Table 2. Summary of Baseline and Residual Risks (Railhead)

Risk Tables Description		Baseline Risk	Residual Risk
2,1	Radiological – Onsite-1 Facility Worker	R: III	R: IV
2.2	Radiological – Onsite-2 Co-located Worker	R: III	R: IV
2.3	Radiological – MOI Offsite	R: NA	R: NA
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: NA	R: NA
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: NA	R: NA
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: NA	R: NA
2.13	Thermal Energy – Onsite-1 Facility Worker	R: *	R: *
2.14	Thermal Energy – Onsite-2 Co-located Worker	R: *	R: *
2.15	Thermal Energy – MOI Offsite	R: NA	R: NA
2.16	Kinetic Energy – Onsite-1 Facility Worker	R: *	R: *
2.17	Kinetic Energy – Onsite-2 Co-located Worker	R: *	R: *
2.18	Kinetic Energy – MOI Offsite	R: NA	R: NA
2.19	Potential Energy- Onsite-1 Facility Worker	R: *	R: *
2.20	Potential Energy – Onsite-2 Co-located Worker	R: *	R: *
2.21	Potential Energy – MOI Offsite	R: NA	R: NA
2.22	Magnetic Fields – Onsite-1 Facility Worker	R: *	R: *
2.23	Magnetic Fields – Onsite-2 Co-located Worker	R: *	R: *
2.24	Magnetic Fields – MOI Offsite	R: NA	R: NA
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: NA	R: NA
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: NA	R: NA
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 values 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)
Radioactive Waste	*Hazard:* Worker receiving elevated dose from radioactive waste.	L: A C: L R: III	P: Items are surveyed prior to storage locations being identified to prevent elevated worker dose from residual activation. P: The workers are trained RCT's and training and awareness prevents them from receiving elevated doses from waste items. M: Do not have any items in storage > 25 rem, which mitigates the potential dose to workers. M: The workers practice ALARA, which mitigates potential dose to workers.	L: EU C: N R: IV
Beryllium-7	*Hazard: Barrel stored in barrels in lundy barn*	L: EU C: L R: IV	No further control measures required	L: EU C: L R: IV
Radioactive Sources	*Hazard: Workers receiving elevated dose managing sources*	L: A C: L R: III	P: Source technicians receive special training for management of sources to prevent exposure to radioactive sources. M: Semi-annual wipes are taken to ensure leak free status of source capsules is maintained, thereby mitigating exposure from leaky sources. P: Source technicians wear special dosimetry while managing sources, to monitor exposure and minimize it by applying ALARA principles.	L: U C: N R: IV

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

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

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

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

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** ≥ 25.0 rem	**C** ≥ 100 rem	**C** ≥ 100 rem
M	25.0 rem > **C** ≥ 5 rem	100 rem > **C** ≥ 25 rem	100 rem > **C** ≥ 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)
Radioactive Waste	*Hazard: Worker receiving elevated dose from radioactive waste.*	L: A C: L R: III	P: Items are surveyed prior to storage locations being identified preventing elevated co-located worker doses from radioactive waste. P: The workers are trained RCT's M: Do not have any items in storage > 25 rem, which mitigates potential dose to co-located workers. P: The co-located workers practice ALARA which mitigates potential dose to co-located workers.	L: EU C: N R: IV
Beryllium-7	*Hazard*: *Barrel stored in barrels in lundy barn*	L: EU C: L R: IV	No further control measures required	L: EU C: L R: IV
Radioactive Sources	*Hazard: Workers receiving elevated dose managing sources*	L: A C: L R: III	P: Source technicians receive special training for management of sources M: Semi-annual wipes are taken to ensure leak free status P: Source technicians wear special dosimetry while managing sources, and co-located workers are prevented from actively participating in source handling, unless they take specialized training. At that point they would be source technicians, not co-located workers.	L: EU C: N R: IV

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

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

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

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

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** ≥ 25.0 rem	**C** ≥ 100 rem	**C** ≥ 100 rem
M	25.0 rem > **C** ≥ 5 rem	100 rem > **C** ≥ 25 rem	100 rem > **C** ≥ 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)
Radioactive Waste	*Hazard: N/A*	L: C: R:	Public not allowed in Railhead	L: C: R:
Beryllium-7	*Hazard:* N/A	L: C: R:	Public not allowed in Railhead	L: C: R:
Radioactive Sources	*Hazard:* N/A	L: C: R:	Public not allowed in Railhead	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** ≥ 25.0 rem	**C** ≥ 100 rem	**C** ≥ 100 rem
M	25.0 rem > **C** ≥ 5 rem	100 rem > **C** ≥ 25 rem	100 rem > **C** ≥ 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:* • *Potential exposure to lead during manual handling of un-encased lead bricks, lead shot, lead paint lead sheets, and soldering operations*	L: A C: M R: I	P: Lead Handling Training P: Administrative policy (moving 10 bricks per day per FESHM) M: PPE (dermal and respiratory) M: IH Sampling (vertical standard)	L: EU C: N R: IV
Beryllium	*Hazard:* • *Potential exposure to beryllium dust during manual handling of un-encased, or machining dusts from fabrication shop activities.*	L: A C: M R: II	P: Administrative policy (ESH review required per FESHM, permitting, etc.) P: Training (Three current beryllium trainings maintained at Fermilab) M: IH Sampling (vertical standard) M: PPE (dermal and respiratory)	L: EU C: L R: IV

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

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

Consequence (C, of event)/year
- **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** ≥ PAC-2	**C** ≥ PAC-3	**C** ≥ IDLH
M	PAC-2 > **C** ≥ PAC-1	PAC-3 > **C** ≥ PAC-2	IDLH > **C** ≥ PEL or TLV_c
L	PAC-1 > **C**	PAC-2 > **C**	PEL or TLV_c > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

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:* • Potential exposure to lead dust during manual handling of un-encased lead bricks, lead shot, and lead sheets.	L: A C: L R: III	P: Work practice control (preventing access to area, prohibiting food and drink, etc.) P: Lead work signage	L: EU C: L R: IV
Beryllium	*Hazard:* • Potential exposure to beryllium dust during manual handling of un-encased, or machining dusts from fabrication shop activities.	L: A C: H R: J	P: Work planning (ESH oversite, i.e. Fermilab doesn't typically allow machining beryllium in general) P: Work practice control (preventing access to area, prohibiting food and drink, etc.) P: Beryllium work signage M: Local exhaust ventilation at the point of work	L: BEU C: M R: IV

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

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

Consequence (C, of event)/year
- **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 minimal 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** ≥ PAC-2	**C** ≥ PAC-3	**C** ≥ IDLH
M	PAC-2 > **C** ≥ PAC-1	PAC-3 > **C** ≥ PAC-2	IDLH > **C** ≥ PEL or TLV_c
L	PAC-1 > **C**	PAC-2 > **C**	PEL or TLV_c > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

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 Shielding *	*Hazard: NA*	L: C: R:	No Public Access to the Railhead	L: C: R:
Beryllium *	*Hazard: NA*	L: C: R:	No Public Access to the Railhead	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** ≥ PAC-2	**C** ≥ PAC-3	**C** ≥ IDLH
M	PAC-2 > **C** ≥ PAC-1	PAC-3 > **C** ≥ PAC-2	IDLH > **C** ≥ PEL or TLV_c
L	PAC-1 > **C**	PAC-2 > **C**	PEL or TLV_c > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

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:* *This hazard is a potential facility fire.* *The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices.* *This hazard can add to the fuel load of a potential facility fire.* *Poor housekeeping can also lead to life safety concerns, such as egress obstructions and tripping hazards.* *The exposure of the hazard to the facility worker is of major concern.*	L: A C: H R: I	P – The use of Operational Readiness Clearance (ORC) and/or WPC process determine if additional combustibles will be introduced to the area P - Fire Safety and Life Safety Inspections are performed Fire Protection Group and the Fire Department. P – Fire alarm systems ITM is performed at prescribed frequences P – Prior to restart, a walkdown is conducted of the complex verifying transient combustibles are removed before operational activities commence. M – Smoke, heat, sprinklers, are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days. M – Air sampling smoke (early) detection is present M – On-site fire department trained in radiological environments	L: BEU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Flammable Materials (Flammable gas, cleaning materials, etc.)	*Hazard:* *The presence of flammable gases in cylinders or storage containers pose an inherent hazard due to their flammability/combustibility properties.* *Exposure to hot work provides a dangerous situation where flammable liquids will ignite. Unmitigated this could lead to an explosion and subsequent fire.* *The exposure of the hazard to the facility worker is of major concern.*	L: A C: H R: I	P – The use of Operational Readiness Clearance (ORC) and/or WPC process determine if additional combustibles will be introduced to the area P - Fire Safety and Life Safety Inspections are performed Fire Protection Group and the Fire Department. P – Fire alarm systems ITM is performed at prescribed frequencies P – Prior to restart, a walkdown is conducted of the complex verifying transient combustibles are removed before operational activities commence. M – Smoke, heat, sprinklers, are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days. M – Air sampling smoke (early) detection is present M – On-site fire department trained in radiological environments	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** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

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:* *The presence of excessive combustible materials can pose a hazard stemming from inadequate housekeeping practices.* *This hazard can add to the fuel load of a potential fire.* *Poor housekeeping can also lead to life safety concerns, such as egress obstructions and tripping hazards.* *The exposure of the hazard to the co-located worker is of concern.*	L: A C: M R: II	P – The use of operational readiness clearance ensures if additional combustibles will be introduced to the area P – All materials are reviewed prior to entering railhead area. P - Fire Safety and Life Safety Inspections are performed Fire Protection Group and the Fire Department. P – Fire alarm systems are tested prior to maintenance activities in shutdown mode. P – Prior to restart, a walkdown is conducted of the complex verifying transient combustibles are removed before operational activities commence. M – Smoke, heat, sprinklers, are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days. M – Air sampling smoke (early) detection is present M – Manual fire suppression services are provided, i.e., hose valve connections in the MI enclosure. M – Egress stairways are constructed as fire barriers. M – On-site fire department trained in radiological environments.	L: BEU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Flammable Materials (Flammable gas, cleaning materials, etc.)	*Hazard:* *The presence of flammable gases in cylinders or storage containers pose an inherent hazard due to their flammability/combustibility properties.* *Exposure to hot work provides a dangerous situation where flammable liquids will ignite. Unmitigated this could lead to an explosion and subsequent fire.* *The exposure of the hazard to the co-located worker is of concern.*	L: A C: M R: II	P – The use of operational readiness clearance ensures if additional combustibles will be introduced to the area P – All materials are reviewed prior to entering railhead. P - Fire Safety and Life Safety Inspections are performed Fire Protection Group and the Fire Department. P – Fire alarm systems are tested prior to maintenance activities in shutdown mode. P – Prior to restart, a walkdown is conducted of the complex verifying transient combustibles are removed before operational activities commence. M – Smoke, heat, sprinklers, are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days. M – Air sampling smoke (early) detection is present M - Automatic sprinkler protection at the alcoves and service buildings. M – Manual fire suppression services are provided, i.e., hose valve connections in the MI enclosure. M – Egress stairways are constructed as fire barriers. M – On-site fire department trained in radiological environments.	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** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

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:* NA	L: C: R:	No Public Access to the Railhead	L: C: R:
Flammable Materials (Flammable gas, cleaning materials, etc.)	*Hazard:* NA	L: C: R:	No Public Access to the Railhead	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** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

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)
High Voltage Exposure	*Hazard:* • *Shock hazard, voltage > 50 V, service building areas*	L: A C: H R: I	P: Equipment is enclosed (dead front panels), and tool use or lock removal is required to access P: Training for electrical workers including no energized manipulative work policy P: Hazard Analysis / LOTO Procedures / Standard Operating Procedures for work on electrical equipment M: Personnel protective equipment and training in proper use.	L: BEU C: I R: IV
	• *Arc Flash, service building area*	L; A C: H R: I	M: Ground current monitors inhibit power supply operation when excessive ground current is detected. Intended for equipment protection but provides some shock mitigation	L: BEU C: I 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** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

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)
High Voltage Exposure	*Hazard:* • *Shock hazard, voltage > 50 V, Service Bldg. Non-Interlocked enclosures* • *Arc Flash, service building Non-Interlocked enclosures*	L: A C: H R: I L: A C: H R: I	P: Equipment is enclosed (dead front panels), and tool use or lock removal is required to access P: Building access restricted to trained individuals P: Basic electrical training for all workers M: Ground current monitors inhibit power supply operation when excessive ground current is detected. Intended for equipment protection but provides some shock mitigation	L: BEU C: M R: IV L: BEU C: M R: IV

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

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

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)
High Voltage Exposure	*Hazard: NA*	L: C: R:	No Public Access to the Railhead	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** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

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:* Personal Injury due to improper use of tool	L: A C: L R:III	P- Inspection of tools before use to insure proper working condition P- Proper Training in use of tools P- Evaluate job to determine proper tool is being used for the job M- Access restricted to only authorized user	L: EU 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** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

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:* Personal Injury due to improper use of tool	L: A C: L R: III	P- Inspection of tools before use to insure proper working condition P- Proper Training in use of tools P- Evaluate job to determine proper tool is being used for the job M- Access restricted to only authorized user	L: EU 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** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**

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: N/A*	L: C: R:	Public is prevented from having access to work areas	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** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization > **C**	Minor injuries; no hospitalization > **C**

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)
Compressed Gasses	*Hazard: Personnel injury due to unexpected release, or unsecure tanks.*	L: A C: H R: I	P: All personnel handling have to take Pressure Safety orientation training FN000271. P: All personnel handling have to take compressed gas cylinder safety training FN000213 P: All personnel handling 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.	L: BEU C: M R: IV
Material Handling	*Hazard: Personnel injury due to moving/handling material (rollovers, crush, etc.)*	L: A C: H R: I	P: All operators must complete Forklift Operator Training FN000014/CR/EV. P: All operators have to be familiar with FESHM 10000 series and apply requirements. P: All PITs are inspected annually by an offsite vendor. P: Backworks Safety training FN000335/CR. P: Industrial Hygiene's reviews ergonomics and maintains a database and FESHM 4120. M: Personal Protective Equipment mitigates severity of injury.	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** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

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)
Compressed Gasses	*Hazard: Collocated personnel injury due to unexpected release, or unsecure tanks*	L: A C: H R: I	P: Complete New Employee ES&H Orientation Subcontractor Orientation New User Affiliate Orientation or Facility Specific Hazard Awareness Training P: Ensure that compressed gas cylinders are properly secured while in-use. P: Ensure that compressed gas cylinders are properly stored with valve protection caps in-place	L: BEU C: H R: III
Material Handling	*Hazard: Personnel injury due to moving/handling material (rollovers, crush, etc.)*	L: A C: H R: I	P: Complete New Employee ES&H Orientation Subcontractor Orientation New User Affiliate Orientation or Facility Specific Hazard Awareness Training P: All personnel are required to follow FESHM 10000 series and any applicable requirements P: All PIT operators shall warn collocated personnel and barricade the area M: Personal Protective Equipment mitigates severity of injury. P: Material movements are performed by trained personel	L: BEU C: M R: III

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

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)
Compressed Gasses	*Hazard: NA*	L: C: R:	No Public Access to the Railhead	L: C: R:
Material Handling	*Hazard: NA*	L: C: R:		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** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

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)
Noise	*Hazard:* *Exposure above OELs via use of machinery, tools, co-location w/ equipment, etc.*	L: A C: I R: III	P: Hearing Conservation Training P: P: Equipment isolation M: Engineering controls (isolation, sound barriers) M: PPE (HPDs)	L: BEU C: N R: IV
Ergonomics	*Hazard:* *Office space Industrial space (over lifting, repetitive motion, static posture)* :	L: A C: H R: I	P: Ergo assesment (ESH SME) P: Training (Back works, office ergo) P: Work planning (HA, prescribed techniques, etc.) M: Administrative Controls, i.e. Lifting techniques, office ergo techniques (stand, sit, 20 min breaks, etc)	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** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

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)
Noise	*Hazard:* *Exposure above OELs via use of machinery, tools, co-location w/ equipment, etc.*	L: A C: L R: III	M: Engineering controls (isolation, sound barriers) M: PPE (HPDs) P: Hearing Conservation Training P: IH Surveys and follow up w/ workers P: Equipment isolation	L: BEU C: N R: IV
Ergonomics	*Hazard:* • *Office space* • *Industrial space (over lifting, repetitive motion, static posture)*	L: BEU C: N R: IV	P: Ergo assessment (ESH SME) P: Training (Back works, office ergo) P: Work planning (HA, prescribed techniques, etc.) M: Administrative Controls, i.e. Lifting techniques, office ergo techniques (stand, sit, 20 min breaks, etc)	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** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

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)
Noise	*Hazard:* NA	L: C: R:	No Public Access to the Railhead	L: C: R:
Ergonomics	*Hazard: NA*	L: C: R:	No Public Access to the Railhead	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** ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.	**C** ≥ Prompt worker fatality or acute injury that is immediately life-threatening or permanently disabling.
M	**C** ≥ Mild, transient adverse effects.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	**C** ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.
L	Mild, transient adverse effects > **C**	Minor injuries; no hospitalization **> C**	Minor injuries; no hospitalization **> C**
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

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