

Table 2. Summary of Baseline and Residual Risks – NuMI

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

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

NOTE:

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

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

Table 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	<i>Hazard: Exposure to ionizing radiation beyond regulatory limits.</i>	L: A C: H R: I	<p>P – RSIS: The Radiation Safety Interlock System uses a key tree system that captures the keys to an accelerator enclosure. These keys are electrically monitored through the Radiation and Electrical Safety Systems to turn off the accelerator enclosure if any key is removed from the key tree.</p> <p>P – Radiological Signage: Signs located in various places throughout the accelerator complex warn of various hazards and occupancy restrictions.</p> <p>P – Radiological Training: An educational system managed by ES&H that establishes basic worker knowledge through presentations and testing.</p> <p>M – Interlocked Beam Loss Detectors: Certified radiation detectors are electrically monitored through the Radiation Safety System that turns off an accelerator enclosure if the detected radiation is measured to be over a predetermined threshold. This is an active mitigation.</p> <p>M – Radiological Shielding: Material placed between radiation sources and the enclosure to be protected. This is a passive mitigation.</p>	L: BEU C: L R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual Activation	<i>Hazard: Exposure to ionizing radiation beyond regulatory limits.</i>	L: A C: H R: I	<p>P – General and/or Job Specific RWP: A Radiological Work Permit is written by ES&H that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure.</p> <p>P – Use of on LSM: Use of a log survey monitor is specified by a RWP. The LSM allows for real time monitoring of radiation levels during work.</p> <p>P – Radiological Training: An educational system managed by ES&H that establishes basic worker knowledge through presentations and testing.</p> <p>M – Radiological Signage and Decay Time Requirements: Signs located in various places throughout the accelerator complex warn of various hazards and occupancy restrictions prior to entry. Furthermore, work may be restricted or prevented until sufficient time has passed such that radiation levels are sufficiently low to allow for safer work to proceed. This mitigation has passive and active components.</p> <p>M – Target Pile Shielding: Material placed between radiation sources in the target pile and the enclosure to be protected. This is a passive mitigation.</p> <p>P – As needed: the RCT or RSO will monitor the job as specified by the RWP.</p>	L: BEU C: L R: IV
Groundwater Activation	<i>Hazard: Radionuclides in ground water exceed regulatory levels</i>	L: A C: H R: I	<p>P – Active and automatic beam tuning is performed to limit beam losses.</p> <p>P – Monitoring wells are sampled periodically to determine the levels if any detectable in the groundwater.</p> <p>P – Sump pump systems are engineered systems engineered to limit water radioactivation.</p>	L: BEU C: L R: IV
Surface Water Activation	<i>Hazard: Radionuclides in surface water exceed regulatory levels</i>	L: A C: H R: I	See Section I Chapter 04	L: BEU C: L R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive Water (RAW) Systems	<i>Hazard: Persons are exposed, beyond regulatory levels, to radioactive water</i>	L: A C: H R: I	<p>P – RAW Key Control System: Multiple key systems prevent personnel access to radioactive water systems.</p> <p>P – Secondary Containment is engineered containment that prevents unintended exposure to contaminated water.</p> <p>P – General and/or Job Specific RWP: A Radiological Work Permit is written by ES&H that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure.</p> <p>P – Use Of an LSM: Use of a log survey monitor is specified by a RWP. The LSM allows for real time monitoring of radiation levels during work.</p> <p>M – Run Conditions: Operating parameters that reduce activation by limiting the total amount of beam that can be delivered are specified. Specifically, this includes an operating limit for protons/hr. This is an active mitigation and the systems that must be operational for running beam are spelled out.</p> <p>M – RCT Or RSO Monitoring: A RWP will specify that a Radiation Control Technician or Radiation Safety Officer be present during certain kinds of work or work conditions. The radiological expert can make real time decisions to limit, stop, or prevent radiation exposure to personnel. This is an active mitigation.</p>	L: BEU C: L R: IV
Air Activation	<i>Hazard: Radionuclides in air exceed regulatory levels</i>	L: A C: H R: I	See Section I Chapter 04	L: EU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Soil Interactions	<i>Hazard: Radionuclides are produced by beam which may contaminate soil near the decay pipe</i>	L: A C: N R: IV	<p>P – Active and automatic beam tuning is performed to limit beam losses.</p> <p>M – Beamline Design and Engineered Beam Dump: the beamline is designed that includes measures to reduce unwanted beam particle losses, as well as the use of a beam dump (absorber) design that minimizes radiological leakage through the use of shielding. This is a passive mitigation.</p> <p>M – Run Conditions: Operating parameters that reduce activation by limiting the total amount of beam that can be delivered are specified. Specifically, this includes an operating limit for protons/hr. This is an active mitigation and the systems that must be operational for running beam are spelled out.</p> <p>M – Past studies have characterized the migration of tritium into shielding and lessons have been applied.</p>	L: U C: N R: IV
Radioactive Waste	<i>Hazard: Persons are exposed to ionizing radiation beyond regulatory levels</i>	L: A C: L R: III	<p>P – General and/or Job Specific RWP: A Radiological Work Permit is written by ES&H that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure.</p> <p>P – Use Of an LSM: Use of a log survey monitor is specified by a RWP. The LSM allows for real time monitoring of radiation levels during work.</p> <p>M – Decay Time Requirements: Work may be restricted or prevented until sufficient time has passed such that radiation levels are sufficiently low to allow for safer work to proceed. This is an active mitigation.</p> <p>M – Material Survey and Release Process: Any item exposed to beam-on conditions is surveyed by radiological workers and classified appropriately when removed from an enclosure. Items identified for disposal are surveyed and processed by Radiological Control organization personnel in accordance with FRCM Chapter 4. This is an active mitigation.</p>	L: EU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Contamination	<i>Hazard:</i> Persons are exposed to ionizing radiation beyond regulatory levels	L: A C: H R: I	<p>P – Shielding for Activated Contamination: Shielding material prevents unintended exposure to sources and personnel.</p> <p>P – Radiological Surveying and Cleaning: RCTs and RSOs survey for and clean radiological contamination as part of the RWP process.</p> <p>P – General and/or Job Specific RWP: A Radiological Work Permit is written by ES&H that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure.</p> <p>P – Use of an LSM: Use of a log survey monitor is specified by a RWP as necessary. The LSM allows for real time monitoring of radiation levels during work.</p> <p>M – Material Survey and Release Process: Any item exposed to beam-on conditions is surveyed by radiological workers and classified appropriately when removed from an enclosure. Items identified for disposal are surveyed and processed by Radiological Control organization personnel in accordance with FRCM Chapter 4. This is an active mitigation. Active mitigation by containing contaminated items to prevent release is used as necessary</p> <p>M – PPE: A RWP may specify that personal protective equipment be used during certain kinds of work or work conditions. The PPE limits the likelihood of bodily exposure to activated material and contamination. This is an active mitigation.</p>	L: BEU C: L R: IV
⁷ Be	<i>Hazard:</i> Potential radiation exposure to ⁷ Be (uptake/committed dose).	L: A C: N R: IV	No prevention or mitigation is required. ⁷ Be isn't hazardous in this pattern of use by facility.	L: A C: N 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
			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																															
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 MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	H	$C \geq 25.0 \text{ rem}$	$C \geq 100 \text{ rem}$	$C \geq 100 \text{ rem}$																																
	M	$25.0 \text{ rem} > C \geq 5 \text{ rem}$	$100 \text{ rem} > C \geq 25 \text{ rem}$	$100 \text{ rem} > C \geq 25 \text{ rem}$																																
	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 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	<i>Hazard: exposure to ionizing radiation beyond regulatory limits.</i>	L: A C: H R: I	<p>P – RSIS: The Radiation Safety Interlock System uses a key tree system that captures the keys to an accelerator enclosure. These keys are electrically monitored through the Radiation and Electrical Safety Systems to turn off the accelerator enclosure if any key is removed from the key tree.</p> <p>P – Radiological Signage: Signs located in various places throughout the accelerator complex warn of various hazards and occupancy restrictions.</p> <p>P – Radiological Training: An educational system managed by ES&H that establishes basic worker knowledge through presentations and testing.</p> <p>M – Interlocked Beam Loss Detectors: Certified radiation detectors are electrically monitored through the Radiation Safety System that turns off an accelerator enclosure if the detected radiation is measured to be over a predetermined threshold. This is an active mitigation.</p> <p>M – Radiological Shielding: Material placed between radiation sources and the enclosure to be protected. This is a passive mitigation.</p>	L: BEU C: L R: IV
Residual Activation	<i>Hazard: exposure to ionizing radiation beyond regulatory limits.</i>	L: A C: H R: I	<p>P – General and/or job specific RWP: A Radiological Work Permit is written by ES&H that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure.</p> <p>P – LSM: Monitors radiation levels during job</p> <p>P – Radiological Training: educates workers about radiological hazards, and general means and methods to reduce exposure.</p> <p>M – Radiological signage and cool off (decay) time requirements prior to entry</p> <p>M – Target pile shielding: attenuates radiation.</p>	L: BEU C: L R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Groundwater Activation	<i>Hazard: radionuclides in ground water exceed regulatory levels</i>	L: A C: H R: I	See Section I Chapter 04	L: BEU C: L R: IV
Surface Water Activation	<i>Hazard radionuclides in surface water exceed regulatory levels</i>	L: A C: H R: I	See Section I Chapter 04	L: BEU C: L R: IV
Radioactive Water (RAW) Systems	<i>Hazard: persons are exposed, beyond regulatory levels, to radioactive water</i>	L: A C: H R: I	<p>P – Active and automatic beam tuning is performed to limit beam losses.</p> <p>P – Monitoring wells are sampled periodically to determine the levels if any detectable in the groundwater.</p> <p>P – Sump pump systems are engineered systems engineered to limit water radioactivation.</p> <p>M – Run Conditions: Operating parameters that reduce activation by limiting the total amount of beam that can be delivered are specified. Specifically, this includes an operating limit for protons/hr. This is an active mitigation and the systems that must be operational for running beam are spelled out.</p>	L: BEU C: L R: IV
Air Activation	<i>Hazard: radionuclides in air exceed regulatory levels</i>	L: A C: H R: I	See Section I Chapter 04	L: EU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Soil Interactions	<i>Hazard: radionuclides are produced which may contaminate ground water</i>	L: A C: N R: IV	<p>P – Active and automatic beam tuning is performed to limit beam losses.</p> <p>M – Beamline Design and Engineered Beam Dump: the beamline is designed that includes measures to reduce unwanted beam particle losses, as well as the use of a beam dump (absorber) design that minimizes radiological leakage through the use of shielding. This is a passive mitigation.</p> <p>M – Run Conditions: Operating parameters that reduce activation by limiting the total amount of beam that can be delivered are specified. Specifically, this includes an operating limit for protons/hr. This is an active mitigation and the systems that must be operational for running beam are spelled out.</p> <p>M – Past studies have characterized the migration of tritium into shielding and lessons have been applied.</p>	L: U C: N R: IV
Radioactive Waste	<i>Hazard: persons are exposed to ionizing radiation beyond regulatory levels</i>	L: A C: L R: III	<p>P – General and/or Job Specific RWP: A Radiological Work Permit is written by ES&H that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure.</p> <p>P – Use Of an LSM: Use of a log survey monitor is specified by a RWP. The LSM allows for real time monitoring of radiation levels during work.</p> <p>M – Decay Time Requirements: Work may be restricted or prevented until sufficient time has passed such that radiation levels are sufficiently low to allow for safer work to proceed. This is an active mitigation.</p> <p>M – Material Survey and Release Process: Any item exposed to beam-on conditions is surveyed by radiological workers and classified appropriately when removed from an enclosure. Items identified for disposal are surveyed and processed by Radiological Control organization personnel in accordance with FRCM Chapter 4. This is an active mitigation.</p>	L: EU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Contamination	<i>Hazard: persons are exposed to ionizing radiation beyond regulatory levels</i>	L: A C: H R: I	<p>P – Shielding for Activated Contamination: Shielding material prevents unintended exposure to sources and personnel.</p> <p>P – Radiological Surveying and Cleaning: RCTs and RSOs survey for and clean radiological contamination as part of the RWP process.</p> <p>P – General and/or Job Specific RWP: A Radiological Work Permit is written by ES&H that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure.</p> <p>P – Use Of an LSM: Use of a log survey monitor is specified by a RWP as necessary. The LSM allows for real time monitoring of radiation levels during work.</p> <p>M – Material Survey and Release Process: Any item exposed to beam-on conditions is surveyed by radiological workers and classified appropriately when removed from an enclosure. Items identified for disposal are surveyed and processed by Radiological Control organization personnel in accordance with FRCM Chapter 4. This is an active mitigation. Active mitigation by containing contaminated items to prevent release is used as necessary</p> <p>M – PPE: A RWP may specify that personal protective equipment be used during certain kinds of work or work conditions. The PPE limits the likelihood of bodily exposure to activated material and contamination. This is an active mitigation.</p>	L: BEU C: L R: IV
⁷ Be	<i>Hazard: Potential radiation exposure to ⁷Be (uptake/committed dose).</i>	L: A C: N R: IV	No prevention or mitigation is required. ⁷ Be isn't hazardous in this pattern of use by facility.	L: A C: N 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
			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																															
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 MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	H	$C \geq 25.0$ rem	$C \geq 100$ rem	$C \geq 100$ rem																																
	M	$25.0 \text{ rem} > C \geq 5$ rem	$100 \text{ rem} > C \geq 25$ rem	$100 \text{ rem} > C \geq 25$ rem																																
	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 2.3 Radiological – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Prompt Ionizing Radiation	<i>Hazard: exposure to ionizing radiation beyond regulatory limits.</i>	L: BEU C: H R: III	<p>P – Access to areas with this hazard are protected by on site access restrictions and restricted access to buildings.</p> <p>P – RSIS: The Radiation Safety Interlock System uses a key tree system that captures the keys to an accelerator enclosure. These keys are electrically monitored through the Radiation and Electrical Safety Systems to turn off the accelerator enclosure if any key is removed from the key tree.</p> <p>P – Radiological Signage: Signs located in various places throughout the accelerator complex warn of various hazards and occupancy restrictions.</p> <p>M – Radiological Shielding: Material placed between radiation sources and the above ground areas. This is a passive mitigation.</p>	L: BEU C: L R: IV
Residual Activation	<i>Hazard: exposure to ionizing radiation beyond regulatory limits.</i>	L: BEU C: H R: III	<p>P – Access to areas with this hazard are protected by on site access restrictions and restricted access to buildings</p> <p>P – Access to the enclosure is further protected by interlocked keys. These keys are not issued to members of the public. This prevents them from being exposed to residual activation.</p> <p>P – Radiological Signage: Signs located in various places throughout the accelerator complex warn of various hazards and occupancy restrictions.</p>	L: BEU C: M R: IV
Groundwater Activation	<i>Hazard: radionuclides in ground water exceed regulatory levels</i>	L: A C: H R: I	See Section I Chapter 04	L: EU C:M R: III

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Surface Water Activation	<i>Hazard: radionuclides in surface water exceed regulatory levels</i>	L: A C: H R: I	See Section I Chapter 04	L: BEU C: M R: IV
Radioactive Water (RAW) Systems	<i>Hazard: persons are exposed, beyond regulatory levels, to radioactive water</i>	L: BEU C: H R: III	<p>P – RAW Key Control System: Multiple key systems prevent personnel access to radioactive water systems.</p> <p>P – Secondary Containment is engineered containment that prevents unintended exposure to contaminated water.</p> <p>M – Run Conditions: Operating parameters that reduce activation by limiting the total amount of beam that can be delivered are specified. Specifically, this includes an operating limit for protons/hr. This is an active mitigation and the systems that must be operational for running beam are spelled out.</p> <p>M – RCT Or RSO Monitoring: A RWP will specify that a Radiation Control Technician or Radiation Safety Officer be present during certain kinds of work or work conditions. The radiological expert can make real time decisions to limit, stop, or prevent radiation exposure to personnel. This is an active mitigation.</p>	L: BEU C: M R: IV
Air Activation	<i>Hazard: radionuclides in air exceed regulatory levels</i>	L: BEU C: H R: III	See Section I Chapter 04	L: BEU C: M R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Soil Interactions	<i>Hazard: radionuclides are produced which may contaminate ground water</i>	L: BEU C: H R: III	<p>P – Active and automatic beam tuning is performed to limit beam losses.</p> <p>M – Beamline Design and Engineered Beam Dump: the beamline is designed that includes measures to reduce unwanted beam particle losses, as well as the use of a beam dump (absorber) design that minimizes radiological leakage through the use of shielding. This is a passive mitigation.</p> <p>M – Run Conditions: Operating parameters that reduce activation by limiting the total amount of beam that can be delivered are specified. Specifically, this includes an operating limit for protons/hr. This is an active mitigation and the systems that must be operational for running beam are spelled out.</p> <p>M – Past studies have characterized the migration of tritium into shielding and lessons have been applied.</p>	L: BEU C: M R: IV
Radioactive Waste	<i>Hazard: persons are exposed to ionizing radiation beyond regulatory levels</i>	L: BEU C: H R: III	<p>P – Access to areas with this hazard are protected by on site access restrictions and restricted access to buildings.</p> <p>P – Radiological Signage: Signs located in various places throughout the accelerator complex warn of various hazards and occupancy restrictions.</p> <p>M – Material Survey and Release Process: Any item exposed to beam-on conditions is surveyed by radiological workers and classified appropriately when removed from an enclosure. Items identified for disposal are surveyed and processed by Radiological Control organization personnel in accordance with FRCM Chapter 4. This is an active mitigation.</p>	L: BEU C: M R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Contamination	<i>Hazard: persons are exposed to ionizing radiation beyond regulatory levels</i>	L: BEU C: H R: III	<p>P – Access to areas with this hazard are protected by on site access restrictions and restricted access to buildings.</p> <p>P – Radiological Signage: Signs located in various places throughout the accelerator complex warn of various hazards and occupancy restrictions.</p> <p>P – Shielding for Activated Contamination: Shielding material prevents unintended exposure to sources and personnel.</p> <p>M – Material Survey and Release Process: Any item exposed to beam-on conditions is surveyed by radiological workers and classified appropriately when removed from an enclosure. Items identified for disposal are surveyed and processed by Radiological Control organization personnel in accordance with FRCM Chapter 4. This is an active mitigation. Active mitigation by containing contaminated items to prevent release is used as necessary.</p>	L: BEU C: M R: IV
⁷ Be	<i>Hazard: Potential radiation exposure to ⁷Be (uptake/committed dose).</i>	L: A C: N R: IV	No prevention or mitigation is required. ⁷ Be isn't hazardous in this pattern of use by facility.	L: A C: N 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
			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																															
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 MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	H	$C \geq 25.0 \text{ rem}$	$C \geq 100 \text{ rem}$	$C \geq 100 \text{ rem}$																																
	M	$25.0 \text{ rem} > C \geq 5 \text{ rem}$	$100 \text{ rem} > C \geq 25 \text{ rem}$	$100 \text{ rem} > C \geq 25 \text{ rem}$																																
	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 2.4 Toxic Materials – Onsite 1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Beryllium	<i>Hazard: Beryllium beam windows may rupture and fragment.</i>	L: U C: L R: III	P – Windows designed to be contained by consumable and replaceable components rather than released into the target hall. M – Engineered designs assure appropriate pressure differential across particle windows.	L: EU C: N R: IV

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		Risk (R, Qualitative Ranking)		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																															
	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 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	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)																																
	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 2.5 Toxic Materials – Onsite 2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Beryllium	<i>Hazard: Beryllium beam windows may rupture and fragment.</i>	L: U C: L R: III	P – Windows designed to be contained by consumable and replaceable components rather than released into the target hall. M – Engineered designs assure appropriate pressure differential across particle windows.	L:EU C: N R: IV

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		Risk (R, Qualitative Ranking)		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																															
	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 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	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)																																
	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 2.6 Toxic Materials – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Beryllium	<i>Hazard: Potential exposure to beryllium dust during manual handling of un-encased, or machining dusts from fabrication shop activities.</i>	L: BEU C:H R:III	P – The NuMI Area is beyond the public access gates P – Components are in beamline, thus inaccessible to public.	L: BEU C: H R: III

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)	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	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
			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																															
H	PAC-2 > C ≥ PAC-1	PAC-3 > C ≥ PAC-2	IDLH > C ≥ PEL or TLV_c																																	
M	PAC-1 > C	PAC-2 > C	PEL or TLV_c > C																																	
L	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level																																	
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 2.7 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 Materials (cables, Boxes, Paper, wood cribbing, etc.)	<i>Hazard:</i>	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																																	
	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)	Risk Matrix																														
	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																															
	L	III	III	IV	IV																															
	N	IV	IV	IV	IV																															
	M	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.																																
	L	Mild, transient adverse effects > C	Minor injuries; no hospitalization > C	Minor injuries; no hospitalization > C																																
	N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level																																

Table 2.8 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 Materials (cables, Boxes, Paper, wood cribbing, 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 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			<table border="1"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="4">Risk Matrix</th> </tr> <tr> <th colspan="4">Likelihood</th> </tr> <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> </thead></table>			Risk Matrix				Likelihood				Consequences	H	I	I	II	III	M	II	II	III	IV	L	III	III	IV	IV	N	IV	IV	IV	IV
			Risk Matrix																																		
Likelihood																																					
Consequences	H	I	I	II	III																																
	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 2.9 Flammable and Combustible Materials – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Combustible Materials (cables, Boxes, Paper, wood cribbing, 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 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)		Likelihood																																
	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"></th> <th colspan="4">Likelihood</th> </tr> <tr> <th colspan="2"></th> <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																																		
	L	III	III	IV	IV																																		
	N	IV	IV	IV	IV																																		
	M	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.																																			
	L	Mild, transient adverse effects > C	Minor injuries; no hospitalization > C	Minor injuries; no hospitalization > C																																			
	N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level																																			

Table 2.10 Electrical Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Stored Energy Exposure		L: C: R:	See Section I Chapter 04	L: C: R:
High Voltage Exposure		L: C: R:	See Section I Chapter 04	L: C: R:
Low Voltage, High Current Exposure.		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																															
	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 2.11 Electrical Energy 1 Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Stored Energy Exposure		L: C: R:	See Section I Chapter 04	L: C: R:
High Voltage Exposure		L: C: R:	See Section I Chapter 04	L: C: R:
Low Voltage, High Current Exposure.		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																															
	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 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 Exposure		L: C: R:	See Section I Chapter 04	L: C: R:
High Voltage Exposure		L: C: R:	See Section I Chapter 04	L: C: R:
Low Voltage, High Current Exposure.		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
		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																															
<p>Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual</p>	<p>C</p>	<p>Offsite (MOI)</p>	<p>Onsite-2 (co-located worker)</p>	<p>Onsite-1 (facility worker)</p>																																
	<p>H</p>	<p>C ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.</p>	<p>C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.</p>	<p>C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.</p>																																
	<p>M</p>	<p>C ≥ Mild, transient adverse effects.</p>	<p>C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.</p>	<p>C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.</p>																																
	<p>L</p>	<p>Mild, transient adverse effects > C</p>	<p>Minor injuries; no hospitalization > C</p>	<p>Minor injuries; no hospitalization > C</p>																																
	<p>N</p>	<p>Consequences less than those for Low Consequence Level</p>	<p>Consequences less than those for Low Consequence Level</p>	<p>Consequences less than those for Low Consequence Level</p>																																

Table 2.13 Thermal Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Hot Work		L: 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																																
	L	III	III	IV	IV																																
	N	IV	IV	IV	IV																																
	M	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.																																	
	L	Mild, transient adverse effects > C	Minor injuries; no hospitalization > C	Minor injuries; no hospitalization > C																																	
	N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level																																	

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Hot Work		L: 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		Risk (R, Qualitative Ranking)		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																															
	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 2.15 Thermal Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Hot Work		L: 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																																
	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 2.16 Kinetic Energy – Onsite-1 Facility Worker

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

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																															
	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 2.17 Kinetic Energy – Onsite-2 Co-located Worker

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

Other Hazard Consequences, derived from Figure C-1, "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																															
	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																																

Table 2.18 Kinetic Energy – MOI Offsite

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

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

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: C: R:	See Section I Chapter 04	L: C: R:
Compressed Gasses		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
			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																															
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 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: C: R:	See Section I Chapter 04	L: C: R:
Compressed Gasses		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
		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																															
<p>Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual</p>	<p>C</p>	<p>Offsite (MOI)</p>	<p>Onsite-2 (co-located worker)</p>	<p>Onsite-1 (facility worker)</p>																																
	<p>H</p>	<p>C ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.</p>	<p>C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.</p>	<p>C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.</p>																																
	<p>M</p>	<p>C ≥ Mild, transient adverse effects.</p>	<p>C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.</p>	<p>C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.</p>																																
	<p>L</p>	<p>Mild, transient adverse effects > C</p>	<p>Minor injuries; no hospitalization > C</p>	<p>Minor injuries; no hospitalization > C</p>																																
	<p>N</p>	<p>Consequences less than those for Low Consequence Level</p>	<p>Consequences less than those for Low Consequence Level</p>	<p>Consequences less than those for Low Consequence Level</p>																																

Table 2.21 Potential Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane 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 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
			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																															
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 2.22 Magnetic Fields – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields		L: 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																																
	L	III	III	IV	IV																																
	N	IV	IV	IV	IV																																
	M	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.																																	
	L	Mild, transient adverse effects > C	Minor injuries; no hospitalization > C	Minor injuries; no hospitalization > C																																	
	N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level																																	

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields		L: 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																															
	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 2.24 Magnetic Fields – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields		L: 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																															
	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 2.25 Other hazards – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces		L: C: R:	See Section I Chapter 04	L: C: R:
Noise		L: C: R:	See Section I Chapter 04	L: C: R:
Ergonomics		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																															
	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 2.26 Other hazards – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces		L: C: R:	See Section I Chapter 04	L: C: R:
Noise		L: C: R:	See Section I Chapter 04	L: C: R:
Ergonomics		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																															
	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 2.27 Other hazards – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	<i>Hazard:</i>	L: C: R:	See Section I Chapter 04	L: C: R:
Noise	<i>Hazard:</i>	L: C: R:	See Section I Chapter 04	L: C: R:
Ergonomics	<i>Hazard:</i>	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																															
	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 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: 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" 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
		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																															
Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual	C Offsite (MOI) H: C ≥ Irreversible, other serious effects, or symptoms which could impair an individual’s ability to take protective action. M: C ≥ Mild, transient adverse effects. L: Mild, transient adverse effects > C N: Consequences less than those for Low Consequence Level	Onsite-2 (co-located worker) C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling. C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no hospitalization > C Consequences less than those for Low Consequence Level	Onsite-1 (facility worker) C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling. C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no hospitalization > C Consequences less than those for Low 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: 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																																
	L	III	III	IV	IV																																
	N	IV	IV	IV	IV																																
	M	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.																																	
	L	Mild, transient adverse effects > C	Minor injuries; no hospitalization > C	Minor injuries; no hospitalization > C																																	
	N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level																																	

Table 2.30 Access & Egress – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety Egress		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" data-bbox="1637 678 2038 893"> <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																															
	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) H: C ≥ Irreversible, other serious effects, or symptoms which could impair an individual’s ability to take protective action. M: C ≥ Mild, transient adverse effects. L: Mild, transient adverse effects > C N: Consequences less than those for Low Consequence Level	Onsite-2 (co-located worker) C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling. C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no hospitalization > C Consequences less than those for Low Consequence Level	Onsite-1 (facility worker) C ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling. C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no hospitalization > C Consequences less than those for Low Consequence Level																																	

Table 2.31 Environmental

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