### Table 28. Summary of Baseline and Residual Risks – Neutrino Switchyard 120 Experimental Areas

28.23Magnetic Fields – Onsite-2 Co-located WorkerR: IR: III, IV28.24Magnetic Fields – MOI OffsiteR: IVR: IV28.25Other Hazards – Onsite-1 Facility WorkerR: *R: *28.26Other Hazards – Onsite-2 Co-located WorkerR: *R: *28.27Other Hazards – MOI OffsiteR: *R: *28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *		<b>Risk Tables Description</b>	Baseline Risk	Residual Risk
28.3Radiological – MOI OffsiteR: IVR: IV28.4Toxic Materials – Onsite 1 Facility WorkerR: IIR: IV28.5Toxic Materials – Onsite 2 Co-located WorkerR: IIIR: IV28.6Toxic Materials – MOI OffsiteR: *R: *R: *28.7Flammable & Combustible Materials – Onsite-1 Facility WorkerR: *R: *R: *28.8Flammable & Combustible Materials – MOI OffsiteR: *R: *R: *28.9Flammable & Combustible Materials – MOI OffsiteR: *R: *R: *28.10Electrical Energy – Onsite-1 Facility WorkerR: *R: *R: *28.11Electrical Energy – Onsite-1 Facility WorkerR: *R: *R: *28.12Electrical Energy – Onsite-1 Facility WorkerR: *R: *R: *28.13Thermal Energy – Onsite-2 Co-located WorkerR: IR: IVR: IV28.14Thermal Energy – Onsite-1 Facility WorkerR: IR: IV28.15Thermal Energy – Onsite-1 Facility WorkerR: IR: IV28.16Kinetic Energy – MOI OffsiteR: *R: *R: *28.17Kinetic Energy – Onsite-1 Co-located WorkerR: IR: IV28.18Kinetic Energy – Onsite-2 Co-located WorkerR: IR: IV28.19Potential Energy – Onsite-1 Facility WorkerR: IR: IV28.20Potential Energy – Onsite-2 Co-located WorkerR: *R: *28.21Potential Energy – Onsite-2 Co-located WorkerR: IR: IV28.2	28,1	Radiological – Onsite-1 Facility Worker	R: I	R: IV
28.4Toxic Materials – Onsite 1 Facility WorkerR: IIR: IV28.5Toxic Materials – Onsite 2 Co-located WorkerR: IIIR: IV28.6Toxic Materials – MOI OffsiteR: *R: *R: *28.7Flammable & Combustible Materials – Onsite-1 Facility WorkerR: *R: *R: *28.8Flammable & Combustible Materials – Onsite-2 Co-located workerR: *R: *R: *28.9Flammable & Combustible Materials – MOI OffsiteR: *R: *R: *28.10Electrical Energy – Onsite-1 Facility WorkerR: *R: *R: *28.11Electrical Energy – Onsite-2 Co-located WorkerR: *R: *R: *28.12Electrical Energy – MOI OffsiteR: *R: *R: *28.13Thermal Energy – Onsite-2 Co-located WorkerR: IR: IV28.14Thermal Energy – Onsite-2 Co-located WorkerR: IR: IV28.15Thermal Energy – MOI OffsiteR: IR: IV28.16Kinetic Energy – MOI OffsiteR: IR: IV28.17Kinetic Energy – Onsite-1 Facility WorkerR: IR: IV28.18Kinetic Energy – Onsite-2 Co-located WorkerR: IR: IV28.19Potential Energy – Onsite-2 Co-located WorkerR: IR: IV28.20Potential Energy – Onsite-2 Co-located WorkerR: IR: NV28.21Potential Energy – Onsite-1 Facility WorkerR: IR: III28.22Magnetic Fields – Onsite-1 Facility WorkerR: IR: IIII, IV28.23M	28.2	Radiological – Onsite-2 Co-located Worker	R: I	R: IV
28.5Toxic Materials – Onsite 2 Co-located WorkerR: IIIR: IV28.6Toxic Materials – MOI OffsiteR: *R: *R: *28.7Flammable & Combustible Materials – Onsite-1 Facility WorkerR: *R: *R: *28.8Flammable & Combustible Materials – Onsite-2 Co-located workerR: *R: *R: *28.9Flammable & Combustible Materials – MOI OffsiteR: *R: *R: *28.10Electrical Energy – Onsite-1 Facility WorkerR: *R: *R: *28.11Electrical Energy – Onsite-2 Co-located WorkerR: *R: *R: *28.12Electrical Energy – MOI OffsiteR: *R: *R: *28.13Thermal Energy – Onsite-2 Co-located WorkerR: IR: IV28.14Thermal Energy – Onsite-1 Facility WorkerR: IR: IV28.15Thermal Energy – Onsite-1 Facility WorkerR: IR: IV28.16Kinetic Energy – Onsite-1 Facility WorkerR: IR: IV28.17Kinetic Energy – Onsite-1 Facility WorkerR: IR: IV28.18Kinetic Energy – Onsite-2 Co-located WorkerR: IR: IV28.19Potential Energy – Onsite-2 Co-located WorkerR: IR: *28.20Potential Energy – Onsite-1 Facility WorkerR: IR: IV28.21Potential Energy – Onsite-2 Co-located WorkerR: IR: II28.22Magnetic Fields – Onsite-2 Co-located WorkerR: IR: III, IV28.23Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV	28.3	Radiological – MOI Offsite	R: IV	R: IV
28.6Toxic Materials – MOI OffsiteR:*R:*R:*28.7Flammable & Combustible Materials – Onsite-1 Facility WorkerR:*R:*R:*28.8Flammable & Combustible Materials – Onsite-2 Co-located workerR:*R:*R:*28.9Flammable & Combustible Materials – MOI OffsiteR:*R:*R:*28.10Electrical Energy – Onsite-1 Facility WorkerR:*R:*R:*28.11Electrical Energy – Onsite-2 Co-located WorkerR:*R:*R:*28.12Electrical Energy – MOI OffsiteR:*R:*R:*28.13Thermal Energy – Onsite-2 Co-located WorkerR: IR: IV28.14Thermal Energy – Onsite-2 Co-located WorkerR: IR: IV28.15Thermal Energy – Onsite-2 Co-located WorkerR: IR: V28.16Kinetic Energy – Onsite-1 Facility WorkerR: IR: IV28.17Kinetic Energy – Onsite-2 Co-located WorkerR: IR: IV28.18Kinetic Energy – Onsite-1 Facility WorkerR: IR: IV28.19Potential Energy – Onsite-2 Co-located WorkerR: R:*R:*28.20Potential Energy – Onsite-2 Co-located WorkerR: R:*R:*28.21Potential Energy – Onsite-2 Co-located WorkerR: IIR: III, IV28.23Magnetic Fields – Onsite-2 Co-located WorkerR: IR: III, IV28.24Magnetic Fields – Onsite-2 Co-located WorkerR: IR: III, IV28.25Other Hazards – Onsite-2 Co-located WorkerR: IR: III, IV	28.4	Toxic Materials – Onsite 1 Facility Worker	R: II	R: IV
28.7Flammable & Combustible Materials – Onsite-1 Facility WorkerR: *R: *28.8Flammable & Combustible Materials – Onsite-2 Co-located workerR: *R: *R: *28.9Flammable & Combustible Materials – MOI OffsiteR: *R: *R: *28.10Electrical Energy – Onsite-1 Facility WorkerR: *R: *R: *28.11Electrical Energy – Onsite-2 Co-located WorkerR: *R: *R: *28.12Electrical Energy – MOI OffsiteR: *R: *R: *28.13Thermal Energy – Onsite-1 Facility WorkerR: IR: IV28.14Thermal Energy – Onsite-2 Co-located WorkerR: IR: IV28.15Thermal Energy – Onsite-1 Facility WorkerR: IR: V28.16Kinetic Energy – MOI OffsiteR: *R: I28.17Kinetic Energy – Onsite-2 Co-located WorkerR: IR: IV28.18Kinetic Energy – Onsite-2 Co-located WorkerR: IR: IV28.19Potential Energy – Onsite-2 Co-located WorkerR: IR: V28.20Potential Energy – Onsite-2 Co-located WorkerR: IR: IV28.21Potential Energy – Onsite-2 Co-located WorkerR: IR: IV28.22Magnetic Fields – Onsite-1 Facility WorkerR: IR: IV28.23Potential Energy – MOI OffsiteR: *R: *28.24Magnetic Fields – Onsite-2 Co-located WorkerR: IR: IV28.25Other Hazards – Onsite-1 Facility WorkerR: IR: III, IV28.24Magnetic Fields –	28.5	Toxic Materials – Onsite 2 Co-located Worker	R: III	R: IV
28.8Flammable & Combustible Materials – Onsite-2 Co-located workerR: *R: *28.9Flammable & Combustible Materials – MOI OffsiteR: *R: *28.10Electrical Energy – Onsite-1 Facility WorkerR: *R: *28.11Electrical Energy – Onsite-2 Co-located WorkerR: *R: *28.12Electrical Energy – MOI OffsiteR: *R: *28.13Thermal Energy – Onsite-1 Facility WorkerR: IR: IV28.14Thermal Energy – Onsite-2 Co-located WorkerR: IR: IV28.15Thermal Energy – Onsite-2 Co-located WorkerR: IR: IV28.16Kinetic Energy – Onsite-1 Facility WorkerR: IR: IV28.17Kinetic Energy – Onsite-2 Co-located WorkerR: IR: IV28.18Kinetic Energy – Onsite-2 Co-located WorkerR: IR: IV28.19Potential Energy – Onsite-2 Co-located WorkerR: IR: IV28.20Potential Energy – MOI OffsiteR: *R: *28.21Potential Energy – Onsite-2 Co-located WorkerR: IR: IV28.22Magnetic Fields – Onsite-2 Co-located WorkerR: IR: IV28.23Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.24Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.23Magnetic Fields – Onsite-2 Co-located WorkerR: IR: III, IV28.24Magnetic Fields – Onsite-2 Co-located WorkerR: NR: *28.25Other Hazards – Onsite-1 Facility WorkerR: *R: * <td>28.6</td> <td>Toxic Materials – MOI Offsite</td> <td>R: *</td> <td>R: *</td>	28.6	Toxic Materials – MOI Offsite	R: *	R: *
28.8Flammable & Combustible Materials – Onsite-2 Co-located workerR: *R: *28.9Flammable & Combustible Materials – MOI OffsiteR: *R: *R: *28.10Electrical Energy – Onsite-1 Facility WorkerR: *R: *R: *28.11Electrical Energy – Onsite-2 Co-located WorkerR: *R: *R: *28.12Electrical Energy – MOI OffsiteR: *R: *R: *28.13Thermal Energy – Onsite-1 Facility WorkerR: IR: IV28.14Thermal Energy – Onsite-2 Co-located WorkerR: IR: IV28.15Thermal Energy – Onsite-2 Co-located WorkerR: IR: IV28.16Kinetic Energy – Onsite-1 Facility WorkerR: IR: IV28.17Kinetic Energy – Onsite-2 Co-located WorkerR: IR: IV28.18Kinetic Energy – Onsite-2 Co-located WorkerR: IR: IV28.19Potential Energy – Onsite-2 Co-located WorkerR: IR: IV28.20Potential Energy – Onsite-2 Co-located WorkerR: IR: IV28.21Potential Energy – Onsite-2 Co-located WorkerR: IR: IV28.22Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.23Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.24Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.25Other Hazards – Onsite-1 Facility WorkerR: IR: III, IV28.24Magnetic Fields – Onsite-2 Co-located WorkerR: *R: *28.25Ot	28.7	Flammable & Combustible Materials – Onsite-1 Facility Worker	R: *	
28.10Electrical Energy – Onsite-1 Facility WorkerR: *R: *R: *28.11Electrical Energy – Onsite-2 Co-located WorkerR: *R: *R: *28.12Electrical Energy – MOI OffsiteR: *R: *R: *28.13Thermal Energy – Onsite-1 Facility WorkerR: IR: IV28.14Thermal Energy – Onsite-2 Co-located WorkerR: IR: IV28.15Thermal Energy – MOI OffsiteR: *R: *28.16Kinetic Energy – Onsite-1 Facility WorkerR: IR: IV28.17Kinetic Energy – Onsite-2 Co-located WorkerR: IR: IV28.18Kinetic Energy – MOI OffsiteR: *R: *28.19Potential Energy – MOI OffsiteR: *R: *28.20Potential Energy – Onsite-2 Co-located WorkerR: IR: IV28.21Potential Energy – Onsite-2 Co-located WorkerR: *R: *28.22Magnetic Fields – Onsite-1 Facility WorkerR: IR: IV28.23Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.24Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.25Other Hazards – Onsite-1 Facility WorkerR: *R: *28.26Other Hazards – Onsite-2 Co-located WorkerR: *R: *28.26Other Hazards – Onsite-2 Co-located WorkerR: *R: *28.27Other Hazards – Onsite-1 Facility WorkerR: *R: *28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *	28.8		R: *	R: *
28.11Electrical Energy – Onsite-2 Co-located WorkerR:*R:*R:*28.12Electrical Energy – MOI OffsiteR:*R:*R:*28.13Thermal Energy – Onsite-1 Facility WorkerR: IR: IV28.14Thermal Energy – Onsite-2 Co-located WorkerR: IR: IV28.15Thermal Energy – MOI OffsiteR:*R:*28.16Kinetic Energy – Onsite-1 Facility WorkerR: IR: IV28.17Kinetic Energy – Onsite-2 Co-located WorkerR: IR: IV28.18Kinetic Energy – MOI OffsiteR:*R:*28.19Potential Energy – MOI OffsiteR: IR: IV28.20Potential Energy – Onsite-2 Co-located WorkerR: IR: IV28.21Potential Energy – MOI OffsiteR:*R:*28.22Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.23Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.24Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.25Other Hazards – Onsite-1 Facility WorkerR: *R: *28.26Other Hazards – Onsite-1 Facility WorkerR: *R: *28.27Other Hazards – Onsite-2 Co-located WorkerR: *R: *28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *	28.9	Flammable & Combustible Materials – MOI Offsite	R: *	R: *
28.11Electrical Energy – Onsite-2 Co-located WorkerR:*R:*R:*28.12Electrical Energy – MOI OffsiteR:*R:*R:*28.13Thermal Energy – Onsite-1 Facility WorkerR: IR: IV28.14Thermal Energy – Onsite-2 Co-located WorkerR: IR: IV28.15Thermal Energy – MOI OffsiteR:*R:*28.16Kinetic Energy – Onsite-1 Facility WorkerR: IR: IV28.17Kinetic Energy – Onsite-2 Co-located WorkerR: IR: IV28.18Kinetic Energy – MOI OffsiteR:*R:*28.19Potential Energy – MOI OffsiteR: IR: IV28.20Potential Energy – Onsite-2 Co-located WorkerR: IR: IV28.21Potential Energy – Onsite-2 Co-located WorkerR:*R:*28.22Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.23Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.24Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.25Other Hazards – Onsite-1 Facility WorkerR: *R: *28.26Other Hazards – Onsite-2 Co-located WorkerR: *R: *28.25Other Hazards – Onsite-1 Facility WorkerR: *R: *28.26Other Hazards – Onsite-1 Facility WorkerR: *R: *28.27Other Hazards – Onsite-1 Co-located WorkerR: *R: *28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *	28.10	Electrical Energy – Onsite-1 Facility Worker	R: *	R: *
28.12Electrical Energy – MOI OffsiteR: *R: *R: *28.13Thermal Energy – Onsite-1 Facility WorkerR: IR: IV28.14Thermal Energy – Onsite-2 Co-located WorkerR: IR: IV28.15Thermal Energy – MOI OffsiteR: *R: *28.16Kinetic Energy – Onsite-1 Facility WorkerR: IR: IV28.17Kinetic Energy – Onsite-2 Co-located WorkerR: IR: IV28.18Kinetic Energy – MOI OffsiteR: *R: *28.19Potential Energy – MOI OffsiteR: *R: *28.20Potential Energy – Onsite-2 Co-located WorkerR: IR: IV28.21Potential Energy – Onsite-2 Co-located WorkerR: *R: *28.22Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.23Magnetic Fields – Onsite-1 Facility WorkerR: IR: IIII, IV28.24Magnetic Fields – Onsite-2 Co-located WorkerR: IR: IIII, IV28.25Other Hazards – Onsite-2 Co-located WorkerR: IR: IV28.24Magnetic Fields – Onsite-1 Facility WorkerR: N: NNIII, IV28.25Other Hazards – Onsite-1 Facility WorkerR: *R: *28.26Other Hazards – Onsite-2 Co-located WorkerR: *R: *28.27Other Hazards – MOI OffsiteR: *R: *28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *			R: *	R: *
28.13Thermal Energy – Onsite-1 Facility WorkerR: IR: IR: IV28.14Thermal Energy – Onsite-2 Co-located WorkerR: IR: IV28.15Thermal Energy – MOI OffsiteR: *R: *28.16Kinetic Energy – Onsite-1 Facility WorkerR: IR: IV28.17Kinetic Energy – Onsite-2 Co-located WorkerR: IR: IV28.18Kinetic Energy – MOI OffsiteR: *R: *28.19Potential Energy – MOI OffsiteR: IR: IV28.20Potential Energy – Onsite-2 Co-located WorkerR: IR: IV28.21Potential Energy – Onsite-2 Co-located WorkerR: *R: *28.22Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.23Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.24Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.25Other Hazards – Onsite-1 Facility WorkerR: N: NN: IV28.24Magnetic Fields – Onsite-1 Facility WorkerR: *R: *28.25Other Hazards – Onsite-1 Facility WorkerR: *R: *28.26Other Hazards – Onsite-2 Co-located WorkerR: *R: *28.27Other Hazards – MOI OffsiteR: *R: *28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *	28.12		R: *	
28.15Thermal Energy – MOI OffsiteR: *R: *R: *28.16Kinetic Energy – Onsite-1 Facility WorkerR: IR: IR: IV28.17Kinetic Energy – Onsite-2 Co-located WorkerR: IR: IV28.18Kinetic Energy – MOI OffsiteR: *R: *R: *28.19Potential Energy – MOI OffsiteR: IR: IV28.20Potential Energy – Onsite-1 Facility WorkerR: IR: IV28.21Potential Energy – Onsite-2 Co-located WorkerR: *R: *28.22Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.23Magnetic Fields – Onsite-2 Co-located WorkerR: IR: III, IV28.24Magnetic Fields – Onsite-1 Facility WorkerR: IR: IIII, IV28.25Other Hazards – Onsite-1 Facility WorkerR: *R: *28.26Other Hazards – Onsite-1 Facility WorkerR: *R: *28.27Other Hazards – MOI OffsiteR: *R: *28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *	28.13		R: I	R: IV
28.15Thermal Energy – MOI OffsiteR: *R: *R: *28.16Kinetic Energy – Onsite-1 Facility WorkerR: IR: IV28.17Kinetic Energy – Onsite-2 Co-located WorkerR: IR: IV28.18Kinetic Energy – MOI OffsiteR: *R: *R: *28.19Potential Energy – MOI OffsiteR: IR: IVR: IV28.20Potential Energy – Onsite-1 Facility WorkerR: IR: IVR: *28.21Potential Energy – Onsite-2 Co-located WorkerR: *R: *R: *28.22Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.23Magnetic Fields – Onsite-2 Co-located WorkerR: IR: III, IV28.24Magnetic Fields – Onsite-2 Co-located WorkerR: IR: III, IV28.25Other Hazards – Onsite-1 Facility WorkerR: *R: *28.26Other Hazards – Onsite-1 Facility WorkerR: *R: *28.27Other Hazards – Onsite-1 Facility WorkerR: *R: *28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *	28.14	Thermal Energy – Onsite-2 Co-located Worker	R: I	R: IV
28.16Kinetic Energy – Onsite-1 Facility WorkerR: IR: IR: IV28.17Kinetic Energy – Onsite-2 Co-located WorkerR: IR: IR: IV28.18Kinetic Energy – MOI OffsiteR: *R: *R: *28.19Potential Energy – Onsite-1 Facility WorkerR: IR: IVR: *28.20Potential Energy – Onsite-2 Co-located WorkerR: *R: *R: *28.21Potential Energy – MOI OffsiteR: *R: *R: *28.22Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.23Magnetic Fields – Onsite-2 Co-located WorkerR: IR: III, IV28.24Magnetic Fields – Onsite-2 Co-located WorkerR: IVR: IV28.25Other Hazards – Onsite-1 Facility WorkerR: *R: *28.26Other Hazards – Onsite-1 Facility WorkerR: *R: *28.27Other Hazards – MOI OffsiteR: *R: *28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *			R: *	R: *
28.17Kinetic Energy – Onsite-2 Co-located WorkerR: IR: IV28.18Kinetic Energy – MOI OffsiteR: *R: *28.19Potential Energy – Onsite-1 Facility WorkerR: IR: IV28.20Potential Energy – Onsite-2 Co-located WorkerR: *R: *28.21Potential Energy – MOI OffsiteR: *R: *28.22Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.23Magnetic Fields – Onsite-2 Co-located WorkerR: IR: III, IV28.24Magnetic Fields – Onsite-2 Co-located WorkerR: IR: III, IV28.25Other Hazards – Onsite-1 Facility WorkerR: *R: *28.26Other Hazards – Onsite-1 Facility WorkerR: *R: *28.27Other Hazards – Onsite-1 Facility WorkerR: *R: *28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *	28.16		R: I	R: IV
28.18Kinetic Energy – MOI OffsiteR: *R: *R: *28.19Potential Energy - Onsite-1 Facility WorkerR: IR: IV28.20Potential Energy – Onsite-2 Co-located WorkerR: *R: *28.21Potential Energy – MOI OffsiteR: *R: *28.22Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.23Magnetic Fields – Onsite-2 Co-located WorkerR: IR: IIII, IV28.24Magnetic Fields – MOI OffsiteR: IVR: IV28.25Other Hazards – Onsite-1 Facility WorkerR: *R: *28.26Other Hazards – Onsite-2 Co-located WorkerR: *R: *28.27Other Hazards – MOI OffsiteR: *R: *28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *			R: I	R: IV
28.19Potential Energy- Onsite-1 Facility WorkerR: IR: IV28.20Potential Energy – Onsite-2 Co-located WorkerR: *R: *28.21Potential Energy – MOI OffsiteR: *R: *28.22Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.23Magnetic Fields – Onsite-2 Co-located WorkerR: IR: III, IV28.24Magnetic Fields – MOI OffsiteR: IVR: IV28.25Other Hazards – Onsite-1 Facility WorkerR: *R: *28.26Other Hazards – Onsite-2 Co-located WorkerR: *R: *28.27Other Hazards – MOI OffsiteR: *R: *28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *	28.18	Kinetic Energy – MOI Offsite	R: *	R: *
28.20Potential Energy – Onsite-2 Co-located WorkerR: *R: *28.21Potential Energy – MOI OffsiteR: *R: *28.22Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.23Magnetic Fields – Onsite-2 Co-located WorkerR: IR: III, IV28.24Magnetic Fields – MOI OffsiteR: IVR: IV28.25Other Hazards – Onsite-1 Facility WorkerR: *R: *28.26Other Hazards – Onsite-2 Co-located WorkerR: *R: *28.27Other Hazards – MOI OffsiteR: *R: *28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *	28.19		R: I	R: IV
28.21Potential Energy – MOI OffsiteR: *R: *28.22Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.23Magnetic Fields – Onsite-2 Co-located WorkerR: IR: III, IV28.24Magnetic Fields – MOI OffsiteR: IVR: IV28.25Other Hazards – Onsite-1 Facility WorkerR: *R: *28.26Other Hazards – Onsite-2 Co-located WorkerR: *R: *28.27Other Hazards – MOI OffsiteR: *R: *28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *		Potential Energy – Onsite-2 Co-located Worker	R: *	R: *
28.22Magnetic Fields – Onsite-1 Facility WorkerR: IR: III, IV28.23Magnetic Fields – Onsite-2 Co-located WorkerR: IR: III, IV28.24Magnetic Fields – MOI OffsiteR: IVR: IV28.25Other Hazards – Onsite-1 Facility WorkerR: *R: *28.26Other Hazards – Onsite-2 Co-located WorkerR: *R: *28.27Other Hazards – MOI OffsiteR: *R: *28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *	28.21		R: *	R: *
28.23Magnetic Fields – Onsite-2 Co-located WorkerR: IR: III, IV28.24Magnetic Fields – MOI OffsiteR: IVR: IV28.25Other Hazards – Onsite-1 Facility WorkerR: *R: *28.26Other Hazards – Onsite-2 Co-located WorkerR: *R: *28.27Other Hazards – MOI OffsiteR: *R: *28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *	28.22		R: I	R: III, IV
28.24Magnetic Fields – MOI OffsiteR: IVR: IV28.25Other Hazards – Onsite-1 Facility WorkerR: *R: *28.26Other Hazards – Onsite-2 Co-located WorkerR: *R: *28.27Other Hazards – MOI OffsiteR: *R: *28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *	28.23	Magnetic Fields – Onsite-2 Co-located Worker	R: I	R: III, IV
28.26Other Hazards – Onsite-2 Co-located WorkerR: *R: *28.27Other Hazards – MOI OffsiteR: *R: *28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *	28.24		R: IV	R: IV
28.26Other Hazards – Onsite-2 Co-located WorkerR: *R: *28.27Other Hazards – MOI OffsiteR: *R: *28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *	28.25	Other Hazards – Onsite-1 Facility Worker	R: *	R: *
28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *	28.26		R: *	R: *
28.28Access & Egress – Onsite-1 Facility WorkerR: *R: *	28.27		R: *	R: *
		Access & Egress – Onsite-1 Facility Worker		R: *
28.29 Access & Egress – Onsite-2 Co-located Worker R: * R: *	28.29		R: *	R: *
28.30 Access & Egress – MOI Offsite R: * R: *			R: *	R: *
28.31 Environmental Hazards R: * R: *			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 28.1 Radiological – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual activation	<ul> <li><i>Hazard:</i></li> <li><i>NM4 target station</i> (ammonia, liquid helium, liquid nitrogen) and front face of the absorber magnet have activation potential.</li> </ul>	L: A C: H R: I	<ul> <li>P – General And/Or Job Specific RWP: A Radiological Work Permit is written by ES&amp;H that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure.</li> <li>P – Use Of A LSM: Use of a log survey monitor is specified by a RWP. The LSM allows for real time monitoring of radiation levels during work.</li> <li>P – Radiological Training: An educational system managed by ES&amp;H that establishes basic worker knowledge through presentations and testing.</li> <li>P – Keyed entry to enclosure</li> <li>M – Radiological Signage And Decay Time Requirements: Signs located in various places throughout the accelerator complex warn of various hazards and occupancy restrictions prior to entry. Furthermore, work may be restricted or prevented until sufficient time has passed such that radiation levels are sufficiently low to allow for safer work to proceed. This mitigation has passive and active components.</li> </ul>	L: BEU C: M R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Groundwater Activation	Hazard: • Radionuclides in groundwater exceed regulatory levels.	L: A C: L <b>R: III</b>	<ul> <li>P- Sump pump sampling</li> <li>M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment.</li> <li>M - Facility designs employ shielding to mitigate the production of activation products in groundwater</li> <li>M - Run Conditions to ensure total radiation levels are within expected parameters</li> </ul>	L: U C: N <b>R: IV</b>
Surface Water Activation	Hazard: • Radionuclides in surface water exceed regulatory levels.	L: A C: L <b>R: III</b>	<ul> <li>P – Sump pump sampling</li> <li>M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment.</li> <li>M – Facility designs employ shielding to mitigate the production of activation products in surface water</li> <li>M – Run Conditions to ensure total radiation levels are within expected parameters</li> </ul>	L: U C: N <b>R: IV</b>

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive Water (RAW) Systems	<ul> <li>Hazard:</li> <li>RAW system present in NM4 for cooling of absorber magnet and target cave has exposure potential if system ruptures.</li> </ul>	L: A C: L R: III	<ul> <li>P – Interlock system preventing access to beam enclosure while beam is present.</li> <li>P – Enclosure keys linked to radiological and controlled access training to enter enclosure</li> <li>P – Training</li> <li>M – Design of water system</li> </ul>	L: BEU C: N R: IV
Air Activation	Hazard: • Scattered 120 GeV beam in NM4 target system can activate air.	L: A C: H R: I	<ul> <li>P – Interlock system preventing access to beam enclosure while beam is present.</li> <li>P – Air monitoring system</li> <li>P – Beam loss monitoring system</li> <li>P – Cool off time imposed at discretion of RSO after beam operations</li> <li>M – The existing ventilation system in NM4 slows transit time adequately to allow for radioactive decay of short-lived positron emitters</li> <li>M – Run conditions</li> </ul>	L: BEU C: L R: IV
Soil Interactions	<ul> <li>Hazard:</li> <li>Scattered beam has potential to activate soil at low levels calculated in the shield assessment.</li> </ul>	L: A C: L <b>R: III</b>	<ul> <li>P – No excavation work without an RWP</li> <li>M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment.</li> <li>M – Run Conditions to ensure total radiation levels are within expected parameters</li> <li>M – Beam dump to contain radiation</li> </ul>	L: U C: N <b>R: IV</b>

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive waste	<ul> <li>Hazard:</li> <li>Activation potential is low in these spaces and experiments typically remove equipment upon completion. Any materials that cannot be cleared and removed by an experiment are subject to the labs radioactive waste program.</li> </ul>	L: A C: L R: III	<ul> <li>P – Radiological worker training</li> <li>P - Locked gates</li> <li>P – Key control progream</li> <li>M – Any item in a beam enclosure during beam-on conditions is removed and surveyed by radiological workers and classified appropriately.</li> <li>M – Any item identified for disposal is surveyed and processed by Radiological Control organization personnel in accordance with FRCM chapter 4.</li> </ul>	L: BEU C: N R: IV
Contamination	Hazard: . • Potential contamination from beam activation	L: A C: H R: I	<ul> <li>P – Locked gates</li> <li>P – Key control program</li> <li>M - Radiological worker training</li> <li>M – RCT coverage and job specific RWP as determined by the RSO</li> <li>M – Contamination wipes to monitor space and equipment</li> </ul>	L: EU C: N R: IV
<sup>7</sup> Be	Hazard: • Potential radiation exposure to 7Be (uptake/committed dose).	L: A C: N R: IV	Not Applicable. No prevention or mitigation is required. <sup>7</sup> Be isn't hazardous in this pattern of use by facility.	L: A C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive	Hazard:	L: A	P – All low activity sealed sources are kept in a lock box and	L: U C: N
Sources	• Various low activity sealed sources (Sr-90, Co-60, CS- 137, Fe-55, Ru-106, etc.)	C: N R: IV	registered through Radiological Control. M – Radiological training is required for source handling.	C: N R: IV

Likelihood (L, of event)/year	Co	sequence (C, of event)/	year	Risk (R, Qualitative R	(anking)	Risk	Matri	х			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = situation$ (even	t) of major concern				Like	lihood	
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = situation$ (even	nt) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		III = situation (eve	ent) of minor concern	s	Н	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (eve	ent) of minimal concern	enc	М	II	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsit	te-2 (co-located worker)	Onsite-1 (facility worker)	nbə	Ţ				
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> 25.0 rem		C <sup>3</sup> 100 rem	C <sup>3</sup> 100 rem	ons	L	III	III	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)	Μ	25.0 rem > C <sup>3</sup> 5 rem	10	00 rem > C <sup>3</sup> 25 rem	100 rem > C <sup>3</sup> 25 rem	0	Ν	IV	IV	IV	IV
Acronyms	L	5 rem > <b>C</b>		25 rem > C	25 rem > C	1					
<b>MOI</b> = Maximally-exposed Offsite Individual	Ν	0.5 rem > <b>C</b>		5  rem > C	5 rem > C	1					

<b>rem</b> = Roentgen equivalent man				
	<b>rem</b> = Roentgen equivalent man			

### Table 28.2 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: • NM4 target station (ammonia, liquid helium, liquid nitrogen) and front face of the absorber magnet have activation potential.	L: A C: H R: I	<ul> <li>P – General And/Or Job Specific RWP: A Radiological Work Permit is written by ES&amp;H that specifies the work that is permitted to be performed, requirements to perform the work, and limitations of radiological exposure.</li> <li>P – Use Of A LSM: Use of a log survey monitor is specified by a RWP. The LSM allows for real time monitoring of radiation levels during work.</li> <li>P – Radiological Training: An educational system managed by ES&amp;H that establishes basic worker knowledge through presentations and testing.</li> <li>P – Keyed entry to enclosure</li> <li>M – Radiological Signage And Decay Time Requirements: Signs located in various places throughout the accelerator complex warn of various hazards and occupancy restrictions prior to entry. Furthermore, work may be restricted or prevented until sufficient time has passed such that radiation levels are sufficiently low to allow for safer work to proceed. This mitigation has passive and active components.</li> </ul>	L: BEU C: M R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Groundwater Activation	Hazard: • Radionuclides in groundwater exceed regulatory levels.	L: A C: L <b>R: III</b>	<ul> <li>P- Sump pump sampling</li> <li>M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment.</li> <li>M - Facility designs employ shielding to mitigate the production of activation products in groundwater</li> <li>M - Run Conditions to ensure total radiation levels are within expected parameters</li> </ul>	L: U C: N <b>R: IV</b>
Surface Water Activation	Hazard: • Radionuclides in surface water exceed regulatory levels.	L: A C: L <b>R: III</b>	<ul> <li>P – Sump pump sampling</li> <li>M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment.</li> <li>M – Facility designs employ shielding to mitigate the production of activation products in surface water</li> <li>M – Run Conditions to ensure total radiation levels are within expected parameters</li> </ul>	L: U C: N <b>R: IV</b>

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive Water (RAW) Systems	<ul> <li>Hazard:</li> <li>RAW system present in NM4 for cooling of absorber magnet and target cave has exposure potential if system ruptures.</li> </ul>	L: A C: L <b>R: III</b>	<ul> <li>P – Interlock system preventing access to beam enclosure while beam is present.</li> <li>P – Enclosure keys linked to radiological and controlled access training to enter enclosure</li> <li>P – Training</li> <li>M – Design of water system</li> </ul>	L: BEU C: N <b>R: IV</b>
Air Activation	Hazard: • Scattered 120 GeV beam in NM4 target system can activate air.	L: A C: H <b>R: I</b>	<ul> <li>P – Interlock system preventing access to beam enclosure while beam is present.</li> <li>P – Air monitoring system</li> <li>P – Beam loss monitoring system</li> <li>P – Cool off time imposed at discretion of RSO after beam operations</li> <li>M – The existing ventilation system in NM4 slows transit time adequately to allow for radioactive decay of short-lived positron emitters</li> <li>M – Run conditions</li> </ul>	L: BEU C: L <b>R: IV</b>
Soil Interactions	<ul> <li>Hazard:</li> <li>Scattered beam has potential to activate soil at low levels calculated in the shield assessment.</li> </ul>	L: A C: L <b>R: III</b>	<ul> <li>P – No excavation work without an RWP</li> <li>M - Sensing equipment (chipmunks) to shut off beam if it exceeds the operating parameters (defense in depth) determined by the shield assessment.</li> <li>M – Run Conditions to ensure total radiation levels are within expected parameters</li> <li>M – Beam dump to contain radiation</li> </ul>	L: U C: N <b>R: IV</b>

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive	Hazard:	L: A	P – Radiological worker training	L: BEU
waste	• Activation potential is low in these spaces and experiments typically remove equipment upon completion. Any materials that cannot be cleared and removed by an experiment are subject to the labs radioactive waste program.	C: L R: III	<ul> <li>P - Locked gates</li> <li>P - Key control progream</li> <li>M - Any item in a beam enclosure during beam-on conditions is removed and surveyed by radiological workers and classified appropriately.</li> <li>M - Any item identified for disposal is surveyed and processed by Radiological Control organization personnel in accordance with FRCM chapter 4.</li> </ul>	C: N <b>R: IV</b>
Contamination	Hazard: . • Potential contamination from beam activation	L: A C: H <b>R: I</b>	<ul> <li>P – Locked gates</li> <li>P – Key control program</li> <li>M - Radiological worker training</li> <li>M – RCT coverage and job specific RWP as determined by the RSO</li> <li>M – Contamination wipes to monitor space and equipment</li> </ul>	L: EU C: N <b>R: IV</b>
<sup>7</sup> Be	Hazard: • Potential radiation exposure to 7Be (uptake/committed dose).	L: A C: N R: IV	Not Applicable. No prevention or mitigation is required. <sup>7</sup> Be isn't hazardous in this pattern of use by facility.	L: A C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive	Hazard:	L: A	P – All low activity sealed sources are kept in a lock box and	L: U
Sources	• Various low activity sealed	C: N	registered through Radiological Control.	C: N
	sources (Sr-90, Co-60, CS- 137, Fe-55, Ru-106, etc.)	R: IV	M – GERT provides recognition that source training is required	R: IV

Likelihood (L, of event)/year	Co	sequence (C, of event)/y	year	Risk (R, Qualitative R	anking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E}-02)$		$\mathbf{H} = \text{High}$		$\mathbf{I} = \text{situation}$ (even	ation (event) of major concern				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		<b>II</b> = situation (even	nt) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (eve	ent) of minor concern	s	Н	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		<b>IV</b> = situation (event) of minimal concern		enc	М	II	II	III	IV	
Control(s) Type	С	Offsite (MOI)	Onsit	te-2 (co-located worker)	Onsite-1 (facility worker)	nbə	т	Ш	ш	IV	IV	
<b>P</b> = Preventive (reduce event occurrence likelihood)	Η	C <sup>3</sup> 25.0 rem		C <sup>3</sup> 100 rem	<b>C</b> <sup>3</sup> 100 rem	ons	L	111	ш	IV	1 V	
$\mathbf{M} = $ Mitigative (reduces event consequences)	Μ	25.0 rem > C <sup>3</sup> 5 rem	10	00 rem > C <sup>3</sup> 25 rem	100 rem > C <sup>3</sup> 25 rem	C	Ν	IV	IV	IV	IV	
Acronyms	L	5 rem $>$ C		25 rem > C	25 rem > <b>C</b>							
MOI = Maximally-exposed Offsite Individual rem = Roentgen equivalent man	Ν	0.5 rem > <b>C</b>		5 rem > C	5 rem > <b>C</b>							

 Table 28.3 Radiological – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Residual activation	<ul> <li>Hazard:</li> <li>NM4 target station (ammonia, liquid helium, liquid nitrogen) and front face of the absorber magnet have activation potential.</li> </ul>	L: BEU C: N R: IV	No further analysis required; this hazard is not accessible to the public in this segments pattern of use	L: BEU C: N R: IV
Groundwater Activation	Hazard: • Scattered beam has potential to activate ground water at low levels calculated in the shield assessment.	L: BEU C: N R: IV	No further analysis required	L: BEU C: N R: IV
Surface Water Activation	Hazard: • Scattered beam has potential to activate surface water at low levels calculated in the shield assessment.	L: BEU C: N R: IV	No further analysis required	L: BEU C: N R: IV

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive waste	<ul> <li>Hazard:</li> <li>Activation potential is low in these spaces and experiments typically remove equipment upon completion. Any materials that cannot be cleared and removed by an experiment are subject to the labs radioactive waste program.</li> </ul>	L: BEU C: N R: IV	No further analysis required; this hazard is not accessible to the public in this segments pattern of use	L: BEU C: N R: IV
Contamination	Hazard: • Potential contaminated items brought into facility by experimenters.	L: BEU C: N R: IV	No further analysis required; this hazard is not accessible to the public in this segments pattern of use	L: BEU C: N R: IV
<sup>7</sup> Be	Hazard: • Potential radiation exposure to 7Be (uptake/committed dose).	L: BEU C: N R: IV	Not Applicable. No prevention or mitigation is required. <sup>7</sup> Be isn't hazardous in this pattern of use by facility.	L: BEU C: N R: IV

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Radioactive Sources	<ul> <li>Hazard:</li> <li>Various low activity sealed sources (Sr-90, Co-60, CS-137, Fe-55, Ru-106, etc.)</li> </ul>	L: BEU C: N R: IV	No further analysis required; this hazard is not accessible to the public in this segments pattern of use	L: BEU C: N R: IV

Likelihood (L, of event)/year	Co	nsequence (C, of event)/ye	ear Risk (R, Qualitative	Ranking)	Risk	Risk Matrix					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = \text{situation}$ (even	ent) of major concern				Like	lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = \text{situation}$ (ev	ent) of concern			Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	<b>III</b> = situation (e	vent) of minor concern	S	Н	Ι	Ι	Π	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$	IV = situation (e	ituation (event) of minimal concern			II	II	III	IV	
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	edu	T	ш	ш	IV	IV	
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> 25.0 rem	C <sup>3</sup> 100 rem	<b>C</b> <sup>3</sup> 100 rem	ons	L	111	111	10	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)	Μ	25.0 rem > C <sup>3</sup> 5 rem	100 rem > C <sup>3</sup> 25 rem	100 rem > C <sup>3</sup> 25 rem	C	Ν	IV	IV	IV	IV	
Acronyms	L	5 rem $>$ C	25 rem > C	25 rem > C							
<b>MOI</b> = Maximally-exposed Offsite Individual <b>rem</b> = Roentgen equivalent man	Ν	0.5 rem > <b>C</b>	5 rem > <b>C</b>	5 rem > C	1						

 Table 28.4 Toxic Materials – Onsite 1 Facility Worker

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

Beryllium*	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Ammonia	• Exposure to target material	L: A C: M <b>R: II</b>	<ul> <li>P: Standard Operating Procedures for handling</li> <li>P: Training</li> <li>M: PPE (dermal)</li> <li>M: Engineering control (Room ventilation)</li> </ul>	L: EU C: N R: IV

Likelihood (L, of event)/year	Co	onsequence (C, of event	)/year	Risk (R, Qualitative	Ranking)	Risk	Matri	ĸ			
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation (event) of major concern}$					Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{d}\mathbf{e}\mathbf{r}\mathbf{a}\mathbf{t}\mathbf{e}$		$\mathbf{II} = \text{situation}$ (eve	ent) of concern			А	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		III = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	duences	М	II	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə					
<b>P</b> = Preventive (reduce event occurrence likelihood)	н	C <sup>3</sup> PAC-2		C <sup>3</sup> PAC-3	C <sup>3</sup> IDLH	onse	L	III	III	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)	M	$PAC-2 > C^{3}PAC-1$	P	$AC-3 > C^{3}PAC-2$	$IDLH > C^{3} PEL \text{ or } TLV_{c}$	Ŭ	Ν	IV	IV	IV	IV
Acronyms	L	PAC-1 > C		PAC-2 > C	PEL or $TLV_c > C$						
<b>IDLH</b> = Immediately Dangerous to Life and Health	Ν	Consequences less	Cor	nsequences less than	Consequences less than						
<b>MOI</b> = Maximally-exposed Offsite Individual		than those for Low	those	for Low Consequence	those for Low						
<b>PAC</b> = Protective Action Criteria		Consequence Level	litobe	Level	Consequence Level						
<b>PEL</b> = Permissible Exposure Limit		Consequence Lever			Consequence Lever						
$TLV_c$ = Threshold Limit Value (ceiling)											

### Table 28.5 Toxic Materials – Onsite 2 Co-located Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Lead *	Hazard:	L: C: R:	See Section I, Chapter 4	L: C: R:
Beryllium*	Hazard:	L: C: R:	See Section I, Chapter 4	L: C: R:
Ammonia	Hazard:     Exposure to target     material	L: A C: L <b>R: III</b>	M: Engineering control (room ventilation)	L: A C: N <b>R: IV</b>

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)	Risk Matrix							
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$	$\mathbf{H} = \text{High}$ $\mathbf{I} = \text{situation (event) of major concern}$			KISK Matrix			Likelihood			
U = Unlikely (1.0E-02 > L > 1.0E-04)	$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = \text{situation (event) of concern}$				А	LIKE U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)	$\mathbf{L} = \mathbf{Low}$	<b>III</b> = situation (event) of minor concern		ہ ر	н	Т	I	Ш	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)	$\mathbf{N} = $ Negligible	IV = situation (event) of minimal concern			11	1	1	- 11	m	

Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	М	II	II	III	IV
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> PAC-2	C <sup>3</sup> PAC-3	C <sup>3</sup> IDLH	т	Ш	ш	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)	Μ	PAC-2 > C <sup>3</sup> PAC-1	PAC-3 > C <sup>3</sup> PAC-2	IDLH > C $^3$ PEL or TLV <sub>c</sub>	L	m	ш	1 V	1 V
Acronyms	L	PAC-1 > C	PAC-2 > C	PEL or $TLV_c > C$	Ν	IV	IV	IV	IV
IDLH = Immediately Dangerous to Life and HealthMOI = Maximally-exposed Offsite IndividualPAC = Protective Action CriteriaPEL = Permissible Exposure LimitTLVc = Threshold Limit Value (ceiling)	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 28.6 Toxic Materials – MOI Offsite

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Lead*	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Beryllium*	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Liquid	Hazard:	L:	See Section I, Chapter 4	L:
Scintillator		C:		<b>C</b> :
		R:		R:
Ammonia	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Nanoparticle	Hazard:	L:	See Section I, Chapter 4	L:
Exposures		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	Co	onsequence (C, of event)	)/year	Risk (R, Qualitative	Ranking)	Risk	Matri	X			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = situation (even$	nt) of major concern			Likelihood			
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = situation (even$	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		<b>IV</b> = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	т	ш	ш	IV	IV
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> PAC-2		C <sup>3</sup> PAC-3	C <sup>3</sup> IDLH	suo	L	III	ш	10	1V
$\mathbf{M} = $ Mitigative (reduces event consequences)	Μ	PAC-2 > C <sup>3</sup> PAC-1	P	$AC-3 > C^{3}PAC-2$	IDLH > C <sup>3</sup> PEL or TLV <sub>c</sub>	C	Ν	IV	IV	IV	IV
Acronyms	L	PAC-1 > C		PAC-2 > C	PEL or $TLV_c > C$						
IDLH = Immediately Dangerous to Life and Health MOI = Maximally-exposed Offsite Individual PAC = Protective Action Criteria PEL = Permissible Exposure Limit TLVc = 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 28.7 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	Hazard:	L:	See Section I, Chapter 4	L:
materials		C:		C:
(cables, Boxes,		R:		R:
Paper, wood				
cribbing, etc.)				
Flammable	Hazard:	L:	See Section I, Chapter 4	L:
Materials		C:		C:
(Flammable gas,		R:		R:
cleaning				
materials, etc.)				

Other Hazard Consequences, derived from Figure C-	1, "E	Example Qualitative Conse	equence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	С	onsequence (C, of event)/y	ear Risk (R, Qualitative	C:						
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = situation$ (eve	ent) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = situation (ev$	ent) of concern			А	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	III = situation (e)	vent) of minor concern	es	Н	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = \mathbf{Negligible}$	<b>IV</b> = situation (e	vent) of minimal concern	enc	М	II	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	ш	ш	IV	IV
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	ш	- 111	1.	1 V
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	С	Ν	IV	IV	IV	IV
Acronyms MOI = Maximally-exposed Offsite Individual		individual's ability to take protective action.	immediately life- threatening or permanently disabling.	immediately life- threatening or permanently disabling.						
	М	C <sup>3</sup> Mild, transient	C 3 Serious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	immediate loss of life no	immediate loss of life no						
			permanent disabilities;	permanent disabilities;						
			hospitalization required.	hospitalization required.						
	L	Mild, transient	Minor injuries; no	Minor injuries; no						
		adverse effects $> C$	hospitalization > C	hospitalization > C						
	Ν	Consequences less	Consequences less than	Consequences less than						
			hose for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

#### Table 28.8 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	Hazard:	L:	See Section I, Chapter 4	L:
materials		C:		C:
(cables, Boxes,		R:		R:
Paper, wood				
cribbing, etc.)				
Flammable	Hazard:	L:	See Section I, Chapter 4	L:
Materials		C:		C:
(Flammable gas,		R:		R:
cleaning				
materials, etc.)				

Other Hazard Consequences, derived from Figure C-	1, "E	Example Qualitative Conse	equence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	С	onsequence (C, of event)/y	ear Risk (R, Qualitative	Ranking)	Risk	Matr	ix			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = \text{situation}$ (eve	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{O}\mathbf{P}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}O$	$\mathbf{II} = \text{situation}$ (even	ent) of concern	r		А	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		N = Negligible	IV = situation (ev	vent) of minimal concern	enc	М	II	П	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	ш	ш	IV	IV
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L			1.	1 V
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	С	Ν	IV	IV	IV	IV
Acronyms MOI = Maximally-exposed Offsite Individual		individual's ability to take protective action.	immediately life- threatening or permanently disabling.	immediately life- itening or permanently threatening or						
	Μ	C <sup>3</sup> Mild, transient	C <sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	immediate loss of life no	immediate loss of life no						
			permanent disabilities;	permanent disabilities;						
	-		hospitalization required.	hospitalization required.						
	L	Mild, transient	Minor injuries; no	Minor injuries; no						
		adverse effects $> C$	hospitalization > C	hospitalization > C						
	Ν	Consequences less	Consequences less than	Consequences less than						
			hose for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

#### Table 28.9 Flammable and Combustible Materials – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-	1, "E	Example Qualitative Conse	quence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	С	onsequence (C, of event)/y	ear Risk (R, Qualitative	R, Qualitative Ranking) Risk Matrix						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = \text{situation}$ (even	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{o}\mathbf{d}\mathbf{e}\mathbf{r}\mathbf{a}\mathbf{t}\mathbf{e}$	$\mathbf{II} = \text{situation}$ (even	ent) of concern		1	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	<b>III</b> = situation (ev	vent) of minor concern	es	Н	Ι	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		N = Negligible	IV = situation (ev	vent) of minimal concern	enc	М	п	Π	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	Ш	Ш	IV	IV
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L			1.	1 V
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	C	Ν	IV	IV	IV	IV
Acronyms MOI = Maximally-exposed Offsite Individual		symptoms which could impair an t individual's ability to take protective action.	immediately life- threatening or permanently disabling.	immediately life- threatening or permanently disabling.						
	Μ	C <sup>3</sup> Mild, transient	C <sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	immediate loss of life no	immediate loss of life no						
			permanent disabilities;	permanent disabilities;						
			hospitalization required.	hospitalization required.						
	L	Mild, transient	Minor injuries; no	Minor injuries; no						
		adverse effects > C	hospitalization > C	hospitalization > C						
	Ν	Consequences less	Consequences less than	Consequences less than						
			hose for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

# Table 28.10 Electrical Energy – Onsite-1 Facility Worker

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

Other Hazard Consequences, derived from Figure C-	1, "E	Example Qualitative Conse	equence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	С	onsequence (C, of event)/y	ear Risk (R, Qualitative	0						
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = situation$ (eve	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{O}\mathbf{P}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}O$	$\mathbf{II} = \text{situation}$ (ev	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	$III = situation (e^{-1})$	vent) of minor concern	es	Н	Ι	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		N = Negligible	IV = situation (evolution)	vent) of minimal concern	enc	М	II	п	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	ш	ш	IV	IV
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	jons	L			1.	1 V
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	С	Ν	IV	IV	IV	IV
Acronyms MOI = Maximally-exposed Offsite Individual		individual's ability to take protective action.	immediately life- threatening or permanently disabling.	immediately life- threatening or permanently disabling.						
	М	C <sup>3</sup> Mild, transient	C 3 Serious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	immediate loss of life no	immediate loss of life no						
			permanent disabilities;	permanent disabilities;						
	_		hospitalization required.	hospitalization required.						
	L	Mild, transient	Minor injuries; no	Minor injuries; no						
		adverse effects $> C$	hospitalization > C	hospitalization > C						
	Ν	Consequences less	Consequences less than	Consequences less than						
			hose for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

### Table 28.11 Electrical Energy 1 Onsite-2 Co-located Worker

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.													
Likelihood (L, of event)/year	С	onsequence (C, of event)/y	ear Risk (R, Qualitative	Risk (R, Qualitative Ranking)			Risk Matrix						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = \text{situation}$ (even	$\mathbf{I} = \text{situation (event) of major concern}$				Likelihood					
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = \text{situation}$ (even	ent) of concern	r		А	U	EU	BEU			
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	III = situation (ev	vent) of minor concern	es	Н	Ι	Ι	II	III			
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	IV = situation (ev	vent) of minimal concern	enc	М	II	П	III	IV			
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	ш	ш	IV	IV			
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	ш	- 111	1.	1 V			
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	C	Ν	IV	IV	IV	IV			
Acronyms MOI = Maximally-exposed Offsite Individual		symptoms which could impair an t individual's ability to take protective action.	immediately life- hreatening or permanently disabling.	5									
	Μ	C <sup>3</sup> Mild, transient	C <sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no									
		adverse effects.	immediate loss of life no	immediate loss of life no									
			permanent disabilities;	permanent disabilities;									
			hospitalization required.	hospitalization required.									
	L	Mild, transient	Minor injuries; no	Minor injuries; no									
		adverse effects > C	hospitalization > C	hospitalization > C									
	Ν	Consequences less	Consequences less than	Consequences less than									
			hose for Low Consequence	those for Low									
		Consequence Level	Level	Consequence Level									

### Table 28.12 Electrical Energy – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	С	onsequence (C, of event)/y	Ranking)	Risk	Matr	ix					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = $ situation (eve	situation (event) of major concern				Likelihood			
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = \text{situation}$ (ev	ent) of concern		r	А	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	III = situation (e)	vent) of minor concern	es	Н	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = \mathbf{Negligible}$	<b>IV</b> = situation (e	vent) of minimal concern	enc	М	II	II	III	IV	
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	ш	ш	IV	IV	
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	ш	- 111	1.	1 V	
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	C	Ν	IV	IV	IV	IV	
Acronyms MOI = Maximally-exposed Offsite Individual		individual's ability to take protective action.	immediately life- threatening or permanently disabling.	immediately life- threatening or permanently disabling.							
	М	C <sup>3</sup> Mild, transient	C 3 Serious injury, no	C <sup>3</sup> Serious injury, no							
		adverse effects.	immediate loss of life no	immediate loss of life no	)						
			permanent disabilities;	permanent disabilities;							
			hospitalization required.	hospitalization required.							
	L	Mild, transient	Minor injuries; no	Minor injuries; no							
		adverse effects > C	hospitalization > C	hospitalization > C							
	Ν	Consequences less	Consequences less than	Consequences less than							
			hose for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

# Table 28.13 Thermal Energy – Onsite-1 Facility Worker

Hazard	Hazard Hazard Description		Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Hot Work	Hazard:	L:	See Section I, Chapter 4	L:
		C:		C:
		R:		R:
Cryogenics	Hazard:	L: A	ODH	L: BEU
		C:H	P – SMEs produce engineering notes on piping and vessel system and ODH	C: N
	Cryogenics are inherently a low risk on	R: I	calculations.	R: IV
	their own as they are non-flammable and		P – ORC process has SMEs review installed system and documentation prior to	
	non-toxic.		operation.	
			M – ODH system of oxygen sensors triggers high volume mixing fans in NM4 and	
	However, if exposed to the cryogenic		NM3 and is tested and calibrated at prescribed intervals.	
liquids, they have the potential of burni skin and creating an oxygen deficient atmosphere which can lead to death.	liquids, they have the potential of burning		P - Fire Safety and Life Safety Inspections are performed by Fire Protection Group	
			and the Fire Department.	
	atmosphere which can lead to death.		P – ODH alarm systems are tested and maintained.	
			M – ODH alarms are monitored by a sitewide monitoring system with notification	
	The exposure of the hazard to the facility		to the emergency dispatch center that is constantly staffed, 24/7, 365 days.	
	worker is of major concern.		M – Area/fixed oxygen monitoring provided in areas where cryogenic liquids are stored.	
			M – Onsite Emergency services are provided.	
			M – Onsite Energency services are provided. M – NM4 Credited Controls: two (2) oxygen monitors (one high, one low), one	
			(1) strobe, and one (1) horn.	Burns
		Burns	M – NM3 Credited Controls: two (2) oxygen monitors (one high, one low), one	L: BEU
		L: A	(1) strobe, and one (1) horn.	C:M
		C: H		R: IV
		R: I	Burns	
			P – Cryogenic system designed and reviewed by qualified personnel	
			P – WPC process provides instructions for use	
			P - Protective clothing rules are enforced when working in areas with exposure to	
			cryogenic liquids.	
			P- Training required for all personnel handling cryogenics	
			M – Onsite Emergency services are provided	

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	C	Consequence (C, of event)/year Risk (R, Qualitative Ranking)			Risk Matrix						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = \text{situation}$ (eve	ent) of major concern			Likelihood				
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{o}\mathbf{d}\mathbf{e}\mathbf{r}\mathbf{a}\mathbf{t}\mathbf{e}$	$\mathbf{II} = \text{situation}$ (ev	vent) of concern		1	Α	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	<b>III</b> = situation (e	vent) of minor concern	es	Н	I	I	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		N = Negligible	<b>IV</b> = situation (e	vent) of minimal concern	enc	М	II	п	III	IV	
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	ш	Ш	IV	IV	
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	ш	- 111	1V	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	C	Ν	IV	IV	IV	IV	
Acronyms		symptoms which	immediately life-	immediately life-							
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an threatening or permanently		threatening or							
		individual's ability to	disabling.	permanently disabling.							
		take protective									
		action.									
	Μ	C <sup>3</sup> Mild, transient	C <sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no							
		adverse effects.	immediate loss of life no	immediate loss of life no							
			permanent disabilities;	permanent disabilities;							
			hospitalization required.	hospitalization required.							
	L	Mild, transient	Minor injuries; no	Minor injuries; no							
		adverse effects > C	hospitalization > C	hospitalization > C							
	Ν	Consequences less	Consequences less than	Consequences less than							
			hose for Low Consequence	those for Low							
		Consequence Level	Level	Consequence Level							

### Table 28.14 Thermal Energy – Onsite-2 Co-located Worker

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

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Cryogenics	<ul> <li>Hazard:</li> <li>Cryogenics are inherently a low risk on their own as they are non-flammable and non-toxic.</li> <li>However, if exposed to the cryogenic liquids, they have the potential of burning skin and creating an oxygen deficient atmosphere which can lead to death.</li> <li>The exposure of the hazard to the facility worker is of major concern.</li> </ul>	L: A C:H R: I Burns L: A C: H R: I	<ul> <li>ODH</li> <li>P - SMEs produce engineering notes on piping and vessel system and ODH calculations.</li> <li>P - ORC process has SMEs review installed system and documentation prior to operation.</li> <li>M - ODH system of oxygen sensors triggers high volume mixing fans in NM4 and NM3 and is tested and calibrated at prescribed intervals.</li> <li>P - Fire Safety and Life Safety Inspections are performed by Fire Protection Group and the Fire Department.</li> <li>P - ODH alarm systems are tested and maintained.</li> <li>M - ODH alarms are monitored by a sitewide monitoring system with notification to the emergency dispatch center that is constantly staffed, 24/7, 365 days.</li> <li>M - Area/fixed oxygen monitoring provided in areas where cryogenic liquids are stored.</li> <li>M - Onsite Emergency services are provided.</li> <li>M - NM4 Credited Controls: two (2) oxygen monitors (one high, one low), one (1) strobe, and one (1) horn.</li> <li>M - NM3 Credited Controls: two (2) oxygen monitors (one high, one low), one (1) strobe, and one (1) horn.</li> <li>P - Cryogenic system designed and reviewed by qualified personnel</li> <li>P - WPC process provides instructions for use</li> <li>P - Protective clothing rules are enforced when working in areas with exposure to cryogenic liquids.</li> <li>P. Training required for all personnel handling cryogenics</li> <li>M - Onsite Emergency services are provided</li> </ul>	L: BEU C: N R: IV Burns L: BEU C:M R: IV

Other Hazard Consequences, derived from Figure C-	1, "E	Example Qualitative Conse	equence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	С	onsequence (C, of event)/y	ear Risk (R, Qualitative	Ranking)	Risk	Matr	ix			
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = situation$ (eve	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{O}\mathbf{P}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}O$	$\mathbf{II} = \text{situation}$ (ev	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	$III = situation (e^{-1})$	event) of minor concern event) of minimal concern	es	Н	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		N = Negligible	IV = situation (evolution)		enc	М	II	П	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	ш	ш	IV	IV
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	jons	L			1.	1 V
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	С	Ν	IV	IV	IV	IV
Acronyms MOI = Maximally-exposed Offsite Individual		individual's ability to take protective action.	immediately life- threatening or permanently disabling.	immediately life- threatening or permanently disabling.						
	М	C <sup>3</sup> Mild, transient	C 3 Serious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	immediate loss of life no	immediate loss of life no						
			permanent disabilities;	permanent disabilities;						
	_		hospitalization required.	hospitalization required.						
	L	Mild, transient	Minor injuries; no	Minor injuries; no						
		adverse effects $> C$	hospitalization > C	hospitalization > C						
	Ν	Consequences less	Consequences less than	Consequences less than						
			hose for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

## Table 28.15 Thermal Energy – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-	1, "E	Example Qualitative Conse	equence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	С	onsequence (C, of event)/y	ear Risk (R, Qualitative	Ranking)	Risk	Matr	ix			
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = situation$ (eve	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{O}\mathbf{P}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}O$	$\mathbf{II} = \text{situation}$ (ev	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	$III = situation (e^{-1})$	event) of minor concern event) of minimal concern	es	Н	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		N = Negligible	IV = situation (evolution)		enc	М	II	П	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	ш	ш	IV	IV
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	jons	L			1.	1 V
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	С	Ν	IV	IV	IV	IV
Acronyms MOI = Maximally-exposed Offsite Individual		individual's ability to take protective action.	immediately life- threatening or permanently disabling.	immediately life- threatening or permanently disabling.						
	М	C <sup>3</sup> Mild, transient	C 3 Serious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	immediate loss of life no	immediate loss of life no						
			permanent disabilities;	permanent disabilities;						
	_		hospitalization required.	hospitalization required.						
	L	Mild, transient	Minor injuries; no	Minor injuries; no						
		adverse effects $> C$	hospitalization > C	hospitalization > C						
	Ν	Consequences less	Consequences less than	Consequences less than						
			hose for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

# Table 28.16 Kinetic Energy – Onsite-1 Facility Worker

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

Other Hazard Consequences, derived from Figure C-	1, "E	Example Qualitative Conse	equence Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	С	onsequence (C, of event)/y	ear Risk (R, Qualitative	Ranking)	Risk	Matri	ix			
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = situation$ (eve	ent) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = situation (ev$	ent) of concern			А	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	III = situation (e)	vent) of minor concern	es	Н	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = \mathbf{Negligible}$	<b>IV</b> = situation (e	event) of minimal concern	enc	М	II	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	ш	ш	IV	IV
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	ш	- 111	1.	1 V
M = Mitigative (reduces event consequences) Acronyms MOI = Maximally-exposed Offsite Individual		serious effects, or	or acute injury that is	or acute injury that is	С	Ν	IV	IV	IV	IV
		individual's ability to take protective action.	immediately life- threatening or permanently disabling.	immediately life- threatening or permanently disabling.						
	М	C <sup>3</sup> Mild, transient	C 3 Serious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	immediate loss of life no	immediate loss of life no						
			permanent disabilities;	permanent disabilities;						
			hospitalization required.	hospitalization required.						
	L	Mild, transient	Minor injuries; no	Minor injuries; no						
		adverse effects $> C$	hospitalization > C	hospitalization > C						
	Ν	Consequences less	Consequences less than	Consequences less than						
			hose for Low Consequence	those for Low						
		Consequence Level	Level	Consequence Level						

#### Table 28.17 Kinetic Energy – Onsite-2 Co-located Worker

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

Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year	Risk (R, Qualitative	Ranking)	Risk	Matri	X			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = situation$ (eve	nt) of major concern				Like	lihood	-
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (ev	<b>II</b> = situation (event) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$		<b>III</b> = situation (ev	vent) of minor concern	es	Η	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06>L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite-2	2 (co-located worker)	Onsite-1 (facility worker)	Consequences					
<b>P</b> = Preventive (reduce event occurrence likelihood)	н	C <sup>3</sup> Irreversible, other	C 3 Pro	ompt worker fatality	C <sup>3</sup> Prompt worker fatality	suc	L	III	III	IV	IV
$\mathbf{M} = \mathbf{M}$ itigative (reduces event consequences)		serious effects, or		cute injury that is	or acute injury that is	Ŭ	Ν	IV	IV	IV	IV
Acronyms		symptoms which		nmediately life-	immediately life-	L			1		
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an		ening or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective		uisuoiing.	permanenti persuoring.						
		action.									
	М	C <sup>3</sup> Mild, transient	C 3 S	Serious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.		diate loss of life no	immediate loss of life no						
			perm	nanent disabilities;	permanent disabilities;						
			-	talization required.	hospitalization required.						
	L	Mild, transient		inor injuries; no	Minor injuries; no						
		adverse effects > C		spitalization > C	hospitalization > C						

## Table 28.18 Kinetic Energy – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-	1, "F	Example Qualitative Cons	equen	ce Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/y	year	Risk (R, Qualitative	Ranking)	Risk	Matr	ix			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \text{High}$		$\mathbf{I} = situation$ (eve	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		II = situation (ev	ent) of concern		1	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathrm{Low}$		<b>III</b> = situation (ev	vent) of minor concern	S	Н	Ι	Ι	п	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	Π	II	III	IV
Control(s) Type	С	Offsite (MOI) Onsite-2 (		-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	L	ш	ш	IV	IV
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood) $\mathbf{M}$ = Mitigative (reduces event consequences)	Н			rompt worker fatality	C <sup>3</sup> Prompt worker fatality	Con					
$\mathbf{M} = \mathbf{M}$ itigative (reduces event consequences)		serious effects, or	or	acute injury that is	or acute injury that is		Ν	IV	IV	IV	IV
Acronyms		symptoms which	immediately life-		immediately life-						
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	ening or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective									
		action.									
	Μ	C <sup>3</sup> Mild, transient	C 3	<sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	imm	ediate loss of life no	immediate loss of life no						
			peri	manent disabilities;	permanent disabilities;						
			hosp	vitalization required.	hospitalization required.						
		Mild, transient	Ν	/linor injuries; no	Minor injuries; no						
		adverse effects $> C$	ho	ospitalization > C	hospitalization > C						

# Table 28.19 Potential Energy – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Crane Hazard: Operations		L: C: R:	See Section I, Chapter 4	L: C: R:
Compressed Gasses	<ul> <li>Hazard:</li> <li>Personnel injury due to unexpected release, or unsecure tanks.</li> <li>May also present flammability and ODH concerns</li> </ul>	L: A C: H R: I	<ul> <li>P – Engineering notes to evaluate ODH for gases brought to facility. New or modified piping/manifolds similarly evaluated.</li> <li>P – NM4 is an engineered ODH 0 space with monitoring/alarms/ventilation discussed further under cryogenic liquid hazards</li> <li>P: All personnel handling compressed gasses have to take Pressure Safety orientation training.</li> <li>P: All personnel handling compressed gasses have to take compressed gas cylinder safety training</li> <li>P: All personnel have to be familiar with FESHM 5000 series and apply requirements.</li> <li>P: Gas cylinders are secured and capped when not in use.</li> <li>M: Personal Protective Equipment mitigates severity of injury.</li> </ul>	L: BEU C: M R: IV
Vacuum/ Pressure Vessels/ Piping	Hazard:	L: C: R:	See Section I, Chapter 4	L: C: R:
Vacuum Pumps	Hazard:	L: C: R:	See Section I, Chapter 4	L: C: R:
Material Handling	Hazard:	L: C: R:	See Section I, Chapter 4	L: C: R:

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Risk (R, Qualitative Ranking)			x				
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I}$ = situation (event) of major concern					Like	lihood		
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{M} = \mathbf{M}$ oderate		ent) of concern	r	1	A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (e	vent) of minor concern	es	Н	Ι	I	Π	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV	
Control(s) Type	С	Offsite (MOI)	Offsite (MOI) Onsite-2 (co-lo		Onsite-1 (facility worker)	Consequences	т	ш	Ш	IV	IV	
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality or acute injury that is		C <sup>3</sup> Prompt worker fatality or acute injury that is	ons	L	ш	111	1V	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or				C	Ν	IV	IV	IV	IV	
Acronyms				immediately life-								
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threa	tening or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective		-								
		action.										
	Μ	C <sup>3</sup> Mild, transient	С	<sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no							
			imn	nediate loss of life no	immediate loss of life no							
			per	rmanent disabilities;	permanent disabilities;							
			hos	pitalization required.	hospitalization required.							

L	M	ild, transient	Minor injuries; no	Minor injuries; no
	adve	rse effects > C	hospitalization > C	hospitalization > C
Ν	Con	sequences less	Consequences less than	Consequences less than
	than	those for Low	those for Low Consequence	those for Low
	Cons	sequence Level	Level	Consequence Level

# Table 28.20 Potential Energy – Onsite-2 Co-located Worker

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.															
Likelihood (L, of event)/year	С	onsequence (C, of event)/y	sequence (C, of event)/year Risk (R, Qualitative Ranking)					rix							
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = situation$ (eve	ent) of major concern				Likelihood							
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = situation (ev$	ent) of concern			А	U	EU	BEU					
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	III = situation (e)	vent) of minor concern	es	Н	Ι	Ι	II	III					
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = \mathbf{Negligible}$	<b>IV</b> = situation (e	vent) of minimal concern	enc	М	II	II	III	IV					
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	ш	ш	IV	IV					
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	ш	- 111	1.	1 V					
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	С	Ν	IV	IV	IV	IV					
Acronyms MOI = Maximally-exposed Offsite Individual		individual's ability to take protective action.	immediately life- threatening or permanently disabling.	manently threatening or											
	М	C <sup>3</sup> Mild, transient	C 3 Serious injury, no	C <sup>3</sup> Serious injury, no											
		adverse effects.	immediate loss of life no	immediate loss of life no											
			permanent disabilities;	permanent disabilities;											
			hospitalization required.	hospitalization required.											
	L	Mild, transient	Minor injuries; no	Minor injuries; no											
		adverse effects $> C$	hospitalization > C	hospitalization > C											
	Ν	Consequences less	Consequences less than	Consequences less than											
			hose for Low Consequence	those for Low											
		Consequence Level	Level	Consequence Level											

## Table 28.21 Potential Energy – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.															
Likelihood (L, of event)/year	С	onsequence (C, of event)/y	sequence (C, of event)/year Risk (R, Qualitative Ranking)					rix							
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = situation$ (eve	ent) of major concern				Likelihood							
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = situation (ev$	ent) of concern			А	U	EU	BEU					
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	III = situation (e)	vent) of minor concern	es	Н	Ι	Ι	II	III					
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = \mathbf{Negligible}$	<b>IV</b> = situation (e	vent) of minimal concern	enc	М	II	II	III	IV					
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	ш	ш	IV	IV					
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	ш	- 111	1.	1 V					
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	С	Ν	IV	IV	IV	IV					
Acronyms MOI = Maximally-exposed Offsite Individual		individual's ability to take protective action.	immediately life- threatening or permanently disabling.	manently threatening or											
	М	C <sup>3</sup> Mild, transient	C 3 Serious injury, no	C <sup>3</sup> Serious injury, no											
		adverse effects.	immediate loss of life no	immediate loss of life no											
			permanent disabilities;	permanent disabilities;											
			hospitalization required.	hospitalization required.											
	L	Mild, transient	Minor injuries; no	Minor injuries; no											
		adverse effects $> C$	hospitalization > C	hospitalization > C											
	Ν	Consequences less	Consequences less than	Consequences less than											
			hose for Low Consequence	those for Low											
		Consequence Level	Level	Consequence Level											

# Table 28.22 Magnetic Fields – Onsite-1 Facility Worker

Hazard	Hazard Description	Baseline Qualitative Risk (without controls)	Preventative (P)/ Mitigative (M)	Residual Qualitative Risk (with controls)
Fringe Fields	Hazard: • Exposure to fringe fields beyond allowable limits (worker with ferromagnetic or electronic medical device(s))	L: A C: H R: I	<ul> <li>P- Industrial hygiene conducts field surveys to establish safe field boundaries for workers.</li> <li>P- Access control points and individual components of concern (e.g., experiment permanent magnet) have postings to notify workers of magnetic hazard.</li> <li>P – Facility specific hazard awareness training alerting to fringe fields</li> </ul>	L: BEU C: H R: III
	• Exposure to fringe fields beyond allowable limits (worker without ferromagnetic or electronic medical device(s))	L: A C: L R: III	<ul> <li>P- Industrial hygiene conducts field surveys to establish safe field boundaries for workers.</li> <li>P- Access control points and individual components of concern (e.g., experiment permanent magnet) have postings to notify workers of magnetic hazard.</li> <li>P - Facility specific hazard awareness training alerting to fringe fields</li> </ul>	L: BEU C: L R: IV
	• Exposure to flying metallic objects causing potential injury.	L: A C: M R: II	<ul> <li>P- Brass tools are used to prevent flying metallic objects from occurring, thereby preventing worker injury as prescribed by relevant magnet SOP</li> <li>P-Work Control procedure/SOP (ferromagnetic object control) requires that all ferromagnetic objects are removed prior to entry into a fringe field area (30G administrative limit).</li> <li>P-Work Control procedure/SOP requires worker training while in areas possessing fringe fields (300 G administrative limit).</li> </ul>	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	С	onsequence (C, of event)/y	ear Risk (R, Qualitative	Ranking)	Risk	Matri	ix					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = \text{situation}$ (even	nt) of major concern				Like	lihood			
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = \text{situation}$ (even	ent) of concern		1	А	U	EU	BEU		
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$	III = situation (ev	vent) of minor concern	S	Н	Ι	Ι	II	III		
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$	IV = situation (ev	vent) of minimal concern	enc	М	II	II	III	IV		
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	ш	ш	IV	IV		
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality or acute injury that is	ons	L			1.	1 V		
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	or acute injury that is		0	Ν	IV	IV	IV	IV		
Acronyms MOI = Maximally-exposed Offsite Individual		symptoms which could impair an t individual's ability to take protective action.	immediately life- hreatening or permanently disabling.	immediately life- threatening or permanently disabling.								
	Μ	C <sup>3</sup> Mild, transient	C <sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no								
		adverse effects.	immediate loss of life no	immediate loss of life no								
			permanent disabilities;	permanent disabilities;								
			hospitalization required.	hospitalization required.								
	L	Mild, transient	Minor injuries; no	Minor injuries; no								
		adverse effects > C	hospitalization > C	hospitalization > C								
	N Consequences less		Consequences less than	Consequences less than								
			hose for Low Consequence	those for Low								
		Consequence Level	Level	Consequence Level								

### Table 28.23 Magnetic Fields – Onsite-2 Co-located Worker

Hazard	Hazard Description	Hazard Description Baseline Qualitative Risk (without controls)						
Fringe Fields	Hazard: • Exposure to fringe fields beyond allowable limits (worker with ferromagnetic or electronic medical device(s))	L: A C: H R: I	<ul> <li>P- Industrial hygiene conducts field surveys to establish safe field boundaries for workers.</li> <li>P- Access control points and individual components of concern (e.g., experiment permanent magnet) have postings to notify workers of magnetic hazard.</li> <li>P – Facility specific hazard awareness training alerting to fringe fields</li> </ul>	L: BEU C: H R: III				
	• Exposure to fringe fields beyond allowable limits (worker without ferromagnetic or electronic medical device(s))	L: A C: L R: III	<ul> <li>P- Industrial hygiene conducts field surveys to establish safe field boundaries for workers.</li> <li>P- Access control points and individual components of concern (e.g., experiment permanent magnet) have postings to notify workers of magnetic hazard.</li> <li>P - Facility specific hazard awareness training alerting to fringe fields</li> </ul>	L: BEU C: L R: IV				
	• Exposure to flying metallic objects causing potential injury.	L: A C: M R: II	<ul> <li>P- Brass tools are used to prevent flying metallic objects from occurring, thereby preventing worker injury as prescribed by relevant magnet SOP</li> <li>P-Work Control procedure/SOP (ferromagnetic object control) requires that all ferromagnetic objects are removed prior to entry into a fringe field area (30G administrative limit).</li> <li>P-Work Control procedure/SOP requires worker training while in areas possessing fringe fields (300 G administrative limit).</li> </ul>	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	С	onsequence (C, of event)/y	sequence (C, of event)/year Risk (R, Qualitative Ranking)					rix							
$\mathbf{A} = \text{Anticipated} (L > 1.0\text{E-}02)$		$\mathbf{H} = \mathrm{High}$	$\mathbf{I} = situation$ (eve	ent) of major concern				Likelihood							
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate	$\mathbf{II} = situation (ev$	ent) of concern			А	U	EU	BEU					
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	III = situation (e)	vent) of minor concern	es	Н	Ι	Ι	II	III					
<b>BEU</b> = Beyond Extremely Unlikely $(1.0E-06>L)$		$\mathbf{N} = \mathbf{Negligible}$	<b>IV</b> = situation (e	vent) of minimal concern	enc	М	II	II	III	IV					
Control(s) Type	С	Offsite (MOI)	Onsite-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	ш	ш	IV	IV					
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	ш	- 111	1.	1 V					
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	or acute injury that is	or acute injury that is	С	Ν	IV	IV	IV	IV					
Acronyms MOI = Maximally-exposed Offsite Individual		individual's ability to take protective action.	immediately life- threatening or permanently disabling.	manently threatening or											
	М	C <sup>3</sup> Mild, transient	C 3 Serious injury, no	C <sup>3</sup> Serious injury, no											
		adverse effects.	immediate loss of life no	immediate loss of life no											
			permanent disabilities;	permanent disabilities;											
			hospitalization required.	hospitalization required.											
	L	Mild, transient	Minor injuries; no	Minor injuries; no											
		adverse effects $> C$	hospitalization > C	hospitalization > C											
	Ν	Consequences less	Consequences less than	Consequences less than											
			hose for Low Consequence	those for Low											
		Consequence Level	Level	Consequence Level											

## Table 28.24 Magnetic Fields – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.												
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = situation (even$	nt) of major concern							
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{O}\mathbf{P}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}O$		$\mathbf{II} = \text{situation}$ (eve	(event) of concern			A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathbf{Low}$	$\mathbf{L} = \mathbf{Low}$		vent) of minor concern	ses	Н	Ι	Ι	II	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$	$\mathbf{N} = $ Negligible		vent) of minimal concern	enc	Μ	Π	II	III	IV	
Control(s) Type	С	Offsite (MOI)	Offsite (MOI) Onsite-2 (co		Onsite-1 (facility worker)	Consequences	т	ш	Ш	IV	IV	
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C 3 P	rompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	III	III	1 V	1 V	
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or	or	acute injury that is	or acute injury that is	C	Ν	IV	IV	IV	IV	
Acronyms		symptoms which	i	immediately life-	immediately life-							
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective										
		action.										
	Μ	C 3 Mild, transient	C	<sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no							
		adverse effects.	imm	nediate loss of life no	immediate loss of life no							
				manent disabilities;	permanent disabilities;							
			hosj	pitalization required.	hospitalization required.							
	L	Mild, transient	Ν	Ainor injuries; no	Minor injuries; no							
		adverse effects > C	adverse effects $> C$ hospita		hospitalization > C							
	Ν	Consequences less		nsequences less than	Consequences less than							
		than those for Low	than those for Low those for Low Consequence those for Low									
		Consequence Level		Level	Consequence Level							

#### Table 28.25 Other hazards - Onsite-1 Facility Worker

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

Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk	x Matri	X			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \text{High}$		$\mathbf{I} = $ situation (even	nt) of major concern				Like	lihood	-
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		$\mathbf{II} = \text{situation}$ (eve	ent) of concern		-	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (ev	vent) of minor concern	8	Η	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	Consequences	М	II	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	nbə	-			13.7	13.7
<b>P</b> = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	<b>C</b> <sup>3</sup> P	Prompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	III	III	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or		acute injury that is	or acute injury that is	U U	Ν	IV	IV	IV	IV
Acronyms		symptoms which	i	immediately life-	immediately life-						
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective									
		action.									
	М	C 3 Mild, transient	С	<sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	imm	nediate loss of life no	immediate loss of life no						
			per	rmanent disabilities;	permanent disabilities;						
			hosp	pitalization required.	hospitalization required.						
	L	Mild, transient	Ν	Minor injuries; no	Minor injuries; no						
		adverse effects $> C$	h	ospitalization > C	hospitalization > C						
	Ν	Consequences less	Cor	nsequences less than	Consequences less than						
		than those for Low	those	for Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

#### Table 28.26 Other hazards – Onsite-2 Co-located Worker

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

Likelihood (L, of event)/year	C	onsequence (C, of event	)/year	Risk (R, Qualitative	Ranking)	Risk	x Matri	x			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (even	nt) of major concern				Like	lihood	
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}$ oderate		II = situation (even	ent) of concern			Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (ev	vent) of minor concern	8	Η	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	Consequences	М	Π	П	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	equ					
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C 3 F	rompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	III	III	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or		acute injury that is	or acute injury that is	C C	Ν	IV	IV	IV	IV
Acronyms		symptoms which		immediately life-	immediately life-						
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threa	tening or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective									
		action.									
	Μ	C <sup>3</sup> Mild, transient	С	<sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	imn	nediate loss of life no	immediate loss of life no						
			per	manent disabilities;	permanent disabilities;						
			hos	pitalization required.	hospitalization required.						
	L	Mild, transient	l	Minor injuries; no	Minor injuries; no	]					
		adverse effects $> C$	h	ospitalization $> C$	hospitalization > C						
	Ν	Consequences less	Co	nsequences less than	Consequences less than						
		than those for Low	those	for Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

#### Table 28.27 Other hazards – MOI Offsite

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

Likelihood (L, of event)/year	C	onsequence (C, of event	)/year	Risk (R, Qualitative	Ranking)	Risk	Matri	x			
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (ever	nt) of major concern				Like	lihood	-
U = Unlikely (1.0E-02 > L > 1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{d}\mathbf{e}\mathbf{r}\mathbf{a}\mathbf{t}\mathbf{e}$		$\mathbf{II} = \text{situation}$ (eve	ent) of concern		T	Α	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		<b>III</b> = situation (ev	vent) of minor concern	8	Н	Ι	Ι	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	Consequences	М	II	Π	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite	e-2 (co-located worker)	Onsite-1 (facility worker)	equ	-			13.7	13.7
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C 3 F	rompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	III	III	IV	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or		acute injury that is	or acute injury that is	0	Ν	IV	IV	IV	IV
Acronyms		symptoms which	:	immediately life-	immediately life-						
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threa	tening or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective									
		action.									
	Μ	C <sup>3</sup> Mild, transient	С	<sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	imn	nediate loss of life no	immediate loss of life no						
			per	manent disabilities;	permanent disabilities;						
			hos	pitalization required.	hospitalization required.						
	L	Mild, transient	l	Minor injuries; no	Minor injuries; no						
		adverse effects > C	h	ospitalization > C	hospitalization > C						
	Ν	Consequences less	Co	nsequences less than	Consequences less than						
		than those for Low	those	for Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

# Table 28.28 Access & Egress – Onsite-1 Facility Worker

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

Other Hazard Consequences, derived from Figure C-1	er Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.										
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year	Risk (R, Qualitative	Ranking)	Risk					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (even	nt) of major concern				-	lihood	
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{e}\mathbf{r}\mathbf{a}\mathbf{t}\mathbf{e}$		$\mathbf{II} = \text{situation}$ (eve	ent) of concern			A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		III = situation (ev	vent) of minor concern	ses	Η	Ι	I	II	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	lenc	М	Π	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite-	2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	Ш	ш	IV	IV
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Pr	ompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	III	III	1V	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or		acute injury that is	or acute injury that is	C	Ν	IV	IV	IV	IV
Acronyms		symptoms which		immediately life- immediately life-							
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threate	ening or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective									
		action.									
	Μ	C <sup>3</sup> Mild, transient	C 3	Serious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	imme	ediate loss of life no	immediate loss of life no						
			pern	nanent disabilities;	permanent disabilities;						
			hospi	italization required.	hospitalization required.						
	L	Mild, transient	Μ	linor injuries; no	Minor injuries; no						
		-		spitalization > C	hospitalization > C						
	Ν	-		sequences less than	Consequences less than						
		than those for Low	those for	or Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

### Table 28.29 Access & Egress – Onsite-2 Co-located Worker

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

Other Hazard Consequences, derived from Figure C-1	, "Е	xample Qualitative Con	sequenc	ce Matrix", DOE-HD	BK-1163-2020.						
Likelihood (L, of event)/year	C	onsequence (C, of event)/	/year	Risk (R, Qualitative	Ranking)	Risk					
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = \text{situation}$ (even	nt) of major concern					lihood	
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{d}\mathbf{e}\mathbf{r}\mathbf{a}\mathbf{t}\mathbf{e}$		$\mathbf{II} = \text{situation (event) of concern}$				A	U	EU	BEU
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = \mathrm{Low}$		III = situation (ev	vent) of minor concern	ses	Η	Ι	I	П	III
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	ienc	М	Π	II	III	IV
Control(s) Type	С	Offsite (MOI)	Onsite-	2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	Ш	TTT	IV	IV
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	H	C <sup>3</sup> Irreversible, other	C <sup>3</sup> Pr	ompt worker fatality	C <sup>3</sup> Prompt worker fatality	suo	L	III	III	1V	IV
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or		acute injury that is	or acute injury that is	С	Ν	IV	IV	IV	IV
Acronyms		symptoms which		immediately life- immediately life-							
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threate	ening or permanently	threatening or						
		individual's ability to		disabling.	permanently disabling.						
		take protective									
		action.									
	Μ	C <sup>3</sup> Mild, transient	C 3	Serious injury, no	C <sup>3</sup> Serious injury, no						
		adverse effects.	imme	ediate loss of life no	immediate loss of life no						
			pern	nanent disabilities;	permanent disabilities;						
			hospi	italization required.	hospitalization required.						
	L	Mild, transient	Μ	linor injuries; no	Minor injuries; no						
				spitalization > C	hospitalization > C						
	Ν	-		sequences less than	Consequences less than						
		than those for Low	those for	or Low Consequence	those for Low						
		Consequence Level		Level	Consequence Level						

## Table 28.30 Access & Egress – MOI Offsite

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

Other Hazard Consequences, derived from Figure C-1	Other Hazard Consequences, derived from Figure C-1, "Example Qualitative Consequence Matrix", DOE-HDBK-1163-2020.											
Likelihood (L, of event)/year	C	onsequence (C, of event)	/year	Risk (R, Qualitative	Ranking)	Risk Matrix						
$\mathbf{A} = \text{Anticipated} (\text{L} > 1.0\text{E}-02)$		$\mathbf{H} = \mathrm{High}$		$\mathbf{I} = $ situation (event) of major concern						lihood		
U = Unlikely (1.0E-02>L>1.0E-04)		$\mathbf{M} = \mathbf{M}\mathbf{O}\mathbf{O}\mathbf{P}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}\mathbf{O}O$		$\mathbf{II} = \text{situation (event) of concern}$				A	U	EU	BEU	
EU = Extremely Unlikely (1.0E-04 > L > 1.0E-06)		$\mathbf{L} = Low$		III = situation (ev	vent) of minor concern	ses	Η	Ι	I	Π	III	
<b>BEU</b> = Beyond Extremely Unlikely (1.0E-06> L)		$\mathbf{N} = \mathbf{Negligible}$		IV = situation (ev	vent) of minimal concern	enc	М	Π	II	III	IV	
Control(s) Type	С	Offsite (MOI)	Onsite	-2 (co-located worker)	Onsite-1 (facility worker)	Consequences	т	III		137	137	
$\mathbf{P}$ = Preventive (reduce event occurrence likelihood)	Н	C <sup>3</sup> Irreversible, other	C 3 P	rompt worker fatality	C <sup>3</sup> Prompt worker fatality	ons	L	ш	III	IV	IV	
$\mathbf{M} = $ Mitigative (reduces event consequences)		serious effects, or		acute injury that is	or acute injury that is	C	Ν	IV	IV	IV	IV	
Acronyms		symptoms which	i	immediately life-	immediately life-							
<b>MOI</b> = Maximally-exposed Offsite Individual		could impair an	threat	tening or permanently	threatening or							
		individual's ability to		disabling.	permanently disabling.							
		take protective										
		action.										
	Μ	C 3 Mild, transient	C	<sup>3</sup> Serious injury, no	C <sup>3</sup> Serious injury, no							
		adverse effects.	imm	ediate loss of life no	immediate loss of life no							
			per	manent disabilities;	permanent disabilities;							
			hosp	pitalization required.	hospitalization required.							
	L	Mild, transient	Ν	Minor injuries; no	Minor injuries; no							
		adverse effects $> C$			hospitalization > C							
	Ν	Consequences less Con		sequences less than	Consequences less than							
		than those for Low	those	for Low Consequence	those for Low							
		Consequence Level		Level	Consequence Level							

#### Table 28.31 Environmental

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