

Table 5. Summary of Baseline and Residual Risks – Linac

Risk Tables Description		Baseline Risk	Residual Risk
5.1	Radiological – Onsite-1 Facility Worker	R: I	R: III
5.2	Radiological – Onsite-2 Co-located Worker	R: I	R: III
5.3	Radiological – MOI Offsite	R: I	R: IV
5.4	Toxic Materials – Onsite 1 Facility Worker	R: *	R: *
5.5	Toxic Materials – Onsite 2 Co-located Worker	R: *	R: *
5.6	Toxic Materials – MOI Offsite	R: *	R: *
5.7	Flammable & Combustible Materials – Onsite-1 Facility Worker	R: I, *	R: IV, *
5.8	Flammable & Combustible Materials – Onsite-2 Co-located worker	R: I, *	R: IV, *
5.9	Flammable & Combustible Materials – MOI Offsite	R: *	R: *
5.10	Electrical Energy – Onsite-1 Facility Worker	R: I, *	R: IV, *
5.11	Electrical Energy – Onsite-2 Co-located Worker	R: I, *	R: IV, *
5.12	Electrical Energy – MOI Offsite	R: *	R: *
5.13	Thermal Energy – Onsite-1 Facility Worker	R: *	R: *
5.14	Thermal Energy – Onsite-2 Co-located Worker	R: *	R: *
5.15	Thermal Energy – MOI Offsite	R: *	R: *
5.16	Kinetic Energy – Onsite-1 Facility Worker	R: *	R: *
5.17	Kinetic Energy – Onsite-2 Co-located Worker	R: *	R: *
5.18	Kinetic Energy – MOI Offsite	R: *	R: *
5.19	Potential Energy- Onsite-1 Facility Worker	R: *	R: *
5.20	Potential Energy – Onsite-2 Co-located Worker	R: *	R: *
5.21	Potential Energy – MOI Offsite	R: *	R: *
5.22	Magnetic Fields – Onsite-1 Facility Worker	R: I	R: III
5.23	Magnetic Fields – Onsite-2 Co-located Worker	R: I	R: III
5.24	Magnetic Fields – MOI Offsite	R: N/A	R: N/A
5.25	Other Hazards – Onsite-1 Facility Worker	R: *	R: *
5.26	Other Hazards – Onsite-2 Co-located Worker	R: *	R: *
5.27	Other Hazards – MOI Offsite	R: *	R: *
5.28	Access & Egress – Onsite-1 Facility Worker	R: *	R: *
5.29	Access & Egress – Onsite-2 Co-located Worker	R: *	R: *
5.30	Access & Egress – MOI Offsite	R: *	R: *
5.31	Environmental Hazards	R: *	R: *
<p>* This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04 <i>Safety Analysis</i>. Work in the specified areas involving this hazard implements the controls specified in the common Risk Matrix table. No unique controls are in use.</p> <p>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).</p>			

Table 5.1 Radiological – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (P)/Mitigative (M) Bold are Credited Controls	Residual Qualitative Risk (with controls)
Prompt Ionizing Radiation	<p><i>Hazards: Exposure to ionizing radiation from beam</i></p> <p><i>Exposure to ionizing radiation from klystrons</i></p>	<p>L: A C: H R: I</p> <p>L: A C: M R: II</p>	<p>M – Shielding (Permanent, Movable, Penetration) P/M – Radiation Safety Interlock System P – Enclosure Search and Secure Process P – Operation Authorization Document P – Staffing P – Fencing and Posting P – Employee Training P – Procedures</p> <p>P – Proper operation of klystron M – Shielding M – ESH gallery radiation surveys</p>	<p>L: BEU C: N R: IV</p> <p>L: A C: N R: IV</p>
Residual Activation	<i>Hazard: Radiation exposure</i>	<p>L: A C: H R: I</p>	<p>P – Employee Rad Worker training P – ALARA plan M – Shielding to reduce activation M – Proper dosimetry</p>	<p>L: EU C: L R: IV</p>
Radioactive Waste	<i>Hazard: Radiation exposure</i>	<p>L: A C: H R: I</p>	<p>P – Postings P – Beam tuned to reduce beam loss to reduce generation of waste M – Shielding to reduce generation of waste M – Material survey and release process</p>	<p>L: EU C: L R: IV</p>

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (P)/Mitigative (M) Bold are Credited Controls	Residual Qualitative Risk (with controls)
Contamination	<i>Hazard: Personnel exposure</i>	L: A C: H R: I	P – Radiological controls personnel survey and decontamination P – Postings place in the event contamination is identified M – Shielding to reduce activation M – Proper PPE specified in RWP	L: EU C: L R: IV
Non-ionizing Radiation – Laser	<i>Hazards: Exposure to Class 3B and 4 lasers</i> <i>Exposure to Class 3R lasers</i> <i>Exposure to Class 1 and 2 Lasers</i>	L: A C: H R: I L: A C: L R: III L: A C: N R: IV	P – Class 1 (light tight) enclosures P – ORC and work planning processes P – Locked/Interlocked system P – LOTO procedure or other procedure approved by the LSO P – Affected areas are posted M – Use of PPE No analysis required No analysis required	L: BEU C: M R: IV L: A C: L R: III L: A C: N R: IV
Non-ionizing Radiation – RF	<i>Hazard: Exposure from RF energy above allowed limits</i>	L: A C: M R: II	P – RF Shielding P – ES&H periodic monitoring P – LOTO procedure P – Affected area postings	L: BEU C: M R: IV

Radiological 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 ($1.0E-06 > L$)	Consequence (C, of event)/year H = High M = Moderate L = Low N = Negligible			Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern			Risk Matrix <table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>							Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
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	H	$C \geq 25.0 \text{ rem}$	$C \geq 100 \text{ rem}$	$C \geq 100 \text{ rem}$																																						
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	L	$5 \text{ rem} > C$	$25 \text{ rem} > C$	$25 \text{ rem} > C$																																						
	N	$0.5 \text{ rem} > C$	$5 \text{ rem} > C$	$5 \text{ rem} > C$																																						

Table 5.2 Radiological – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (P)/Mitigative (M) Bold are Credited Controls	Residual Qualitative Risk (with controls)
Prompt Ionizing Radiation	<p><i>Hazards: Exposure to ionizing radiation from beam</i></p> <p><i>Exposure to ionizing radiation from klystrons</i></p>	<p>L: A C: H R: I</p> <p>L: A C: M R: II</p>	<p>M – Shielding (Permanent, Movable, Penetration) P/M – Radiation Safety Interlock System P – Enclosure Search and Secure Process P – Operation Authorization Document P – Staffing P – Fencing and Posting P – Employee Training P – Procedures</p> <p>P – Proper operation of klystron M – Shielding M – ESH gallery radiation surveys</p>	<p>L: BEU C: N R: IV</p> <p>L: A C: N R: IV</p>
Residual Activation	<i>Hazard: Radiation exposure</i>	<p>L: A C: H R: I</p>	<p>P – Employee Rad Worker training P – ALARA plan M – Shielding to reduce activation M – Proper dosimetry</p>	<p>L: EU C: L R: IV</p>
Radioactive Waste	<i>Hazard: Radiation exposure</i>	<p>L: A C: H R: I</p>	<p>P – Postings P – Beam tuned to reduce beam loss M – Shielding to reduce generation of waste M – Material survey and release process</p>	<p>L: EU C: L R: IV</p>

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (P)/Mitigative (M) Bold are Credited Controls	Residual Qualitative Risk (with controls)
Contamination	<i>Hazard: Radiation exposure</i>	L: A C: H R: I	P – Radiological controls personnel survey and decontamination P – Postings place in the event contamination is identified M – Shielding to reduce generation of waste M – Material survey and release process	L: EU C: L R: IV
Non-ionizing Radiation – Laser	<i>Hazards: Exposure to Class 3B and 4 lasers</i>	L: A C: H R: I	P – Class 1 (light tight) enclosures P – Locked/Interlocked system or administrative control approved by the LSO P – LOTO procedure or other procedure approved by the LSO P – Affected areas are posted	L: BEU C: H R: IV
	<i>Exposure to Class 3R lasers</i>	L: A C: L R: III	No analysis required	L: A C: L R: III
	<i>Exposure to Class 1 and 2 Lasers</i>	L: A C: N R: IV	No analysis required	L: A C: N R: IV
Non-ionizing Radiation – RF	<i>Hazard: Exposure from RF energy above allowed limits</i>	L: A C: M R: II	P RF Shielding P ES&H periodic monitoring P LOTO procedure performed by facility worker P Affected area postings	L: BEU C: M R: IV

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

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Table 5.3 Radiological – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (P)/Mitigative (M) Bold are Credited Controls	Residual Qualitative Risk (with controls)
Prompt Ionizing Radiation	<p><i>Hazards: Exposure to ionizing radiation from beam</i></p> <p><i>Exposure to ionizing radiation from klystrons</i></p>	<p>L: A C: H R: I</p> <p>L:N/A C: R:</p>	<p>M – Shielding (Permanent, Movable, Penetration) P/M – Radiation Safety Interlock System P – Enclosure Search and Secure Process P – Operation Authorization Document P – Staffing P – Fencing and Posting</p> <p>Hazard does not apply to the public</p>	<p>L: BEU C: N R: IV</p> <p>L: N/A C: R:</p>
Residual Activation	<i>Hazard: Radiation exposure</i>	<p>L: N/A C: R:</p>	Hazard does not apply to the public	<p>L: N/A C: R:</p>
Radioactive Waste	<i>Hazard: Radiation exposure</i>	<p>L: N/A C: R:</p>	Hazard does not apply to the public	<p>L: N/A C: R:</p>
Contamination	<i>Hazard: Radiation exposure</i>	<p>L: N/A C: R:</p>	Hazard does not apply to the public	<p>L: N/A C: R:</p>
Non-ionizing Radiation – RF	<i>Hazard: Exposure from RF energy above allowed limits</i>	<p>L: A C: M R: II</p>	<p>P RF Shielding P ES&H periodic monitoring P Affected area postings</p>	<p>L: BEU C: M R: IV</p>

Radiological Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.																																				
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Table 5.4 Toxic Materials – Onsite 1 Facility Worker

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

Chemical Hazard Consequences, derived from Figure C-1, “Example Qualitative Consequence Matrix”, DOE-HDBK-1163-2020.																																					
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	Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)																																	
Acronyms IDLH = Immediately Dangerous to Life and Health MOI = Maximally-exposed Offsite Individual PAC = Protective Action Criteria PEL = Permissible Exposure Limit TLV _c = Threshold Limit Value (ceiling)	C					<table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>			Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
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		M	II	II	III		IV																														
L		III	III	IV	IV																																
N		IV	IV	IV	IV																																
H	$C \geq PAC-2$	$C \geq PAC-3$	$C \geq IDLH$																																		
M	$PAC-2 > C \geq PAC-1$	$PAC-3 > C \geq PAC-2$	$IDLH > C \geq PEL$ or TLV_c																																		
L	$PAC-1 > C$	$PAC-2 > C$	PEL or $TLV_c > C$																																		
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 5.5 Toxic Materials – Onsite 2 Co-located Worker

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

Chemical 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)	Consequence (C, of event)/year H = High M = Moderate L = Low N = Negligible		Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern		Risk Matrix																															
	Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences)	C	Offsite (MOI)	Onsite-2 (co-located worker)		Onsite-1 (facility worker)																														
Acronyms IDLH = Immediately Dangerous to Life and Health MOI = Maximally-exposed Offsite Individual PAC = Protective Action Criteria PEL = Permissible Exposure Limit TLV _c = Threshold Limit Value (ceiling)	H	C ≥ PAC-2	C ≥ PAC-3	C ≥ IDLH	<table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>			Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
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		M	II	II		III	IV																													
L		III	III	IV	IV																															
N		IV	IV	IV	IV																															
M	PAC-2 > C ≥ PAC-1	PAC-3 > C ≥ PAC-2	IDLH > C ≥ PEL or TLV_c																																	
L	PAC-1 > C	PAC-2 > C	PEL or TLV_c > 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 5.6 Toxic Materials – MOI Offsite

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

Chemical 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 ($1.0E-06 > L$)	Consequence (C, of event)/year H = High M = Moderate L = Low N = Negligible		Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern		Risk Matrix <table border="1" data-bbox="1637 678 2038 895"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>			Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
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Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms IDLH = Immediately Dangerous to Life and Health MOI = Maximally-exposed Offsite Individual PAC = Protective Action Criteria PEL = Permissible Exposure Limit TLV _c = Threshold Limit Value (ceiling)	C H M L N	Offsite (MOI) C ≥ PAC-2 PAC-2 > C ≥ PAC-1 PAC-1 > C Consequences less than those for Low Consequence Level	Onsite-2 (co-located worker) C ≥ PAC-3 PAC-3 > C ≥ PAC-2 PAC-2 > C Consequences less than those for Low Consequence Level	Onsite-1 (facility worker) C ≥ IDLH IDLH > C ≥ PEL or TLV _c PEL or TLV _c > C Consequences less than those for Low Consequence Level																																

Table 5.7 Flammable and Combustible Materials – Onsite -1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (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.)	<i>Hazard: H2 leaking, igniting, and causing a fire.</i> <i>Other flammable materials</i>	L: A C: H R: I L: C: R:	P – Biannual leak inspections M – Hydrogen leak detectors M – Fire department response M – Evacuation training/evacuation drills See Section I Chapter 04	L: U C: N R: 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 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 ($1.0E-06 > L$)	Consequence (C, of event)/year H = High M = Moderate L = Low N = Negligible		Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern		Risk Matrix <table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>			Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
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Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)																																
	H	C ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.																																
	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.																																
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	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 5.8 Flammable and Combustible Materials – Onsite -2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (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.)	<i>Hazards: H2 leaking, igniting, and causing a fire.</i> <i>Other flammable materials</i>	L: A C: H R: I L: C: R	P – Biannual leak inspections M – Hydrogen leak detectors M – Fire department response M – Evacuation training/evacuation drills See Section I Chapter 04	L: U C: N R: 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 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 ($1.0E-06 > L$)	Consequence (C, of event)/year H = High M = Moderate L = Low N = Negligible		Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern		Risk Matrix <table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>			Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
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A			U	EU	BEU																															
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	H	C ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.																																
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	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 5.9 Flammable and Combustible Materials – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (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.)	<p><i>Hazards: H2 leak igniting and causing a fire</i></p> <p><i>Hazard: Other flammable materials</i></p>	<p>L: N/A C: R:</p> <p>L: C: R:</p>	<p>Hazard does not extend to offsite areas</p> <p>See Section I Chapter 04</p>	<p>L: N/A C: R:</p> <p>L: C: R:</p>

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 ($1.0E-06 > L$)	Consequence (C, of event)/year H = High M = Moderate L = Low N = Negligible		Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern		Risk Matrix <table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>			Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
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	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 5.10 Electrical Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Stored Energy Exposure	<i>Hazard: Capacitors stored in gallery present shock hazard.</i>	L:A C:M R:II	P – Store capacitors with terminals grounded P – Capacitor storage away from common areas P – Electrical worker training	L:BEU C:M R:IV
High Voltage Exposure		L: C: R:	See Section I Chapter 04	L: C: R:
Low Voltage, High Current Exposure.	<i>Hazards: Burns caused by contact with legacy conductors. The general controls in Section I, Ch. 4 are not applicable.</i> <i>Dropped tools causing arc flash</i>	L:U C:M R:II L:U C:H R:I	P – Insulating guards/closed cabinets prevent incidental contact P – Electrical worker training P – Removal of metallic jewelry P – Conductors are posted as: “Caution High Current” P – Insulating guards/closed cabinets prevent incidental contact P – Electrical worker training P – Conductors are posted as: “Caution High Current” M – Overcurrent protection	L:BEU C:M R:IV L:BEU C:M R:IV

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.																																				
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	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 5.11 Electrical Energy 1 Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Stored Energy Exposure	<i>Hazard: Capacitors stored in gallery present shock hazard.</i>	L:A C:M R:II	P – Store capacitors with terminals grounded P – Capacitor storage away from common areas P – Electrical worker training	L:BEU C:M R:IV
High Voltage Exposure		L: C: R:	See Section I Chapter 04	L: C: R:
Low Voltage, High Current Exposure.	<i>Hazards: Burns caused by contact with legacy conductors. The general controls in Section I, Ch. 4 are not applicable.</i> <i>Dropped tools causing arc flash</i>	L:U C:M R:II L:U C:H R:I	P – Insulating guards/closed cabinets prevent incidental contact P – Electrical worker training P – Removal of metallic jewelry P – Conductors are posted as: “Caution High Current” P – Insulating guards/closed cabinets prevent incidental contact P – Electrical worker training P – Conductors are posted as: “Caution High Current” M – Overcurrent protection	L:BEU C:M R:IV L:BEU C:M R:IV

Other Hazard Consequences, derived from Figure C-1, “Example Qualitative Consequence Matrix”, DOE-HDBK-1163-2020.

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Table 5.12 Electrical Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Stored Energy Exposure	<i>Hazard: Capacitors stored in gallery present shock hazard.</i>	L: C: R:	Hazard does not apply to the public.	L: C: R:
High Voltage Exposure		L: C: R:	See Section I Chapter 04	L: C: R:
Low Voltage, High Current Exposure.	<i>Hazards: Burns caused by contact with legacy conductors. The general controls in Section I, Ch. 4 are not applicable.</i> <i>Dropped tools causing arc flash</i>	L: C: R:	Hazard does not apply to the public.	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 ($1.0E-06 > L$)	Consequence (C, of event)/year H = High M = Moderate L = Low N = Negligible		Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern		Risk Matrix <table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>			Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
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Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)																																
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	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 5.13 Thermal Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Magnet Bakeouts		L: C: R:	See Section I Chapter 04	L: C: R:
Hot work		L: C: R:	See Section I Chapter 04	L: C: R:
Cryogenics		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 ($1.0E-06 > L$)	Consequence (C, of event)/year H = High M = Moderate L = Low N = Negligible		Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern		Risk Matrix <table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>			Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
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	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 5.14 Thermal Energy – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Magnet Bakeouts		L: C: R:	See Section I Chapter 04	L: C: R:
Hot work		L: C: R:	See Section I Chapter 04	L: C: R:
Cryogenics		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 ($1.0E-06 > L$)	Consequence (C, of event)/year H = High M = Moderate L = Low N = Negligible		Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern		Risk Matrix <table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>			Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
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Table 5.15 Thermal Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Magnet Bakeouts		L: C: R:	See Section I Chapter 04	L: C: R:
Hot work		L: C: R:	See Section I Chapter 04	L: C: R:
Cryogenics		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 ($1.0E-06 > L$)	Consequence (C, of event)/year H = High M = Moderate L = Low N = Negligible		Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern		Risk Matrix <table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>			Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
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Table 5.16 Kinetic Energy – Onsite-1 Facility Worker

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

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 ($1.0E-06 > L$)	Consequence (C, of event)/year H = High M = Moderate L = Low N = Negligible		Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern		Risk Matrix <table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>			Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
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Table 5.17 Kinetic Energy – Onsite-2 Co-located Worker

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

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 ($1.0E-06 > L$)	Consequence (C, of event)/year H = High M = Moderate L = Low N = Negligible		Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern		Risk Matrix <table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>			Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
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Table 5.18 Kinetic Energy – MOI Offsite

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

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 ($1.0E-06 > L$)	Consequence (C, of event)/year H = High M = Moderate L = Low N = Negligible		Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern		Risk Matrix <table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>			Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
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Table 5.19 Potential Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (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, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.

<p>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 ($1.0E-06 > L$)</p>	<p>Consequence (C, of event)/year H = High M = Moderate L = Low N = Negligible</p>		<p>Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern</p>		<p>Risk Matrix</p> <table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>			Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
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Table 5.20 Potential Energy – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (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:

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	H C ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.																																	
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	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 5.21 Potential Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (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, "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 ($1.0E-06 > L$)	Consequence (C, of event)/year H = High M = Moderate L = Low N = Negligible		Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern		Risk Matrix <table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>			Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
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	H	C ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.																																
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	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 5.22 Magnetic Fields – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields	<i>Hazard: Fringe fields causing heart pacemaker malfunction</i>	L: A C: H R: I	P – Work planning that warns about magnetic hazard. P – Magnetic hazard warning part of hazard specification sheet. P – Postings of magnetic field hazard at entry points.	L: BEU C: H R: III

Other Hazard Consequences, derived from Figure C-1, “Example Qualitative Consequence Matrix”, DOE-HDBK-1163-2020.																																				
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Table 5.23 Magnetic Fields – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields	<i>Hazard: Fringe fields causing heart pacemaker malfunction</i>	L: A C: H R: I	P – Work planning that warns about magnetic hazard. P – Magnetic hazard warning part of hazard specification sheet. P – Postings of magnetic field hazard at entry points.	L: BEU C: H R: III

Other Hazard Consequences, derived from Figure C-1, “Example Qualitative Consequence Matrix”, DOE-HDBK-1163-2020.																																				
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	H	C ≥ Irreversible, other serious effects, or symptoms which could impair an individual’s ability to take protective action.	C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	<table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>			Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
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Table 5.24 Magnetic Fields – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields		L: N/A C: R:	Hazard does not apply to the public.	L: N/A 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)	Consequence (C, of event)/year H = High M = Moderate L = Low N = Negligible		Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern		Risk Matrix																															
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Table 5.25 Other hazards – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces		L: C: R:	See Section I Chapter 04	L: C: R:
Noise		L: C: R:	See Section I Chapter 04	L: C: R:
Silica		L: C: R:	See Section I Chapter 04	L: C: R:
Ergonomics		L: C: R:	See Section I Chapter 04	L: C: R:
Asbestos		L: C: R:	See Section I Chapter 04	L: C: R:
Working at Heights		L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.																																				
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	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 5.26 Other hazards – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces		L: C: R:	See Section I Chapter 04	L: C: R:
Noise		L: C: R:	See Section I Chapter 04	L: C: R:
Silica		L: C: R:	See Section I Chapter 04	L: C: R:
Ergonomics		L: C: R:	See Section I Chapter 04	L: C: R:
Asbestos		L: C: R:	See Section I Chapter 04	L: C: R:
Working at Heights		L: C: R:	See Section I Chapter 04	L: C: R:

Other Hazard Consequences, derived from Figure C-1, “Example Qualitative Consequence Matrix”, DOE-HDBK-1163-2020.

<p>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 ($1.0E-06 > L$)</p>	<p>Consequence (C, of event)/year H = High M = Moderate L = Low N = Negligible</p>		<p>Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern</p>		<p>Risk Matrix</p> <table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>			Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
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Table 5.27 Other hazards – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces		L: C: R:	See Section I Chapter 04	L: C: R:
Noise		L: C: R:	See Section I Chapter 04	L: C: R:
Silica		L: C: R:	See Section I Chapter 04	L: C: R:
Ergonomics		L: C: R:	See Section I Chapter 04	L: C: R:
Asbestos		L: C: R:	See Section I Chapter 04	L: C: R:
Working at Heights		L: C: R:	See Section I Chapter 04	L: C: R:

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	M	II	II	III	IV																															
	L	III	III	IV	IV																															
	N	IV	IV	IV	IV																															
Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual	C Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)																																	
	H C ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.																																	
	M C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.																																	
	L Mild, transient adverse effects > C	Minor injuries; no hospitalization > C	Minor injuries; no hospitalization > C																																	
	N Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level																																	

Table 5.28 Access & Egress – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety Egress		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)	Consequence (C, of event)/year H = High M = Moderate L = Low N = Negligible		Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern			Risk Matrix																															
	Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)																																
	H	C ≥ Irreversible, other serious effects, or symptoms which could impair an individual’s ability to take protective action.	C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.		<table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>			Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
		Likelihood																																			
		A	U	EU	BEU																																
Consequences	H	I	I	II	III																																
	M	II	II	III	IV																																
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	L	Mild, transient adverse effects > C	Minor injuries; no hospitalization > C	Minor injuries; no hospitalization > C																																	
	N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level																																	

Table 5.29 Access & Egress – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety Egress		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)	Consequence (C, of event)/year H = High M = Moderate L = Low N = Negligible		Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern			Risk Matrix																															
	Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)																																
	H	C ≥ Irreversible, other serious effects, or symptoms which could impair an individual’s ability to take protective action.	C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.		<table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>			Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
		Likelihood																																			
		A	U	EU	BEU																																
Consequences	H	I	I	II	III																																
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	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 5.30 Access & Egress – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventive (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety Egress		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 ($1.0E-06 > L$)	Consequence (C, of event)/year H = High M = Moderate L = Low N = Negligible		Risk (R, Qualitative Ranking) I = situation (event) of major concern II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern		Risk Matrix <table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th>A</th> <th>U</th> <th>EU</th> <th>BEU</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Consequences</th> <th>H</th> <td>I</td> <td>I</td> <td>II</td> <td>III</td> </tr> <tr> <th>M</th> <td>II</td> <td>II</td> <td>III</td> <td>IV</td> </tr> <tr> <th>L</th> <td>III</td> <td>III</td> <td>IV</td> <td>IV</td> </tr> <tr> <th>N</th> <td>IV</td> <td>IV</td> <td>IV</td> <td>IV</td> </tr> </tbody> </table>			Likelihood				A	U	EU	BEU	Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
			Likelihood																																	
A			U	EU	BEU																															
Consequences	H	I	I	II	III																															
	M	II	II	III	IV																															
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	L Mild, transient adverse effects > C	Minor injuries; no hospitalization > C	Minor injuries; no hospitalization > C																																	
	N Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level																																	

Table 5.31 Environmental

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