocked enclosures</u>	L: C: R:	See Section I Chapter 04	L: C: R:
High Voltage Exposure	Hazards: Shock hazard, voltage > 50 V, <u>Non-interlocked enclosures</u>	L: C: R:	See Section I Chapter 04	L: C: R:
	Arc Flash, <u>Non-interlocked</u> enclosures	L: C: R:	See Section I Chapter 04	L: C: R:

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year  A = Anticipated (L > 1.0E-02)  U = Unlikely (1.0E-02> L > 1.0E-04)  EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)  BEU = Beyond Extremely Unlikely (1.0E-06> L)	H M L	onsequence (C, of event)/ = High [ = Moderate = Low = Negligible	I = situation (event) II = situation (event) III = situation (event)	Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern			ix				
Control(s) Type	C		Onsite-2 (co-located worker)	IV = situation (event) of minimal concern -2 (co-located worker) Onsite-1 (facility worker)			A	Like	EU	BEU	
<b>D</b> D (1 / 1 1 1 1)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality		С	Н	I	I	II	III	
		other serious effects, or symptoms which	or acute injury that is immediately life-	fatality or acute injury that is immediately life-	o n	M	П	II	III	IV	
MOI = Maximally-exposed Offsite Individual		could impair an	could impair an threatening or permanently t		s e	L	Ш	III	IV	IV	
		individual's ability to take protective action.	disabling.	disabling.	q u e						
	M	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	n c e s	N	IV	IV	IV	IV	
	L	Mild, transient adverse effects > C	Minor injuries; no hospitalization > C	Minor injuries; no hospitalization > C							
		Consequences less than those for Low	Consequences less than those for Low Consequence	Consequences less than							
		Consequence Level	Level	Consequence Level							

**Table 2.12 Electrical Energy – MOI Offsite** 

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

Other Hazard Consequences, derived from Figure C-	1, "F	Example Qualitative Con	sequence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year  A = Anticipated (L > 1.0E-02)  U = Unlikely (1.0E-02> L > 1.0E-04)  EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)  BEU = Beyond Extremely Unlikely (1.0E-06> L)	H M L	onsequence (C, of event) = High I = Moderate = Low = Negligible	year Risk (R, Qualitative I = situation (event) o II = situation (event) III = situation (event) IV = situation (event)	of major concern of concern of minor concern	Risk	k Matri	x			
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)				A	Like	<b>lihood</b> EU	BEU
	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	C	Н	I	I	II	III
Acronyms		other serious effects, or symptoms which	or acute injury that is immediately life-	fatality or acute injury that is immediately life-	o n	M	II	II	III	IV
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or permanently	s	L	III	III	IV	IV
		individual's ability to take protective action.	disabling.	disabling.	q u e					
	M	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	n c e s	N	IV	IV	IV	IV
	L	Mild, transient adverse effects > C	Minor injuries; no hospitalization > C	Minor injuries; no hospitalization > C						
		Consequences less than those for Low	Consequences less than those for Low Consequence	Consequences less than those for Low						
		Consequence Level	Level	Consequence Level						

Table 2.13 Thermal Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Cryogenic	Hazard: Exposure to Oxygen	L:	See Section I Chapter 04	L:
Liquids	Deficiency Hazard (ODH) due to	C:		C:
	uncontrolled release of cryogenic	R:		R:
	liquid or gas			

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

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Cryogenic	Hazard: Exposure to Oxygen	L:	See Section I Chapter 04	L:
Liquids	Deficiency Hazard (ODH) due to	C:		C:
	uncontrolled release of cryogenic	R:		R:
	liquid or gas			

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)/ye	ar Risk (R, Qualitative	Ranking)	Risk Matrix							
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (eve	nt) of major concern				Like	lihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (even	ent) of concern		ı	A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	III = situation (ev	vent) of minor concern	ses	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	ienc	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	nsite-2 (co-located worker)	Onsite-1 (facility worker)	sedneuces	L	TTT	III	IV	IV		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible, C	≥ Prompt worker fatality	C ≥ Prompt worker	Cons	L	III	111	1 V	1 V		
<b>M</b> = 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 could impair an individual's ability to take protective action.	immediately life- reatening or permanently disabling.	is immediately life- threatening or permanently disabling.								
	M		C ≥ Serious injury, no mmediate loss of life no permanent disabilities; hospitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization > C								
	N	Consequences less	Consequences less than	Consequences less than								
		than those for Low the	ose for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

**Table 2.15** Thermal Energy – MOI 1 Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Cryogenic	Hazard: Exposure to Oxygen	L:	See Section I Chapter 04	L:
Liquids	Deficiency Hazard (ODH) due to	C:		C:
	uncontrolled release of cryogenic	R:		R:
	liquid or gas	K.		K.

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)/ye	ar Risk (R, Qualitative	Ranking)	Risk	Matri	ix					
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		nt) of major concern				Likelihood		DELL		
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)		$\mathbf{L} = \mathbf{Low}$	-	vent) of minor concern	ses	Н	1	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		vent) of minimal concern	nen	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	nsite-2 (co-located worker)	Onsite-1 (facility worker)	sednences	T.	III	III	IV	IV		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible, C	? ≥ Prompt worker fatality	C ≥ 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 - Mayimally avacced Offsite Individual		or symptoms which	immediately life-	is immediately life-								
MOI = Maximally-exposed Offsite Individual		_	reatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective										
	2.7	action.	a. a	a. a								
	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 > C								
	N	-	Consequences less than	Consequences less than								
			ose for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

Table 2.16 Kinetic Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power Tools	Hazard: Personnel injury due to improper use of power tools	L: C:	See Section I Chapter 04	L: C:
		R:		R:
Pumps and		L:	See Section I Chapter 04	L:
Motors		C:		C:
		R:		R:

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

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

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

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

**Table 2.18 Kinetic Energy – MOI 1 Offsite** 

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.													
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year   Risk (R, Qualitative	Ranking)	Risk	Matr	ix						
A = 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)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (ev	ent) of concern		ı	A	U	EU	BEU			
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	<b>III</b> = situation (e	vent) of minor concern	nces	Н	I	I	II	III			
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	$IV = situation (e^{-1})$	vent) of minimal concern	(a)	M	II	II	III	IV			
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	edno	т.	TTT	111	17.7	13.7			
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	$C \ge Prompt$ worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV			
<b>M</b> = Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV			
Acronyms		or symptoms which	immediately life-	is immediately life-					•				
<b>MOI</b> = Maximally-exposed Offsite Individual		, ı	threatening or permanently	threatening or									
		individual's ability to	disabling.	permanently disabling.									
		take protective	8	7 8									
		action.											
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no									
		adverse effects.	immediate loss of life no	immediate loss of life no									
			permanent disabilities;	permanent disabilities;									
			hospitalization required.	hospitalization required.									
	L	Mild, transient	Minor injuries; no	Minor injuries; no									
		adverse effects > C	hospitalization > C	hospitalization > C									

**Table 2.19 Potential Energy – Onsite-1 Facility Worker** 

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

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

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

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

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

**Table 2.21 Potential Energy – MOI 1 Offsite** 

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

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

**Table 2.22 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 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)/y	year Risk (R, Qualitative	Ranking)	Risk	Matri	ix		-			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (eve	situation (event) of major concern				Like	elihood			
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (ev	ent) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situation (e	vent) of minor concern	s	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	ences	M	II	П	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	· ·	TTT	777	77.7	77.7		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	$C \ge Prompt worker fatality$	C ≥ Prompt worker	=	L	III	III	IV	IV		
<b>M</b> = Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	ŭ	N	IV	IV	IV	IV		
Acronyms		or symptoms which	immediately life-	is immediately life-								
<b>MOI</b> = Maximally-exposed Offsite Individual		· 1	threatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective	5									
		action.										
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization > C								
	N	Consequences less	Consequences less than	Consequences less than								
		than those for Low t	those for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

Table 2.23 Magnetic Fields – Onsite-2 Co-located Worker

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	C	onsequence (C, of event)/y	vear Risk (R, Qualitative	Ranking)	Risk	Matri	ix				
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (even	nt) of major concern				Like	lihood		
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)		L = Low	III = situation (ev	vent) of minor concern	es	Н	I	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible	<b>IV</b> = situation (ev	vent) of minimal concern	enc	M	П	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sednences	_	***	***	***	***	
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV	
<b>M</b> = Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	0	N	IV	IV	IV	IV	
Acronyms		or symptoms which	immediately life-	is immediately life-							
<b>MOI</b> = Maximally-exposed Offsite Individual			threatening or permanently	threatening or							
		individual's ability to	disabling.	permanently disabling.							
		take protective	S	1 3 5							
		action.									
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no							
		adverse effects.	immediate loss of life no	immediate loss of life no							
			permanent disabilities;	permanent disabilities;							
			hospitalization required.	hospitalization required.							
	L	Mild, transient	Minor injuries; no	Minor injuries; no							
		adverse effects > C	hospitalization > C	hospitalization > C							
	N	Consequences less	Consequences less than	Consequences less than							
		than those for Low t	those for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

**Table 2.24 Magnetic Fields – MOI 1 Offsite** 

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	C	onsequence (C, of event)/y	year Risk (R, Qualitative	Ranking)	Risk	Matri	ix				
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (ever	nt) of major concern				Like	lihood		
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (evolution)	ent) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	<b>III</b> = situation (ev	vent) of minor concern	sə	Н	I	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible	<b>IV</b> = situation (ev	vent) of minimal concern	enc	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sednences		TTT	TTT	77.7	YX /	
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV	
<b>M</b> = Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV	
Acronyms		or symptoms which	immediately life-	is immediately life-				•	•		
MOI = Maximally-exposed Offsite Individual			threatening or permanently	threatening or							
		individual's ability to	disabling.	permanently disabling.							
		take protective	<u> </u>								
		action.									
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no							
		adverse effects.	immediate loss of life no	immediate loss of life no							
			permanent disabilities;	permanent disabilities;							
			hospitalization required.	hospitalization required.							
	L	Mild, transient	Minor injuries; no	Minor injuries; no							
		adverse effects > C	hospitalization > C	hospitalization > C							
	N	Consequences less	Consequences less than	Consequences less than							
		than those for Low t	those for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

Table 2.25 Other hazards – Onsite-1 Facility Worker

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

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

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

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

Other Hazard Consequences, derived from Figure C-	Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year A = Anticipated (L > 1.0E-02)	C	onsequence (C, of event)/ye H = High		Ranking) ent) of major concern	Risk	Matri			lihood			
U = Unlikely (1.0E-02> L >1.0E-04) EU = Extremely Unlikely (1.0E-04 > L >1.0E-06) BEU = Beyond Extremely Unlikely (1.0E-06> L)		<ul><li>M = Moderate</li><li>L = Low</li><li>N = Negligible</li></ul>		ent) of concern vent) of minor concern vent) of minimal concern	sou	Н	I	I	EU II	BEU		
Control(s) Type  P = Preventive (reduce event occurrence likelihood)  M = Mitigative (reduces event consequences)  Acronyms  MOI = Maximally-exposed Offsite Individual	С	Offsite (MOI) O	nsite-2 (co-located worker)  E > Prompt worker fatality	Onsite-1 (facility worker)  C ≥ Prompt worker	Consequences	M L	III	III	IV	IV IV		
		other serious effects, or symptoms which	or acute injury that is immediately life-threatening or permanently disabling.	fatality or acute injury that is immediately life-threatening or permanently disabling.	ŭ	N	IV	IV	IV	IV		
	M L		C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.  Minor injuries; no hospitalization > C	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.  Minor injuries; no hospitalization > C								
	N	Consequences less than those for Low Consequence Level	Consequences less than nose for Low Consequence Level	Consequences less than those for Low Consequence Level								

**Table 2.27 Other hazards – MOI 1 Offsite** 

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

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

Table 2.28 Access & Egress – Onsite-1 Facility Worker

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

Other Hazard Consequences, derived from Figure C-	1, "E	Example Qualitative Cons	sequence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year Risk (R, Qualitative	Ranking)	Risk	Matri	ix			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (eve	<b>I</b> = situation (event) of major concern				elihood		
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (ev	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situation (e	vent) of minor concern	es	Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ex	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)	mbəs		TTT	TTT	17.7	17.7
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV
<b>M</b> = Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV
Acronyms		or symptoms which	immediately life-	is immediately life-						•
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or						
		individual's ability to	disabling.	permanently disabling.						
		take protective	Č							
		action.								
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no						
		adverse effects.	immediate loss of life no	immediate loss of life no						
			permanent disabilities;	permanent disabilities;						
			hospitalization required.	hospitalization required.						
	L	Mild, transient	Minor injuries; no	Minor injuries; no						
		adverse effects > C	hospitalization > C	hospitalization > C						
	N	Consequences less	Consequences less than	Consequences less than						
		than those for Low	those for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

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

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year Consequence (C, of event)/year			vear Risk (R, Qualitative	Risk (R, Qualitative Ranking) Risk				Risk Matrix				
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (ever	I = situation (event) of major concern				Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (eve	II = situation (event) 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	s	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06 > L)$		N = Negligible	<b>IV</b> = situation (ev	vent) of minimal concern	enc	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sednences	- T	TTT	777	13.7	13.7		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
<b>M</b> = Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that		N	IV	IV	IV	IV		
Acronyms		or symptoms which	immediately life-	is immediately life-								
MOI = Maximally-exposed Offsite Individual			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 > C	hospitalization > C	hospitalization $> C$								
	N	Consequences less	Consequences less than	Consequences less than								
		than those for Low t	those for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

**Table 2.30 Access & Egress – MOI 1 Offsite** 

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

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

**Table 2.31 Environmental** 

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