



STATE OF DELAWARE
DEPARTMENT OF TRANSPORTATION
800 BAY ROAD
P.O. BOX 778
DOVER, DELAWARE 19903

SHANTÉ A. HASTINGS
SECRETARY

VIA WEBSITE POSTING

August 19, 2026

Contract No. **T202153104.03**

DOVER BUS CANOPY SOLAR PANELS – READVERTISEMENT

Federal No. 5339-2021(02)

Prospective Bidders,

Enclosed is **Addendum No. 4** for the referenced contract consisting of the following:

1. **Revised** Bid Proposal Cover, to be substituted for the same page of the Proposal.
2. **Revised** Appendix A pages labeled 263100-1 – 263100-10, to be substituted for the same pages of the Appendix A.
3. **Amendment** file is not required for this addendum.

Please note the revisions listed above and attached, and submit bid based upon this information.

Sincerely,
~signature on file~
Kimberly Smith
Contract Administration
(302) 760-2031

DIGITAL ACCESSIBILITY NOTICE

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STATE OF DELAWARE
DEPARTMENT OF TRANSPORTATION

ADDENDUM 4
August 19, 2026



BID PROPOSAL

CONTRACT T202153104.03

**DOVER BUS CANOPY SOLAR PANELS -
READVERTISEMENT**

FTA Funding No. 5339-2021(02)

FTA is providing 80 % of funding for this project

CFDA: 20.526

Advertisement Date: July 1, 2026

INCLUDED IN THIS DOCUMENT:

BID PROPOSAL:

GENERAL DESCRIPTION

PROSPECTIVE BIDDERS NOTES

GENERAL NOTICES

ADDITIONAL BID PROPOSAL ITEMS:

ATTACHED OR POSTED DOCUMENTS:

PROJECT PLANS

QUESTIONS & ANSWERS (if posted)

REFERENCED DOCUMENTS

BIDDERS LIST

**PAPER BIDDERS CONTACT DELDOT
FOR BID SUBMITTAL DOCUMENTS:**

DRUG TESTING AFFIDAVIT

CERTIFICATION FORM

BID BOND FORM

CD FOR BID PRICE ENTRY & PRINTING

BIDDERS LIST

This Bid Proposal and related documents can be viewed on <https://bids.delaware.gov/> and, for subscribers <https://bidx.com/de/main>

Internet Bids for Bidders with Bid Express® accounts can be submitted at [BIDX.com/de](https://bidx.com/de/); **OR**;

Paper Bids with CD will be received in the Bidder's Room at the DelDOT Administration Building, Dover, DE;

ALL BIDS DUE PRIOR TO 2:00 P.M. Local Time, ~~AUGUST 18, 2026~~ AUGUST 25, 2026

SECTION 263100
PHOTOVOLTAIC SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. PV modules.
 - 2. Inverters.
 - 3. System overcurrent protection.
 - 4. Mounting structures.
 - 5. Monitoring software
 - 6. Ancillary equipment.
- B. Related Requirements:
 - 1. Section 133419 "Metal Building Systems".

1.3 DEFINITIONS

- A. ETFE: Ethylene tetrafluoroethylene.
- B. FEP: Fluorinated ethylene propylene.
- C. IP Code: Required ingress protection to comply with IEC 60529.
- D. MPPT: Maximum power point tracking.
- E. PV: Photovoltaic.
- F. STC: Standard Test Conditions defined in IEC 61215.
- G. Voc: Open circuit voltage at STC.
- H. Isc: Short circuit current at STC.
- I. Vmpp: Maximum power point voltage.
- J. Impp: Maximum power point current.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for PV panels.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. For PV modules.
 - a. Include plans, elevations, sections, and mounting details.
 - b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - c. Detail fabrication and assembly.
 - d. Include diagrams for power, signal, and control wiring.
 - 2. For PV solar panel standing seam mounting system.
 - a. Include material and design for PV solar panel standing seam mounting system with quantity of ballasted paver blocks per area.
 - 3. For PV inverter.
 - a. Include material and design for PV inverter sizing.
- C. Calculations (applies to AC and DC system):
 - 1. Voltage drop.
 - 2. Conductor ampacity.
 - 3. Conduit size and fill.
- D. Certificates: Submit product certificates signed by the manufacturer certifying material compliance with specified performance characteristics and criteria, and physical requirements.
- E. Delegated-Design Submittal: For PV System. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Buy America Certification: Provide written and signed certification by the manufacturer/contractor that manufactured products meet FTA Buy America requirements of 49 U.S.C. 5323(j)(1) and the applicable regulations in 49 C.F.R. Part 661.5.

B. Field quality-control reports.

C. Sample Warranty: For manufacturer's special materials and workmanship warranty and minimum power output warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For all system components. Provide three (3) copies to engineer for distribution. Include as built source circuit string diagrams showing string locations and polarity. Include as built inverter locations and ancillary equipment locations. Include third party testing and field reports.

1.7 WARRANTY

A. Special Warranty: Contractor shall warrant the system for proper operation and against defects in material and workmanship for a period of two (2) years from date of startup.

B. Solar Module: Manufacture agrees to repair or replace components of PV modules that fail in materials or workmanship within the specified warranty period.

1. Solar Module Manufacturer's materials and workmanship warranties include, but are not limited to the following:

a. Repair, replacement, or refund warranty due to defects in materials or workmanship in normal application, installation, use, and service conditions.

2. Warranty Period: Five years from date of delivery.

C. Manufacturer's Special Minimum Power Output Warranty: Manufacturer agrees to repair or replace components of PV modules that fail to exhibit the minimum power output within specified warranty period. Special warranty, applying to modules only, on a prorated basis, for period specified.

1. Manufacturer's minimum power output warranties include, but are not limited to, the following warranty periods, from date of Substantial Completion:

a. 10-year limited power warranty for modules exhibiting a power output less than 90% of minimum peak power as specified at date of delivery by the manufacturer if such loss is determined to be caused by a defect in materials or workmanship.

b. 25-year limited power warranty for modules exhibiting a power output less than 80% of minimum peak power as specified at the date of delivery by the manufacturer if such loss is determined to be caused by a defect in materials or workmanship.

D. Inverters

1. Manufacturer's special materials and workmanship warranty: Manufacturer agrees to repair or replace components of combiner boxes that fail in materials or workmanship within specified warranty period.
2. Inverter Manufacturer's materials and workmanship warranties include, but are not limited to, the following:
 - a. Repair, replacement, or refund warranty due to defects in materials or workmanship in normal application, installation, use, and service conditions.
3. Warranty Period: Base warranty of 10 years from date of delivery.
 - a. Contractor to purchase and supply to the owner an additional extended Manufacturer's Warranty to increase the total warranty period to twenty (20) years.

E. Ancillary Equipment

1. Ancillary Equipment such as disconnect switches, cable, wire, conduit, fittings, etc. shall carry the standard warranty as supplied by the equipment manufacturer.

F. Support Structure (Steel Canopy mounted)

1. System Warranty: Contractor shall warrant the system for proper operation and against defects in material and workmanship for a period of twenty (20) years from date of startup.

1.8 CONTRACTOR QUALIFICATIONS

- A. Contractors and all employees working with/for the contractor on this project shall have NABCEP Certification.
- B. Engage an installer having skilled craftsmen or individuals with a minimum of seven (7) years' experience who has successfully completed installations similar in material, design, and extent to that indicated for project.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. The Solar Array Equipment and all components shall be designed, manufactured, installed, and tested in accordance with the latest editions of the following codes and standards:
 1. NFPA 70, National Electrical Code (NEC)
 2. National Electrical Manufacturers Association (NEMA)
 3. Institute of Electrical and Electronics Engineers (IEEE)

- a. IEEE 1547
 - b. IEEE 1547.1
 - c. IEEE C62.41.2
 - d. IEEE C62.45
 - e. IEEE 519-1992
4. Underwriters Laboratory (UL) listed and labeled.
 5. American National Standards Institute (ANSI)
 6. Uniform Solar Energy Code (ICC)
 7. UL Standard 1741

2.2 PERFORMANCE REQUIREMENTS

- A. NRTL (Nationally Recognized Testing Laboratory) Listing: Entire assembly shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for electrical and fire safety, Class C according to UL 1703.

2.3 PV SYSTEMS DESCRIPTION

- A. Hybrid PV System: PV modules connected to provide power to dc and ac loads, connected to utility through interactive inverters or meters, and connected to energy storage. Refer to PV system one-line diagram on electrical drawings.
 1. Number of strings per array as required per contractor's design.
 2. PV Equipment quantity and layout as required per contractor's design.
 3. System Components:
 - a. PV modules.
 - b. Array frame.
 - c. Charge Controller
 - d. Energy Storage
 - e. System Controller
 - f. Utility-interactive inverter.
 - g. Overcurrent protection, disconnect, and rapid shutdown devices.
 - h. Mounting structure.
 - i. PV Cell Materials.

2.4 MANUFACTURED PV UNITS

- A. Cell Materials: Monocrystalline.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equal: Qcells Q.PEAK DUO XL
- C. Module Construction:
 1. Nominal Size: 44.6 inches wide by 96.9 inches long.
 2. Weight: 76.9 lb.

3. Front Panel: Thermally pre-stressed glass.
4. Back Panel: Semi-tempered glass.
5. Bypass Diode Protection: N/A.
6. Junction Box:
 - a. Size: 2.09 by 1.26 by 0.59 inch Minimum.
 - b. IP Code: IP67.
7. Output Cabling:
 - a. Quick, multiconnect, polarized connectors.
 - b. Length: 47 inches
8. Series Fuse Rating: 25A.
9. Minimum Capacities and characteristics
 - a. Rated Open Circuit Voltage (Voc): 53.60 Vdc
 - b. Maximum System Voltage: 1500 Vdc UL
 - c. Rated Short-Circuit Current (Isc): 13.74 A
 - d. Rated Power Point Current (Imp): 13.12 A
 - e. Maximum Power at STC (Pmax): 590 W
 - f. Module efficiency: 21.1 % (minimum)
10. Temperature Coefficients
 - a. Normal Operating Cell Temperature (NOCT): 42 deg. C
 - b. Temperature Coefficient of Pmax: -0.34 %/deg C
 - c. Temperature Coefficient of Voc: -0.27 %/deg. C
 - d. Temperature Coefficient of Isc: 0.04 %/deg C
11. Module Framing: Anodized Aluminum.

2.5 PV ARRAY CONSTRUCTION

A. Framing:

1. Material: G235 Steel.
2. Maximum System Weight: Less than 4 lb./sq. ft.
3. Raceway Cover Plates: Galvanized steel.

B. Steel Support Canopy Mounting:

1. Racking systems attached to standing seams of steel support canopy.
2. 6-inch row spacing.
3. Meeting ASCE 7-98 wind loading criteria for 90 – 120 MPH with proper ballast design and installation.
4. Supply wire tray within PV array.

2.6 INVERTER

- A. Inverter Type: String.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equal: Sunny HighPower
- C. Control Type: Maximum power point tracker control.
- D. Inverter Electrical Characteristics:
 - 1. Maximum Recommended PV Input Power: As required based upon system design.
 - 2. Maximum DC voltage: 1500 Vdc.
 - 3. MPPT Voltage Range: 684 – 1500 Vdc
 - 4. Maximum Input Current: 180A.
 - 5. Number of Independent MPPT Circuits: 1.
 - 6. Nominal Output Voltage: 480/277 V
 - 7. Maximum Output Current: As required based upon system design.
 - 8. Peak Efficiency: 98.5 percent.
 - 9. Communications Interface: Ethernet, MODBUS TCP
 - 10. Utility Interface: Utility-interactive inverter.
 - 11. Topology: Transformerless
- E. Operating Conditions:
 - 1. Operating Ambient Temperatures: Minus -13 to plus 140 deg F.
- F. Protection Devices:
 - 1. DC reverse polarity protection.
 - 2. Ground fault monitoring.
 - 3. DC AFCI compliant to UL 1699B
 - 4. AC short circuit protection.
- G. Enclosure:
 - 1. NEMA 250, Type 4X.
 - 2. Cooling Methods:
 - a. Fan convection cooling.
 - 3. Mounting location: Canopy Supports; under structural mounting equipment.
 - 4. Nominal Size: 31 inches wide by 33 inches long by 18 inches thick.
- H. Characteristics:
 - 1. Inverter Weight: 121 lbs.

I. Communication:

1. Provide and install communication wiring to allow internet access. Coordinate with owner to determine best method of connection. Daisy Chain configuration shall be used to have single controller connection.

2.7 INVERTER MOUNTING

- A. On canopy supports, under solar panel canopy structural mounting.
- B. Corrosion resistant Steel rack structure.
- C. Stainless steel mounting hardware for mounting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until mounting surfaces have been properly prepared.
- B. If preparation of mounting surfaces is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Examine modules and array frame before installation. Reject modules and arrays that are wet, moisture damaged, or mold damaged.
- D. Examine roofs, supports, and supporting structures for suitable conditions where PV system will be installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to:
 1. Test and inspect components, assemblies, and equipment installations, including connections.
 2. Perform phase rotation test prior to connecting power to the inverter output per the manufacturer's recommendations.
 3. Equipment and components will be considered defective if they do not pass tests and inspections.
 4. Prepare test and inspection reports.
- B. Third Party Testing Agency: Engage a third-party testing agency. Testing agency shall have qualified NABCEP Certified individuals to perform these tests.
 1. Perform meter trending on the output of each inverter for a duration of one week with sampling points at 15-minute intervals. These sampling points shall be

compared to the PV monitoring software trending points. PV inverters will be considered functional if sampling points are within +/- 5% of PV monitoring software trending points.

2. Perform an additional follow-up meter trending on the output of each inverter for a duration of one week with sampling points at 15-minute intervals, 11 months after date of Substantial Completion. These sampling points shall be compared to the PV monitoring software trending points. PV inverters will be considered functional if sampling points are within +/- 5% of PV monitoring software trending points.
 3. Perform meter trending at the main circuit breaker of Panel SL and SR for a duration of one week with sampling points at 15-minute intervals. Perform meter trending at Panel SL and SR feeder circuit breaker at existing switchgear for a duration of one week with sampling points at 15-minute intervals. These sampling points shall be compared and must be within +/- 5% of each other.
 4. Perform an additional follow-up meter trending at the main circuit breaker of Panel SL and SR for a duration of one week with sampling points at 15-minute intervals, 11 months after date of Substantial Completion. Perform meter trending at Panel SL and SR feeder circuit breaker at existing switchgear for a duration of one week with sampling points at 15-minute intervals. These sampling points shall be compared and must be within +/- 5% of each other.
 5. PV system will be considered defective if it does not pass tests. Contractor shall investigate and replace defective equipment and components and retest.
 6. Prepare test reports.
- C. When the installation is reported in writing by the Contractor to be complete and ready for acceptance, an inspection shall be made by the Contractor in the presence of the Engineer to ascertain whether it complies with the contract documents. If in the opinion of the Engineer it fails to do so, the Contractor shall at once remedy all defects and shortcomings. Any additional tests that may be required shall be entirely at the Contractor's expense. All the testing work shall be done when and as directed by the Engineer.
- D. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of applicable ANSI and NEMA standards.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Coordinate layout and installation of PV panels with support assembly and other construction.
- C. Support PV panel assemblies independent of supports for other elements such as roof and support assemblies, enclosures, vents, pipes, and conduits. Support assembly to prevent twisting from eccentric loading.
- D. Install PV inverters, energy storage, charge controller, and system control in locations indicated on Drawings.

E. Wiring Method: Install cables in raceways.

F. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.4 CONNECTIONS

A. Coordinate PV panel cabling to equipment enclosures to ensure proper connections.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

3.5 TRAINING

A. Training: Provide up to 8 hours of remote support during microgrid site readiness and commissioning period.

B. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.

1. Use operation and maintenance manual as training reference, supplemented with additional training material as required.
2. Training session shall be recorded and provided digitally to Owner.
3. Provide minimum of eight hours of training.
4. Instructor: Manufacturer's authorized representative.
5. Location: At project site.

END OF SECTION

SECTION 263100
PHOTOVOLTAIC SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. PV modules.
 - 2. Inverters.
 - 3. System overcurrent protection.
 - 4. Mounting structures.
 - 5. Monitoring software
 - 6. Ancillary equipment.
- B. Related Requirements:
 - 1. Section 133419 "Metal Building Systems".

1.3 DEFINITIONS

- A. ETFE: Ethylene tetrafluoroethylene.
- B. FEP: Fluorinated ethylene propylene.
- C. IP Code: Required ingress protection to comply with IEC 60529.
- D. MPPT: Maximum power point tracking.
- E. PV: Photovoltaic.
- F. STC: Standard Test Conditions defined in IEC 61215.
- G. Voc: Open circuit voltage at STC.
- H. Isc: Short circuit current at STC.
- I. Vmpp: Maximum power point voltage.
- J. Impp: Maximum power point current.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for PV panels.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. For PV modules.
 - a. Include plans, elevations, sections, and mounting details.
 - b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - c. Detail fabrication and assembly.
 - d. Include diagrams for power, signal, and control wiring.
 - 2. For PV solar panel standing seam mounting system.
 - a. Include material and design for PV solar panel standing seam mounting system with quantity of ballasted paver blocks per area.
 - 3. For PV inverter.
 - a. Include material and design for PV inverter sizing.
- C. Calculations (applies to AC and DC system):
 - 1. Voltage drop.
 - 2. Conductor ampacity.
 - 3. Conduit size and fill.
- D. Certificates: Submit product certificates signed by the manufacturer certifying material compliance with specified performance characteristics and criteria, and physical requirements.
- E. Delegated-Design Submittal: For PV System. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Buy America Certification: Provide written and signed certification by the manufacturer/contractor that manufactured products meet FTA Buy America requirements of 49 U.S.C. 5323(j)(1) and the applicable regulations in 49 C.F.R. Part 661.5.

- B. Field quality-control reports.
- C. Sample Warranty: For manufacturer's special materials and workmanship warranty and minimum power output warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For all system components. Provide three (3) copies to engineer for distribution. Include as built source circuit string diagrams showing string locations and polarity. Include as built inverter locations and ancillary equipment locations. Include third party testing and field reports.

1.7 WARRANTY

- A. Special Warranty: Contractor shall warrant the system for proper operation and against defects in material and workmanship for a period of two (2) years from date of startup.



- B. Solar Module: Manufacture agrees to repair or replace components of PV modules that fail in materials ~~or workmanship~~ within the specified warranty period.



- 1. Solar Module Manufacturer's materials ~~and workmanship~~ warranties include, but are not limited to the following:



- a. Repair, replacement, or refund warranty due to defects in materials ~~or workmanship~~ in normal application, installation, use, and service conditions.

- 2. Warranty Period: Five years from date of delivery.

- C. Manufacturer's Special Minimum Power Output Warranty: Manufacturer agrees to repair or replace components of PV modules that fail to exhibit the minimum power output within specified warranty period. Special warranty, applying to modules only, on a prorated basis, for period specified.

- 1. Manufacturer's minimum power output warranties include, but are not limited to, the following warranty periods, from date of Substantial Completion:



- a. 10-year limited power warranty for modules exhibiting a power output less than 90% of minimum peak power as specified at date of delivery by the manufacturer if such loss is determined to be caused by a defect in materials ~~or workmanship~~.



- b. 25-year limited power warranty for modules exhibiting a power output less than 80% of minimum peak power as specified at the date of delivery by the manufacturer if such loss is determined to be caused by a defect in materials ~~or workmanship~~.

- D. Inverters

- 4 1. Manufacturer's special materials and workmanship warranty: Manufacturer agrees to repair or replace components of combiner boxes that fail in materials ~~or workmanship~~ within specified warranty period.
2. Inverter Manufacturer's materials ~~and workmanship~~ warranties include, but are not limited to, the following:

- 4 a. Repair, replacement, or refund warranty due to defects in materials ~~or workmanship~~ in normal application, installation, use, and service conditions.

3. Warranty Period: Base warranty of 10 years from date of delivery.

- 4 a. Contractor to purchase and supply to the owner an additional extended Manufacturer's Warranty to increase the total warranty period to ~~twenty (20) years.~~ **ten (10) years.**

E. Ancillary Equipment

1. Ancillary Equipment such as disconnect switches, cable, wire, conduit, fittings, etc. shall carry the standard warranty as supplied by the equipment manufacturer.

F. Support Structure (Steel Canopy mounted)

- 4 1. System Warranty: Contractor shall warrant the system for proper operation and against defects in material and workmanship for a period of ~~twenty (20) years~~ **ten (10) years** from date of startup.

1.8 CONTRACTOR QUALIFICATIONS

- A. Contractors and all employees working with/for the contractor on this project shall have NABCEP Certification.
- B. Engage an installer having skilled craftsmen or individuals with a minimum of seven (7) years' experience who has successfully completed installations similar in material, design, and extent to that indicated for project.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. The Solar Array Equipment and all components shall be designed, manufactured, installed, and tested in accordance with the latest editions of the following codes and standards:
1. NFPA 70, National Electrical Code (NEC)
2. National Electrical Manufacturers Association (NEMA)
3. Institute of Electrical and Electronics Engineers (IEEE)

- a. IEEE 1547
 - b. IEEE 1547.1
 - c. IEEE C62.41.2
 - d. IEEE C62.45
 - e. IEEE 519-1992
4. Underwriters Laboratory (UL) listed and labeled.
 5. American National Standards Institute (ANSI)
 6. Uniform Solar Energy Code (ICC)
 7. UL Standard 1741

2.2 PERFORMANCE REQUIREMENTS

- A. NRTL (Nationally Recognized Testing Laboratory) Listing: Entire assembly shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for electrical and fire safety, Class C according to UL 1703.

2.3 PV SYSTEMS DESCRIPTION

- A. Hybrid PV System: PV modules connected to provide power to dc and ac loads, connected to utility through interactive inverters or meters, and connected to energy storage. Refer to PV system one-line diagram on electrical drawings.
 1. Number of strings per array as required per contractor's design.
 2. PV Equipment quantity and layout as required per contractor's design.
 3. System Components:
 - a. PV modules.
 - b. Array frame.
 - c. Charge Controller
 - d. Energy Storage
 - e. System Controller
 - f. Utility-interactive inverter.
 - g. Overcurrent protection, disconnect, and rapid shutdown devices.
 - h. Mounting structure.
 - i. PV Cell Materials.

2.4 MANUFACTURED PV UNITS

- A. Cell Materials: Monocrystalline.
- B. Basis of Design: Qcells Q.PEAK DUO XL
- C. Module Construction:
 1. Nominal Size: 44.6 inches wide by 96.9 inches long.
 2. Weight: 76.9 lb.
 3. Front Panel: Thermally pre-stressed glass.

4. Back Panel: Semi-tempered glass.
5. Bypass Diode Protection: N/A.
6. Junction Box:
 - a. Size: 2.09 by 1.26 by 0.59 inch Minimum.
 - b. IP Code: IP67.
7. Output Cabling:
 - a. Quick, multiconnect, polarized connectors.
 - b. Length: 47 inches
8. Series Fuse Rating: 25A.
9. Minimum Capacities and characteristics
 - a. Rated Open Circuit Voltage (Voc): 53.60 Vdc
 - b. Maximum System Voltage: 1500 Vdc UL
 - c. Rated Short-Circuit Current (Isc): 13.74 A
 - d. Rated Power Point Current (Imp): 13.12 A
 - e. Maximum Power at STC (Pmax): 590 W
 - f. Module efficiency: 21.1 % (minimum)
10. Temperature Coefficients
 - a. Normal Operating Cell Temperature (NOCT): 42 deg. C
 - b. Temperature Coefficient of Pmax: -0.34 %/deg C
 - c. Temperature Coefficient of Voc: -0.27 %/deg. C
 - d. Temperature Coefficient of Isc: 0.04 %/deg C
11. Module Framing: Anodized Aluminum.

2.5 PV ARRAY CONSTRUCTION

- A. Framing:
 1. Material: G235 Steel.
 2. Maximum System Weight: Less than 4 lb./sq. ft.
 3. Raceway Cover Plates: Galvanized steel.
- B. Steel Support Canopy Mounting:
 1. Racking systems attached to standing seams of steel support canopy.
 2. 6-inch row spacing.
 3. Meeting ASCE 7-98 wind loading criteria for 90 – 120 MPH with proper ballast design and installation.
 4. Supply wire tray within PV array.

2.6 INVERTER

- A. Inverter Type: String.
- B. Basis of Design: Sunny HighPower
- C. Control Type: Maximum power point tracker control.
- D. Inverter Electrical Characteristics:
 - 1. Maximum Recommended PV Input Power: As required based upon system design.
 - 2. Maximum DC voltage: 1500 Vdc.
 - 3. MPPT Voltage Range: 684 – 1500 Vdc
 - 4. Maximum Input Current: 180A.
 - 5. Number of Independent MPPT Circuits: 1.
 - 6. Nominal Output Voltage: 480/277 V
 - 7. Maximum Output Current: As required based upon system design.
 - 8. Peak Efficiency: 98.5 percent.
 - 9. Communications Interface: Ethernet, MODBUS TCP
 - 10. Utility Interface: Utility-interactive inverter.
 - 11. Topology: Transformerless
- E. Operating Conditions:
 - 1. Operating Ambient Temperatures: Minus -13 to plus 140 deg F.
- F. Protection Devices:
 - 1. DC reverse polarity protection.
 - 2. Ground fault monitoring.
 - 3. DC AFCI compliant to UL 1699B
 - 4. AC short circuit protection.
- G. Enclosure:
 - 1. NEMA 250, Type 4X.
 - 2. Cooling Methods:
 - a. Fan convection cooling.
 - 3. Mounting location: Canopy Supports; under structural mounting equipment.
 - 4. Nominal Size: 31 inches wide by 33 inches long by 18 inches thick.
- H. Characteristics:
 - 1. Inverter Weight: 121 lbs.
- I. Communication:

1. Provide and install communication wiring to allow internet access. Coordinate with owner to determine best method of connection. Daisy Chain configuration shall be used to have single controller connection.

2.7 INVERTER MOUNTING

- A. On canopy supports, under solar panel canopy structural mounting.
- B. Corrosion resistant Steel rack structure.
- C. Stainless steel mounting hardware for mounting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until mounting surfaces have been properly prepared.
- B. If preparation of mounting surfaces is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Examine modules and array frame before installation. Reject modules and arrays that are wet, moisture damaged, or mold damaged.
- D. Examine roofs, supports, and supporting structures for suitable conditions where PV system will be installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to:
 1. Test and inspect components, assemblies, and equipment installations, including connections.
 2. Perform phase rotation test prior to connecting power to the inverter output per the manufacturer's recommendations.
 3. Equipment and components will be considered defective if they do not pass tests and inspections.
 4. Prepare test and inspection reports.
- B. Third Party Testing Agency: Engage a third-party testing agency. Testing agency shall have qualified NABCEP Certified individuals to perform these tests.
 1. Perform meter trending on the output of each inverter for a duration of one week with sampling points at 15-minute intervals. These sampling points shall be compared to the PV monitoring software trending points. PV inverters will be

- considered functional if sampling points are within +/- 5% of PV monitoring software trending points.
2. Perform an additional follow-up meter trending on the output of each inverter for a duration of one week with sampling points at 15-minute intervals, 11 months after date of Substantial Completion. These sampling points shall be compared to the PV monitoring software trending points. PV inverters will be considered functional if sampling points are within +/- 5% of PV monitoring software trending points.
 3. Perform meter trending at the main circuit breaker of Panel SL and SR for a duration of one week with sampling points at 15-minute intervals. Perform meter trending at Panel SL and SR feeder circuit breaker at existing switchgear for a duration of one week with sampling points at 15-minute intervals. These sampling points shall be compared and must be within +/- 5% of each other.
 4. Perform an additional follow-up meter trending at the main circuit breaker of Panel SL and SR for a duration of one week with sampling points at 15-minute intervals, 11 months after date of Substantial Completion. Perform meter trending at Panel SL and SR feeder circuit breaker at existing switchgear for a duration of one week with sampling points at 15-minute intervals. These sampling points shall be compared and must be within +/- 5% of each other.
 5. PV system will be considered defective if it does not pass tests. Contractor shall investigate and replace defective equipment and components and retest.
 6. Prepare test reports.
- C. When the installation is reported in writing by the Contractor to be complete and ready for acceptance, an inspection shall be made by the Contractor in the presence of the Engineer to ascertain whether it complies with the contract documents. If in the opinion of the Engineer it fails to do so, the Contractor shall at once remedy all defects and shortcomings. Any additional tests that may be required shall be entirely at the Contractor's expense. All the testing work shall be done when and as directed by the Engineer.
- D. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of applicable ANSI and NEMA standards.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Coordinate layout and installation of PV panels with support assembly and other construction.
- C. Support PV panel assemblies independent of supports for other elements such as roof and support assemblies, enclosures, vents, pipes, and conduits. Support assembly to prevent twisting from eccentric loading.
- D. Install PV inverters, energy storage, charge controller, and system control in locations indicated on Drawings.
- E. Wiring Method: Install cables in raceways.

- F. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.4 CONNECTIONS

- A. Coordinate PV panel cabling to equipment enclosures to ensure proper connections.
- B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

3.5 TRAINING

- A. Training: Provide up to 8 hours of remote support during microgrid site readiness and commissioning period.
- B. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training material as required.
 - 2. Training session shall be recorded and provided digitally to Owner.
 - 3. Provide minimum of eight hours of training.
 - 4. Instructor: Manufacturer's authorized representative.
 - 5. Location: At project site.

END OF SECTION