Table 2. Summary of Baseline and Residual Risks – Switchyard 120 Experimental Areas

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

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

NOTE:
Per DOE-HDBK-1163-2020, Appendix C, "Risk Assessment Methodology":
"Events with an unmitigated risk value of III or IV would not require additional control assignments to provide reasonable assurance of adequate protection. Whereas, for events with an unmitigated risk value of I or II, controls would need to be assigned to either reduce the likelihood or the consequence, and therefore the overall mitigated risk. Generally, preventive controls are applied prior to a loss event – reflecting a likelihood reduction and mitigative controls are applied after a loss event – reflecting a consequence reduction. Each control is credited for a single "bin drop" either in likelihood or consequence; not both. Following a standard hierarchy of controls, controls are applied until the residual risk is acceptable – reflecting a mitigated risk value of III or IV. After controls are credited, events with a remaining unacceptable residual risk (i.e., I or II) are candidates for additional analyses and additional controls, often quantitative in nature." For Fermilab, these controls for accelerator-specific hazards are identified as Credited Controls and further summarized in the Accelerator Safety Envelope (ASE).

Table 2.1 Radiological – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Prompt Ionizing Radiation	*Hazard:* • *Prompt ionizing radiation generated from the particle beam interaction with materials, such as the beam pipes, beamline elements, and beamline instrumentation, and direct beam exposure.*	L: A C: H R: I	P – Shielding in place around the beam line and experiment enclosures per the relevant shield assessments P – Interlock system preventing access to beam enclosure while beam is present. P – Enclosure keys linked to radiological and controlled access training to enter enclosure P – Search and secure of beam enclosure by main control room prior to beam delivery M – Dosimetry as required by the relevant RWP M – Audible alarm when enclosure is interlocked before beam is delivered	L: BEU C: L R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual activation	*Hazard:* • *NM4 target station (ammonia, liquid helium, liquid nitrogen) and front face of the absorber magnet have activation potential.* • *Positioning detector components in the path of the beam may result in activation of the components. Experiments wish to take equipment offsite upon project completion.*	NM4 L: A C: N R: IV MTest/MCenter/M03 L: A C: N R: IV	NM4/M03 P – Enclosure keys linked to radiological and controlled access training to enter enclosure M – Any item in a beam enclosure during beam-on conditions is removed and surveyed by radiological workers and classified appropriately M – Any item requiring shipment or unrestricted release is surveyed and processed by Radiological Control organization personnel in accordance with FRCM chapter 4. M – Dosimetry as required by the relevant RWP M – Enclosure surveys as required by the relevant RWP M – PPE as required by the relevant RWP MTest/MCenter M – Radiological worker training M – Any item in a beam enclosure during beam-on conditions is removed and surveyed by radiological workers and classified appropriately M – Any item requiring shipment or unrestricted release is surveyed and processed by Radiological Control organization personnel in accordance with FRCM chapter 4. M – Dosimetry as required by the relevant RWP M – Enclosure surveys as required by the relevant RWP M – PPE as required by the relevant RWP	NM4 L: U C: N R: IV MTest/MCenter/M03 L: A C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Groundwater Activation	*Hazard:* • *Potential exposure due to construction activities (e.g., earthmoving)*	L: A C: N R: IV	M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment. M – Facility designs employ shielding to mitigate the production of activation products in groundwater	L: A C: N R: IV
Surface Water Activation	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Radioactive Water (RAW) Systems	*Hazard: (NM4 Only)* • *RAW system present in NM4 for cooling of absorber magnet and target cave has exposure potential if system ruptures.*	L: A C: N R: IV	P – Interlock system preventing access to beam enclosure while beam is present. P – Enclosure keys linked to radiological and controlled access training to enter enclosure M – Dosimetry as required by the relevant RWP M – Enclosure surveys as required by the relevant RWP M – PPE as required by the relevant RWP	L: EU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Air Activation	*Hazard: (NM4 Only)* • *Scattered 120 GeV beam in NM4 target system can activate air.*	L: A C: N R: IV	P – Interlock system preventing access to beam enclosure while beam is present. P – Cool off time imposed at discretion of RSO after beam operations P – Enclosure keys linked to radiological and controlled access training to enter enclosure M – The existing ventilation system in NM4 slows transit time adequately to allow for radioactive decay of short-lived positron emitters M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment.	L: BEU C: N R: IV
Soil Interactions	*Hazard:* • *Scattered beam has potential to activate soil at low levels calculated in the shield assessment.*	L: A C: N R: IV	M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment.	L: A C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive waste	*Hazard:* • *Activation potential is low in these spaces and experiments typically remove equipment upon completion. Any materials that cannot be cleared and removed by an experiment are subject to the labs radioactive waste program.*	L: A C: N R: IV	M – Radiological worker training M – Any item in a beam enclosure during beam-on conditions is removed and surveyed by radiological workers and classified appropriately (typically class 0 at these facilities). M – Any item identified for disposal is surveyed and processed by Radiological Control organization personnel in accordance with FRCM chapter 4.	L: A C: N R: IV
Contamination	*Hazard:* • *Potential contaminated items brought into facility by experimenters.* • *Potential contamination from beam activation (NM4 and M03)*	L: A C: N R: IV L: A C: N R: IV	P – Radiological control prescreens items with contamination potential prior to acceptance. If contamination exists, the item is rejected. M – Radiological worker training to recognize hazard M – RCT coverage and job specific RWP as determined by the RSO M – Contamination wipes to monitor space and equipment	L: U C: N R: IV L: A C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
^{7}Be	*Hazard:* • *Potential radiation exposure to 7Be (uptake/committed dose).*	L: A C: N R: IV	Not Applicable. No prevention or mitigation is required. ^{7}Be isn't hazardous in this pattern of use by facility.	L: A C: N R: IV
Radioactive Sources	*Hazard:* • *Various low activity sealed sources (Sr-90, Co-60, CS-137, Fe-55, Ru-106, etc.)*	L: A C: N R: IV	P – All low activity sealed sources are kept in a lock box and registered through Radiological Control. M – Radiological training is required for source handling.	L: U C: N R: IV
Non-ionizing Radiation Hazards	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual
- **rem =** Roentgen equivalent man

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

Risk Matrix

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

Table 2.2 Radiological – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Prompt Ionizing Radiation	*Hazard:* • *Prompt ionizing radiation generated from the particle beam interaction with materials, such as the beam pipes, beamline elements, and beamline instrumentation.*	L: A C: H R: I	P – Shielding in place around the beam line and experiment enclosures per the relevant shield assessments P – Interlock system preventing access to beam enclosure while beam is present. P – Enclosure keys linked to radiological and controlled access training to enter enclosure P – Search and secure of beam enclosure by main control room prior to beam delivery M – Dosimetry as required by the relevant RWP M – Audible alarm when enclosure is interlocked before beam is delivered	L: BEU C: L R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual activation	*Hazard:* • *NM4 target station (ammonia, liquid helium, liquid nitrogen) and front face of the absorber magnet have activation potential.* • *Positioning detector components in the path of the beam may result in activation of the components. Experiments wish to take equipment offsite upon project completion.*	NM4 L: A C: N R: IV MTest/MCenter/M03 L: A C: N R: IV	NM4/M03 P – Enclosure keys linked to radiological and controlled access training to enter enclosure M – Any item in a beam enclosure during beam-on conditions is removed and surveyed by radiological workers and classified appropriately M – Any item requiring shipment or unrestricted release is surveyed and processed by Radiological Control organization personnel in accordance with FRCM chapter 4. M – Dosimetry as required by the relevant RWP M – Enclosure surveys as required by the relevant RWP M – PPE as required by the relevant RWP MTest/MCenter P – GERT training at minimum to recognize hazard M – Any item in a beam enclosure during beam-on conditions is removed and surveyed by radiological workers and classified appropriately M – Any item requiring shipment or unrestricted release is surveyed and processed by Radiological Control organization personnel in accordance with FRCM chapter 4. M – Dosimetry as required by the relevant RWP M – Enclosure surveys as required by the relevant RWP M – PPE as required by the relevant RWP	NM4 L: U C: N R: IV MTest/MCenter/M03 L: U C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Groundwater Activation	*Hazard:* • *Potential exposure due to construction activities (e.g., earthmoving)*	L: A C: N R: IV	M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment. M – Facility designs employ shielding to mitigate the production of activation products in groundwater	L: A C: N R: IV
Surface Water Activation	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Radioactive Water (RAW) Systems	*Hazard: (NM4 Only)* • *RAW system present in NM4 for cooling of absorber magnet and target cave has exposure potential if system ruptures.*	L: A C: N R: IV	P – Interlock system preventing access to beam enclosure while beam is present. P – Enclosure keys linked to radiological and controlled access training to enter enclosure M – Dosimetry as required by the relevant RWP M – Enclosure surveys as required by the relevant RWP M – PPE as required by the relevant RWP	L: EU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Air Activation	*Hazard: (NM4 Only)* • *Scattered 120 GeV beam in NM4 target system can activate air.*	L: A C: N R: IV	P – Interlock system preventing access to beam enclosure while beam is present. P – Cool off time imposed at discretion of RSO after beam operations P – Enclosure keys linked to radiological and controlled access training to enter enclosure M – The existing ventilation system in NM4 slows transit time adequately to allow for radioactive decay of short-lived positron emitters M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment.	L: BEU C: N R: IV
Soil Interactions	*Hazard:* • *Scattered beam has potential to activate soil at low levels calculated in the shield assessment.*	L: A C: N R: IV	M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment.	L: A C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive waste	*Hazard:* • *Activation potential is low in these spaces and experiments typically remove equipment upon completion. Any materials that cannot be cleared and removed by an experiment are subject to the labs radioactive waste program.*	L: A C: N R: IV	P – GERT training provides recognition further training required M – Any item in a beam enclosure during beam-on conditions is removed and surveyed by radiological workers and classified appropriately (typically class 0 at these facilities). M – Any item identified for disposal is surveyed and processed by Radiological Control organization personnel in accordance with FRCM chapter 4.	L: U C: N R: IV
Contamination	*Hazard:* • *Potential contaminated items brought into facility by experimenters.* • *Potential contamination from beam activation (NM4 and M03)*	L: A C: N R: IV L: A C: N R: IV	P – Radiological control prescreens items with contamination potential prior to acceptance. If contamination exists the item is rejected. P – GERT training provides recognition further training required M – RCT coverage and job specific RWP as determined by the RSO M – Contamination wipes to monitor space and equipment	L: U C: N R: IV L: A C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
^{7}Be	*Hazard:* • *Potential radiation exposure to 7Be (uptake/committed dose).*	L: A C: N R: IV	Not Applicable. No prevention or mitigation is required. ^{7}Be isn't hazardous in this pattern of use by facility.	L: A C: N R: IV
Radioactive Sources	*Hazard:* • *Various low activity sealed sources (Sr-90, Co-60, CS-137, Fe-55, Ru-106, etc.)*	L: A C: N R: IV	P – All low activity sealed sources are kept in a lock box and registered through Radiological Control. M – GERT provides recognition that source training is required	L: U C: N R: IV
Non-ionizing Radiation Hazards	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)

Acronyms
MOI = Maximally-exposed Offsite Individual
rem = Roentgen equivalent man

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

Risk Matrix

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

Table 2.3 Radiological – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Prompt Ionizing Radiation	*Hazard:* • *Prompt ionizing radiation generated from the particle beam interaction with materials, such as the beam pipes, beamline elements, and beamline instrumentation.*	L: BEU C: H R: III	No further analysis required; this hazard is not accessible to the public in this segments pattern of use	L: BEU C: H R: III

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual activation	*Hazard:* • *NM4 target station (ammonia, liquid helium, liquid nitrogen) and front face of the absorber magnet have activation potential.* • *Positioning detector components in the path of the beam may result in activation of the components. Experiments wish to take equipment offsite upon project completion.*	L: BEU C: N R: IV	No further analysis required; this hazard is not accessible to the public in this segments pattern of use	L: BEU C: N R: IV
Groundwater Activation	*Hazard:* • *Scattered beam has potential to activate ground water at low levels calculated in the shield assessment.*	L: BEU C: N R: IV	No further analysis required	L: BEU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Surface Water Activation	*Hazard:* • *Scattered beam has potential to activate surface water at low levels calculated in the shield assessment.*	L: BEU C: N R: IV	No further analysis required	L: BEU C: N R: IV
Radioactive Water (RAW) Systems	*Hazard: (NM4 Only)* • *RAW system present in NM4 for cooling of absorber magnet and target cave has exposure potential if system ruptures.*	L: BEU C: N R: IV	No further analysis required; this hazard is not accessible to the public in this segments pattern of use	L: BEU C: N R: IV
Air Activation	*Hazard: (NM4 Only)* • *Scattered 120 GeV beam in NM4 target system can activate air.*	L: BEU C: N R: IV	No further analysis required	L: BEU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Soil Interactions	*Hazard:* • *Scattered beam has potential to activate soil at low levels calculated in the shield assessment.*	L: BEU C: N R: IV	No further analysis required	L: BEU C: N R: IV
Radioactive waste	*Hazard:* • *Activation potential is low in these spaces and experiments typically remove equipment upon completion. Any materials that cannot be cleared and removed by an experiment are subject to the labs radioactive waste program.*	L: BEU C: N R: IV	No further analysis required; this hazard is not accessible to the public in this segments pattern of use	L: BEU C: N R: IV
Contamination	*Hazard:* • *Potential contaminated items brought into facility by experimenters.*	L: BEU C: N R: IV	No further analysis required; this hazard is not accessible to the public in this segments pattern of use	L: BEU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
^{7}Be	*Hazard:* • *Potential radiation exposure to 7Be (uptake/committed dose).*	L: A C: N R: IV	Not Applicable. No prevention or mitigation is required. ^{7}Be isn't hazardous in this pattern of use by facility.	L: A C: N R: IV
Radioactive Sources	*Hazard:* • *Various low activity sealed sources (Sr-90, Co-60, CS-137, Fe-55, Ru-106, etc.)*	L: BEU C: N R: IV	No further analysis required; this hazard is not accessible to the public in this segments pattern of use	L: BEU C: N R: IV
Non-ionizing Radiation Hazards	*Hazard:*	L: C: R:	See section I, chapter 4	L: C: R:

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

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

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

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

Control(s) Type
P = Preventive (reduce event occurrence likelihood)
M = Mitigative (reduces event consequences)

Acronyms
MOI = Maximally-exposed Offsite Individual
rem = Roentgen equivalent man

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

Risk Matrix

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

Table 2.4 Toxic Materials – Onsite 1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Lead*	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Beryllium*	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Liquid Scintillator	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Ammonia	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Nanoparticle Exposures	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **IDLH** = Immediately Dangerous to Life and Health
- **MOI =** Maximally-exposed Offsite Individual
- **PAC** = Protective Action Criteria
- **PEL** = Permissible Exposure Limit
- **TLV_c =** Threshold Limit Value (ceiling)

C	**Offsite (MOI)**	**Onsite-2 (co-located worker)**	**Onsite-1 (facility worker)**
H	**C** ³ PAC-2	**C** ³ PAC-3	**C** ³ IDLH
M	PAC-2 > **C** ³ PAC-1	PAC-3 > **C** ³ PAC-2	IDLH > **C** ³ PEL or TLV_c
L	PAC-1 > **C**	PAC-2 > **C**	PEL or TLV_c > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

Table 2.5 Toxic Materials – Onsite 2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Lead *	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Beryllium*	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Liquid Scintillator	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Ammonia	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Nanoparticle Exposures	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **IDLH** = Immediately Dangerous to Life and Health
- **MOI =** Maximally-exposed Offsite Individual
- **PAC** = Protective Action Criteria
- **PEL** = Permissible Exposure Limit
- **TLV_c =** Threshold Limit Value (ceiling)

C	**Offsite (MOI)**	**Onsite-2 (co-located worker)**	**Onsite-1 (facility worker)**
H	**C** ³ PAC-2	**C** ³ PAC-3	**C** ³ IDLH
M	PAC-2 > **C** ³ PAC-1	PAC-3 > **C** ³ PAC-2	IDLH > **C** ³ PEL or TLV_c
L	PAC-1 > **C**	PAC-2 > **C**	PEL or TLV_c > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

Table 2.6 Toxic Materials – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Lead*	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Beryllium*	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Liquid Scintillator	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Ammonia	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Nanoparticle Exposures	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **IDLH** = Immediately Dangerous to Life and Health
- **MOI =** Maximally-exposed Offsite Individual
- **PAC** = Protective Action Criteria
- **PEL** = Permissible Exposure Limit
- **TLV_c =** Threshold Limit Value (ceiling)

C	**Offsite (MOI)**	**Onsite-2 (co-located worker)**	**Onsite-1 (facility worker)**
H	**C** ³ PAC-2	**C** ³ PAC-3	**C** ³ IDLH
M	PAC-2 > **C** ³ PAC-1	PAC-3 > **C** ³ PAC-2	IDLH > **C** ³ PEL or TLV_c
L	PAC-1 > **C**	PAC-2 > **C**	PEL or TLV_c > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Combustible materials (cables, Boxes, Paper, wood cribbing, etc.)	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Flammable Materials (Flammable gas, cleaning materials, etc.)	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Combustible materials (cables, Boxes, Paper, wood cribbing, etc.)	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Flammable Materials (Flammable gas, cleaning materials, etc.)	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

Table 2.9 Flammable and Combustible Materials – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Combustible materials (cables, Boxes, Paper, wood cribbing, etc.)	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Flammable Materials (Flammable gas, cleaning materials, etc.)	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

Table 2.10 Electrical Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Stored Energy Exposure	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
High Voltage Exposure	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Low Voltage, High Current Exposure.	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Stored Energy Exposure	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
High Voltage Exposure	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Low Voltage, High Current Exposure.	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

Table 2.12 Electrical Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Stored Energy Exposure	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
High Voltage Exposure	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Low Voltage, High Current Exposure.	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

Table 2.13 Thermal Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Hot Work	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Cryogenics	*Hazard:* *Cryogenics are inherently a low risk on their own as they are non-flammable and non-toxic.* *However, if exposed to the cryogenic liquids, they have the potential of burning skin and creating an oxygen deficient atmosphere which can lead to death.* *The exposure of the hazard to the facility worker is of major concern.*	ODH for NM4 L: A C:H R: I ODH for MTest/MCenter L: A C: N R: IV Burns L: A C: H R: I	ODH forNM4 P – SMEs produce engineering notes on piping and vessel system and ODH calculations P – ORC process has SMEs review installed system and documentation prior to operation P – ODH system of oxygen sensors that trigger high volume vans in NM4 that is tested and calibrated at prescribed intervals to maintain an engineered ODH 0 classification P - Fire Safety and Life Safety Inspections are performed Fire Protection Group and the Fire Department. P – ODH alarm systems are tested and maintained M – ODH alarms are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days. M – Area/fixed Oxygen Monitoring provided in areas where cryogenic liquids are stored M – Onsite Emergency services are provided. ODH MTest/MCenter P – TSW flags intended cryogenics for SME review prior to arrival P – SMEs produce engineering notes on piping and vessel system and ODH calculations. At present all amounts of cryogenic liquids in these spaces are ODH 0 or rejected P – ORC process has SMEs review installed system and documentation prior to operation Burns P – Cryogenic system designed and reviewed by qualified personnel P – WPC process provides instructions for use P - Protective clothing rules are enforced when working in areas with exposure to cryogenic liquids. P- Training required for all personnel handling cryogenics M – Onsite Emergency services are provided	ODH for NM4 L: BEU C: N R: IV ODH for MTest/MCenter L: BEU C: N R: IV Burns L: BEU C:M R: IV

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Hot Work	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Cryogenics	*Hazard:* *Cryogenics are inherently a low risk on their own as they are non-flammable and non-toxic.* *However, if exposed to the cryogenic liquids, they have the potential of burning skin and creating an oxygen deficient atmosphere which can lead to death.* *The exposure of the hazard to the facility worker is of major concern.*	ODH for NM4 L: A C:H R: I ODH for MTest/MCenter L: A C: N R: IV Burns L: A C: H R: I	ODH forNM4 P – SMEs produce engineering notes on piping and vessel system and ODH calculations P – ORC process has SMEs review installed system and documentation prior to operation P – ODH system of oxygen sensors that trigger high volume vans in NM4 that is tested and calibrated at prescribed intervals to maintain an engineered ODH 0 classification P - Fire Safety and Life Safety Inspections are performed Fire Protection Group and the Fire Department. P – ODH alarm systems are tested and maintained M – ODH alarms are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days. M – Area/fixed Oxygen Monitoring provided in areas where cryogenic liquids are stored M – Onsite Emergency services are provided. MTest/MCenter P – TSW flags intended cryogenics for SME review prior to arrival P – SMEs produce engineering notes on piping and vessel system and ODH calculations. At present all amounts of cryogenic liquids in these spaces are ODH 0 or rejected P – ORC process has SMEs review installed system and documentation prior to operation P – Cryogenic system designed and reviewed by qualified personnel P – WPC process provides instructions for use P - Protective clothing rules are enforced when working in areas with exposure to cryogenic liquids. P- Training required for all personnel handling cryogenics M – Onsite Emergency services are provided	ODH for NM4 L: BEU C: N R: IV ODH for MTest/MCenter L: BEU C: N R: IV Burns L: BEU C:M R: IV

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

Table 2.15 Thermal Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Hot Work	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Cryogenics	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

Table 2.16 Kinetic Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power tools	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Pumps and Motors	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Motion Tables	*Hazard:* • *Personnel injury due to pinch points, tip-overs, caught in between, crushing.*	L: A C: H R: I	P – Engineering notes/ORC procedure P – Safety stops P – Computer authorization for motion table controls P – Physical isolation of system (FTBF absorbers) M – Emergency stop as determined by SME M – Speed restrictions on motor	L: BEU C: L R: IV

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power tools	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Pumps and Motors	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Motion Tables	*Hazard:* • *Personnel injury due to pinch points, tip-overs, caught in between, crushing.*	L: A C: H R: I	P – Engineering Notes/ORC procedure evaluates the tables for stability and user safety P – Safety stops (where applicable) prevent injury due to pinch points and getting caught in between events P – Computer authorization to access motion table control systems P – Physical isolation of system (FTBF absorbers) M – Speed restrictions on motor M – General facility HA training to recognize hazard	L: BEU C: L R: IV

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	**Offsite (MOI)**	**Onsite-2 (co-located worker)**	**Onsite-1 (facility worker)**
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**

Risk Matrix

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

Table 2.18 Kinetic Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power tools	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Pumps and Motors	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Motion Tables	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	**Offsite (MOI)**	**Onsite-2 (co-located worker)**	**Onsite-1 (facility worker)**
H	**C** ³ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ³ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ³ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ³ Mild, transient adverse effects.	**C** ³ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ³ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**

Risk Matrix

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

Table 2.19 Potential Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane Operations	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Compressed Gasses	*Hazard:* • *Personnel injury due to unexpected release, or unsecure tanks.* • *May also present flammability and ODH concerns*	NM4 L: A C: H R: I MTest/MCenter/M03 L: A C: H R: I	P – Engineering notes to evaluate ODH for gases brought to facility. New or modified piping/manifolds similarly evaluated. P – NM4 is an engineered ODH 0 space with monitoring/alarms/ventilation discussed further under cryogenic liquid hazards P: All personnel handling compressed gasses have to take Pressure Safety orientation training. P: All personnel handling compressed gasses have to take compressed gas cylinder safety training P: All personnel have to be familiar with FESHM 5000 series and apply requirements. P: Gas cylinders are secured and capped when not in use. M: Personal Protective Equipment mitigates severity of injury. MTest/MCenter P – Engineering notes to evaluate ODH for gases brought to facility. All gas bottles are in quantities to remain ODH 0 for a given enclosure. New or modified piping/manifolds similarly evaluated. P – TSW and/or ORC process to evaluate gas bottle and distribution installation and operation before use P: All personnel handling compressed gasses have to take Pressure Safety orientation training. P: All personnel handling compressed gasses have to take compressed gas cylinder safety training P: All personnel have to be familiar with FESHM 5000 series and apply requirements. P: Gas cylinders are secured and capped when not in use. M: Personal Protective Equipment mitigates severity of injury.	NM4 L: BEU C: M R: IV MTest/MCenter L: BEU C: M R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Vacuum/ Pressure Vessels/ Piping	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Vacuum Pumps	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Material Handling	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane Operations	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Compressed Gasses	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Vacuum/ Pressure Vessels/ Piping	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Vacuum Pumps	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Material Handling	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ³ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ³ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ³ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ³ Mild, transient adverse effects.	**C** ³ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ³ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

Table 2.21 Potential Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane Operations	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Compressed Gasses	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Vacuum/ Pressure Vessels/ Piping	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Vacuum Pumps	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Material Handling	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

Table 2.22 Magnetic Fields – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields	*Hazard:* • *Exposure to fringe fields beyond allowable limits (worker **with** ferromagnetic or electronic medical device(s))*	L: A C: H R: I	P- Industrial hygiene conducts field surveys to establish safe field boundaries for workers. P- Access control points and individual components of concern (e.g., experiment permanent magnet) have postings to notify workers of magnetic hazard. P – Facility specific hazard awareness training alerting to fringe fields	L: BEU C: H R: III
	• *Exposure to fringe fields beyond allowable limits (worker **without** ferromagnetic or electronic medical device(s))*	L: A C: L R: III	P- Industrial hygiene conducts field surveys to establish safe field boundaries for workers. P- Access control points and individual components of concern (e.g., experiment permanent magnet) have postings to notify workers of magnetic hazard. P – Facility specific hazard awareness training alerting to fringe fields	L: BEU C: L R: IV
	• *Exposure to flying metallic objects causing potential injury.*	L: A C: M R: II	P- Brass tools are used to prevent flying metallic objects from occurring, thereby preventing worker injury as prescribed by relevant magnet SOP P-Work Control procedure/SOP (ferromagnetic object control) requires that all ferromagnetic objects are removed prior to entry into a fringe field area (30G administrative limit). P-Work Control procedure/SOP requires worker training while in areas possessing fringe fields (300 G administrative limit).	L: BEU C: M R: IV

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields	*Hazard:* • *Exposure to fringe fields beyond allowable limits (worker **with** ferromagnetic or electronic medical device(s))*	L: A C: H R: I	P- Industrial hygiene conducts field surveys to establish safe field boundaries for workers. P- Access control points and individual components of concern (e.g., experiment permanent magnet) have postings to notify workers of magnetic hazard. P – Facility specific hazard awareness training alerting to fringe fields	L: BEU C: H R: III
	• *Exposure to fringe fields beyond allowable limits (worker **without** ferromagnetic or electronic medical device(s))*	L: A C: L R: III	P- Industrial hygiene conducts field surveys to establish safe field boundaries for workers. P- Access control points and individual components of concern (e.g., experiment permanent magnet) have postings to notify workers of magnetic hazard. P – Facility specific hazard awareness training alerting to fringe fields	L: BEU C: L R: IV
	• *Exposure to flying metallic objects causing potential injury.*	L: A C: M R: II	P- Brass tools are used to prevent flying metallic objects from occurring, thereby preventing worker injury as prescribed by relevant magnet SOP P-Work Control procedure/SOP (ferromagnetic object control) requires that all ferromagnetic objects are removed prior to entry into a fringe field area (30G administrative limit). P-Work Control procedure/SOP requires worker training while in areas possessing fringe fields (300 G administrative limit).	L: BEU C: M R: IV

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

Table 2.24 Magnetic Fields – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields	*Hazard:*	L: BEU C: N R: IV	No fringe fields are accessible to the public, no further analysis required	L: BEU C: N R: IV

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

Table 2.25 Other hazards – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Silica	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Ergonomics	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Working at Heights	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Silica	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Ergonomics	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Working at Heights	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

Table 2.27 Other hazards – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Silica	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Ergonomics	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Working at Heights	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** [3] Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** [3] Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** [3] Mild, transient adverse effects.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** [3] Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

Table 2.28 Access & Egress – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety Egress	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ³ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ³ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ³ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ³ Mild, transient adverse effects.	**C** ³ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ³ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety Egress	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ³ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ³ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ³ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ³ Mild, transient adverse effects.	**C** ³ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ³ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

Table 2.30 Access & Egress – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety Egress	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:

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

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

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

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

Control(s) Type
- **P** = Preventive (reduce event occurrence likelihood)
- **M** = Mitigative (reduces event consequences)

Acronyms
- **MOI =** Maximally-exposed Offsite Individual

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	**C** ³ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ³ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ³ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ³ Mild, transient adverse effects.	**C** ³ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ³ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

Table 2.31 Environmental

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Airborne	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Water	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R:
Soil	*Hazard:*	L: C: R:	See Section I, Chapter 4	L: C: R: