PV System Arc Flash Report

Performed for the Proposed Commercial PV Solar Project at

[redacted]

Located in [redacted]

Prepared for

[redacted]

[redacted]

[redacted]

Project: [redacted]

Attn: [redacted]
[redacted]

Subject: PV System Arc Flash Report

Project Address: [redacted]

The following report will take into consideration the effect of adding a new PV system to the service at the address above, pursuant to the following scope:

- Arc fault calculations and arc flash placards

Please reference the attached reports as provided:

Appendix A: Arc Fault Calculations

Appendix B: Arc Flash Placards

We hope this provides the information you require. If you have any questions regarding the contents of our report, or if we can be of further assistance, please contact us.

Respectfully submitted,

Richard Dobbins, PE

Appendix A

Arc Fault Calculations

The total available fault current supplied by the utility, combined with the new fault current contribution from the PV system, must not exceed the fault rating of the main service panel. We will determine the available fault current at each piece of equipment using the following equations:

$$Fault\ Current\ (I_{AIC}) = \frac{kVA\ x\ 100000}{V\ x\ \sqrt{3}\ x\ \%Z}$$

$$f = \frac{\sqrt{3}\ x\ L\ x\ I_{AIC}}{N\ x\ C\ x\ V} \qquad\qquad I_{AIC'} = I_{AIC}\ x\ \frac{1}{1+f}$$

Where kVA is the transformer rating (in kVA), V is the service voltage (in volts), %Z is the transformer impedance, and L, N, and C are respectively the length (in feet), parallel number, and C constant of conductors between the equipment we are measuring the fault current at and the equipment the fault current is being sourced from.

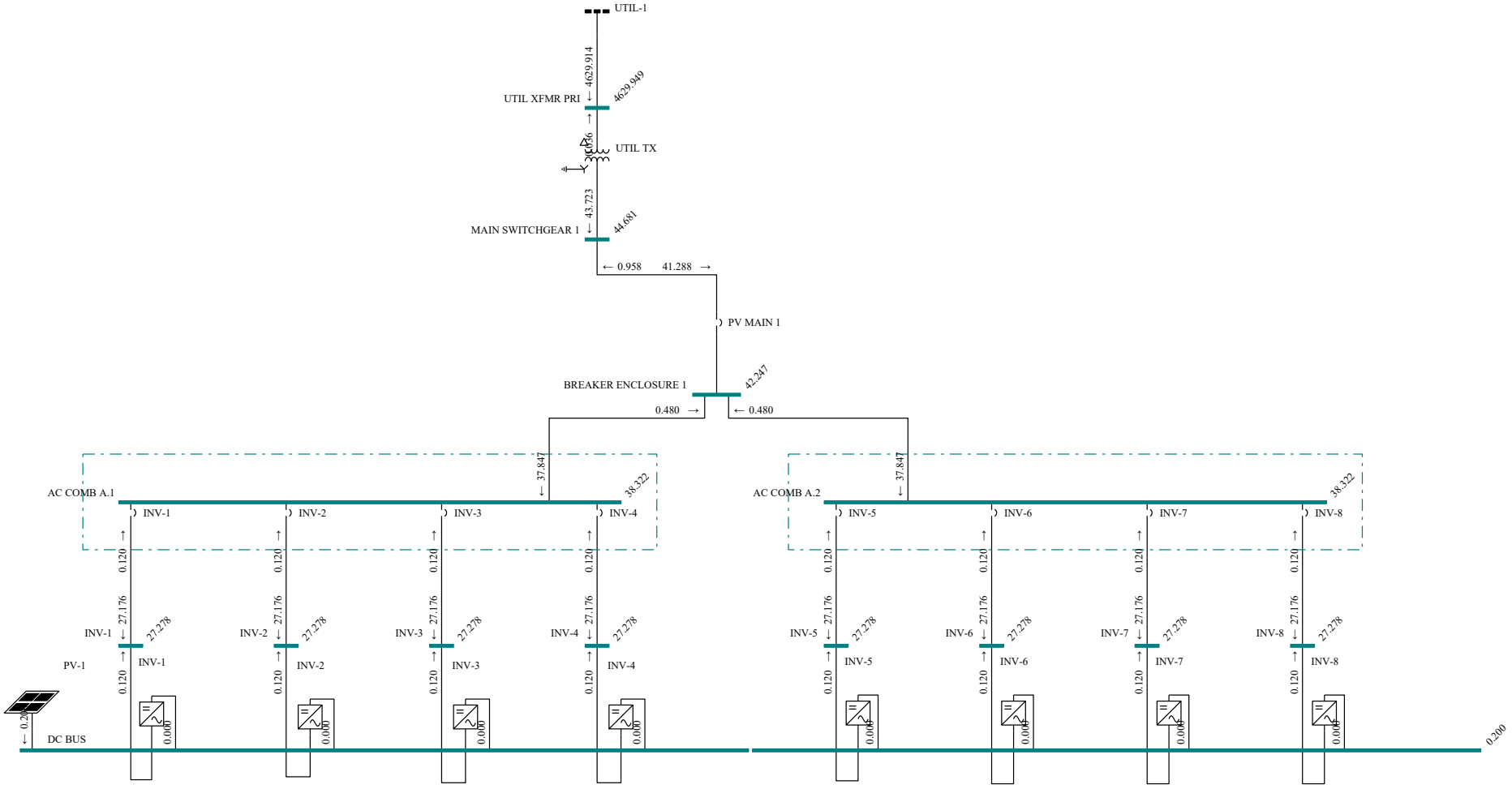
Using the infinite bus method, and assuming the kVA rating of the utility transformer to be 2000kVA for each service, we have determined that the maximum fault current contribution from the utility at each service will not exceed 43.723 kAIC.

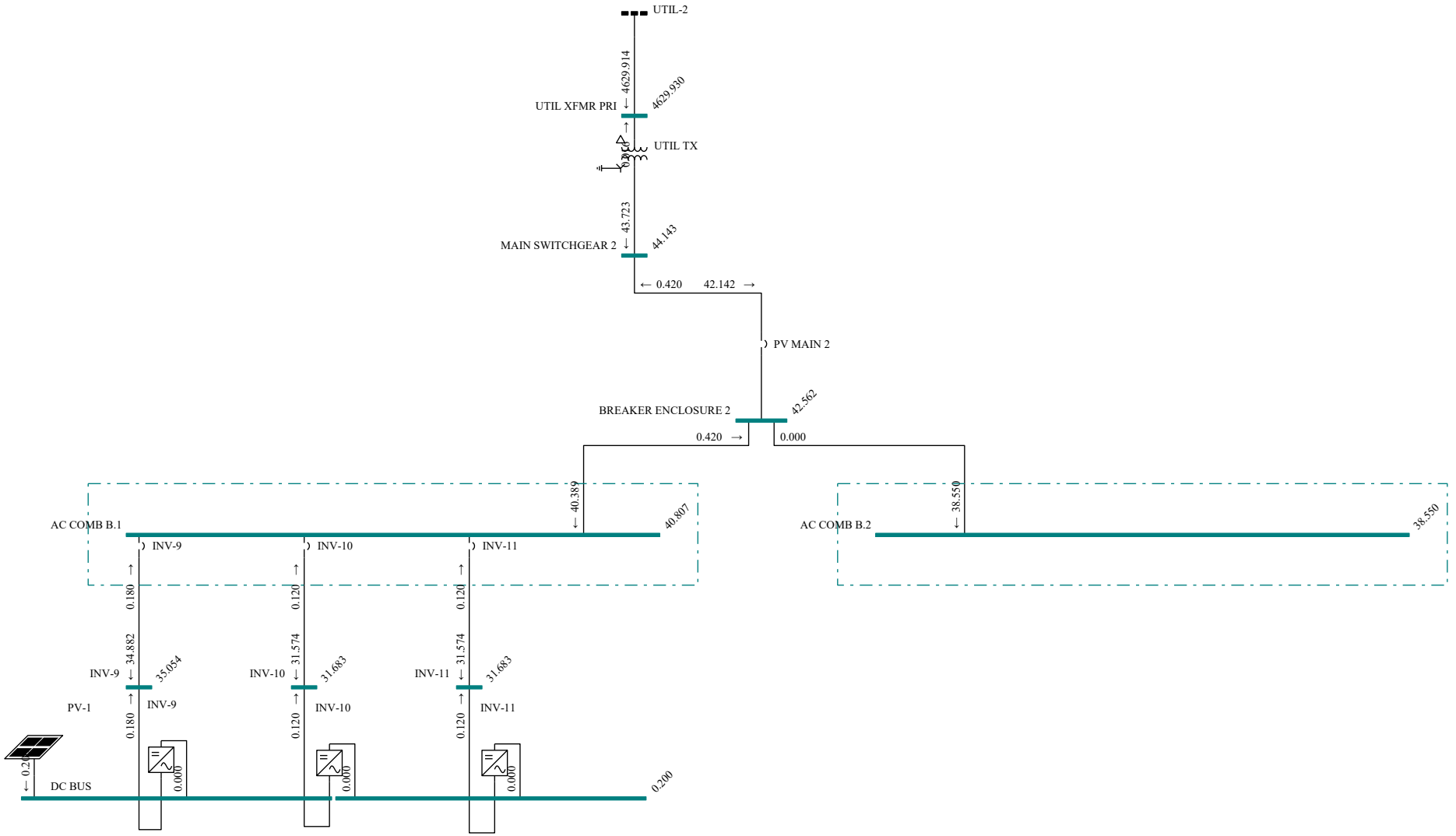
The available utility fault current at the point of service will drop off from the main switchgear, changing as it passes through the equipment and conductors on the site. Each PV inverter will also contribute fault current to the system, albeit at a much lower value than that of the utility. Because they are power-limited devices, each inverter can contribute a maximum of 150% of its rated maximum operational current. For the 66.6kW PV inverters, this comes out to approximately 120 AIC each. For the 100kW PV inverters, this comes out to approximately 180 AIC each.

For system A, combining the utility and PV fault current contributions, the estimated maximum potential combined fault current at the PV AC Combiner Panel A.1 and A.2 is 38.322 kAIC at each panel. Likewise, the maximum potential sum of fault currents at the Main Service Panel is 44.681 kAIC.

For system B, combining the utility and PV fault current contributions, the estimated maximum potential combined fault current at the PV AC Combiner Panel B.1 is 40.807 kAIC. Likewise, the maximum potential sum of fault currents at the Main Service Panel is 44.143 kAIC.

We have used the point-to-point calculation method to determine the available fault current at the other equipment in the system, as shown on the following page:


UTIL-1
4629.914
4629.949
UTIL XFMR PRI
UTIL TX
43.723
44.681
MAIN SWITCHGEAR 1
0.958
41.288
PV MAIN 1
BREAKER ENCLOSURE 1
42.247
0.480
0.480
37.847
38.322
AC COMB A.1
AC COMB A.2
INV-1
INV-2
INV-3
INV-4
INV-5
INV-6
INV-7
INV-8
0.120
27.176
27.278
PV-1
0.200
DC BUS
0.000


UTIL-2
4629.914
UTIL XFMR PRI
4629.930
UTIL TX
43.723
MAIN SWITCHGEAR 2
44.143
0.420
42.142
PV MAIN 2
BREAKER ENCLOSURE 2
42.562
0.420
0.000
40.389
AC COMB B.1
40.807
38.550
AC COMB B.2
38.550
INV-9
INV-10
INV-11
0.180
0.120
0.120
34.882
31.574
31.574
INV-9
35.054
INV-10
31.683
INV-11
31.683
PV-1
INV-9
INV-10
INV-11
0.180
0.120
0.120
0.000
0.000
0.000
DC BUS
0.200

Appendix B

Arc Flash Labels

The following table displays the total bolted and arc fault currents available (as the sum of contributions from the utility and each PV inverter) at each piece of equipment in the system, as well as the incident energy and arc flash boundary for each.

Arc Fault Bus Name	Arc Fault Bus kV	Equip Type	Bus Bolted Fault (kA)*	Bus Arc Fault (kA)	Trip Time (sec)	Arc Time (sec)	Est Arc Flash Boundary (inches)	Working Distance (inches)	Incident Energy (cal/cm2)**
AC COMB A.1	0.48	Panelboard	38.322	26.583	1000	0.2	80.3	18	13.1
AC COMB A.2	0.48	Panelboard	38.322	26.583	1000	0.2	80.3	18	13.1
BREAKER ENCLOSURE 1	0.48	Other	42.247	27.673	1000	0.2	86.8	18	14.8
AC COMB B.1	0.48	Panelboard	40.807	27.752	1000	0.2	82.8	18	13.8
AC COMB B.2	0.48	Panelboard	38.550	26.694	1000	0.2	80.6	18	13.2
BREAKER ENCLOSURE 2	0.48	Other	42.562	27.806	1000	0.2	87.1	18	14.9
INV-1	0.48	Other	27.278	19.797	0.2	0.2	69	18	10.3
INV-2	0.48	Other	27.278	19.797	0.2	0.2	69	18	10.3
INV-3	0.48	Other	27.278	19.797	0.2	0.2	69	18	10.3
INV-4	0.48	Other	27.278	19.797	0.2	0.2	69	18	10.3
INV-5	0.48	Other	27.278	19.797	0.2	0.2	69	18	10.3
INV-6	0.48	Other	27.278	19.797	0.2	0.2	69	18	10.3
INV-7	0.48	Other	27.278	19.797	0.2	0.2	69	18	10.3
INV-8	0.48	Other	27.278	19.797	0.2	0.2	69	18	10.3
INV-9	0.48	Other	35.054	24.270	0.2	0.2	79.3	18	12.8
INV-10	0.48	Other	31.683	22.431	0.2	0.2	75.1	18	11.8
INV-11	0.48	Other	31.683	22.431	0.2	0.2	75.1	18	11.8
*Values are including fault contributions from utility and all generation sources - please reference SLD for breakdown of individual contributions									
**Refer to NFPA 70E-2018 Table 130.5(G) for PPE requirements									

The following labels shall be affixed to the designated equipment (displaying the incident energy, arc flash boundary, and limited and restricted approach boundaries):

WARNING

Arc Flash and Shock Risk Assessment
Appropriate PPE Required

6' - 8"	Arc Flash Boundary
13.1	cal/cm2 at 18.0 Inches - Arc Flash Incident Energy
	Refer to NFPA 70E-2021 Table 130.5(G)
0.48	kV Shock Hazard when cover is removed
3' - 6"	Limited Approach
1' - 0"	Restricted Approach - Class 00 Voltage Gloves

Equipment Name: AC COMB A.1

WARNING

Arc Flash and Shock Risk Assessment
Appropriate PPE Required

6' - 8"	Arc Flash Boundary
13.1	cal/cm2 at 18.0 Inches - Arc Flash Incident Energy
	Refer to NFPA 70E-2021 Table 130.5(G)
0.48	kV Shock Hazard when cover is removed
3' - 6"	Limited Approach
1' - 0"	Restricted Approach - Class 00 Voltage Gloves

Equipment Name: AC COMB A.2

WARNING

Arc Flash and Shock Risk Assessment
Appropriate PPE Required

7' - 3"	Arc Flash Boundary
14.8	cal/cm2 at 18.0 Inches - Arc Flash Incident Energy
	Refer to NFPA 70E-2021 Table 130.5(G)
0.48	kV Shock Hazard when cover is removed
3' - 6"	Limited Approach
1' - 0"	Restricted Approach - Class 00 Voltage Gloves

Equipment Name: BREAKER ENCLOSURE 1

WARNING

Arc Flash and Shock Risk Assessment
Appropriate PPE Required

5' - 9"	Arc Flash Boundary
10.3	cal/cm2 at 18.0 Inches - Arc Flash Incident Energy
	Refer to NFPA 70E-2021 Table 130.5(G)
0.48	kV Shock Hazard when cover is removed
3' - 6"	Limited Approach
1' - 0"	Restricted Approach - Class 00 Voltage Gloves

Equipment Name: INV-1

WARNING

Arc Flash and Shock Risk Assessment
Appropriate PPE Required

5' - 9"	Arc Flash Boundary
10.3	cal/cm2 at 18.0 Inches - Arc Flash Incident Energy
	Refer to NFPA 70E-2021 Table 130.5(G)
0.48	kV Shock Hazard when cover is removed
3' - 6"	Limited Approach
1' - 0"	Restricted Approach - Class 00 Voltage Gloves

Equipment Name: INV-2

WARNING

Arc Flash and Shock Risk Assessment
Appropriate PPE Required

5' - 9"	Arc Flash Boundary
10.3	cal/cm2 at 18.0 Inches - Arc Flash Incident Energy
	Refer to NFPA 70E-2021 Table 130.5(G)
0.48	kV Shock Hazard when cover is removed
3' - 6"	Limited Approach
1' - 0"	Restricted Approach - Class 00 Voltage Gloves

Equipment Name: INV-3

Arc Flash and Shock Risk Assessment
Appropriate PPE Required

5' - 9"	Arc Flash Boundary
10.3	cal/cm2 at 18.0 Inches - Arc Flash Incident Energy
	Refer to NFPA 70E-2021 Table 130.5(G)
0.48	kV Shock Hazard when cover is removed
3' - 6"	Limited Approach
1' - 0"	Restricted Approach - Class 00 Voltage Gloves

Equipment Name: INV-4

Arc Flash and Shock Risk Assessment
Appropriate PPE Required

5' - 9"	Arc Flash Boundary
10.3	cal/cm2 at 18.0 Inches - Arc Flash Incident Energy
	Refer to NFPA 70E-2021 Table 130.5(G)
0.48	kV Shock Hazard when cover is removed
3' - 6"	Limited Approach
1' - 0"	Restricted Approach - Class 00 Voltage Gloves

Equipment Name: INV-5

Arc Flash and Shock Risk Assessment
Appropriate PPE Required

5' - 9"	Arc Flash Boundary
10.3	cal/cm2 at 18.0 Inches - Arc Flash Incident Energy
	Refer to NFPA 70E-2021 Table 130.5(G)
0.48	kV Shock Hazard when cover is removed
3' - 6"	Limited Approach
1' - 0"	Restricted Approach - Class 00 Voltage Gloves

Equipment Name: INV-6

Arc Flash and Shock Risk Assessment
Appropriate PPE Required

5' - 9"	Arc Flash Boundary
10.3	cal/cm2 at 18.0 Inches - Arc Flash Incident Energy
	Refer to NFPA 70E-2021 Table 130.5(G)
0.48	kV Shock Hazard when cover is removed
3' - 6"	Limited Approach
1' - 0"	Restricted Approach - Class 00 Voltage Gloves

Equipment Name: INV-7

Arc Flash and Shock Risk Assessment
Appropriate PPE Required

5' - 9"	Arc Flash Boundary
10.3	cal/cm2 at 18.0 Inches - Arc Flash Incident Energy
	Refer to NFPA 70E-2021 Table 130.5(G)
0.48	kV Shock Hazard when cover is removed
3' - 6"	Limited Approach
1' - 0"	Restricted Approach - Class 00 Voltage Gloves

Equipment Name: INV-8

WARNING

Arc Flash and Shock Risk Assessment
Appropriate PPE Required

6' - 11"	Arc Flash Boundary
13.8	cal/cm2 at 18.0 Inches - Arc Flash Incident Energy
	Refer to NFPA 70E-2021 Table 130.5(G)
0.48	kV Shock Hazard when cover is removed
3' - 6"	Limited Approach
1' - 0"	Restricted Approach - Class 00 Voltage Gloves

Equipment Name: AC COMB B.1

WARNING

Arc Flash and Shock Risk Assessment
Appropriate PPE Required

6' - 9"	Arc Flash Boundary
13.2	cal/cm2 at 18.0 Inches - Arc Flash Incident Energy
	Refer to NFPA 70E-2021 Table 130.5(G)
0.48	kV Shock Hazard when cover is removed
3' - 6"	Limited Approach
1' - 0"	Restricted Approach - Class 00 Voltage Gloves

Equipment Name: AC COMB B.2

WARNING

Arc Flash and Shock Risk Assessment
Appropriate PPE Required

7' - 3"	Arc Flash Boundary
14.9	cal/cm2 at 18.0 Inches - Arc Flash Incident Energy
	Refer to NFPA 70E-2021 Table 130.5(G)
0.48	kV Shock Hazard when cover is removed
3' - 6"	Limited Approach
1' - 0"	Restricted Approach - Class 00 Voltage Gloves

Equipment Name: BREAKER ENCLOSURE 2

WARNING

Arc Flash and Shock Risk Assessment
Appropriate PPE Required

6' - 7"	Arc Flash Boundary
12.8	cal/cm2 at 18.0 Inches - Arc Flash Incident Energy
	Refer to NFPA 70E-2021 Table 130.5(G)
0.48	kV Shock Hazard when cover is removed
3' - 6"	Limited Approach
1' - 0"	Restricted Approach - Class 00 Voltage Gloves

Equipment Name: INV-9

WARNING

Arc Flash and Shock Risk Assessment
Appropriate PPE Required

6' - 3"	Arc Flash Boundary
11.8	cal/cm2 at 18.0 Inches - Arc Flash Incident Energy
	Refer to NFPA 70E-2021 Table 130.5(G)
0.48	kV Shock Hazard when cover is removed
3' - 6"	Limited Approach
1' - 0"	Restricted Approach - Class 00 Voltage Gloves

Equipment Name: INV-10

WARNING

Arc Flash and Shock Risk Assessment
Appropriate PPE Required

6' - 3"	Arc Flash Boundary
11.8	cal/cm2 at 18.0 Inches - Arc Flash Incident Energy
	Refer to NFPA 70E-2021 Table 130.5(G)
0.48	kV Shock Hazard when cover is removed
3' - 6"	Limited Approach
1' - 0"	Restricted Approach - Class 00 Voltage Gloves

Equipment Name: INV-11