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: *
-to			

^{*} 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).

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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	Hazard: Worker receiving elevated	L: A	P: Items are surveyed prior to storage locations being identified to prevent	L: EU
Waste	dose from radioactive waste.	C: L	elevated worker dose from residual activation.	C: N
		R: III	 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. 	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	Hazard: Workers receiving elevated	L: A	P: Source technicians receive special training for management of sources to	L: U
Sources	dose managing sources	C: L	prevent exposure to radioactive sources.	C: N
		R: III	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.	R: IV

Likelihood (L, of event)/year	Co	nsequence (C, of event)/y	year	Risk (R, Qualitative R	lanking)	Risk	Matri	X			
$\mathbf{A} = \text{Anticipated } (L > 1.0E-02)$		$\mathbf{H} = \mathbf{High}$		I = situation (even)	t) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{H} = \text{situation (even}$	nt) of concern		1	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (eve	ent) of minor concern	es	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (eve	ent) of minimal concern	enc	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edn	_	***	***	***	***
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ 25.0 rem		C ≥ 100 rem	C ≥ 100 rem	ons	L	III	III	IV	IV
M = Mitigative (reduces event consequences)	M	$25.0 \text{ rem} > \mathbf{C} \ge 5 \text{ rem}$	100	0 rem > C ≥ 25 rem	100 rem > C ≥ 25 rem	0	N	IV	IV	IV	IV
Acronyms	L	5 rem > C		25 rem > C	25 rem > C						
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	N	0.5 rem > C		5 rem > C	5 rem > C						

Table 2.2 Radiological – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
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

Likelihood (L, of event)/year	Co	nsequence (C, of event)/y	year	Risk (R, Qualitative R	Ranking)	Risk	Matri	X			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (even	t) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ever	nt) of concern		1	A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (eve	ent) of minor concern	es	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (eve	ent) of minimal concern	enc	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	edn		***	***		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ 25.0 rem		C ≥ 100 rem	C ≥ 100 rem	ons	L	III	III	IV	IV
M = Mitigative (reduces event consequences)	M	$25.0 \text{ rem} > \mathbf{C} \ge 5 \text{ rem}$	100	$0 \text{ rem} > \mathbf{C} \ge 25 \text{ rem}$	100 rem > C ≥ 25 rem	0	N	IV	IV	IV	IV
Acronyms	L	5 rem > C		25 rem > C	25 rem > C						
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	N	0.5 rem > C		5 rem > C	5 rem > C						

Table 2.3 Radiological – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive	Hazard: N/A	L:	Public not allowed in Railhead	L:
Waste		C:		C:
		R:		R:
Beryllium-7	Hazard: N/A	L:	Public not allowed in Railhead	L:
		C:		C:
		R:		R:
Radioactive	Hazard: N/A	L:	Public not allowed in Railhead	L:
Sources		C:		C:
		R:		R:

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

Table 2.4 Toxic Materials – Onsite 1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
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

Likelihood (L, of event)/year	Co	onsequence (C, of event))/year	Risk (R, Qualitative	k (R, Qualitative Ranking)			X			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ev	II = situation (event) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ev	vent) of minor concern	es	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	ences	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə			***		
	Н	C ≥ PAC-2		C≥PAC-3	C≥IDLH	ons	L	III	III	IV	IV
M = Mitigative (reduces event consequences)	М	$PAC-2 > C \ge PAC-1$	РΔ	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$	Č	N	IV	IV	IV	IV
Acronyms IDLH = Immediately Dangerous to Life and Health	L	PAC-1 > C	17:	$\frac{\text{PAC-2} > C}{\text{PAC-2} > C}$	PEL or $TLV_c > C$		•				
MOI = Maximally-exposed Offsite Individual PAC = Protective Action Criteria PEL = Permissible Exposure Limit	N	Consequences less than those for Low Consequence Level		nsequences less than for Low Consequence Level	Consequences less than those for Low Consequence Level						
TLV_c = Threshold Limit Value (ceiling)											

Table 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	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	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

Likelihood (L, of event)/year	Co	onsequence (C, of event))/year	Risk (R, Qualitative	k (R, Qualitative Ranking)			X			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (ever	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (evo	II = situation (event) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ev	vent) of minor concern	es	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	ences	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	nbə					
	Н	C ≥ PAC-2		C ≥ PAC-3	C≥IDLH	ous	L	III	III	IV	IV
M = Mitigative (reduces event consequences)	М	$PAC-2 > C \ge PAC-1$	PΔ	$AC-3 > C \ge PAC-2$	$IDLH > C \ge PEL \text{ or } TLV_c$	Č	N	IV	IV	IV	IV
Acronyms IDLH = Immediately Dangerous to Life and Health	L	PAC-1 > C	17:	$\frac{\text{PAC-2} \cdot \text{C} = 1 \cdot \text{RC-2}}{\text{PAC-2} \cdot \text{C}}$	PEL or $TLV_c > C$						
MOI = Maximally-exposed Offsite Individual PAC = Protective Action Criteria PEL = Permissible Exposure Limit	N	Consequences less than those for Low Consequence Level		nsequences less than for Low Consequence Level	Consequences less than those for Low Consequence Level						
TLV_c = Threshold Limit Value (ceiling)											

Table 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:	No Public Access to the Railhead	L:
		C:		C:
		R:		R:
Beryllium *	Hazard: NA	L:	No Public Access to the Railhead	L:
		C:		C:
		R:		R:

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

Table 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.	,	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)	C	onsequence (C, of event)/y H = High	I = situation (eve	ent) of major concern	Risk	Matri	ix A	Like U	lihood EU	BEU	
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)		 M = Moderate L = Low N = Negligible 	,	vent) of concern vent) of minor concern vent) of minimal concern	ences	H M	I	I	II	III IV	
Control(s) Type P = Preventive (reduce event occurrence likelihood)	C H	Offsite (MOI)	Onsite-2 (co-located worker) C ≥ Prompt worker fatality	Onsite-1 (facility worker) C ≥ Prompt worker	Conseque	L	III	III	IV	IV	
M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual		other serious effects, or symptoms which could impair an individual's ability to take protective action.	or acute injury that is immediately life-threatening or permanently disabling.	fatality or acute injury that is immediately life- threatening or permanently disabling.		N	IV	IV	IV	IV	
	M	C ≥ Mild, transient adverse effects. Mild, transient	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no							
	L	adverse effects > C	hospitalization > C	hospitalization > C							
	N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level							

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Combustible materials (cables, Boxes, Paper, wood cribbing, etc.)	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-	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)	C	onsequence (C, of event)/y H = High M = Moderate	I = situation (eve	nt) of major concern	Risk	Matri	A	Like U	lihood EU	BEU		
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)		$\mathbf{L} = \mathbf{M}$ $\mathbf{L} = \mathbf{L}$ $\mathbf{N} = \mathbf{N}$ $\mathbf{N} = \mathbf{N}$	-	vent) of concern vent) of minor concern vent) of minimal concern	ences	H M	I II	I	II III	III IV		
Control(s) Type P = Preventive (reduce event occurrence likelihood)	С	Offsite (MOI)	Onsite-2 (co-located worker) $C \ge \text{Prompt worker fatality}$	Onsite-1 (facility worker) C ≥ Prompt worker	nbəsu	L	III	III	IV	IV		
M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual		other serious effects, or symptoms which	or acute injury that is immediately life- threatening or permanently disabling.	fatality or acute injury that is immediately life-threatening or permanently disabling.	Cor	N	IV	IV	IV	IV		
	M	C ≥ Mild, transient adverse effects. Mild, transient	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no								
	N	adverse effects > C Consequences less	hospitalization > C Consequences less than	hospitalization > C Consequences less than								
			hose for Low Consequence Level	those for Low Consequence Level								

Table 2.9 Flammable and Combustible Materials – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Combustible materials (cables, Boxes, Paper, wood cribbing, etc.)	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-	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)	C	onsequence (C, of event)/y H = High M = Moderate	I = situation (eve	nt) of major concern	Risk	Matri	A	Like U	lihood EU	BEU		
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)		$\mathbf{L} = \mathbf{M}$ $\mathbf{L} = \mathbf{L}$ $\mathbf{N} = \mathbf{N}$ $\mathbf{N} = \mathbf{N}$	-	vent) of concern vent) of minor concern vent) of minimal concern	ences	H M	I II	I	II III	III IV		
Control(s) Type P = Preventive (reduce event occurrence likelihood)	С	Offsite (MOI)	Onsite-2 (co-located worker) $C \ge \text{Prompt worker fatality}$	Onsite-1 (facility worker) C ≥ Prompt worker	nbəsu	L	III	III	IV	IV		
M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual		other serious effects, or symptoms which	or acute injury that is immediately life- threatening or permanently disabling.	fatality or acute injury that is immediately life-threatening or permanently disabling.	Cor	N	IV	IV	IV	IV		
	M	C ≥ Mild, transient adverse effects. Mild, transient	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no								
	N	adverse effects > C Consequences less	hospitalization > C Consequences less than	hospitalization > C Consequences less than								
			hose for Low Consequence Level	those for Low Consequence Level								

Table 2.10 Electrical Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
High Voltage	Hazard:	L: A	P: Equipment is enclosed (dead front panels), and tool use or lock removal	L: BEU
Exposure	 Shock hazard, 	C: H	is required to access	C: I
	 voltage > 50 V, service building areas Arc Flash, service building area 	R: I L; A C: H R: I	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. M: Ground current monitors inhibit power supply operation when excessive ground current is detected. Intended for equipment protection but provides some shock mitigation	R: IV 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) L = Unlikely (1.0E-02> L > 1.0E-04)	C	onsequence (C, of event)/y H = High M = Moderate	I = situation (eve	ent) of major concern	Risk	Matri	ix A	Like U	lihood EU	BEU	
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)		$\mathbf{L} = \mathbf{Low}$ $\mathbf{N} = \mathbf{Negligible}$	III = situation (e	II = situation (event) of concern III = situation (event) of minor concern IV = situation (event) of minimal concern			I	I	II III	III IV	
Control(s) Type	C H	C ≥ Irreversible, other serious effects, or symptoms which	Onsite-2 (co-located worker) C ≥ Prompt worker fatality or acute injury that is immediately life- threatening or permanently disabling.	Onsite-1 (facility worker) C ≥ Prompt worker fatality or acute injury that is immediately life- threatening or permanently disabling.	Consequences	L N	III IV	III IV	IV IV	IV IV	
	M L	C ≥ Mild, transient adverse effects. Mild, transient adverse effects > C	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no hospitalization > C	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no hospitalization > C							
	N	Consequences less than those for Low Consequence Level	Consequences less than hose for Low Consequence Level	Consequences less than those for Low Consequence Level							

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
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, "F	Example Qualitative Conse	equence Matrix", DOE-HD	BK-1163-2020.BEU								
Likelihood (L, of event)/year A = Anticipated (L > 1.0E-02)	C	onsequence (C, of event)/y H = High	I = situation (eve	nt) of major concern	Risk	Matri		Likelihood				
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)		 M = Moderate L = Low N = Negligible 	,	ent) of concern vent) of minor concern vent) of minimal concern	ences	H M	I II	I II	EU II	BEU III IV		
Control(s) Type P = Preventive (reduce event occurrence likelihood)	C H	Offsite (MOI)	Onsite-2 (co-located worker) $C \ge \text{Prompt worker fatality}$	Onsite-1 (facility worker) $C \ge \text{Prompt worker}$	Conseque	L	III	III	IV	IV		
M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual		other serious effects, or symptoms which	or acute injury that is immediately life-threatening or permanently disabling.	fatality or acute injury that is immediately life- threatening or permanently disabling.	Э	N	IV	IV	IV	IV		
	M L	C ≥ Mild, transient adverse effects. Mild, transient	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no								
	N	adverse effects > C Consequences less than those for Low Consequence Level	hospitalization > C Consequences less than hose for Low Consequence Level	hospitalization > C Consequences less than those for Low Consequence Level								

Table 2.12 Electrical Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
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	l, "E	Example Qualitative Con	sequen	ce Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year A = Anticipated (L > 1.0E-02)	C	onsequence (C, of event) H = High	/year	Risk (R, Qualitative I = situation (eve	Ranking) ent) of major concern	Risk	Matri	x	Like	lihood	1
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ev	ent) of concern		11	A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06) BEU = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{L} = \mathbf{Low}$ $\mathbf{N} = \mathbf{Negligible}$		*	vent) of minor concern vent) of minimal concern	ences	H M	II	II	III	IV
Control(s) Type P = Preventive (reduce event occurrence likelihood)	С	Offsite (MOI)		-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	L	III	III	IV	IV
M = Mitigative (reduces event consequences)	Н	C ≥ Irreversible, other serious effects,		rompt worker fatality acute injury that is	C ≥ Prompt worker fatality or acute injury that	Col	N	IV	IV	IV	IV
Acronyms MOI = Maximally-exposed Offsite Individual		or symptoms which could impair an individual's ability to take protective action.		mmediately life- tening or permanently disabling.	is immediately life- threatening or permanently disabling.						
	M	C ≥ Mild, transient adverse effects.	imm per	≥ Serious injury, no lediate loss of life no manent disabilities; bitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.						
	L	Mild, transient adverse effects > C		Minor injuries; no ospitalization > C	Minor injuries; no hospitalization > C						
	N	Consequences less than those for Low Consequence Level	Con	asequences less than for Low Consequence Level	Consequences less than those for Low Consequence Level						

Table 2.16 Kinetic Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power tools	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, "E	Example Qualitative Con	sequence	e Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year l	Risk (R, Qualitative	Ranking)	Risk	Matri	ix			
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (eve	ation (event) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		II = situation (ev	ent) of concern		1	A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ev	vent) of minor concern	sə	Н	I	I	II	III
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	ences	M	II	II	III	IV
Control(s) Type	C	Offsite (MOI)	Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	nbəs	т .	TTT	777	13.7	13.7
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	$C \ge Pro$	ompt worker fatality	C ≥ Prompt worker	Cons	L	III	III	IV	IV
M = Mitigative (reduces event consequences)		other serious effects,		cute injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV
Acronyms		or symptoms which		mediately life-	is immediately life-					•	
MOI = Maximally-exposed Offsite Individual		could impair an		ning or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective		C							
		action.									
	M	C ≥ Mild, transient	C ≥ S	Serious injury, no	C ≥ Serious injury, no						
		adverse effects.	immed	diate loss of life no	immediate loss of life no						
			perma	anent disabilities;	permanent disabilities;						
			hospit	talization required.	hospitalization required.						
	L	Mild, transient	Mi	inor injuries; no	Minor injuries; no						
		adverse effects > C	hos	spitalization > C	hospitalization > C						
	N	Consequences less	Conse	equences less than	Consequences less than						
		than those for Low	those fo	or Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power tools	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, "E	Example Qualitative Conse	equence l	Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event)/y	year Ri	kisk (R, Qualitative	Ranking)	Ris	k Mat	rix					
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (eve	ent) of major concern				Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (ev}$	ent) of concern			A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (e	vent) of minor concern	nces	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	enc	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite-2 ((co-located worker)	Onsite-1 (facility worker)	edn	_	TTT	TTT	TX 7	77.7		
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C > Pron	mpt worker fatality	C ≥ Prompt worker	ons	L	III	III	IV	IV		
M = Mitigative (reduces event consequences)		other serious effects,		ate injury that is	fatality or acute injury that	C	N	IV	IV	IV	IV		
Acronyms		or symptoms which		nediately life-	is immediately life-								
MOI = Maximally-exposed Offsite Individual		* *		ing or permanently	threatening or								
		individual's ability to		disabling.	permanently disabling.								
		take protective		C									
		action.											
	M	C ≥ Mild, transient	C≥Se	erious injury, no	C ≥ Serious injury, no								
		adverse effects.	immedia	iate loss of life no	immediate loss of life no								
			permar	nent disabilities;	permanent disabilities;								
			hospital	ilization required.	hospitalization required.								
	L	Mild, transient	Mino	or injuries; no	Minor injuries; no								
		adverse effects > C	hospi	oitalization > C	hospitalization > C								

Table 2.18 Kinetic Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power tools	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, "F	Example Qualitative Cor	ısequei	nce Matrix", DOE-HD	BK-1163-2020.								
Likelihood (L, of event)/year	C	onsequence (C, of event))/year	Risk (R, Qualitative	Ranking)	Ris	k Mat	rix					
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$		I = situation (eve	nt) of major concern				Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$		$\mathbf{II} = \text{situation (ev}$	ent) of concern	_		A	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		L = Low		III = situation (ex	vent) of minor concern	es	Н	I	I	II	III		
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible		IV = situation (ev	vent) of minimal concern	ences	M	II	II	III	IV		
Control(s) Type	C	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbəs	T	III	III	IV	IV		
 P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual 	Н	C ≥ Irreversible, other serious effects, or symptoms which could impair an individual's ability to take protective action.	or	Prompt worker fatality acute injury that is immediately life-tening or permanently disabling.	C ≥ Prompt worker fatality or acute injury that is immediately lifethreatening or permanently disabling.	Cons	N	IV		IV	IV		
	M L	C ≥ Mild, transient adverse effects. Mild, transient adverse effects > C	imm per hosp	≥ Serious injury, no nediate loss of life no manent disabilities; pitalization required. Minor injuries; no ospitalization > C	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required. Minor injuries; no hospitalization > C								

Table 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, "F	Example Qualitative Cons	equence Matrix", DOE-HD	BK-1163-2020.							
Likelihood (L, of event)/year A = Anticipated (L > 1.0E-02)	C	onsequence (C, of event)/y H = High	I = situation (eve	ent) of major concern	Risk	Matri	ix A	Likelihood			
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)		 M = Moderate L = Low N = Negligible 	,	vent) of minor concern vent) of minimal concern	ences	H M	I	I	II	BEU III IV	
Control(s) Type P = Preventive (reduce event occurrence likelihood)	C H	Offsite (MOI)	Onsite-2 (co-located worker) C ≥ Prompt worker fatality	Onsite-1 (facility worker) C ≥ Prompt worker	Conseque	L	III	III	IV	IV	
M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual		other serious effects, or symptoms which could impair an individual's ability to take protective action.	or acute injury that is immediately life-threatening or permanently disabling.	fatality or acute injury that is immediately life- threatening or permanently disabling.		N	IV	IV	IV	IV	
	M	C ≥ Mild, transient adverse effects. Mild, transient	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	adverse effects > C	Minor injuries; no hospitalization > C	Minor injuries; no hospitalization > C							
	N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level							

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
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-	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)	C	onsequence (C, of event)/y H = High	I = situation (eve	ent) of major concern	najor concern			Risk Matrix Likeliho A U E			
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)		 M = Moderate L = Low N = Negligible 	,	ent) of concern vent) of minor concern vent) of minimal concern	ences	H M	I	I	EU II	BEU III IV	
Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual	C H	Offsite (MOI)	Onsite-2 (co-located worker) C ≥ Prompt worker fatality	Onsite-1 (facility worker) C ≥ Prompt worker	Conseque	L	III	III	IV	IV	
		other serious effects, or symptoms which could impair an individual's ability to take protective action.	or acute injury that is immediately life-threatening or permanently disabling.	fatality or acute injury that is immediately life- threatening or permanently disabling.		N	IV	IV	IV	IV	
	M	C ≥ Mild, transient adverse effects. Mild, transient	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.							
		adverse effects > C	Minor injuries; no hospitalization > C	Minor injuries; no hospitalization > C							
	N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level							

Table 2.21 Potential Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Compressed Gasses	Hazard: <u>NA</u>	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-	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)	C	onsequence (C, of event)/y H = High	I = situation (event) of major concern		Risk	Matri	ix A	Likelihood			
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)		M = Moderate $L = Low$ $N = Negligible$	E Eo., Statistion (event) of minor concern	H M	I	I	II	BEU III IV			
Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual	C H	Offsite (MOI)	Onsite-2 (co-located worker) $C \ge \text{Prompt worker fatality}$	Onsite-1 (facility worker) C ≥ Prompt worker	Conseque	L	III	III	IV	IV	
		other serious effects, or symptoms which could impair an individual's ability to take protective action.	or acute injury that is immediately life-threatening or permanently disabling.	fatality or acute injury that is immediately life- threatening or permanently disabling.		N	IV	IV	IV	IV	
	M	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.							
		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 hose for Low Consequence Level	Consequences less than those for Low Consequence Level							

Table 2.25 Other hazards – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
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-	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)	C	onsequence (C, of event)/y H = High	I = situation (event) of major concern		Risk	Matri	ix A	Likelihood			
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)		M = Moderate $L = Low$ $N = Negligible$	E Eo., Statistion (event) of minor concern	H M	I	I	II	BEU III IV			
Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual	C H	Offsite (MOI)	Onsite-2 (co-located worker) $C \ge \text{Prompt worker fatality}$	Onsite-1 (facility worker) C ≥ Prompt worker	Conseque	L	III	III	IV	IV	
		other serious effects, or symptoms which could impair an individual's ability to take protective action.	or acute injury that is immediately life-threatening or permanently disabling.	fatality or acute injury that is immediately life- threatening or permanently disabling.		N	IV	IV	IV	IV	
	M	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.							
		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 hose for Low Consequence Level	Consequences less than those for Low Consequence Level							

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
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	C	onsequence (C, of event)/	year Risk (R, Q	ualitative	Ranking)	Risk Matrix						
A = Anticipated (L > 1.0E-02)		$\mathbf{H} = \mathbf{High}$	I = situ	ation (eve	ent) of major concern				Likelihood			
U = Unlikely (1.0E-02> L > 1.0E-04)		$\mathbf{M} = \mathbf{Moderate}$	$\mathbf{II} = \mathbf{sit}$	uation (ev	ent) of concern		1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	III = s	ituation (ev	vent) of minor concern	nces	Н	I	I	II	III	
BEU = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = si	tuation (ev	vent) of minimal concern	E	M	II	II	III	IV	
Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located	worker)	Onsite-1 (facility worker)	sedn	r	III	III	IV	IV	
P = Preventive (reduce event occurrence likelihood)	Н	C ≥ Irreversible,	C ≥ Prompt worke	r fatality	C ≥ Prompt worker	Cons	L	111	111	1 V	1 V	
M = Mitigative (reduces event consequences)		other serious effects,	or acute injury	-	fatality or acute injury that		N	IV	IV	IV	IV	
Acronyms		or symptoms which	immediately 1		is immediately life-	,						
MOI = Maximally-exposed Offsite Individual		could impair an	threatening or perr	nanently	threatening or							
		individual's ability to	disabling.	-	permanently disabling.							
		take protective										
		action.										
	M	C ≥ Mild, transient	C ≥ Serious inju	ıry, no	C ≥ Serious injury, no							
		adverse effects.	immediate loss of	f life no	immediate loss of life no							
			permanent disab	ilities;	permanent disabilities;							
			hospitalization re		hospitalization required.							
	L	Mild, transient	Minor injuries	s; no	Minor injuries; no							
		adverse effects > C	hospitalization	> C	hospitalization > C							
	N	Consequences less	Consequences le		Consequences less than							
		than those for Low	those for Low Con	sequence	those for Low							
		Consequence Level	Level		Consequence Level							

Table 2.27 Other hazards – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
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-	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)	C	onsequence (C, of event)/y H = High	I = situation (event) of major concern		Risk	Matri	ix A	BEU			
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)		 M = Moderate L = Low N = Negligible 	,	ent) of concern vent) of minor concern vent) of minimal concern	ences	H M	I	I II	EU II	III IV	
Control(s) Type P = Preventive (reduce event occurrence likelihood) M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual	C H	Offsite (MOI)	Onsite-2 (co-located worker) $C \ge \text{Prompt worker fatality}$	Onsite-1 (facility worker) C ≥ Prompt worker	Conseque	L	III	III	IV	IV	
		other serious effects, or symptoms which could impair an individual's ability to take protective action.	or acute injury that is immediately life-threatening or permanently disabling.	fatality or acute injury that is immediately life- threatening or permanently disabling.		N	IV	IV	IV	IV	
	M	C ≥ Mild, transient adverse effects.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.	C ≥ Serious injury, no immediate loss of life no permanent disabilities; hospitalization required.							
		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 hose for Low Consequence Level	Consequences less than those for Low Consequence Level							