Table 6. Summary of Baseline and Residual Risks – Booster Neutrino Beam (BNB)

Risk Tables Description		Baseline Risk	Residual Risk
6.1	Radiological – Onsite-1 Facility Worker	R: I	R: IV
6.2	Radiological – Onsite-2 Co-located Worker	R: I	R: IV
6.3	Radiological – MOI Offsite	R: I	R: IV
6.4	Toxic Materials – Onsite 1 Facility Worker	R: *	R: *
6.5	Toxic Materials – Onsite 2 Co-located Worker	R: *	R: *
6.6	Toxic Materials – MOI Offsite	R: *	R: *
6.7	Flammable & Combustible Materials – Onsite-1 Facility Worker	R: *	R: *
6.8	Flammable & Combustible Materials – Onsite-2 Co-located worker	R: *	R: *
6.9	Flammable & Combustible Materials – MOI Offsite	R: *	R: *
6.10	Electrical Energy – Onsite-1 Facility Worker	R: *	R: *
6.11	Electrical Energy – Onsite-2 Co-located Worker	R: *	R: *
6.12	Electrical Energy – MOI Offsite	R: *	R: *
6.13	Thermal Energy – Onsite-1 Facility Worker	R: *	R: *
6.14	Thermal Energy – Onsite-2 Co-located Worker	R: *	R: *
6.15	Thermal Energy – MOI Offsite	R: *	R: *
6.16	Kinetic Energy – Onsite-1 Facility Worker	R: *	R: *
6.17	Kinetic Energy – Onsite-2 Co-located Worker	R: *	R: *
6.18	Kinetic Energy – MOI Offsite	R: *	R: *
6.19	Potential Energy- Onsite-1 Facility Worker	R: *	R: *
6.20	Potential Energy – Onsite-2 Co-located Worker	R: *	R: *
6.21	Potential Energy – MOI Offsite	R: *	R: *
6.22	Magnetic Fields – Onsite-1 Facility Worker	R: *	R: *
6.23	Magnetic Fields – Onsite-2 Co-located Worker	R: *	R: *
6.24	Magnetic Fields – MOI Offsite	R: *	R: *
6.25	Other Hazards – Onsite-1 Facility Worker	R: *	R: *
6.26	Other Hazards – Onsite-2 Co-located Worker	R: *	R: *
6.27	Other Hazards – MOI Offsite	R: *	R: *
6.28	Access & Egress – Onsite-1 Facility Worker	R: *	R: *
6.29	Access & Egress – Onsite-2 Co-located Worker	R: *	R: *
6.30	Access & Egress – MOI Offsite	R: *	R: *
6.31	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 6.1 Radiological – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Residual Activation	*Hazard: Exposure to residual activation*	L: A C: H R: I	P – General and/or Job Specific RWP: A RWP 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 – LSM: An LSM allows for real time monitoring of radiation levels during work, and its use is specified in the relevant RWP when deemed appropriate for the work. P – Radiological Training: An educational system managed by ES&H that establishes basic worker knowledge through presentations and testing. 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. M – Target Pile Shielding: Material placed between radiation sources in the target pile and the enclosure to be protected. This is a passive mitigation.	L: BEU C: L R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Groundwater Activation	*Hazards:* *Potential exposure due to construction activities, (e.g., earthmoving).*	L: A C: N R: IV	P – Water Evaluation: Sump water is evaluated to determine the presence of tritium or other activation products to prevent personnel exposure. P – Water Capture: Sump pits/enclosures capture activated water to prevent releases exceeding allowed discharge limits. M – Facility Designs: Facility designs employ shielding to mitigate the production of activation products in groundwater.	L: EU C: N R: IV
	Draining of groundwater captured in tanks.	L: A C: N R: IV	P – Water Sampling: Sump water is periodically sampled, and tank draining is performed by RCTs (specialized training). M – RCTs Drain Tanks: Highly trained personnel (RCTs) employ ALARA principles to mitigate exposures during tank draining activities.	L: U C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Surface Water Activation	*Hazards:* *Potential exposure to activated surface water due to beam loss leakage from beam enclosures, located under the surface water impoundment.*	L: A C: N R: IV	P – Beam Loss Monitoring: Beam loss monitors in enclosures prevent excessive beam loss. M – Radiation Detectors: Radiation detectors in enclosures and berms reduce the amount of activation to surface water, by promptly disabling the beam. M – Shielding: Soil, concrete, and/or steel shielding reduces surface water activation.	L: U C: N R: IV
	Potential exposure to activated surface water due to mixing surface water with a captured groundwater source.	L: A C: N R: IV	P – Discharge Limit: Off-site discharge limit is applied to any water mixed into onsite surface water. This prevents surface water concentrations from approaching the Derived Concentration Standard. P – Monitoring Potential Sources: Monitoring of potential mixed sources allow for diversion of water, preventing exposure to waters above the Derived Concentration Standard. M – Operations Pause: In situations where surface water activation is higher than expected (discovered by monitoring), the facility stops operations until the facility upset condition is resolved. M – Monitoring Surface Water: Frequent surface water monitoring at many locations to mitigate increases in activity approaching the Derived Concentration Standard.	L: EU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Radioactive Water (RAW) Systems	*Hazard: Persons are exposed, beyond regulatory levels, to radioactive water*	L: A C: H R: I	P – RAW Key Control System: A key system that prevents personnel access to radioactive water systems. P – Secondary Containment: Engineered containment prevents unintended exposure to contaminated water. P – General and/or Job Specific RWP: A RWP 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 – LSM: An LSM allows for real time monitoring of radiation levels during work, and its use is specified in the relevant RWP when deemed appropriate for the work M – Run Condition: Operating parameters that reduce activation by limiting the total amount of beam that could be delivered. Specifically, this includes an operating limit for protons/hr. This is an active mitigation. M – RCT Or RSO Monitoring: A RWP will specify that a RCT or RSO 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.	L: BEU C: L R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Air Activation	*Hazard: Radionuclides in air exceed regulatory levels*	L: A C: H R: I	P – Active Air Monitoring: Key issuance to enclosures is restricted until after the air monitors show that there is a sufficiently low level of radiation coming from the activated air components. P – LSM: An LSM allows for real time monitoring of radiation levels during work, and its use is specified in the relevant RWP when deemed appropriate for the work. M – Air Dilution and Decay Time: The air flow is engineered to dilute the activated air components and provide time for these components to decay away prior to the release of the air from the enclosure. M – Run Condition: Operating parameters that reduce activation by limiting the total amount of beam that could be delivered. Specifically, this includes an operating limit for protons/hr. This is an active mitigation. M – Target Pile Shielding: Material placed between radiation sources in the target pile and the enclosure to be protected. This is a passive mitigation.	L: EU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Closed Loop Air Cooling	*Hazard: Radionuclides in air exceed regulatory levels leading to potential worker exposure*	L: A C: H R: I	P – Active Air Monitoring: Key issuance to enclosures is restricted until after the air monitors show that there is an acceptable level of radiation coming from the activated air components. P – LSM: An LSM allows for real time monitoring of radiation levels during work, and its use is specified in the relevant RWP when deemed appropriate for the work. P – Air Containment: Engineered containment of the cooling air is used to keep it separate from the breathable air. M – Run Condition: Operating parameters that reduce activation by limiting the total amount of beam that could be delivered. Specifically, this includes an operating limit for protons/hr. This is an active mitigation. M – Target Pile Shielding: Material placed between radiation sources in the target pile and the enclosure to be protected. This is a passive mitigation.	L: BEU C: L R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Soil Interactions	*Hazard: Radionuclides are produced by beam which may contaminate soil near the decay pipe*	L: A C: N R: IV	P – General and/or Job Specific RWP: A RWP 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. M – Beamline and Beam Dump Designs: The use of beamline designs that include measures to reduce unwanted beam particle losses, along with the use of beam dump (absorber) designs that minimizes radiological leakage through the use of shielding. This is a passive mitigation. 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. M – Run Condition: Operating parameters that reduce activation by limiting the total amount of beam that could be delivered. Specifically, this includes an operating limit for protons/hr. This is an active mitigation.	L: U C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Radioactive Waste	*Hazard: Persons are exposed to ionizing radiation beyond regulatory levels*	L: A C: L R: III	P – General and/or Job Specific RWP: A RWP 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 – LSM: An LSM allows for real time monitoring of radiation levels during work, and its use is specified in the relevant RWP when deemed appropriate for the work. 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. 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.	L: EU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Contamination	*Hazard: Persons are exposed to ionizing radiation beyond regulatory levels*	L: A C: H R: I	P – Shielding for Activated Contamination: Material placed between radiation sources and the personnel to be protected. P – Radiological Surveying and Cleaning: RCTs and RSOs survey for and clean radiological contamination as part of the RWP process. P – General and/or Job Specific RWP: A RWP 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 – LSM: An LSM allows for real time monitoring of radiation levels during work, and its use is specified in the relevant RWP when deemed appropriate for the work. 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. 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.	L: BEU C: L R: IV
^{7}Be	*Hazard: 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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Radioactive Sources	*Hazard: Persons are exposed to ionizing radiation beyond regulatory levels*	L: A C: H R: I	P – Radiological Signage on or Near Source Cabinets: Signs give warning of the presence of radioactive sources. P – Radiological Training: An educational system managed by ES&H that establishes basic worker knowledge through presentations and testing. P – Kept Under Lock-and-key: Radioactive sources are kept in locked storage, where key issuance is a controlled process. M – Kept in Storage: Unused radioactive sources are kept in storage, which prevents the close proximity of these sources and people. This is a passive mitigation. M – Shielded Containers: Unused high activity sources are stored within shielded containers. This is a passive mitigation.	L: BEU C: L R: IV

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

Likelihood (L, of event)/year
- **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
- **rem =** Roentgen equivalent man

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ³ 25.0 rem	**C** ³ 100 rem	**C** ³ 100 rem
M	25.0 rem > **C** ³ 5 rem	100 rem **> C** ³ 25 rem	100 rem **> C** ³ 25 rem
L	5 rem > **C**	25 rem **> C**	25 rem **> C**
N	0.5 rem > **C**	5 rem **> C**	5 rem **> C**

Risk Matrix

Consequences \ Likelihood	A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.2 Radiological – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Residual Activation	*Hazard: exposure to residual activation*	L: A C: H R: I	P – General and/or Job Specific RWP: A RWP 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 – LSM: An LSM allows for real time monitoring of radiation levels during work, and its use is specified in the relevant RWP when deemed appropriate for the work. P – Radiological Training: An educational system managed by ES&H that establishes basic worker knowledge through presentations and testing. 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. M – Target Pile Shielding: Material placed between radiation sources in the target pile and the enclosure to be protected. This is a passive mitigation.	L: BEU C: L R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Groundwater Activation	*Hazards:* *Potential exposure due to construction activities, (e.g., earthmoving).*	L: A C: N R: IV	P – Water Evaluation: Sump water is evaluated to determine the presence of tritium or other activation products to prevent personnel exposure. P – Water Capture: Sump pits/enclosures capture activated water to prevent releases exceeding allowed discharge limits. M – Facility Designs: Facility designs employ shielding to mitigate the production of activation products in groundwater.	L: EU C: N R: IV
	Draining of groundwater captured in tanks.	L: A C: N R: IV	P – Water Sampling: Sump water is periodically sampled, and tank draining is performed by RCTs (specialized training). M – RCTs Drain Tanks: Highly trained personnel (RCTs) employ ALARA principles to mitigate exposures during tank draining activities.	L: U C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Surface Water Activation	*Hazards:* *Potential exposure to activated surface water due to beam loss leakage from beam enclosures, located under the surface water impoundment.*	L: A C: N R: IV	P – Beam Loss Monitoring: Beam loss monitors in enclosures prevent excessive beam loss. M – Radiation Detectors: Radiation detectors in enclosures and berms reduce the amount of activation to surface water, by promptly disabling the beam. M – Shielding: Soil, concrete, and/or steel shielding reduces surface water activation.	L: U C: N R: IV
	Potential exposure to activated surface water due to mixing surface water with a captured groundwater source.	L: A C: N R: IV	P – Discharge Limit: Off-site discharge limit is applied to any water mixed into onsite surface water. This prevents surface water concentrations from approaching the Derived Concentration Standard. P – Monitoring Potential Sources: Monitoring of potential mixed sources allow for diversion of water, preventing exposure to waters above the Derived Concentration Standard. M – Operations Pause: In situations where surface water activation is higher than expected (discovered by monitoring), the facility stops operations until the facility upset condition is resolved. M – Monitoring Surface Water: Frequent surface water monitoring at many locations to mitigate increases in activity approaching the Derived Concentration Standard.	L: EU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Radioactive Water (RAW) Systems	*Hazard: persons are exposed, beyond regulatory levels, to radioactive water*	L: A C: H R: I	P – RAW Key Control System: A key system that prevents personnel access to radioactive water systems. P – Secondary Containment: Engineered containment prevents unintended exposure to contaminated water. P – General and/or Job Specific RWP: A RWP 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 – LSM: An LSM allows for real time monitoring of radiation levels during work, and its use is specified in the relevant RWP when deemed appropriate for the work. M – Run Condition: Operating parameters that reduce activation by limiting the total amount of beam that could be delivered. Specifically, this includes an operating limit for protons/hr. This is an active mitigation. M – RCT Or RSO Monitoring: A RWP will specify that a RCT or RSO 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.	L: BEU C: L R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Air Activation	*Hazard: radionuclides in air exceed regulatory levels*	L: A C: H R: I	P – Active Air Monitoring: Key issuance to enclosures is restricted until after the air monitors show that there is a sufficiently low level of radiation coming from the activated air components. P – LSM: An LSM allows for real time monitoring of radiation levels during work, and its use is specified in the relevant RWP when deemed appropriate for the work. M – Air Dilution and Decay Time: The air flow is engineered to dilute the activated air components and provide time for these components to decay away prior to the release of the air from the enclosure. M – Run Condition: Operating parameters that reduce activation by limiting the total amount of beam that could be delivered. Specifically, this includes an operating limit for protons/hr. This is an active mitigation. M – Target Pile Shielding: Material placed between radiation sources in the target pile and the enclosure to be protected. This is a passive mitigation.	L: EU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Closed Loop Air Cooling	*Hazard: radionuclides in air exceed regulatory levels*	L: A C: H R: I	P – Active Air Monitoring: Key issuance to enclosures is restricted until after the air monitors show that there is an acceptable level of radiation coming from the activated air components. P – LSM: An LSM allows for real time monitoring of radiation levels during work, and its use is specified in the relevant RWP when deemed appropriate for the work. P – Air Containment: Engineered containment of the cooling air is used to keep it separate from the breathable air. M – Run Condition: Operating parameters that reduce activation by limiting the total amount of beam that could be delivered. Specifically, this includes an operating limit for protons/hr. This is an active mitigation. M – Target Pile Shielding: Material placed between radiation sources in the target pile and the enclosure to be protected. This is a passive mitigation.	L: BEU C: L R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Soil Interactions	*Hazard: radionuclides are produced which may contaminate ground water*	L: A C: N R: IV	P – General and/or Job Specific RWP: A RWP 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. M – Beamline and Beam Dump Designs: The use of beamline designs that include measures to reduce unwanted beam particle losses, along with the use of beam dump (absorber) designs that minimizes radiological leakage through the use of shielding. This is a passive mitigation. 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. M – Run Condition: Operating parameters that reduce activation by limiting the total amount of beam that could be delivered. Specifically, this includes an operating limit for protons/hr. This is an active mitigation.	L: U C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Radioactive Waste	*Hazard: persons are exposed to ionizing radiation beyond regulatory levels*	L: A C: L R: III	P – General and/or Job Specific RWP: A RWP 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 – LSM: An LSM allows for real time monitoring of radiation levels during work, and its use is specified in the relevant RWP when deemed appropriate for the work. 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. 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.	L: EU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Contamination	*Hazard: persons are exposed to ionizing radiation beyond regulatory levels*	L: A C: H R: I	P – Shielding for Activated Contamination: Material placed between radiation sources and the personnel to be protected. P – Radiological Surveying and Cleaning: RCTs and RSOs survey for and clean radiological contamination as part of the RWP process. P – General and/or Job Specific RWP: A RWP 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 – LSM: An LSM allows for real time monitoring of radiation levels during work, and its use is specified in the relevant RWP when deemed appropriate for the work. 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. 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.	L:BEU C: L R: IV
^{7}Be	*Hazard: 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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Radioactive Sources	*Hazard: persons are exposed to ionizing radiation beyond regulatory levels*	L: A C: H R: I	P – Radiological Signage on or Near Source Cabinets: Signs give warning of the presence of radioactive sources. P – Radiological Training: An educational system managed by ES&H that establishes basic worker knowledge through presentations and testing. P – Kept Under Lock-and-key: Radioactive sources are kept in locked storage, where key issuance is a controlled process. M – Kept in Storage: Unused radioactive sources are kept in storage, which prevents the close proximity of these sources and people. This is a passive mitigation. M – Shielded Containers: Unused high activity sources are stored within shielded containers. This is a passive mitigation.	L:BEU C: L R: IV

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

Likelihood (L, of event)/year
- **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
- **rem =** Roentgen equivalent man

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ³ 25.0 rem	**C** ³ 100 rem	**C** ³ 100 rem
M	25.0 rem > **C** ³ 5 rem	100 rem **> C** ³ 25 rem	100 rem **> C** ³ 25 rem
L	5 rem > **C**	25 rem **> C**	25 rem **> C**
N	0.5 rem > **C**	5 rem **> C**	5 rem **> C**

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.3 Radiological – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Residual Activation	*Hazard: exposure to residual activation*	L: BEU C: H R: III	P – Gates: Public access gates prevent unauthorized access by public. M – Radiological Shielding to Limit Activation: Material placed between radiation sources and other materials that may come into the close proximity of people. This is a passive mitigation.	L: BEU C: M R: IV
Groundwater Activation	*Hazards:* *Potential exposure due to construction activities, (e.g., earthmoving).*	L: A C: N R: IV	P – Water Evaluation: Sump water is evaluated to determine the presence of tritium or other activation products to prevent personnel exposure. P – Water Capture: Sump pits/enclosures capture activated water to prevent releases exceeding allowed discharge limits. M – Facility Designs: Facility designs employ shielding to mitigate the production of activation products in groundwater.	L: EU C: N R: IV
	Draining of groundwater captured in tanks.	L: A C: N R: IV	P – Water Sampling: Sump water is periodically sampled, and tank draining is performed by RCTs (specialized training). M – RCTs Drain Tanks: Highly trained personnel (RCTs) employ ALARA principles to mitigate exposures during tank draining activities.	L: U C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Surface Water Activation	*Hazards:* *Potential exposure to activated surface water due to beam loss leakage from beam enclosures, located under the surface water impoundment.*	L: A C: N R: IV	P – Beam Loss Monitoring: Beam loss monitors in enclosures prevent excessive beam loss. M – Radiation Detectors: Radiation detectors in enclosures and berms reduce the amount of activation to surface water, by promptly disabling the beam. M – Shielding: Soil, concrete, and/or steel shielding reduces surface water activation.	L: U C: N R: IV
	Potential exposure to activated surface water due to mixing surface water with a captured groundwater source.	L: A C: N R: IV	P – Discharge Limit: Off-site discharge limit is applied to any water mixed into onsite surface water. This prevents surface water concentrations from approaching the Derived Concentration Standard. P – Monitoring Potential Sources: Monitoring of potential mixed sources allow for diversion of water, preventing exposure to waters above the Derived Concentration Standard. M – Operations Pause: In situations where surface water activation is higher than expected (discovered by monitoring), the facility stops operations until the facility upset condition is resolved. M – Monitoring Surface Water: Frequent surface water monitoring at many locations to mitigate increases in activity approaching the Derived Concentration Standard.	L: EU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Radioactive Water (RAW) Systems	*Hazard: persons are exposed, beyond regulatory levels, to radioactive water*	L: BEU C: H R: III	P – Gates: Public access gates prevent unauthorized access by public. M – Radiological Shielding to Limit Exposure: Material placed between radiation sources and people, which prevents the close proximity of these sources and people. This is a passive mitigation.	L: BEU C: M R: IV
Air Activation	*Hazard: radionuclides in air exceed regulatory levels*	L: BEU C: H R: III	P – Gates: Public access gates prevent unauthorized access by public. M – Controlled Release: The release of activated air is engineered to reduce potential exposure consequences. This is a passive mitigation.	L: BEU C: M R: IV
Closed Loop Air Cooling	*Hazard: radionuclides in air exceed regulatory levels*	L: BEU C: H R: III	P – Gates: Public access gates prevent unauthorized access by public. P – Air Containment: Engineered containment of the cooling air is used to keep it separate from the breathable air. M – Controlled Release: The release of activated air is engineered to reduce potential exposure consequences. This is a passive mitigation.	L: BEU C: M R: IV
Soil Interactions	*Hazard: radionuclides are produced which may contaminate ground water*	L: BEU C: N R: IV	P – Gates: Public access gates prevent unauthorized access by public.	L: BEU C: N R: IV
Radioactive Waste	*Hazard: persons are exposed to ionizing radiation beyond regulatory levels*	L: BEU C: H R: III	P – Gates: Public access gates prevent unauthorized access by public. M – Radiological Shielding to Limit Exposure: Material placed between radiation sources and people, which prevents the close proximity of these sources and people. This is a passive mitigation.	L: BEU C: M R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Contamination	*Hazard: persons are exposed to ionizing radiation beyond regulatory levels*	L: BEU C: H R: III	P – Gates: Public access gates prevent unauthorized access by public. M – Radiological Shielding to Limit Exposure: Material placed between radiation sources and people, which prevents the close proximity of these sources and people. This is a passive mitigation.	L: BEU C: M R: IV
^{7}Be	*Hazard: 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
Radioactive Sources	*Hazard: persons are exposed to ionizing radiation beyond regulatory levels*	L: BEU C: H R: III	P – Gates: Public access gates prevent unauthorized access by public. M – Kept in Storage: Unused radioactive sources are kept in storage, which prevents the close proximity of these sources and people. This is a passive mitigation. M – Shielded Containers: Unused high activity sources are stored within shielded containers. This is a passive mitigation.	L: BEU C: L R: IV

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

Likelihood (L, of event)/year
- **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
- **rem =** Roentgen equivalent man

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ³ 25.0 rem	**C** ³ 100 rem	**C** ³ 100 rem
M	25.0 rem > **C** ³ 5 rem	100 rem **> C** ³ 25 rem	100 rem **> C** ³ 25 rem
L	5 rem > **C**	25 rem **> C**	25 rem **> C**
N	0.5 rem > **C**	5 rem **> C**	5 rem **> C**

Risk Matrix

Consequences \ Likelihood	A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.4 Toxic Materials – Onsite 1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Lead	*Hazard: Potential exposure to lead dust during manual handling of un-encased lead bricks, lead shot, and lead sheets.*	L: C: R:	See Section I Chapter 04.	L: C: R:
Beryllium	*Hazard: Potential exposure to beryllium dust during manual handling of un-encased, or machining dusts from fabrication shop activities.*	L: C: R:	See Section I Chapter 04.	L: C: R:

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

Likelihood (L, of event)/year
- **A** = Anticipated (L > 1.0E-02)
- **U** = Unlikely (1.0E-02> L >1.0E-04)
- **EU** = Extremely Unlikely (1.0E-04 > L >1.0E-06)
- **BEU** = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
- **H** = High
- **M** = Moderate
- **L** = Low
- **N** = Negligible

Risk (R, Qualitative Ranking)
- **I** = situation (event) of major concern
- **II** = situation (event) of concern
- **III** = situation (event) of minor concern
- **IV** = situation (event) of minimal concern

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** ³ PAC-2	**C** ³ PAC-3	**C** ³ IDLH
M	PAC-2 > **C** ³ PAC-1	PAC-3 **> C** ³ PAC-2	IDLH **> C** ³ 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

Risk Matrix

Consequences \ Likelihood	A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.5 Toxic Materials – Onsite 2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Lead	*Hazard: Potential exposure to lead dust during manual handling of un-encased lead bricks, lead shot, and lead sheets.*	L: C: R:	See Section I Chapter 04.	L: C: R:
Beryllium	*Hazard: Potential exposure to beryllium dust during manual handling of un-encased, or machining dusts from fabrication shop activities.*	L: C: R:	See Section I Chapter 04.	L: C: R:

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

Likelihood (L, of event)/year
- **A** = Anticipated (L > 1.0E-02)
- **U** = Unlikely (1.0E-02> L >1.0E-04)
- **EU** = Extremely Unlikely (1.0E-04 > L >1.0E-06)
- **BEU** = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
- **H** = High
- **M** = Moderate
- **L** = Low
- **N** = Negligible

Risk (R, Qualitative Ranking)
- **I** = situation (event) of major concern
- **II** = situation (event) of concern
- **III** = situation (event) of minor concern
- **IV** = situation (event) of minimal concern

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** ³ PAC-2	**C** ³ PAC-3	**C** ³ IDLH
M	PAC-2 > **C** ³ PAC-1	PAC-3 **> C** ³ PAC-2	IDLH **> C** ³ 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

Risk Matrix

Consequences \ Likelihood	A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.6 Toxic Materials – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Lead	*Hazard: Potential exposure to lead dust during manual handling of un-encased lead bricks, lead shot, and lead sheets.*	L: C: R:	See Section I Chapter 04.	L: C: R:
Beryllium	*Hazard: Potential exposure to beryllium dust during manual handling of un-encased, or machining dusts from fabrication shop activities.*	L: C: R:	See Section I Chapter 04.	L: C: R:

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

Likelihood (L, of event)/year
- **A** = Anticipated (L > 1.0E-02)
- **U** = Unlikely (1.0E-02> L >1.0E-04)
- **EU** = Extremely Unlikely (1.0E-04 > L >1.0E-06)
- **BEU** = Beyond Extremely Unlikely (1.0E-06> L)

Consequence (C, of event)/year
- **H** = High
- **M** = Moderate
- **L** = Low
- **N** = Negligible

Risk (R, Qualitative Ranking)
- **I** = situation (event) of major concern
- **II** = situation (event) of concern
- **III** = situation (event) of minor concern
- **IV** = situation (event) of minimal concern

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
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** ³ PAC-2	**C** ³ PAC-3	**C** ³ IDLH
M	PAC-2 > **C** ³ PAC-1	PAC-3 **> C** ³ PAC-2	IDLH **> C** ³ 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 6.7 Flammable and Combustible Materials – Onsite -1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Combustible materials (cables, boxes, paper, wood cribbing, etc.)	*Hazards:* *Hazard: This hazard is a potential facility fire.* *The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices.* *This hazard can add to the fuel load of a potential facility fire.* *Poor housekeeping can also lead to life safety concerns, such as egress obstructions and tripping hazards.* *The exposure of the hazard to the facility worker is of major concern.*	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)**
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.8 Flammable and Combustible Materials – Onsite -2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Combustible materials (cables, boxes, paper, wood cribbing, etc.)	*Hazards:* *This hazard is a potential facility fire.* *The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices.* *This hazard can add to the fuel load of a potential facility fire.* *Poor housekeeping can also lead to life safety concerns, such as egress obstructions and tripping hazards.* *The exposure of the hazard to the facility worker is of major concern.*	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)**
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.9 Flammable and Combustible Materials – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Combustible materials (cables, boxes, paper, wood cribbing, etc.)	*Hazards:* *Hazard: This hazard is a potential facility fire.* *The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices.* *This hazard can add to the fuel load of a potential facility fire.* *Poor housekeeping can also lead to life safety concerns, such as egress obstructions and tripping hazards.* *The exposure of the hazard to the facility worker is of major concern.*	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)**
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.10 Electrical Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Stored Energy Exposure	*Hazards:* *Shock hazard, >50 V, Non-interlocked enclosures* *Arc Flash, Non-interlocked enclosures*	L: C: R:	See Section I Chapter 04.	L: C: R:
Stored Energy Exposure	*Hazards:* *Shock hazard,>50 V, Interlocked enclosure area* *Arc Flash, Interlocked enclosure area*	L: C: R:	See Section I Chapter 04.	L: C: R:
High Voltage Exposure	*Hazards:* *Shock hazard, voltage > 50 V, Non-interlocked enclosures* *Arc Flash, Non-interlocked enclosures*	L: C: R:	See Section I Chapter 04.	L: C: R:
High Voltage Exposure	*Hazards:* *Shock hazard, voltage > 50 V, Interlocked enclosures* *Arc Flash, Interlocked enclosures*	L: C: R:	See Section I Chapter 04.	L: C: R:
Low Voltage, High Current Exposure.	*Hazards:* *Arc Flash, Non-interlocked enclosures* *Fire hazard from high current causing smoke inhalation and burns.*	L: C: R:	See Section I Chapter 04.	L: C: R:

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Low Voltage, High Current Exposure.	*Hazard:* *Arc Flash, Interlocked enclosures* *Fire hazard from high current causing smoke inhalation and burns.*	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)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences \ Likelihood	A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.11 Electrical Energy 1 Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Stored Energy Exposure	*Hazard:* • *Shock hazard, >50 V, Non-interlocked enclosures* • *Arc Flash, Non-interlocked enclosures*	L: C: R:	See Section I Chapter 04.	L: C: R:
Stored Energy Exposure	*Hazard:* • *Shock hazard,>50 V, Interlocked enclosures* • *Arc Flash, Interlocked enclosures*	L: C: R:	See Section I Chapter 04.	L: C: R:
High Voltage Exposure	*Hazard:* • *Shock hazard, voltage > 50 V, Non-interlocked enclosures* • *Arc Flash, Non-interlocked enclosures*	L: C: R:	See Section I Chapter 04.	L: C: R:

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Low Voltage, High Current Exposure.	*Hazard:* • *Arc Flash, Interlocked enclosures* • *Fire hazard from high current causing smoke inhalation and burns, beam line enclosure areas*	L: C: R:	See Section I Chapter 04.	L: C: R:

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

Likelihood (L, of event)/year
A = Anticipated (L > 1.0E-02)
U = Unlikely (1.0E-02> L >1.0E-04)
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)
BEU = Beyond Extremely Unlikely (1.0E-06> L)

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)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.

Risk Matrix

Consequences \ Likelihood	A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

	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 6.12 Electrical Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Stored Energy Exposure	*Hazard: Shock hazard, >50 V, Arc flash*	L: C: R:	See Section I Chapter 04.	L: C: R:
High Voltage Exposure	*Hazard: Shock hazard, > 50 V, Arc flash outside*	L: C: R:	See Section I Chapter 04.	L: C: R:
Low Voltage, High Current Exposure.	*Hazards: N/A*	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)**
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.13 Thermal Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Hot Work	*Hazard:* • *Hot work will cause elevated temperatures. If hot work is not supervised, there is a potential for combustibles in the surrounding area to be ignited due to exposure to slag or elevated temperatures. This could lead to excessive heat and burning, which could potentially lead to a fire.* • *The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices.* • *This hazard can add to the fuel load of a potential fire.* • *The exposure of the hazard to the facility*	L: C: R:	See Section I Chapter 04.	L: C: R:

	worker is of major concern.			

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)**
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.14 Thermal Energy – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Hot Work	*Hazard:* *A bakeout will cause elevated temperatures. If the bake out were to not have runaway temperature capabilities, this could lead to excessive heat and burning, which could potentially lead to a fire.* *The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices.* • *This hazard can add to the fuel load of a potential fire.* • *The exposure of the hazard to the co-located worker is of minor concern.*	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)**
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.15 Thermal Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Hot Work	*Hazards:* *Hot work will cause elevated temperatures. If hot work is not supervised, there is a potential for combustibles in the surrounding area to be ignited due to exposure to slag or elevated temperatures. This could lead to excessive heat and burning, which could potentially lead to a fire.* *The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices.* *This hazard can add to the fuel load of a potential fire.* *The exposure of the hazard to the public is of minimal concern.*	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)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.16 Kinetic Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Power Tools	*Hazard: Personnel injury due to improper use of power tools.*	L: C: R:	See Section I Chapter 04.	L: C: R:
Pumps and Motors	*Hazard: Personnel injury due to entrapment/entanglement*	L: C: R:	See Section I Chapter 04.	L: C: R:
Motion Tables	*Hazard: Personnel injury due to pinch points, tip-overs, caught in between.*	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)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.17 Kinetic Energy – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Power Tools	*Hazard: Personnel injury due to power tool use (flying debris, struck by object).*	L: C: R:	See Section I Chapter 04.	L: C: R:
Pumps and Motors	*Hazard: Personnel injury due to entrapment/entanglement.*	L: C: R:	See Section I Chapter 04.	L: C: R:
Motion Tables	*Hazard: Personnel injury due to tip-overs, caught in between, crushing*	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)**
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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**

Risk Matrix

Consequences	**Likelihood** A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.18 Kinetic Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Power tools	*Hazard: N/A*	L: C: R:	See Section I Chapter 04.	L: C: R:
Pumps and Motors	*Hazard: N/A*	L: C: R:	See Section I Chapter 04.	L: C: R:
Motion Tables	*Hazard: N/A*	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)**
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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**

Risk Matrix

Consequences	**Likelihood** A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.19 Potential Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Crane Operations	*Hazard: personnel injury due to improper crane operations.*	L: C: R:	See Section I Chapter 04.	L: C: R:
Compressed Gasses	*Hazard: Personnel injury due to unexpected release, or unsecure tanks.*	L: C: R:	See Section I Chapter 04.	L: C: R:
Vacuum/ Pressure Vessels/Piping	*Hazards:* *Personnel injury due to unexpected pressure release.* *Beam pipes under vacuum*	L: C: R:	See Section I Chapter 04.	L: C: R:
Vacuum Pumps	*Hazard: Personnel injury due to interaction with existing vacuum.*	L: C: R:	See Section I Chapter 04.	L: C: R:
Material Handling	*Hazard: Personnel injury due to moving/handing material (rollovers, crush, 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

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** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.20 Potential Energy – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Crane Operations	*Hazard: Struck by falling, swinging loads*	L: C: R:	See Section I Chapter 04.	L: C: R:
Compressed Gasses	*Hazard: Collocated personnel injury due to unexpected release, or unsecure tanks*	L: C: R:	See Section I Chapter 04.	L: C: R:
Vacuum/ Pressure Vessels/Piping	*Hazards:* *Collocated personnel injury due to unexpected pressure release.* *Beam pipes under vacuum*	L: C: R:	See Section I Chapter 04.	L: C: R:
Vacuum Pumps	*Hazard: Personnel injury due to interaction with existing vacuum.*	L: C: R:	See Section I Chapter 04.	L: C: R:
Material Handling	*Hazard: Collocated personnel injury due to moving/handing material (rollovers, crush, 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

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** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.21 Potential Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Crane Operations	*Hazard: N/A*	L: C: R:	See Section I Chapter 04.	L: C: R:
Compressed Gasses	*Hazard: Injury due to unexpected release, or unsecure tanks outside of buildings*	L: C: R:	See Section I Chapter 04.	L: C: R:
Vacuum/ Pressure Vessels/Piping	*Hazard: Injury due to unexpected release, or unsecure tanks outside of buildings*	L: C: R:	See Section I Chapter 04.	L: C: R:
Vacuum Pumps	*Hazard: N/A*	L: C: R:	See Section I Chapter 04.	L: C: R:
Material Handling	*Hazard: N/A*	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)**
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.22 Magnetic Fields – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Fringe Fields	*Hazard:* *Exposure to fringe fields beyond allowable limits (worker **with** ferromagnetic or electronic medical device(s))* *Exposure to fringe fields beyond allowable limits (worker **without** ferromagnetic or electronic medical device(s))* *Exposure to flying metallic objects causing potential injury.*	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)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.23 Magnetic Fields – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Fringe Fields	*Hazards:* *Exposure to fringe fields beyond allowable limits (worker **with** ferromagnetic or electronic medical device(s))* *Exposure to fringe fields beyond allowable limits (worker **without** ferromagnetic or electronic medical device(s))* *Exposure to flying metallic objects causing potential injury.*	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)**
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.24 Magnetic Fields – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Fringe Fields	*Hazards:* *Exposure to fringe fields beyond allowable limits (worker **with** ferromagnetic or electronic medical device(s))* *Exposure to fringe fields beyond allowable limits (worker **without** ferromagnetic or electronic medical device(s))* *Exposure to flying metallic objects causing potential injury.*	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)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.25 Other hazards – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Confined Spaces	*Hazards:* *Toxic atmosphere* *Limited egress* *Poor quality walking surface*	L: C: R:	See Section I Chapter 04.	L: C: R:
Noise	*Hazard: Exposure above OELs via use of machinery, tools, co-location w/ equipment, etc.*	L: C: R:	See Section I Chapter 04.	L: C: R:
Silica	*Hazard: Airborne exposure above OEL via concrete (or similar material) machining, moving dirt or gravel*	L: C: R:	See Section I Chapter 04.	L: C: R:
Ergonomics	*Hazards:* *Office space* *Industrial space (over lifting, repetitive motion, static posture)*	L: C: R:	See Section I Chapter 04.	L: C: R:
Working at Heights	*Hazard: Falls, dropped tools/material*	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)**
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.26 Other hazards – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Confined Spaces	*Hazard:* *Toxic atmosphere* *Accidental entry*	L: C: R:	See Section I Chapter 04.	L: C: R:
Noise	*Hazard: Exposure above OELs via use of machinery, tools, co-location w/ equipment, etc.*	L: C: R:	See Section I Chapter 04.	L: C: R:
Silica	*Hazard: Airborne exposure above OEL via concrete (or similar material) machining, moving dirt or gravel*	L: C: R	See Section I Chapter 04.	L: C: R
Ergonomics	*Hazard: N/A*	L: C: R:	See Section I Chapter 04.	L: C: R:
Working at Heights	*Hazard: Struck by dropped tools/material*	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)**
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.27 Other hazards – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Confined Spaces	*Hazards:* *Toxic atmosphere* *Accidental entry*	L: C: R:	See Section I Chapter 04.	L: C: R:
Noise	*Hazard: Exposure above OELs via use of machinery, tools, co-location w/ equipment, etc.*	L: C: R:	See Section I Chapter 04.	L: C: R:
Silica	*Hazard: Airborne exposure above OEL via concrete (or similar material) machining, moving dirt or gravel*	L: C: R:	See Section I Chapter 04.	L: C: R:
Ergonomics	*Hazard: N/A*	L: C: R:	See Section I Chapter 04.	L: C: R:
Working at Heights	*Hazard: Struck by dropped tools/material*	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)**
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences \ Likelihood	A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.28 Access & Egress – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Life Safety Egress	*Hazards:* *A blocked egress would be of major life safety concern.* *An egress might be blocked due to construction work, poor housekeeping, or faulty doors.* *In the event of a fire or other life-threatening event, a blocked egress would be life threatening.* *The exposure of the hazard to the facility worker is of major concern.*	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)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.29 Access & Egress – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Life Safety Egress	*Hazards:* *A blocked egress would be of major life safety concern.* *An egress might be blocked due to construction work, poor housekeeping, or faulty doors.* *In the event of a fire, a blocked egress would be life threatening.* *The exposure of the hazard to the co-located worker is of concern.*	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)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.30 Access & Egress – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Life Safety Egress	*Hazard: N/A*	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)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] 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

Risk Matrix

Consequences	Likelihood: A	U	EU	BEU
H	I	I	II	III
M	II	II	III	IV
L	III	III	IV	IV
N	IV	IV	IV	IV

Table 6.31 Environmental

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Airborne	*Hazards:* *Airborne release of radionuclides beyond permitted limits* *Airborne release of chemicals beyond permitted limits (consequence based on Onsite Worker qualitative consequence matrix)*	L: C: R:	See Section I Chapter 04.	L: C: R:
Water	*Hazards:* *Discharge of radionuclides into onsite waters beyond permitted limits* *Discharge of chemicals into onsite waters beyond permitted limits (Consequence based on Onsite worker qualitative consequence matrix)*	L: C: R:	See Section I Chapter 04.	L: C: R:
Soil	*Hazards:* *Radioactive soil in beam loss areas beyond allowable concentrations of radionuclides above Fermilab limits* *Discharge of chemicals into onsite soils beyond RCRA limits (Consequence based on Onsite*	L: C: R:	See Section I Chapter 04.	L: C: R:

	worker qualitative consequence matrix)			