Table 5. Summary of Baseline and Residual Risks – Booster Neutrino Beam (BNB)

	Risk Tables Description	Baseline Risk	Residual Risk
5.1	Radiological – Onsite-1 Facility Worker	R: I	R: IV
5.2	Radiological – Onsite-2 Co-located Worker	R: I	R: IV
5.3	Radiological – MOI Offsite	R: I	R: IV
5.4	Toxic Materials – Onsite 1 Facility Worker	R: *	R: *
5.5	Toxic Materials – Onsite 2 Co-located Worker	R: *	R: *
5.6	Toxic Materials – MOI Offsite	R: *	R: *
5.7	Flammable & Combustible Materials – Onsite-1 Facility Worker	R: *	R: *
5.8	Flammable & Combustible Materials – Onsite-2 Co-located worker	R: *	R: *
5.9	Flammable & Combustible Materials – MOI Offsite	R: *	R: *
5.10	Electrical Energy – Onsite-1 Facility Worker	R: *	R: *
5.11	Electrical Energy – Onsite-2 Co-located Worker	R: *	R: *
5.12	Electrical Energy – MOI Offsite	R: *	R: *
5.13	Thermal Energy – Onsite-1 Facility Worker	R: *	R: *
5.14	Thermal Energy – Onsite-2 Co-located Worker	R: *	R: *
5.15	Thermal Energy – MOI Offsite	R: *	R: *
5.16	Kinetic Energy – Onsite-1 Facility Worker	R: *	R: *
5.17	Kinetic Energy – Onsite-2 Co-located Worker	R: *	R: *
5.18	Kinetic Energy – MOI Offsite	R: *	R: *
5.19	Potential Energy- Onsite-1 Facility Worker	R: *	R: *
5.20	Potential Energy – Onsite-2 Co-located Worker	R: *	R: *
5.21	Potential Energy – MOI Offsite	R: *	R: *
5.22	Magnetic Fields – Onsite-1 Facility Worker	R: *	R: *
5.23	Magnetic Fields – Onsite-2 Co-located Worker	R: *	R: *
5.24	Magnetic Fields – MOI Offsite	R: *	R: *
5.25	Other Hazards – Onsite-1 Facility Worker	R: *	R: *
5.26	Other Hazards – Onsite-2 Co-located Worker	R: *	R: *
5.27	Other Hazards – MOI Offsite	R: *	R: *
5.28	Access & Egress – Onsite-1 Facility Worker	R: *	R: *
5.29	Access & Egress – Onsite-2 Co-located Worker	R: *	R: *
5.30	Access & Egress – MOI Offsite	R: *	R: *
5.31	Environmental Hazards	R: *	R: *

<sup>\*</sup> 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 5.1 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)
Activation	activation	C: H R: I	<ul> <li>P – General and/or Job Specific RWP: A RWP is written by ES&amp;H that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure.</li> <li>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.</li> <li>P – Radiological Training: An educational system managed by ES&amp;H that establishes basic worker knowledge through presentations and testing.</li> <li>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</li> </ul>	C: L R: IV
			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.	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Groundwater	Hazards:			
Activation	Potential exposure due to construction	L: A	P – Water Evaluation: Sump water is evaluated to determine the presence	L: EU
	activities, (e.g., earthmoving).	C: N	of tritium or other activation products to prevent personnel exposure.	C: N
		R: IV	<ul> <li>P – Water Capture: Sump pits/enclosures capture activated water to prevent releases exceeding allowed discharge limits.</li> <li>M – Facility Designs: Facility designs employ shielding to mitigate the production of activation products in groundwater.</li> </ul>	R: IV
	Draining of groundwater captured in	L: A	P – Water Sampling: Sump water is periodically sampled, and tank	L: U
	tanks.	C: N	draining is performed by RCTs (specialized training).	C: N
		R: IV	M – RCTs Drain Tanks: Highly trained personnel (RCTs) employ ALARA principles to mitigate exposures during tank draining activities.	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	L: A	P – Beam Loss Monitoring: Beam loss monitors in enclosures prevent	L: U
Activation	surface water due to beam loss	C: N	excessive beam loss.	C: N
	leakage from beam enclosures, located under the surface water impoundment.	R: IV	<ul> <li>M – Radiation Detectors: Radiation detectors in enclosures and berms reduce the amount of activation to surface water, by promptly disabling the beam.</li> <li>M – Shielding: Soil, concrete, and/or steel shielding reduces surface water activation.</li> </ul>	R: IV
	Potential exposure to activated surface water due to mixing surface water with a captured groundwater source.	L: A C: N R: IV	<ul> <li>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.</li> <li>P – Monitoring Potential Sources: Monitoring of potential mixed sources allow for diversion of water, preventing exposure to waters above the Derived Concentration Standard.</li> <li>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.</li> <li>M – Monitoring Surface Water: Frequent surface water monitoring at many locations to mitigate increases in activity approaching the Derived Concentration Standard.</li> </ul>	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	Hazard: Persons are exposed, beyond	L: A	P – RAW Key Control System: A key system that prevents personnel	L: BEU
Water (RAW)	regulatory levels, to radioactive water	C: H	access to radioactive water systems.	C: L
Systems		R: I	<ul> <li>P – Secondary Containment: Engineered containment prevents unintended exposure to contaminated water.</li> <li>P – General and/or Job Specific RWP: A RWP is written by ES&amp;H that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure.</li> <li>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</li> <li>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.</li> <li>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.</li> </ul>	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	<ul> <li>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.</li> <li>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.</li> <li>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.</li> <li>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.</li> <li>M — Target Pile Shielding: Material placed between radiation sources in the target pile and the enclosure to be protected. This is a passive mitigation.</li> </ul>	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	Hazard: Radionuclides in air exceed	L: A	P – Active Air Monitoring: Key issuance to enclosures is restricted until	L: BEU
Cooling	regulatory levels leading to potential worker exposure	C: H R: I	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.	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	<ul> <li>P – General and/or Job Specific RWP: A RWP is written by ES&amp;H that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure.</li> <li>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.</li> <li>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.</li> <li>M – Run Condition: Operating parameters that reduce activation by limiting the total amount of beam that could be delivered.</li> </ul>	L: U C: N R: IV
			Specifically, this includes an operating limit for protons/hr. This is an active mitigation.	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Radioactive	Hazard: Persons are exposed to	L: A		L: EU
Waste	ionizing radiation beyond regulatory levels	C: L R: III	<ul> <li>P – General and/or Job Specific RWP: A RWP is written by ES&amp;H that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure.</li> <li>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.</li> <li>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.</li> <li>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.</li> </ul>	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	<ul> <li>P – Shielding for Activated Contamination: Material placed between radiation sources and the personnel to be protected.</li> <li>P – Radiological Surveying and Cleaning: RCTs and RSOs survey for and clean radiological contamination as part of the RWP process.</li> <li>P – General and/or Job Specific RWP: A RWP is written by ES&amp;H that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure.</li> <li>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.</li> <li>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.</li> <li>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.</li> </ul>	L: BEU C: L R: IV
<sup>7</sup> Be	Hazard: Potential radiation exposure to <sup>7</sup> Be (uptake/committed dose).	L: A C: N R: IV	No prevention or mitigation is required. <sup>7</sup> 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	Hazard: Persons are exposed to	L: A	P – Radiological Signage on or Near Source Cabinets: Signs give warning	L: BEU
Sources	ionizing radiation beyond regulatory	C: H	of the presence of radioactive sources.	C: L
	levels	R: I	<ul> <li>P – Radiological Training: An educational system managed by ES&amp;H that establishes basic worker knowledge through presentations and testing.</li> <li>P – Kept Under Lock-and-key: Radioactive sources are kept in locked storage, where key issuance is a controlled process.</li> <li>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.</li> <li>M – Shielded Containers: Unused high activity sources are stored within shielded containers. This is a passive mitigation.</li> </ul>	R: IV

Radiological Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	Cor	nsequence (C, of event)/y	year	Risk (R, Qualitative R	lanking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (even	t) of major concern				Like	lihood		
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H} = \text{situation (even}$	nt) of concern	_	1	A	U	EU	BEU	
$\mathbf{EU} = \text{Extremely Unlikely } (1.0\text{E}-04 > \text{L} > 1.0\text{E}-06)$		L = Low		<b>III</b> = situation (eve	ent) of minor concern	ences	Н	I	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		<b>IV</b> = situation (eve	<b>IV</b> = situation (event) of minimal concern		M	II	II	Ш	IV	
Control(s) Type	C	Offsite (MOI)	Onsi	te-2 (co-located worker)	Onsite-1 (facility worker)	edn	Ţ	***	777	***	***	
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	<b>C</b> ≥ 25.0 rem		<b>C</b> ≥ 100 rem	<b>C</b> ≥ 100 rem	ons	L	III	III	IV	IV	
M = Mitigative (reduces event consequences)	M	$25.0 \text{ rem} > \mathbf{C} \ge 5 \text{ rem}$	10	00 rem > <b>C</b> ≥ 25 rem	100 rem > <b>C</b> ≥ 25 rem		N	IV	IV	IV	IV	
Acronyms  MOI Manipuelly approach Officia Individual	L	5 rem > <b>C</b>		25 rem > C	25 rem > <b>C</b>							
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	N	0.5 rem > <b>C</b>		5 rem > C	5 rem > C							

Table 5.2 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)
Activation	activation	C: H R: I	<ul> <li>P – General and/or Job Specific RWP: A RWP is written by ES&amp;H that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure.</li> <li>P – LSM: An LSM allows for real time monitoring of radiation levels</li> </ul>	C: L R: IV
			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.	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Groundwater	Hazards:			
Activation	Potential exposure due to construction	L: A	P – Water Evaluation: Sump water is evaluated to determine the presence	L: EU
	activities, (e.g., earthmoving).	C: N	of tritium or other activation products to prevent personnel exposure.	C: N
	R: IV		<ul> <li>P — Water Capture: Sump pits/enclosures capture activated water to prevent releases exceeding allowed discharge limits.</li> <li>M — Facility Designs: Facility designs employ shielding to mitigate the production of activation products in groundwater.</li> </ul>	R: IV
	Draining of groundwater captured in	L: A	P – Water Sampling: Sump water is periodically sampled, and tank	L: U
	tanks.	C: N	draining is performed by RCTs (specialized training).	C: N
		R: IV	<ul> <li>M – RCTs Drain Tanks: Highly trained personnel (RCTs) employ</li> <li>ALARA principles to mitigate exposures during tank draining activities.</li> </ul>	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	Hazards:			
Activation	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	<ul> <li>P – Beam Loss Monitoring: Beam loss monitors in enclosures prevent excessive beam loss.</li> <li>M – Radiation Detectors: Radiation detectors in enclosures and berms reduce the amount of activation to surface water, by promptly disabling the beam.</li> <li>M – Shielding: Soil, concrete, and/or steel shielding reduces surface water activation.</li> </ul>	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	<ul> <li>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.</li> <li>P – Monitoring Potential Sources: Monitoring of potential mixed sources allow for diversion of water, preventing exposure to waters above the Derived Concentration Standard.</li> <li>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.</li> <li>M – Monitoring Surface Water: Frequent surface water monitoring at many locations to mitigate increases in activity approaching the Derived Concentration Standard.</li> </ul>	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	Hazard: persons are exposed, beyond	L: A	P – RAW Key Control System: A key system that prevents personnel	L: BEU
Water (RAW)	regulatory levels, to radioactive water	C: H	access to radioactive water systems.	C: L
Systems		R: I	<ul> <li>P – Secondary Containment: Engineered containment prevents unintended exposure to contaminated water.</li> <li>P – General and/or Job Specific RWP: A RWP is written by ES&amp;H that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure.</li> <li>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.</li> <li>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.</li> <li>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.</li> </ul>	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	L: A	P – Active Air Monitoring: Key issuance to enclosures is restricted until	L: EU
	regulatory levels	C: H	after the air monitors show that there is a sufficiently low level of	C: N
		R: I	radiation coming from the activated air components.	R: IV
			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.	

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	Hazard: radionuclides in air exceed	L: A	P – Active Air Monitoring: Key issuance to enclosures is restricted until	L: BEU
Cooling	regulatory levels	C: H	after the air monitors show that there is an acceptable level of	C: L
		R: I	radiation coming from the activated air components.	R: IV
			<ul> <li>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.</li> <li>P – Air Containment: Engineered containment of the cooling air is used to keep it separate from the breathable air.</li> <li>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.</li> <li>M – Target Pile Shielding: Material placed between radiation sources in the target pile and the enclosure to be protected. This is a passive mitigation.</li> </ul>	

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	L: A	P – General and/or Job Specific RWP: A RWP is written by ES&H that	L: U
	which may contaminate ground water	C: N	specifies the work that is permitted to be performed, requirements to	C: N
		R: IV	perform the work, and limitations of radiological exposure.	R: IV
			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.	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/Mitigative (M) Credited Controls Are In Bold	Residual Qualitative Risk (with controls)
Radioactive	Hazard: persons are exposed to	L: A	P – General and/or Job Specific RWP: A RWP is written by ES&H that	L: EU
Waste	ionizing radiation beyond regulatory	C: L	specifies the work that is permitted to be performed, requirements to	C: N
	levels	R: III	perform the work, and limitations of radiological exposure.	R: IV
			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.	

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	<ul> <li>P – Shielding for Activated Contamination: Material placed between radiation sources and the personnel to be protected.</li> <li>P – Radiological Surveying and Cleaning: RCTs and RSOs survey for and clean radiological contamination as part of the RWP process.</li> <li>P – General and/or Job Specific RWP: A RWP is written by ES&amp;H that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure.</li> <li>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.</li> <li>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.</li> <li>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.</li> </ul>	L:BEU C: L R: IV
<sup>7</sup> Be	Hazard: Potential radiation exposure to <sup>7</sup> Be (uptake/committed dose).	L: A C: N R: IV	No prevention or mitigation is required. <sup>7</sup> 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	Hazard: persons are exposed to	L: A	P – Radiological Signage on or Near Source Cabinets: Signs give	L:BEU
Sources	ionizing radiation beyond regulatory	C: H	warning of the presence of radioactive sources.	C: L
	levels	R: I	<ul> <li>P – Radiological Training: An educational system managed by ES&amp;H that establishes basic worker knowledge through presentations and testing.</li> <li>P – Kept Under Lock-and-key: Radioactive sources are kept in locked storage, where key issuance is a controlled process.</li> <li>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.</li> <li>M – Shielded Containers: Unused high activity sources are stored within shielded containers. This is a passive mitigation.</li> </ul>	R: IV

Radiological Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	Co	nsequence (C, of event)/	year	Risk (R, Qualitative R	anking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (even)	t) of major concern				Like	lihood		
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (even}$	nt) of concern		1	Α	U	EU	BEU	
$\mathbf{EU} = \text{Extremely Unlikely } (1.0\text{E}-04 > \text{L} > 1.0\text{E}-06)$		L = Low		<b>III</b> = situation (eve	ent) of minor concern	ences	Н	I	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		<b>IV</b> = situation (eve	nation (event) of minimal concern		M	II	II	Ш	IV	
Control(s) Type	C	Offsite (MOI)	Onsi	te-2 (co-located worker)	Onsite-1 (facility worker)	edn		777	***	77.7	***	
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ 25.0 rem		<b>C</b> ≥ 100 rem	<b>C</b> ≥ 100 rem	ons	L	III	III	IV	IV	
M = Mitigative (reduces event consequences)	M	$25.0 \text{ rem} > \mathbf{C} \ge 5 \text{ rem}$	10	00 rem > <b>C</b> ≥ 25 rem	100 rem > <b>C</b> ≥ 25 rem		N	IV	IV	IV	IV	
Acronyms  MOI Manipus III amount Officia Individual	L	5 rem > <b>C</b>		25 rem > C	25 rem > <b>C</b>							
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	N	0.5 rem > <b>C</b>		5 rem > C	5 rem > C							

**Table 5.3 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	<ul> <li>P — Gates: Public access gates prevent unauthorized access by public.</li> <li>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.</li> </ul>	L: BEU C: M R: IV
Groundwater Activation	Hazards: Potential exposure due to construction activities, (e.g., earthmoving).	L: A C: N R: IV	<ul> <li>P — Water Evaluation: Sump water is evaluated to determine the presence of tritium or other activation products to prevent personnel exposure.</li> <li>P — Water Capture: Sump pits/enclosures capture activated water to prevent releases exceeding allowed discharge limits.</li> <li>M — Facility Designs: Facility designs employ shielding to mitigate the production of activation products in groundwater.</li> </ul>	L: EU C: N R: IV
	Draining of groundwater captured in tanks.	L: A C: N R: IV	<ul> <li>P – Water Sampling: Sump water is periodically sampled, and tank draining is performed by RCTs (specialized training).</li> <li>M – RCTs Drain Tanks: Highly trained personnel (RCTs) employ ALARA principles to mitigate exposures during tank draining activities.</li> </ul>	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	<ul> <li>P – Beam Loss Monitoring: Beam loss monitors in enclosures prevent excessive beam loss.</li> <li>M – Radiation Detectors: Radiation detectors in enclosures and berms reduce the amount of activation to surface water, by promptly disabling the beam.</li> <li>M – Shielding: Soil, concrete, and/or steel shielding reduces surface water activation.</li> </ul>	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	<ul> <li>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.</li> <li>P – Monitoring Potential Sources: Monitoring of potential mixed sources allow for diversion of water, preventing exposure to waters above the Derived Concentration Standard.</li> <li>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.</li> <li>M – Monitoring Surface Water: Frequent surface water monitoring at many locations to mitigate increases in activity approaching the Derived Concentration Standard.</li> </ul>	L: EU C: N R: IV
Radioactive Water (RAW) Systems	Hazard: persons are exposed, beyond regulatory levels, to radioactive water	L: BEU C: H R: III	<ul> <li>P – Gates: Public access gates prevent unauthorized access by public.</li> <li>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.</li> </ul>	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)
Air Activation	Hazard: radionuclides in air exceed regulatory levels	L: BEU C: H R: III	<ul> <li>P – Gates: Public access gates prevent unauthorized access by public.</li> <li>M – Controlled Release: The release of activated air is engineered to reduce potential exposure consequences. This is a passive mitigation.</li> </ul>	L: BEU C: M R: IV
Closed Loop Air Cooling	Hazard: radionuclides in air exceed regulatory levels	L: BEU C: H R: III	<ul> <li>P – Gates: Public access gates prevent unauthorized access by public.</li> <li>P – Air Containment: Engineered containment of the cooling air is used to keep it separate from the breathable air.</li> <li>M – Controlled Release: The release of activated air is engineered to reduce potential exposure consequences. This is a passive mitigation.</li> </ul>	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	<ul> <li>P – Gates: Public access gates prevent unauthorized access by public.</li> <li>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.</li> </ul>	L: BEU C: M R: IV
Contamination	Hazard: persons are exposed to ionizing radiation beyond regulatory levels	L: BEU C: H R: III	<ul> <li>P – Gates: Public access gates prevent unauthorized access by public.</li> <li>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.</li> </ul>	L: BEU C: M R: IV
<sup>7</sup> Be	Hazard: Potential radiation exposure to <sup>7</sup> Be (uptake/committed dose).	L: A C: N R: IV	No prevention or mitigation is required. <sup>7</sup> 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	Hazard: persons are exposed to	L: BEU	P – Gates: Public access gates prevent unauthorized access by public.	L: BEU
Sources	ionizing radiation beyond regulatory	C: H	M – Kept in Storage: Unused radioactive sources are kept in storage,	C: L
	levels	R: III	which prevents the close proximity of these sources and people. This is a passive mitigation.	R: IV
			M – Shielded Containers: Unused high activity sources are stored within shielded containers. This is a passive mitigation.	

Radiological Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.															
Likelihood (L, of event)/year	Co	nsequence (C, of event)/y	ear	Risk (R, Qualitative F	Risk (R, Qualitative Ranking)			Risk Matrix							
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (even	t) of major concern			Likelihood							
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (even}$	nt) of concern			Α	U	EU	BEU				
$\mathbf{EU} = \text{Extremely Unlikely } (1.0\text{E}-04 > \text{L} > 1.0\text{E}-06)$		L = Low		<b>III</b> = situation (evo	ent) of minor concern	જ	Н	I	I	II	III				
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		<b>IV</b> = situation (event) of minimal concern		enc	M	II	II	III	IV				
Control(s) Type	C	Offsite (MOI)	Onsi	te-2 (co-located worker)	Onsite-1 (facility worker)	edn		TTT	TIT	TX 7	13.7				
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ 25.0 rem		<b>C</b> ≥ 100 rem	<b>C</b> ≥ 100 rem	Suo	L	III	III	IV	IV				
M = Mitigative (reduces event consequences)	M	$25.0 \text{ rem} > \mathbf{C} \ge 5 \text{ rem}$	10	00 rem > <b>C</b> ≥ 25 rem	100 rem > <b>C</b> ≥ 25 rem	0	N	IV	IV	IV	IV				
Acronyms  MOI - Movimelly, avenued Officia Individual	L	5 rem > <b>C</b>		25 rem > <b>C</b>	25 rem > <b>C</b>										
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	N	0.5 rem > <b>C</b>		5 rem > C	5 rem > C										

**Table 5.4 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	L:	See Section I Chapter 04.	L:
	dust during manual handling of un-	C:		C:
	encased lead bricks, lead shot, and	R:		R:
	lead sheets.			
Beryllium	Hazard: Potential exposure to	L:	See Section I Chapter 04.	L:
	beryllium dust during manual	C:		C:
	handling of un-encased, or machining	R:		R:
	dusts from fabrication shop activities.			

Chemical Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event	)/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern				Like	lihood		
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (even	ent) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		<b>III</b> = situation (ev	vent) of minor concern	es	Н	I	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	M	II	II	Ш	IV	
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edn	_	TTT	111	TX 7	13.7	
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ PAC-2		C ≥ PAC-3	C ≥ IDLH	ons	L	III	III	IV	IV	
<b>M</b> = Mitigative (reduces event consequences)	M	$PAC-2 > C \ge PAC-1$	P/	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$		N	IV	IV	IV	IV	
Acronyms  IDLH = Immediately Dangerous to Life and Health	L	PAC-1 > <b>C</b>		PAC-2 > C	PEL or $TLV_c > C$							
MOI = Maximally-exposed Offsite Individual PAC = Protective Action Criteria PEL = Permissible Exposure Limit TLV <sub>c</sub> = Threshold Limit Value (ceiling)	N	Consequences less than those for Low Consequence Level		nsequences less than for Low Consequence Level	Consequences less than those for Low Consequence Level							

**Table 5.5 Toxic Materials – Onsite 2 Co-located Worker** 

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

Chemical Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.													
Likelihood (L, of event)/year	C	onsequence (C, of event	)/year	Risk (R, Qualitative Ranking)			Risk Matrix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II}$ = situation (ev	ent) of concern	_	1	A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		<b>III</b> = situation (e	vent) of minor concern	ences	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		<b>IV</b> = situation (ev	<b>IV</b> = situation (event) of minimal concern			II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edn	т	Ш	Ш	IV	IV		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ PAC-2		C ≥ PAC-3	C ≥ IDLH	,ons	L		111	1 V			
M = Mitigative (reduces event consequences)	M	$PAC-2 > C \ge PAC-1$	P/	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$		N	IV	IV	IV	IV		
Acronyms  IDLH = Immediately Dangerous to Life and Health	L	PAC-1 > <b>C</b>		PAC-2 > <b>C</b>	PEL or $TLV_c > C$								
MOI = Maximally-exposed Offsite Individual PAC = Protective Action Criteria PEL = Permissible Exposure Limit	N	Consequences less than those for Low Consequence Level		nsequences less than for Low Consequence Level	Consequences less than those for Low Consequence Level								
$TLV_c$ = Threshold Limit Value (ceiling)													

**Table 5.6 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	L:	See Section I Chapter 04.	L:
	dust during manual handling of un-	C:		C:
	encased lead bricks, lead shot, and	R:		R:
	lead sheets.			
Beryllium	Hazard: Potential exposure to	L:	See Section I Chapter 04.	L:
	beryllium dust during manual	C:		C:
	handling of un-encased, or machining	R:		R:
	dusts from fabrication shop activities.			

Chemical Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)	)/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated (L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern				Like	lihood		
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (even	ent) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		<b>III</b> = situation (ev	vent) of minor concern	es	Н	I	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edn	_	TTT	111	TX 7	13.7	
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ PAC-2		C ≥ PAC-3	C ≥ IDLH	ons	L	III	III	IV	IV	
<b>M</b> = Mitigative (reduces event consequences)	M	PAC-2 > <b>C</b> ≥ PAC-1	P/	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$		N	IV	IV	IV	IV	
Acronyms  IDLH = Immediately Dangerous to Life and Health	L	PAC-1 > <b>C</b>		PAC-2 > C	PEL or $TLV_c > C$							
MOI = Maximally-exposed Offsite Individual PAC = Protective Action Criteria PEL = Permissible Exposure Limit TLV <sub>c</sub> = Threshold Limit Value (ceiling)	N	Consequences less than those for Low Consequence Level		nsequences less than for Low Consequence Level	Consequences less than those for Low Consequence Level							

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	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	C	onsequence (C, of event)/	year   Risk (R, Qualitative	Ranking)	Risk Matrix							
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \text{High}$	$\mathbf{I} = \text{situation (even}$	ent) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situation (ev}$	vent) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	<b>III</b> = situation (e	vent) of minor concern	ences	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (e	event) of minimal concern		M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sedne		***	***	77.7	***		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
$\mathbf{M} = \text{Mitigative (reduces event consequences)}$		other serious effects,	or acute injury that is	fatality or acute injury that	5	N	IV	IV	IV	IV		
Acronyms		or symptoms which	immediately life-	is immediately life-			•					
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective	Ç									
		action.										
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization $> C$								
	N	Consequences less	Consequences less than	Consequences less than								
		than those for Low	those for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

Table 5.8 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	C	onsequence (C, of event)/	year   Risk (R, Qualita	tive I	Ranking)	Risk Matrix							
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \text{High}$	I = situation	(ever	nt) of major concern				Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{H} = \text{situation}$	ı (eve	ent) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III = situatio	n (ev	vent) of minor concern	es	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situatio	n (ev	vent) of minimal concern	ences	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worke	er)	Onsite-1 (facility worker)	sedno		TTT	TIT	13.7	TX /		
<b>P</b> = Preventive (reduce event occurrence likelihood)	H	C ≥ Irreversible,	C ≥ Prompt worker fatal	itv	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
<b>M</b> = Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	-	fatality or acute injury that	5	N	IV	IV	IV	IV		
Acronyms		or symptoms which	immediately life-		is immediately life-			•	•	•			
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatening or permanen	tly	threatening or								
		individual's ability to	disabling.		permanently disabling.								
		take protective	· ·										
		action.											
	M	C ≥ Mild, transient	C ≥ Serious injury, no	)	C ≥ Serious injury, no								
		adverse effects.	immediate loss of life n	10	immediate loss of life no								
			permanent disabilities;	;	permanent disabilities;								
			hospitalization required	1.	hospitalization required.								
	L	Mild, transient	Minor injuries; no		Minor injuries; no								
		adverse effects > C	hospitalization > C		hospitalization $> \mathbf{C}$								
	N	Consequences less	Consequences less than		Consequences less than								
		than those for Low	those for Low Consequer	nce	those for Low								
		Consequence Level	Level		Consequence Level								

**Table 5.9 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	C	onsequence (C, of event)/	year   Risk (R, Qualitative	Ranking)	Risk Matrix							
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \text{High}$	$\mathbf{I} = \text{situation (even}$	ent) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situation (ev}$	vent) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	<b>III</b> = situation (e	vent) of minor concern	ences	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (e	event) of minimal concern		M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sedne		***	***	77.7	***		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
$\mathbf{M} = \text{Mitigative (reduces event consequences)}$		other serious effects,	or acute injury that is	fatality or acute injury that	5	N	IV	IV	IV	IV		
Acronyms		or symptoms which	immediately life-	is immediately life-			•		•			
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective	Ç									
		action.										
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization $> C$								
	N	Consequences less	Consequences less than	Consequences less than								
		than those for Low	those for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

**Table 5.10 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	Hazards:			
Exposure	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	Hazards:			
Exposure	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	Hazards:			
Exposure	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	Hazards:			
Exposure	Shock hazard, voltage > 50 V, Interlocked enclosures  Arc Flash, 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)
Low Voltage,	Hazards:			
High Current	Arc Flash, Non-interlocked	L:	See Section I Chapter 04.	L:
Exposure.	enclosures	C:		C:
		R:		R:
	Fire hazard from high current			
	causing smoke inhalation and burns.			
Low Voltage,	Hazard:			
High Current	Arc Flash, Interlocked enclosures	L:	See Section I Chapter 04.	L:
Exposure.		C:		C:
	Fire hazard from high current	R:		R:
	causing smoke inhalation and burns.			

Other Hazard Consequences, derived from Figure C-1	l, "F	Example Qualitative Cons	equence Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year   Risk (R, Qualitative	Ranking)	Risk	Risk Matrix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$	I = situation (eve	ent) of major concern				Like	lihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{H} = \text{situation (ev}$	ent) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	<b>III</b> = situation (ex	vent) of minor concern	sə	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	ences	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sedne				***	***		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	_	L	III	III	IV	IV		
<b>M</b> = Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	ِي ت	N	IV	IV	IV	IV		
Acronyms		or symptoms which	immediately life-	is immediately life-								
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective	8.	Francisco S.								
		action.										
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization > C								
	N	Consequences less	Consequences less than	Consequences less than								
		than those for Low	those for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

Table 5.11 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	<ul> <li>Hazard:</li> <li>Shock hazard, &gt;50 V, Non-interlocked enclosures</li> <li>Arc Flash, Non- interlocked enclosures</li> </ul>	L: C: R:	See Section I Chapter 04.	L: C: R:
Stored Energy Exposure	<ul> <li>Hazard:</li> <li>Shock hazard,&gt;50 V,</li></ul>	L: C: R:	See Section I Chapter 04.	L: C: R:
High Voltage Exposure	<ul> <li>Hazard:</li> <li>Shock hazard, voltage &gt; 50 V, Non-interlocked enclosures</li> <li>Arc Flash, Non-interlocked enclosures</li> </ul>	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.	<ul> <li>Hazards</li> <li>Arc Flash, Non- interlocked enclosures</li> <li>Fire hazard from high current causing smoke inhalation and burns service building areas.</li> </ul>	L: C: R:	See Section I Chapter 04.	L: C: R:
Low Voltage, High Current Exposure.	<ul> <li>Hazard:</li> <li>Arc Flash, Interlocked enclosures</li> <li>Fire hazard from high current causing smoke inhalation and burns, beam line enclosure areas</li> </ul>	L: C: R:	See Section I Chapter 04.	L: C: R:

Other Hazard Consequences, derived from Figure C-1	Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	C	onsequence (C, of event).	/year   Risk (R, Qualitative	Ranking)	Risk Matrix							
$\mathbf{A} = \text{Anticipated (L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathbf{High}$	I = situation (eve	ent) of major concern				Like	lihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{H} = \text{situation (ev}$	vent) of concern	l .		A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$	<b>III</b> = situation (e	vent) of minor concern	seou	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	<b>IV</b> = situation (e	vent) of minimal concern	- E	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	_	TTT	777	77.7	TX /		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
<b>M</b> = Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that		N	IV	IV	IV	IV		
Acronyms		or symptoms which	immediately life-	is immediately life-					•			
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective	<u> </u>									
		action.										
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects $> \mathbf{C}$	hospitalization > C	hospitalization > C								
	N	Consequences less	Consequences less than	Consequences less than								
		than those for Low	those for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

**Table 5.12 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	Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year R	Risk (R, Qualitative	Ranking)	Risk	Risk Matrix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern				Like	lihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H}$ = situation (evo	ent) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		<b>III</b> = situation (ev	vent) of minor concern	nces	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		<b>IV</b> = situation (ev	vent) of minimal concern		M	П	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (	(co-located worker)	Onsite-1 (facility worker)	sedn	_	***	***	77.7	77.7		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Pror	mpt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
<b>M</b> = Mitigative (reduces event consequences)				ute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV		
Acronyms		or symptoms which		mediately life-	is immediately life-								
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threateni	ing or permanently	threatening or								
		individual's ability to		disabling.	permanently disabling.								
		take protective		-									
		action.											
	M	$C \ge Mild$ , transient	C≥Se	erious injury, no	C ≥ Serious injury, no								
		adverse effects.	immedi	iate loss of life no	immediate loss of life no								
			perma	ment disabilities;	permanent disabilities;								
			hospita	alization required.	hospitalization required.								
	L	Mild, transient	Min	nor injuries; no	Minor injuries; no								
				oitalization > C	hospitalization > C								
	N			quences less than	Consequences less than								
		than those for Low	those for	Low Consequence	those for Low								
		Consequence Level		Level	Consequence Level								

**Table 5.13 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	<ul> <li>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.</li> <li>The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices.</li> <li>This hazard can add to the fuel load of a potential fire.</li> <li>The exposure of the hazard to the facility worker is of major concern.</li> </ul>	L: C: R:	See Section I Chapter 04.	L: C: R:

Other Hazard Consequences, derived from Figure C-1	Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	C	onsequence (C, of event).	/year   Risk (R, Qualitative	Ranking)	Risk Matrix							
$\mathbf{A} = \text{Anticipated (L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathbf{High}$	$\mathbf{I} = \text{situation (even}$	ent) of major concern				Like	lihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{H} = \text{situation (ev}$	vent) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$	III = situation (e	vent) of minor concern	uces	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (e	vent) of minimal concern	- a	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	_	***	***	77.7	TX /		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
<b>M</b> = Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	5	N	IV	IV	IV	IV		
Acronyms		or symptoms which	immediately life-	is immediately life-								
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective	J									
		action.										
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization $> C$								
	N	Consequences less	Consequences less than	Consequences less than								
		than those for Low	those for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

**Table 5.14 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	Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year Risl	k (R, Qualitative	Ranking)	Risk	Risk Matrix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (even	nt) of major concern				Like	lihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II}$ = situation (even	ent) of concern		1	Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		<b>III</b> = situation (ev	vent) of minor concern	nces	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern		M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co	o-located worker)	Onsite-1 (facility worker)	nbəs		***	777	77.7	77.7		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Promp	ot worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
<b>M</b> = Mitigative (reduces event consequences)				e injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV		
Acronyms		or symptoms which		diately life-	is immediately life-					•	<u> </u>		
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an		g or permanently	threatening or								
		individual's ability to	-	isabling.	permanently disabling.								
		take protective		C									
		action.											
	M	C ≥ Mild, transient	C ≥ Seri	ious injury, no	C ≥ Serious injury, no								
		adverse effects.	immediate	te loss of life no	immediate loss of life no								
			permane	ent disabilities;	permanent disabilities;								
			hospitaliz	zation required.	hospitalization required.								
	L	Mild, transient	Minor	r injuries; no	Minor injuries; no								
				alization > C	hospitalization $> \mathbf{C}$								
	N			ences less than	Consequences less than								
		than those for Low	those for Lo	ow Consequence	those for Low								
		Consequence Level	]	Level	Consequence Level								

**Table 5.15 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	, "F	xample Qualitative Cons	sequence	e Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year R	Risk (R, Qualitative	Ranking)	Risk	Matri	ix			
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern						
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (even}$	ent) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ev	vent) of minor concern	nces	Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern		M	П	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2	(co-located worker)	Onsite-1 (facility worker)	sedn	_	***	***	77.7	77.7
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Pro	mpt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV
<b>M</b> = Mitigative (reduces event consequences)		other serious effects,		cute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV
Acronyms		or symptoms which		mediately life-	is immediately life-	-		•	•	•	<u> </u>
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an		ning or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective		, and the second							
		action.									
	M	C ≥ Mild, transient	$C \ge S$	Serious injury, no	C ≥ Serious injury, no						
		adverse effects.	immed	liate loss of life no	immediate loss of life no						
			perma	anent disabilities;	permanent disabilities;						
			hospita	alization required.	hospitalization required.						
	L	Mild, transient	Min	nor injuries; no	Minor injuries; no						
		adverse effects > C	hosp	pitalization > C	hospitalization $> \mathbf{C}$						
	N	Consequences less	Conse	equences less than	Consequences less than						
		than those for Low	those for	r Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

Table 5.16 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	l, "F	Example Qualitative Cons	sequence Matri	x", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year   Risk (R	, Qualitative	Ranking)	Risk	Matri	X					
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \text{High}$	I =	situation (eve	ent) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II =	situation (ev	ent) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III	= situation (e	vent) of minor concern	es	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV	= situation (ev	vent) of minimal concern	ences	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-loca	ted worker)	Onsite-1 (facility worker)	sedne		TTT	***	***	***		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt wo	rker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
$\mathbf{M} = \text{Mitigative (reduces event consequences)}$		other serious effects,	or acute inju	-	fatality or acute injury that	5	N	IV	IV	IV	IV		
Acronyms		or symptoms which	immediate	•	is immediately life-								
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatening or p	•	threatening or								
		individual's ability to	disabli	-	permanently disabling.								
		take protective		C									
		action.											
	M	C ≥ Mild, transient	C ≥ Serious	injury, no	C ≥ Serious injury, no								
		adverse effects.	immediate los	s of life no	immediate loss of life no								
			permanent di	sabilities;	permanent disabilities;								
			hospitalizatio	n required.	hospitalization required.								
	L	Mild, transient	Minor inju	ries; no	Minor injuries; no								
		adverse effects > C	hospitaliza	tion > C	hospitalization $> \mathbf{C}$								
	N	Consequences less	Consequence	s less than	Consequences less than	1							
		than those for Low	those for Low C	Consequence	those for Low								
		Consequence Level	Leve	el	Consequence Level								

**Table 5.17 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 tipovers, caught in between, crushing	L: C: R:	See Section I Chapter 04.	L: C: R:

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

**Table 5.18 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, "F	Example Qualitative Con	sequer	nce Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk	Matri	X			
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (even)	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (evolution)	ent) of concern		1	A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ev	vent) of minor concern	seou	Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern		M	II	II	Ш	IV
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	т .	III	III	IV	IV
<ul> <li>P = Preventive (reduce event occurrence likelihood)</li> <li>M = Mitigative (reduces event consequences)</li> <li>Acronyms</li> <li>MOI = Maximally-exposed Offsite Individual</li> </ul>	Н	C ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	or i	Prompt worker fatality acute injury that is immediately life- tening or permanently disabling.	C ≥ Prompt worker fatality or acute injury that is immediately lifethreatening or permanently disabling.	Cons	N	IV	IV	IV	IV
	M L	C ≥ Mild, transient adverse effects.  Mild, transient adverse effects > C	imm per hosp	≥ Serious injury, no lediate loss of life no manent disabilities; pitalization required.  Minor injuries; no lospitalization > C	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.  Minor injuries; no hospitalization > C						

**Table 5.19 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	l, "F	Example Qualitative Cons	equence Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year   Risk (R, Qualitative	Ranking)	Risk	Matri	ix					
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situation (eve	ent) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situation (ev}$	ent) of concern		1	A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	$III = situation (e^{-1})$	vent) of minor concern	es	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	ences	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sedne		***	***	77.7	TX /		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
$\mathbf{M} = \text{Mitigative (reduces event consequences)}$		other serious effects,	or acute injury that is	fatality or acute injury that	ت ا	N	IV	IV	IV	IV		
Acronyms		or symptoms which	immediately life-	is immediately life-			•		•			
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective										
		action.										
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization $> \mathbf{C}$								
	N	Consequences less	Consequences less than	Consequences less than								
		than those for Low	those for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

**Table 5.20 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	l, "F	Example Qualitative Cons	sequence Matrix", DOE-HD	DBK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/	year   Risk (R, Qualitative	Ranking)	Risk	Matri	ix					
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \text{High}$	$\mathbf{I} = \text{situation (even}$	ent) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situation (ev}$	vent) of concern		1	A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	<b>III</b> = situation (e	event) of minor concern	es	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (e	vent) of minimal concern	ences	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sedne		***	***	77.7	***		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
$\mathbf{M} = \text{Mitigative (reduces event consequences)}$		other serious effects,	or acute injury that is	fatality or acute injury that	5	N	IV	IV	IV	IV		
Acronyms		or symptoms which	immediately life-	is immediately life-			•		•			
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or								
		individual's ability to	disabling.	permanently disabling.								
		take protective	J									
		action.										
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization > C								
	N	Consequences less	Consequences less than	Consequences less than								
		than those for Low	those for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

Table 5.21 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	, "F	xample Qualitative Cons	sequence	e Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year l	Risk (R, Qualitative	Ranking)	Risk	Matri	ix					
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	ent) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H}$ = situation (evo	ent) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ev	vent) of minor concern	nces	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern		M	П	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2	(co-located worker)	Onsite-1 (facility worker)	sedn	_	***	777	77.7	77.7		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Pro	ompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
<b>M</b> = Mitigative (reduces event consequences)		other serious effects,		cute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV		
Acronyms		or symptoms which		mediately life-	is immediately life-	-		•		•	<u> </u>		
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an		ning or permanently	threatening or								
		individual's ability to		disabling.	permanently disabling.								
		take protective		· ·									
		action.											
	M	C ≥ Mild, transient	<b>C</b> ≥ S	Serious injury, no	C ≥ Serious injury, no								
		adverse effects.	immed	diate loss of life no	immediate loss of life no								
			perma	anent disabilities;	permanent disabilities;								
			hospit	alization required.	hospitalization required.								
	L	Mild, transient	Mi	nor injuries; no	Minor injuries; no								
		adverse effects > C	hos	pitalization > C	hospitalization $> \mathbf{C}$								
	N	Consequences less	Consequences less Conseque		Consequences less than								
		than those for Low	those fo	or Low Consequence	those for Low								
		Consequence Level		Level	Consequence Level								

**Table 5.22 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	l, "F	Example Qualitative Cons	sequence Matri	x", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year													
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \text{High}$	I =	situation (eve	ent) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II =	situation (ev	vent) of concern			Α	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III	= situation (e	vent) of minor concern	es	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV	= situation (ev	vent) of minimal concern	ences	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-loca	ted worker)	Onsite-1 (facility worker)	sedne		TTT	***	***	***		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt wo	rker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
$\mathbf{M} = \text{Mitigative (reduces event consequences)}$		other serious effects,	or acute inju	-	fatality or acute injury that	5	N	IV	IV	IV	IV		
Acronyms		or symptoms which	immediate	•	is immediately life-								
<b>MOI</b> = Maximally-exposed Offsite Individual	cite Individual				threatening or								
		individual's ability to	threatening or p	-	permanently disabling.								
		take protective		C									
		action.											
	M	C ≥ Mild, transient	C ≥ Serious	injury, no	C ≥ Serious injury, no								
		adverse effects.	immediate los	s of life no	immediate loss of life no								
			permanent di	sabilities;	permanent disabilities;								
			hospitalizatio	n required.	hospitalization required.								
	L	Mild, transient	Minor inju	ries; no	Minor injuries; no								
		adverse effects > C	hospitaliza	tion > C	hospitalization $> \mathbf{C}$								
	N	Consequences less	Consequence	s less than	Consequences less than	1							
		than those for Low	those for Low C	Consequence	those for Low								
		Consequence Level	Leve	el	Consequence Level								

**Table 5.23 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))	L: C: R:	See Section I Chapter 04.	L: C: R:
	Exposure to fringe fields beyond allowable limits (worker without ferromagnetic or electronic medical device(s))  Exposure to flying metallic objects causing potential injury.			

Other Hazard Consequences, derived from Figure C-1	l, "F	Example Qualitative Cons	sequence Matri	x", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year													
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \text{High}$	I =	situation (eve	ent) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II =	situation (ev	vent) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III	= situation (e	vent) of minor concern	es	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV	= situation (ev	vent) of minimal concern	ences	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-loca	ted worker)	Onsite-1 (facility worker)	sedne		TTT	***	***	***		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt wo	rker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
$\mathbf{M} = \text{Mitigative (reduces event consequences)}$		other serious effects,	or acute inju	-	fatality or acute injury that	5	N	IV	IV	IV	IV		
Acronyms		or symptoms which	immediate	•	is immediately life-								
<b>MOI</b> = Maximally-exposed Offsite Individual	cite Individual				threatening or								
		individual's ability to	threatening or p	-	permanently disabling.								
		take protective		C									
		action.											
	M	C ≥ Mild, transient	C ≥ Serious	injury, no	C ≥ Serious injury, no								
		adverse effects.	immediate los	s of life no	immediate loss of life no								
			permanent di	sabilities;	permanent disabilities;								
			hospitalizatio	n required.	hospitalization required.								
	L	Mild, transient	Minor inju	ries; no	Minor injuries; no								
		adverse effects > C	hospitaliza	tion > C	hospitalization $> \mathbf{C}$								
	N	Consequences less	Consequence	s less than	Consequences less than	1							
		than those for Low	those for Low C	Consequence	those for Low								
		Consequence Level	Leve	el	Consequence Level								

**Table 5.24 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	l, "F	Example Qualitative Cons	sequence Matri	x", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year													
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \text{High}$	I =	situation (eve	ent) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II =	situation (ev	vent) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	III	= situation (e	vent) of minor concern	es	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV	= situation (ev	vent) of minimal concern	ences	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-loca	ted worker)	Onsite-1 (facility worker)	sedne		TTT	***	***	***		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt wo	rker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
$\mathbf{M} = \text{Mitigative (reduces event consequences)}$		other serious effects,	or acute inju	-	fatality or acute injury that	5	N	IV	IV	IV	IV		
Acronyms		or symptoms which	immediate	•	is immediately life-								
<b>MOI</b> = Maximally-exposed Offsite Individual	cite Individual				threatening or								
		individual's ability to	threatening or p	-	permanently disabling.								
		take protective		C									
		action.											
	M	C ≥ Mild, transient	C ≥ Serious	injury, no	C ≥ Serious injury, no								
		adverse effects.	immediate los	s of life no	immediate loss of life no								
			permanent di	sabilities;	permanent disabilities;								
			hospitalizatio	n required.	hospitalization required.								
	L	Mild, transient	Minor inju	ries; no	Minor injuries; no								
		adverse effects > C	hospitaliza	tion > C	hospitalization $> \mathbf{C}$								
	N	Consequences less	Consequence	s less than	Consequences less than	1							
		than those for Low	those for Low C	Consequence	those for Low								
		Consequence Level	Leve	el	Consequence Level								

Table 5.25 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   Consequence (C. of event)/year   Risk (R. Qualitative Ranking)   Risk Matrix										
Likelihood (L, of event)/year	f event)/year   Consequence (C, of event)/year   Risk (R, Qualitative Ranking)									
$\mathbf{A} = \text{Anticipated (L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathbf{High}$	$\mathbf{I} = \text{situation (even}$	ent) of major concern				lihood		
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{H} = \text{situation (ev}$	vent) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$	III = situation (e	vent) of minor concern	uces	Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (e	ent) of minimal concern	- a	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	_	TTT	777	77.7	TX /
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV
<b>M</b> = Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	)	N	IV	IV	IV	IV
Acronyms		or symptoms which	immediately life-	is immediately life-					•	<u> </u>
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or						
		individual's ability to	disabling.	permanently disabling.						
		take protective								
		action.								
	M	$C \ge Mild$ , transient	C ≥ Serious injury, no	C ≥ Serious injury, no						
		adverse effects.	immediate loss of life no	immediate loss of life no						
			permanent disabilities;	permanent disabilities;						
			hospitalization required.	hospitalization required.						
	L	Mild, transient	Minor injuries; no	Minor injuries; no	1					
		adverse effects > C	hospitalization > C	hospitalization > C						
	N	Consequences less	Consequences less than	Consequences less than						
		than those for Low	those for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

Table 5.26 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	, "F	xample Qualitative Cons	sequence	Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year R	Risk (R, Qualitative	Ranking)	Risk	Matri	ix					
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern				Likelihood				
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H}$ = situation (evo	ent) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		<b>III</b> = situation (ev	vent) of minor concern	nces	Н	I	I	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		<b>IV</b> = situation (ev	vent) of minimal concern		M	П	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 (	(co-located worker)	Onsite-1 (facility worker)	sedn	_	***	***	77.7	77.7		
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Pror	mpt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV		
<b>M</b> = Mitigative (reduces event consequences)		other serious effects,		ute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV		
Acronyms		or symptoms which		mediately life-	is immediately life-								
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threateni	ing or permanently	threatening or								
		individual's ability to		disabling.	permanently disabling.								
		take protective		-									
		action.											
	M	$C \ge Mild$ , transient	C≥Se	erious injury, no	C ≥ Serious injury, no								
		adverse effects.	immedi	iate loss of life no	immediate loss of life no								
			perma	ment disabilities;	permanent disabilities;								
			hospita	alization required.	hospitalization required.								
	L	Mild, transient	Min	nor injuries; no	Minor injuries; no								
		adverse effects > C	hosp	oitalization > C	hospitalization > C								
	N	Consequences less	Consec	quences less than	Consequences less than								
		than those for Low	those for	Low Consequence	those for Low								
		Consequence Level		Level	Consequence Level								

**Table 5.27 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	Consequence (C, of event)/year			Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern							
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = situation (evolution (evolution for evolution $	ent) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \text{Low}$		III = situation (ev	vent) of minor concern	nces	Н	I	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern		M	П	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-2	(co-located worker)	Onsite-1 (facility worker)	sedn	_	***	777	77.7	77.7	
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Pro	ompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV	
<b>M</b> = Mitigative (reduces event consequences)		other serious effects,		cute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV	
Acronyms		or symptoms which		mediately life-	is immediately life-							
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threaten	ning or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective		-								
		action.										
	M	C ≥ Mild, transient	$C \ge S$	Serious injury, no	C ≥ Serious injury, no							
		adverse effects.	immed	liate loss of life no	immediate loss of life no							
			perma	anent disabilities;	permanent disabilities;							
			hospita	alization required.	hospitalization required.							
	L	Mild, transient	Mir	nor injuries; no	Minor injuries; no							
		adverse effects > C	hosp	pitalization > C	hospitalization > C							
	N	Consequences less	Conse	equences less than	Consequences less than							
		than those for Low	those for	r Low Consequence	those for Low							
		Consequence Level		Level	Consequence Level							

Table 5.28 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:	L:	See Section I Chapter 04.	L:
	A blocked egress would be of major	C:		C:
	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 lifethreatening event, a blocked egress would be life threatening.	R:		R:
	The exposure of the hazard to the facility 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	C	onsequence (C, of event)/	year   Risk (R, Qualitative	Ranking)	Risk Matrix						
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \text{High}$	$\mathbf{I} = \text{situation (even}$	ent) of major concern							
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \text{situation (ev}$	vent) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	<b>III</b> = situation (e	vent) of minor concern	es	Н	I	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (e	vent) of minimal concern	ences	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	sedne		***	***	77.7	***	
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	$C \ge Prompt$ worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV	
$\mathbf{M} = \text{Mitigative (reduces event consequences)}$		other serious effects,	or acute injury that is	fatality or acute injury that	5	N	IV	IV	IV	IV	
Acronyms		or symptoms which	immediately life-	is immediately life-			•		•		
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or							
		individual's ability to	disabling.	permanently disabling.							
		take protective	Ç								
		action.									
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no							
		adverse effects.	immediate loss of life no	immediate loss of life no							
			permanent disabilities;	permanent disabilities;							
			hospitalization required.	hospitalization required.							
	L	Mild, transient	Minor injuries; no	Minor injuries; no							
		adverse effects > C	hospitalization > C	hospitalization $> C$							
	N	Consequences less	Consequences less than	Consequences less than							
		than those for Low	those for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

Table 5.29 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:	L:	See Section I Chapter 04.	L:
	A blocked egress would be of major	C:		C:
	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 colocated worker is of concern.	R:		R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year Ri	isk (R, Qualitative	Ranking)	Risk Matrix					
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (even	nt) of major concern						
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (even)	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		<b>III</b> = situation (ev	vent) of minor concern	nces	Н	I	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	- E	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2 (	(co-located worker)	Onsite-1 (facility worker)	sedn	_	***	777	77.7	77.7
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Pron	npt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV
<b>M</b> = Mitigative (reduces event consequences)		other serious effects,		ite injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV
Acronyms		or symptoms which		nediately life-	is immediately life-					•	<u> </u>
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an		ing or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective		Ü							
		action.									
	M	C ≥ Mild, transient	C ≥ Se	erious injury, no	C ≥ Serious injury, no						
		adverse effects.	immedia	ate loss of life no	immediate loss of life no						
			permar	nent disabilities;	permanent disabilities;						
			hospital	lization required.	hospitalization required.						
	L	Mild, transient	Mino	or injuries; no	Minor injuries; no						
		adverse effects > C	hospi	italization > C	hospitalization $> \mathbf{C}$						
	N	Consequences less	Conseq	quences less than	Consequences less than						
		than those for Low	those for	Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

**Table 5.30 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	C	onsequence (C, of event)/	year Risk (R, Qualitative	Ranking)	Risk Matrix								
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$	I = situation (eve	ent) of major concern				Likelihood					
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	II = situation (ev	vent) of concern	l		A	U	EU	BEU			
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low	<b>III</b> = situation (e	vent) of minor concern	ક	Н	I	I	II	III			
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (e	vent) of minimal concern	enc	M	II	II	III	IV			
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	_	***		** *	***			
<b>P</b> = Preventive (reduce event occurrence likelihood)	H	C ≥ Irreversible,	$C \ge Prompt worker fatality$	C ≥ Prompt worker	Suo	L	III	III	IV	IV			
<b>M</b> = Mitigative (reduces event consequences)		other serious effects,	or acute injury that is	fatality or acute injury that	S	N	IV	IV	IV	IV			
Acronyms		or symptoms which	immediately life-	is immediately life-									
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threatening or permanently	threatening or									
		individual's ability to	disabling.	permanently disabling.									
		take protective	Č										
		action.											
	M	C ≥ Mild, transient	C ≥ Serious injury, no	C ≥ Serious injury, no									
		adverse effects.	immediate loss of life no	immediate loss of life no									
			permanent disabilities;	permanent disabilities;									
			hospitalization required.	hospitalization required.									
	L	Mild, transient	Minor injuries; no	Minor injuries; no									
		adverse effects > C	hospitalization > C	hospitalization > C									
	N	Consequences less	Consequences less than	Consequences less than									
		than those for Low	those for Low Consequence	those for Low									
		Consequence Level	Level	Consequence Level									

**Table 5.31 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 worker qualitative consequence matrix)	L: C: R:	See Section I Chapter 04.	L: C: R: