Table 2. Summary of Baseline and Residual Risks – Tevatron

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

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

NOTE:

Per DOE-HDBK-1163-2020, Appendix C, "Risk Assessment Methodology":

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

Table 2.1 Radiological – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual Activation	*Hazard:* *Persons are exposed to residual activation beyond regulatory limits*	L: A C: M R: II	P – Locked Gates: Locked gates are barriers to entrances of areas that contain radioactive material. Keys are required to open these gates. P – Key Control Program: The key control program checks the worker's training prior to issuing them a key to the accelerator enclosure. P – Radiological Work Permit (RWP): The RWP is a permit written by Safety that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure M – Shielding: Shielding is material placed between the irradiated component and the area to be protected. Shielding attenuates radiation flux.	L: BEU C: L R: IV
	Tevatron, excluding C0 *Reference as per the radiation survey dated October 3, 2011, the greatest residual dose rate is 35 mrem/hr at 1 foot in the Tevatron tunnels*	L: A C: H R: I	P – Individual Storage Locations: Irradiated items are stored in individual crypts. Access requires motorized equipment. P – Locked Motorized Equipment: The equipment needed to access the individual crypts is locked.. P – Radiological Work Permit (RWP): The RWP is a permit written by Safety that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure M – Shielding: Shielding is material placed between the irradiated component and the area to be protected. Shielding attenuates radiation flux. M – Remote Handling – Items stored in C0 are handled remotely, reducing the exposure.	L: BEU C: L R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Groundwater Activation	*Hazard: Radionuclides in ground water exceed regulatory limits*	L: C: R:	The Tevatron Area is non-operational; radionuclide production has ceased. See Section I Chapter 4	L: C: R:
Radioactive Waste	*Hazards:* *Persons are exposed to residual activation beyond regulatory limits at* ***Tevatron***	L: BEU C: N R: IV	P – Radioactive waste is not present in the Tevatron. "Non-operational" status precludes generation of waste. This reduces the baseline likelihood to "beyond extremely unlikely".	L: BEU C: N R: IV
	Persons are exposed to residual activation beyond regulatory limits at ***C0***	L: A C: H I: I	P – Hazard Analysis and Work Planning: Job specific hazard analysis and work planning identifies procedures to prevent exposure beyond allowed limits. Work planning reduces time spent on task. M – Remote Handling: Remote handling allows increased distance between worker and radioactive waste. M – Shielding: Shielding between the worker and the radioactive waste reduces the radiation flux. M – Personal Protective Equipment (PPE); PPE decreases the exposure to radioactive waste.	L: U C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Contamination	*Hazards:* *Persons are exposed to residual activation beyond regulatory limits* at ***Tevatron***	L: BEU C: N R: IV	P – Radiation Survey: The radiation survey conducted October 3, 2011, found no accessible contamination. Beam has not been transported since then. This reduces the baseline likelihood to "beyond extremely unlikely". M – The mitigative measurements, "frisk upon exit" and "survey material", remain in place. Before work is conducted, additional preventative and mitigative measures will be determined through a job-specific hazard analysis.	L: BEU C: N R: IV
	Persons are exposed to residual activation beyond regulatory limits at ***C0***	L: A C: H R: I	P – Hazard Analysis and Work Planning: Job specific hazard analysis and work planning identifies procedures to prevent exposure beyond allowed limits. Work planning reduces likelihood of workers being exposed to contamination, and reduces the amount of time spent workers are exposed to this hazard. P – Remote Handling: Remote handling prevents worker from directly contacting the contaminated material. M – Shielding: Shielding between the worker and the radioactive waste reduces the radiation flux. M – Personal Protective Equipment (PPE): PPE reduces the consequences of exposure to contamination. If exposure occurs, the contamination remains on the PPE.	L: EU C: L R: IV

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

Likelihood (L, of event)/year			Consequence (C, of event)/year		Risk (R, Qualitative Ranking)	
A = Anticipated (L > 1.0E-02)			**H** = High		**I** = situation (event) of major concern	
U = Unlikely (1.0E-02> L >1.0E-04)			**M** = Moderate		**II** = situation (event) of concern	
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)			**L** = Low		**III** = situation (event) of minor concern	
BEU = Beyond Extremely Unlikely (1.0E-06> L)			**N** = Negligible		**IV** = situation (event) of minimal concern	

Risk Matrix

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

Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
P = Preventive (reduce event occurrence likelihood)	H	C ≥ 25.0 rem	C ≥ 100 rem	C ≥ 100 rem
M = Mitigative (reduces event consequences)	M	25.0 rem > C ≥ 5 rem	100 rem > C ≥ 25 rem	100 rem > C ≥ 25 rem
Acronyms	L	5 rem > C	25 rem > C	25 rem > C
MOI = Maximally-exposed Offsite Individual	N	0.5 rem > C	5 rem > C	5 rem > C
rem = Roentgen equivalent man				

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)
Residual Activation	*Hazard: Persons are exposed to residual activation beyond regulatory limits*	L: A C: H R: I	P – Locked Gates: Locked gates are barriers to entrances of areas that contain radioactive material. Keys are required to open these gates. P – Key Control Program: The key control program checks the worker's training prior to issuing them a key to the accelerator enclosure. P – Radiological Work Permit (RWP): The RWP is a permit written by Safety that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure M – Shielding: Shielding is material placed between the irradiated component and the area to be protected. Shielding attenuates radiation flux. Note: Additionally, in C0, stored items are handled remotely.	L: BEU C: M R: IV
Groundwater Activation	*Hazard: Radionuclides in ground water exceed regulatory limits*	L: C: R:	The Tevatron Area is non-operational; radionuclide production has ceased. See Section I Chapter 4	L: C: R:

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive Waste	*Hazards:* *Persons are exposed to residual activation beyond regulatory limits at* ***Tevatron***	L: BEU C: N R: IV	P – Radioactive waste is not present in the Tevatron tunnels. "Non-operational" status precludes generation. This reduces the baseline likelihood to "beyond extremely unlikely".	L: BEU C: N R: IV
	Persons are exposed to residual activation beyond regulatory limits at ***C0***	L: A C:H R:I	P – Hazard Analysis and Work Planning: Job specific hazard analysis and work planning identifies procedures to prevent exposure beyond allowed limits. Work planning reduces time spent on task. M – Remote Handling: Remote handling allows increased distance between worker and radioactive waste. M – Shielding: Shielding between the worker and the radioactive waste reduces the radiation flux. M – Personal Protective Equipment (PPE); PPE decreases the exposure to radioactive waste.	L: U C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Contamination	*Hazards:* *Persons are exposed to residual activation beyond regulatory limits at* ***Tevatron***	L: BEU C: N R: IV	P – Radiation Survey: The radiation survey conducted October 3, 2011, found no accessible contamination. Beam has not been transported since then. This reduces the baseline likelihood to "beyond extremely unlikely". M – The mitigative measurements, "frisk upon exit" and "survey material", remain in place. Before work is conducted, additional preventative and mitigative measures will be determined through a job-specific hazard analysis.	L: BEU C: M R: IV
	Persons are exposed to residual activation beyond regulatory limits at ***C0***	L: A C: H R: I	P – Hazard Analysis and Work Planning: Job specific hazard analysis and work planning identifies procedures to prevent exposure beyond allowed limits. Work planning reduces likelihood of workers being exposed to contamination, and reduces the amount of time spent workers are exposed to this hazard. P – Remote Handling: Remote handling prevents worker from directly contacting the contaminated material. M – Shielding: Shielding between the worker and the radioactive waste reduces the radiation flux. M – Personal Protective Equipment (PPE): PPE reduces the consequences of exposure to contamination. If exposure occurs, the contamination remains on the PPE.	L: EU C: L R: IV

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

Likelihood (L, of event)/year	Consequence (C, of event)/year	Risk (R, Qualitative Ranking)
A = Anticipated (L > 1.0E-02)	**H** = High	**I** = situation (event) of major concern
U = Unlikely (1.0E-02> L >1.0E-04)	**M** = Moderate	**II** = situation (event) of concern
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)	**L** = Low	**III** = situation (event) of minor concern
BEU = Beyond Extremely Unlikely (1.0E-06> L)	**N** = Negligible	**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

		Likelihood			
		A	U	EU	BEU
Consequences	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)
Residual Activation	*Hazards:* *Persons are exposed to residual activation beyond regulatory limits at* ***Tevatron***	L: BEU C: H R: III	P – Public Access Gates: Public access gates prevent unauthorized access to the Tevatron Area by the public, thus reducing the baseline likelihood to "beyond extremely unlikely". M – Shielding: Shielding is material placed between the irradiated component and the area to be protected. Shielding attenuates radiation flux. The Tevatron tunnels (the location of the activated components) are underground; the earthen overburden provides more than sufficient shielding.	L: BEU C:M R: IV
	Persons are exposed to residual activation beyond regulatory limits at ***CO***	L: BEU C: H R: III	P – Public access gates prevent unauthorized access to the Tevatron Area (thusly, C0) by the public, thus reducing the baseline likelihood to "beyond extremely unlikely". M – Shielding: Shielding is material placed between the irradiated component and the area to be protected. Shielding attenuates radiation flux.	L: BEU C: M R: IV
Groundwater Activation	*Hazard: Radionuclides in ground water exceed regulatory limits*	L: C: R:	The Tevatron Area is non-operational; radionuclide production has ceased. See Section I Chapter 4	L: C: R:

Radioactive Waste	*Hazards:* *Persons are exposed to residual activation beyond regulatory limits at* **Tevatron**	L: BEU C: N R: IV	P – Radioactive waste is not present in the Tevatron. "Non-operational" status precludes generation. This reduces the baseline likelihood to "beyond extremely unlikely"; baseline consequence is "negligible".	L: BEU C: N R: IV
	Persons are exposed to residual activation beyond regulatory limits at **C0**	L: BEU C: H R: III	P – Public access gates prevent unauthorized access to C0 by the public, thus reducing the baseline likelihood to "beyond extremely unlikely". M – Shielding: Shielding is material placed between the irradiated component and the area to be protected. Shielding attenuates radiation flux.	L: BEU C: M R: IV
Contamination	*Hazard:* *Persons are exposed to residual activation beyond regulatory limits at* **Tevatron**	L: BEU C: N R: IV	P – Public access gates prevent unauthorized access to the Tevatron Area by the public, thus reducing the baseline likelihood to "beyond extremely unlikely". Additionally, the radiation survey conducted October 3, 2011, found no accessible contamination. Finally, beam can no longer be transported through these sections. Therefore, contamination cannot be produced. No mitigation is necessary	L: BEU C: N R: IV
	Persons are exposed to residual activation beyond regulatory limits at **C0**	L: BEU C: H R: III	P – Public access gates prevent unauthorized access to C0 by the public, thus reducing the baseline likelihood to "beyond extremely unlikely". M – ES&H survey and cleaning: Survey and cleaning ensures that contamination is not present beyond the building.	L: BEU C: M R: IV

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

Likelihood (L, of event)/year	Consequence (C, of event)/year	Risk (R, Qualitative Ranking)
A = Anticipated (L > 1.0E-02)	**H** = High	**I** = situation (event) of major concern
U = Unlikely (1.0E-02> L >1.0E-04)	**M** = Moderate	**II** = situation (event) of concern
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)	**L** = Low	**III** = situation (event) of minor concern
BEU = Beyond Extremely Unlikely (1.0E-06> L)	**N** = Negligible	**IV** = situation (event) of minimal concern

Risk Matrix

		Likelihood			
		A	U	EU	BEU
C	H	I	I	II	III

Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
P = Preventive (reduce event occurrence likelihood)	**H**	C ≥ 25.0 rem	C ≥ 100 rem	C ≥ 100 rem
M = Mitigative (reduces event consequences)	**M**	25.0 rem > C ≥ 5 rem	100 rem > C ≥ 25 rem	100 rem > C ≥ 25 rem
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

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 dust during manual handling of un-encased lead bricks, lead shot, and lead sheets.	L: A C:H R: I	See Section I Chapter 4	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	Consequence (C, of event)/year	Risk (R, Qualitative Ranking)
A = Anticipated (L > 1.0E-02)	**H** = High	**I** = situation (event) of major concern
U = Unlikely (1.0E-02> L >1.0E-04)	**M** = Moderate	**II** = situation (event) of concern
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)	**L** = Low	**III** = situation (event) of minor concern
BEU = Beyond Extremely Unlikely (1.0E-06> L)	**N** = Negligible	**IV** = situation (event) of minimal concern

Risk Matrix

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

Control(s) Type
  P = Preventive (reduce event occurrence likelihood)
  M = Mitigative (reduces event consequences)
Acronyms
  IDLH = Immediately Dangerous to Life and Health
  MOI = Maximally-exposed Offsite Individual
  PAC = Protective Action Criteria
  PEL = Permissible Exposure Limit
  TLV$_c$ = Threshold Limit Value (ceiling)

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

Table 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:H R: I	See Section I Chapter 4	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 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	$C \geq PAC-2$	$C \geq PAC-3$	$C \geq IDLH$
M	$PAC-2 > C \geq PAC-1$	$PAC-3 > C \geq PAC-2$	$IDLH > C \geq PEL$ or TLV_c
L	$PAC-1 > C$	$PAC-2 > C$	PEL or $TLV_c > C$
N	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level	Consequences less than those for Low Consequence Level

Risk Matrix

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

Table 2.6 Toxic Materials – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Lead *	*Hazard:* Potential exposure to lead dust during manual handling of un-encased lead bricks, lead shot, and lead sheets.	L: A C:H R: I	See Section I Chapter 4	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 minor concern
- **IV** = situation (event) of minimal concern

Risk Matrix

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

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

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

C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
H	C ≥ 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

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: Burns*	L: A C: H R: I	See Section I Chapter 4	L: BEU C: L R: IV

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

Likelihood (L, of event)/year	Consequence (C, of event)/year	Risk (R, Qualitative Ranking)
A = Anticipated (L > 1.0E-02)	**H** = High	**I** = situation (event) of major concern
U = Unlikely (1.0E-02> L >1.0E-04)	**M** = Moderate	**II** = situation (event) of concern
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)	**L** = Low	**III** = situation (event) of minor concern
BEU = Beyond Extremely Unlikely (1.0E-06> L)	**N** = Negligible	**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

		Likelihood			
		A	U	EU	BEU
Consequences	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: Burns*	L: A C: H R: I	See Section I Chapter 4	L: BEU C: L R: IV

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

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

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

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

Control(s) Type
  P = Preventive (reduce event occurrence likelihood)
  M = Mitigative (reduces event consequences)
Acronyms
  MOI = Maximally-exposed Offsite Individual

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

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

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: Burns*	L: A C: H R: I	See Section I Chapter 4	L: BEU C: L R: IV

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

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

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

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

Control(s) Type
  P = Preventive (reduce event occurrence likelihood)
  M = Mitigative (reduces event consequences)
Acronyms
  MOI = Maximally-exposed Offsite Individual

Risk Matrix

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

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

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: Electric shock*	L: A C: H R: I	See Section I Chapter 4	L: BEU C: M R: IV
Low Voltage, High Current Exposure.	*Hazard: Electric shock*	L: A C: H R: I	See Section I Chapter 4	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

Risk Matrix

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

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

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: Electric shock*	L: A C: H R: I	See Section I Chapter 4	L: BEU C: M R: IV
Low Voltage, High Current Exposure.	*Hazard: Electric shock*	L: A C: H R: I	See Section I Chapter 4	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 2.12 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: Electric shock*	L: A C: H R: I	See Section I Chapter 4	L: BEU C: M R: IV
Low Voltage, High Current Exposure.	*N/A*	L: A C: H R: I	See Section I Chapter 4	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	Consequence (C, of event)/year	Risk (R, Qualitative Ranking)
A = Anticipated (L > 1.0E-02)	**H** = High	**I** = situation (event) of major concern
U = Unlikely (1.0E-02> L >1.0E-04)	**M** = Moderate	**II** = situation (event) of concern
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)	**L** = Low	**III** = situation (event) of minor concern
BEU = Beyond Extremely Unlikely (1.0E-06> L)	**N** = Negligible	**IV** = situation (event) of minimal concern

Risk Matrix

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

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

Table 2.13 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: Injury*	L: A C: H R: I	See Section I Chapter 4	L: EU C: M R: III
Pumps and Motors	*Hazard: Injury*	L: A C: H R: I	See Section I Chapter 4	L: BEU C: M R: IV
Mobile Shielding	*Hazard: Personnel injury due to pinch points, tip-overs, caught in between, crushing*	L: A C: H R: I	See Section I Chapter 4	L: BEU C: H R: III

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

Likelihood (L, of event)/year	Consequence (C, of event)/year	Risk (R, Qualitative Ranking)
A = Anticipated (L > 1.0E-02)	**H** = High	**I** = situation (event) of major concern
U = Unlikely (1.0E-02> L >1.0E-04)	**M** = Moderate	**II** = situation (event) of concern
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)	**L** = Low	**III** = situation (event) of minor concern
BEU = Beyond Extremely Unlikely (1.0E-06> L)	**N** = Negligible	**IV** = situation (event) of minimal concern

Risk Matrix

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

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

Table 2.14 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: Injury*	L: A C: H R: I	See Section I Chapter 4	L: EU C: L R: IV
Pumps and Motors	*Hazard: Injury*	L: A C: H R: I	See Section I Chapter 4	L: BEU C: L R: IV
Mobile Shielding	*Hazard: Personnel injury due to pinch points, tip-overs, caught in between, crushing*	L: A C: H R: I	See Section I Chapter 4	L: BEU C: H R: III

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

Likelihood (L, of event)/year	Consequence (C, of event)/year	Risk (R, Qualitative Ranking)
A = Anticipated (L > 1.0E-02)	**H** = High	**I** = situation (event) of major concern
U = Unlikely (1.0E-02> L >1.0E-04)	**M** = Moderate	**II** = situation (event) of concern
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)	**L** = Low	**III** = situation (event) of minor concern
BEU = Beyond Extremely Unlikely (1.0E-06> L)	**N** = Negligible	**IV** = situation (event) of minimal concern

Risk Matrix

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

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

Table 2.15 Kinetic Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Power tools	*Hazard: Injury*	L: A C: H R: I	See Section I Chapter 4	L: BEU C: M R: IV
Pumps and Motors	*Hazard: Injury*	L: A C: H R: I	See Section I Chapter 4	L: BEU C: A R: III
Mobile Shielding	*Hazard: N/A*	L: C: R:	See Section I Chapter 4	L: C: R:

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

Likelihood (L, of event)/year	Consequence (C, of event)/year	Risk (R, Qualitative Ranking)
A = Anticipated (L > 1.0E-02)	**H** = High	**I** = situation (event) of major concern
U = Unlikely (1.0E-02> L >1.0E-04)	**M** = Moderate	**II** = situation (event) of concern
EU = Extremely Unlikely (1.0E-04 > L >1.0E-06)	**L** = Low	**III** = situation (event) of minor concern
BEU = Beyond Extremely Unlikely (1.0E-06> L)	**N** = Negligible	**IV** = situation (event) of minimal concern

Risk Matrix

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

Control(s) Type	C	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)
P = Preventive (reduce event occurrence likelihood) **M** = Mitigative (reduces event consequences) **Acronyms** **MOI =** Maximally-exposed Offsite Individual	**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**

Table 2.16 Potential Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane Operations	*Hazard: injury*	L: A C: H R: I	See Section I Chapter 4	L: BEU C: M R: IV
Material Handling	*Hazard: injury*	L: A C: H R: I	See Section I Chapter 4	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

Risk Matrix

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

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

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane Operations	*Hazard: injury*	L: A C: H R: I	See Section I Chapter 4	L: BEU C: M R: IV
Material Handling	*Hazard: injury*	L: A C: H R: I	See Section I Chapter 4	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

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

Table 2.18 Potential Energy – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane Operations	*Hazard: injury*	L: A C: H R: I	See Section I Chapter 4	L: BEU C: H R: III
Material Handling	*Hazard: injury*	L: A C: H R: I	See Section I Chapter 4	L: BEU C: H 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

Risk Matrix

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

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

Table 2.19 Other hazards – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	*Hazard: asphyxiation*	L: A C: H R: I	See Section I Chapter 4	L: BEU C: M R: IV
Ergonomics	*Hazard: injury*	L: A C: H R: I	See Section I Chapter 4	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

Risk Matrix

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

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

Table 2.20 Other hazards – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	*Hazard: asphyxiation*	L: A C: H R: I	See Section I Chapter 4	L: BEU C: M R: IV
Ergonomics	*Hazard: injury*	L: A C: H R: I	See Section I Chapter 4	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	Consequence (C, of event)/year	Risk (R, Qualitative Ranking)
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)	**H** = High **M** = Moderate **L** = Low **N** = Negligible	**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

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

Table 2.21 Other hazards – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Confined Spaces	*Hazard: asphyxiation*	L: A C: H R: I	See Section I Chapter 4	L: BEU C: A R: III
Ergonomics	*Hazard: injury*	L: A C: H R: I	See Section I Chapter 4	L: BEU C: A R: III

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

Likelihood (L, of event)/year	Consequence (C, of event)/year	Risk (R, Qualitative Ranking)
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)	**H** = High **M** = Moderate **L** = Low **N** = Negligible	**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 2.22 Access & Egress – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety Egress	*Hazard: injury due to inability to exit*	L: A C: H R: I	See Section I Chapter 4	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

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

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

Table 2.23 Access & Egress – Onsite-2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Life Safety Egress	*Hazard: injury due to inability to exit*	L: A C: H R: I	See Section I Chapter 4	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

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

Table 2.24 Access & Egress – MOI Offsite

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

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

Table 2.25 Environmental

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Airborne	*Hazards:* *Airborne release of radionuclides beyond permitted limits.*	L: C: R:	See Section I Chapter 4	L: C: R:
	Discharge of chemicals into onsite surface waters beyond permitted limits.		See Section I Chapter 4	
Water	*Hazards:* *Discharge of radionuclides into onsite surface waters beyond permitted limits.*	L: C: R:	See Section I Chapter 4	L: C: R:
	Discharge of chemicals into onsite surface waters beyond permitted limits.		See Section I Chapter 4	

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Soil	*Hazards:* *Radioactive soil in beam loss areas beyond allowable concentrations of radionuclides beyond calculated Fermilab limits.* *Discharge of chemicals into onsite soils beyond permitted limits.*	L: C: R:	Standard analysis applies Standard analysis applies	L: C: R: