

Photovoltaic System Design and Installation Criteria Proposition 39 Energy Savings Projects at Waterford High School, Waterford, CA

Table of Contents

Schedule A

- I. Design Criteria**
- II. Electrical Interconnection**
- III. Codes, Standards, Regulations and Permitting**
- IV. Major Equipment**
- V. Contractor Design Services Description**
- VI. Contractor Construction Services Description**
- VII. Attachments**

Attachment 1 –Electrical Specifications

Attachment 2 –PV Commissioning Requirements

Attachment 3 – RESERVED

Attachment 4 – Images for Sites

Attachment 5 – Simulated Power Production – Fixed System

Attachment 6 – MID Net Metering Application

Attachment 7 – MID Electric Service Guide Solar PV

Attachment 8 – MID Electric Service Rule 21

Attachment 9 – MID Electric Solar Handbook 2019

Attachment 10 – MID Net Metering Agreement

Attachment 11 – MID NET METERING 2.0 Schedule

**SCHEDULE A
CONTRACTOR'S WORK**

ECM-01: INSTALL SOLAR PHOTOVOLTAIC ARRAYS

SCOPE OF WORK

I. GENERAL DESCRIPTION OF CONTRACTOR'S WORK

- A. Contractor shall provide one (1) complete turn-key installations of Solar Photovoltaic (PV) Array Energy Conservation Measures (ECMs) (the "Project") at the following facility: Waterford High School located at: 121 S. Reinway Ave, Waterford, CA 95386, owned and operated by the Waterford Unified School District (the "Owner"). Contractor's work encompasses, but is not limited to, the following:
 - 1. Base Bid: Contractor shall design, fabricate, furnish, and install one (1) turn-key fixed solar photovoltaic (PV) electric generating system mounted on a permanent cantilever-style, single axis-supported, single-slope shade structure at Waterford High School. The approximate dimensions of the shade structure will be 70'x30', and initial solar capacity models indicate that the capacity of PV systems of this size and at this location are approximately 32 kW-DC.
- B. The Contractor shall perform all Work to provide complete and functional systems in accordance with Schedule A – Contractor's Work, Sections I & II and the referenced attachments in the Table of Contents.
- C. The Work and all supporting Contract Documents serve to define the intent of the Work and shall not be interpreted as a detailed specification. Contractor shall provide a complete and operational Project on a Design/Build basis in compliance with Contractor's other obligations under Schedule A. The sample Contract Agreement can be found in the *Short Bid Form Documents and General Conditions*. Contractor shall perform all Work specified in Schedule A and all other work as is necessary to support achievement of the objectives set herein. It is understood and agreed that the intent of the Agreement is to relieve the Owner of the necessity of engaging in or supplying any labor, service, material or equipment to complete the Project, except to the extent any such obligation is expressly required to be provided by Owner herein. Contractor shall submit all known matters requiring interpretation to Owner, in writing, for resolution prior to the start of Work.
- D. Contractor shall not proceed with any construction Work under this Contract, until authorized by Owner's written Notice to Proceed. The execution of this Contract is authorization for Contractor to proceed with engineering and design. A Notice to Proceed is defined as the starting date and time which Contractor is authorized by Owner to commence pre-construction Work as detailed herein. Site construction work shall not commence until June 30, 2019. Under no circumstances shall Contractor start any construction Work without receipt of a "Notice to Proceed" from Owner's Project Manager. This Notice to Proceed may be issued in the form of an email, letter or facsimile.
- E. Project Schedule:
Construction work shall commence on June 30, 2019 or later with construction and final commissioning to be complete prior to May 8, 2020.
- F. Project Deliverable Schedule.
 - 1. Contractor shall provide, at a minimum, the following Deliverables to Owner:

Item No.	Description	Copies Required for Submission	Format (Paper/Electronic)	Due
1	75% Design package with catalog data for all equipment & materials being furnished	5	Electronic & Paper	Within 30 days after NTP
2	100% Completed Design	5	Electronic & Paper	Within 15 days after receipt of review comments on 75%

Item No.	Description	Copies Required for Submission	Format (Paper/Electronic)	Due
				Design
3	Draft Commissioning Plan for Owner review	3	Electronic & Paper	Within 30 days after NTP
4	Final Commissioning Plan with Owner comments incorporated	3	Electronic & Paper	Within 15 days after receipt of review comments
5	Draft Training Plan for Owner review	3	Electronic & Paper	Within 30 days after NTP
6	Final Training Plan with Owner comments incorporated	3	Electronic	Within 15 days after receipt of review comments
7	Contract Administration			
8	Certificate of Insurance	1 & 1	Paper	Needed for Award
9	Payment & Performance Bonds	1 & 1	Electronic & Paper	Immediately
10	Project Schedule & Schedule Access Request: 3 week look ahead	1	Electronic or paper	Project Schedule Monthly and 3 week look ahead submitted prior week
11	Standard Forms from Contract Agreement	1	Paper	5 days after contract award
12	Safety toolboxes meeting minutes	1	Paper	Weekly (1 st day of the week)
13	Weekly Reports	1	Paper	Weekly (last day of the week)
14	Payment application	1 & 3	Electronic & Paper	Monthly by the 15th
15	Notice & Requests			
16	Requests for Work Outside Normal Hours	1	Electronic or paper	15 work days prior to start of work
17	Utility Shutdown Requests	1	Electronic or paper	15 work days prior to shutdown
18	Security Clearance Staffing Requests	1	Electronic or paper	10 days after the Effective Date of the Contract Agreement
19	Operation & Maintenance Manuals			
20	Draft Manuals for Owner review	3	Paper or electronic	10 days after Substantial Completion
21	Final Manuals with Owner comments incorporated	1 & 3	Electronic & Paper	25 days after Substantial Completion
22	As-Built Drawings			
23	As-Built Drawings progress reviews	10	Paper	Monthly
24	As-Built Drawings for Owner review	1 & 3	Electronic & Paper	10 days after Substantial Completion
25	Final As-Built Drawings with Owner comments incorporated	1 & 3	Electronic & Paper	25 days after Substantial Completion

II. DETAILED DESCRIPTION OF CONTRACTOR'S WORK

Base Bid: Waterford High School

Waterford High School –Scope Area

The southern edge of the existing open grass area directly to the north of the Multi-purpose building amphitheater stage will be designated as the area to install a permanent shade structure with a PV system on its roof. The shade structure will be positioned such that ~50% of the short sides cover the southern edge of the existing grass area, and ~50% cover the existing concrete area.

Proposed Scope of Work:

The permanent shade structure shall be of cantilever-style, single axis-supported, single-slope design and comprised of structural steel with a continuous roof or decking designed to shade and fully protect the area below from the weather/rain. At Waterford High School the shade structure shall be slightly pitched downward (<15°) to the south, in order to increase electricity production and shed rain. Each structure shall have a permanent rain gutter system incorporated into the structure.

On the shade structure, the Contractor shall design, furnish, and install a fixed array solar PV system complete with monocrystalline or polycrystalline solar PV panels, string inverters, balance of system, electrical equipment, electrical interconnections, and structural racking system. The scope of work includes turn-key procurement and installations of the complete solar PV system, including any necessary structural and or soil analysis, electrical studies, concrete work, utility interconnect agreements, and permitting. This scope also includes any site prep that may be required, including grading and vegetation removal.

1) Site Prep

- a) Contractor shall install concrete as needed under shade structure and for support stanchions. At Waterford High School, new concrete will be installed under shade structure and extending out 5' to the north, east, and west structure edges as needed to replace the grass in this area. Grading of the adjacent grass area may be required for a level transition from new concrete to existing grass.
- b) Contractor shall cut and/or patch the existing concrete slab as needed in order to install the permanent shade structure, electrical conduit, etc.

2) New Work

- a) Shade Structure:
 - i) The shade structure and PV system base design shall be pre-approved (i.e., pre-check, or PC) by the State of California Division of State Architect (DSA).
 - ii) The shade structure of approximately 70'x30' dimensions shall be constructed of structural steel and meet the wind load requirements of the latest adopted version International Building Code (IBC) and California Building Code 2016. The structure design shall be cantilever-style, single-slope, and supported from a single axis. Efforts should be taken to minimize the number of support columns so as to maximize the usable space beneath the structure.
 - iii) The shade structure's low (south) edge shall be at least 15' above the grade (existing concrete) level.
 - iv) LED lighting shall be furnished and installed in order to provide illumination under the structure during periods of darkness. The lights shall be outdoor rated and controlled from both a photocell mounted on top of the structure as well as motion/occupancy sensors mounted under the structure canopy or incorporated into each fixture.
 - v) LED dual-lamp flood light fixtures shall be mounted to the top of the shade structure, one fixture at each corner, and projecting light outward and downward to illuminate the grounds surrounding the structure. The lights shall be outdoor rated and controlled from a photocell mounted on top of the structure (photocell specified in 2.v. above can be utilized for both lighting applications). The flood lights shall be switched via an outdoor rated key-box located on a structure support.

- vi) The shade structure shall have eight (8) 120V dual receptacles with outdoor rated boxes/enclosures and GFCIs. The receptacles shall be mounted along the structure columns at approximately 4' above the existing concrete slab.
 - vii) Bird deterrent spikes shall be installed on the top sides of all horizontal structure surfaces and any other structure surface that would support bird nesting or roosting.
- b) PV Equipment and Sizing:
- i) The proposed system shall be mounted on the new shade structure and installed at an angle (<15° south) for shedding rain and increased energy production.
 - ii) Furnish and install PV modules, racking system, and inverters for a solar array system.
 - (1) Major equipment shall meet the design criteria outlined below
 - (2) Furnish and install PV modules to maximize the PV capacity for a structure of approximately 70'x30' dimensions. Initial solar capacity models indicate the capacity of a PV system of this size and at this location is approximately 32 kW-DC (based on STC rating of modules).
 - (3) PV Modules shall be UL Listed to meet Standard 1703, and be manufactured by one of the following manufacturers:
 - (a) LG
 - (b) Panasonic
 - (c) SunPower
 - (4) All systems must use components listed on the CEC list of Eligible Equipment (<https://www.gosolarcalifornia.ca.gov/equipment/index.php>)
 - iii) Solar PV inverter(s) and all associated equipment shall be UL Listed to meet Standard 1741.
 - (1) Inverters shall be provided based on design criteria listed in Section I: Design Criteria, following the Schedule A section.
 - (2) All equipment will be installed in accordance with manufacturer's instructions.
 - (3) All systems must use components listed on the CEC list of Eligible Equipment (<https://www.gosolarcalifornia.ca.gov/equipment/index.php>)
- c) Electrical Work:
- i) PV system shall be interconnected to existing electrical panel that can accommodate the load in accordance with the NEC. Contractor shall field investigate and determine optimal point of interconnection on the existing electrical system.
 - (1) Provide field verification that selected panel can accommodate electric load from the proposed PV system prior to starting work.
 - (2) Contractor shall be responsible for all trenching, road patching, concrete work, etc. for electrical interconnection per current NEC codes.
 - ii) Verify existing and new circuit breakers in the feedback circuit are reverse feed rated. Provide and install new reverse feed circuit breakers with the proper AIC rating and trip settings required by the NEC if the existing breakers are not reverse feed rated.
 - iii) Interconnection: The PV systems shall be interconnected to the Customer's electrical distribution system. The PV system shall comply with current guidelines governing interconnection with the electrical distribution system, and any subsequent revisions to these guidelines.
 - iv) AC Disconnect: Furnish and install a utility-accessible AC disconnect per utility interconnection requirements. All solar electric generation systems are required to have an alternating current, full load break disconnect switches with a lockable handle. The handle shall be capable of locking in the open position and the switch contacts must provide a "visible open". This requirement assures that no electricity can back feed into the service panel which could result in personal injury or damage to the equipment. Modesto Irrigation District (MID) must be able to isolate the electric meter to perform maintenance in a safe manner.
- d) Structural Work:
- i) The structure shall be electrically grounded.

- ii) The structural steel for the mounting structure shall be galvanized steel.
- iii) PV system shall be designed for wind loads in accordance with the latest adopted version International Building Code (IBC) and California Building Code 2016.

I. Design Criteria

- A. The design intent is to provide turn-key solar photovoltaic (PV) systems with corrosion resistant mounting structures as outlined below:
 - 1. Provide and install permanent shade structure roof mounted PV arrays.
- B. The PV system and structure shall meet the requirements of the latest adopted version International Building Code (IBC) and California Building Code 2016.
- C. Contractor shall provide a draft submittal of Interconnect Agreement for Owner review and approval for each installation meter being supplied with PV power.
- D. Contractor shall obtain all local permits required to install PV systems.
- E. Design shall be based on monocrystalline or polycrystalline PV panels manufactured by LG, Panasonic, or SunPower and listed on the CEC list of Eligible Equipment (<https://www.gosolarcalifornia.ca.gov/equipment/index.php>).
- F. Arrays shall be fixed mounted at tilt angles optimized for production (<15° south).
- G. Design shall be based on inverters listed on the CEC list of Eligible Equipment (<https://www.gosolarcalifornia.ca.gov/equipment/index.php>).
- H. Design shall include balance of system (BOS): accumulation panels, metering, conductors, raceways, safety disconnect switches (AC and DC), over-current protection devices, DC combiner and re-combiner boxes as necessary, junction boxes, grounding weather station, and lightning protection.
- I. Racking systems shall be permanent and corrosion resistant.
- J. Finished shade structure with racking system and panels shall be impermeable to rain.
- K. Each location shall include web-based monitoring system using the approved installed inverter.
- L. Complete system shall have a monitoring system capable of transmitting operational data over existing local cell networks.
 - 1) Data to be transmitted shall be:
 - (a) Current power production
 - (b) Current and accumulated energy production
 - (c) Solar irradiance data accumulated

II. Electrical Interconnection

- A. The system shall be permitted under the Modesto Irrigation District (MID) Net Energy Metering (NEM) rules and guidelines.
- B. A detailed analysis of the historical utility bills indicates that the solar PV system will offset power purchased from MID and may also export power back to the grid.
- C. Contractor shall work with Owner to prepare the application documents and prepare final designs per the requirements delineated by MID after the review and approval of the Interconnect Application. Additional equipment as required by MID shall be part of the final design documents.
- D. Contractor shall prepare a final expected power production and California Solar Imitative solar calculator and shall submit to Owner for inclusion in the Interconnection Application, submitted to MID.
- E. Contractor shall provide and install reverse fed circuit breakers sized per NEC for the interconnection. Contractor shall be responsible for retrofits of existing panel boards to make interconnection code compliant (i.e. increase bus ampacity, replace main circuit breakers, and ground bus) as applicable.

III. Codes, Standards, Regulations and Permitting

- A. All design and construction under this Agreement shall comply with the current codes and standards of the Owner, State of California, and City of Waterford. Contractor shall obtain such requirements from the jurisdictions having authority. Notwithstanding any City requirements, construction for this work shall comply with the most recent currently approved version of the following codes and standards:
1. 2016 CA Building Codes and Standards
 2. International Building Code 2018 Edition (IBC);
 3. National Electrical Code, NFPA 70 2017 Edition (NEC);
 4. National Fire Protection Association (NFPA),
 5. American National Standards Institute (ANSI);
 6. Institute of Electrical and Electronic Engineers (IEEE);
 7. National Electrical Standards for Construction (NECA);
 8. Modesto Irrigation District Electrical Service Guide Solar Photovoltaic;
 9. Modesto Irrigation District Electrical Service Rule 21
 10. US Department of Labor – Occupational Safety & Health Act (OSHA); and
 11. IEEE 1547 (current version) Standard for Interconnecting Distributed Resources with Electric Power Systems (including use of IEEE 1547.1 testing protocols to establish conformity)
 12. UL 1741 Inverters, Converters, and Controllers for Use in Independent Power Systems
 13. IEEE Std 929-2000 IEEE Recommended Practice for Utility Interface of Photovoltaic (PV) Systems
 14. IEEE SW C37.90.1-2002, IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems
 15. IEEE Std C37.90.2-2004, IEEE Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers
 16. IEEE SW C37.108-2002, IEEE Guide for the Protection of Network Transformers
 17. IEEE Std C57.12.44-2000, IEEE Standard Requirements for Secondary Network Protectors
 18. IEEE Std C62.41.2-2002, IEEE Recommended Practice on Characterization of Surges in Low Voltage (1000V and Less) AC Power Circuits
 19. IEEE Std C62.45-2002, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits
 20. ANSI C84.1-2016 Electric Power Systems and Equipment - Voltage Ratings (60 hertz) IEEE Std 100-2000, IEEE Standard Dictionary of Electrical and Electronic Terms NEMA MG 1-1998, Motors and Small Resources, Revision 3
 21. IEEE SW 519-2014, IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
 22. NEMA MG 1-2016, Motors and Generators, Revision 1
- Contractor shall comply with the requirements of Attachment 1 and Attachment 2 for commissioning photovoltaic systems.
- B. Applicable Guidelines, Regulations and Standards shall include but are not limited to: NEC Article 690 – Solar PV Systems; Article 705 – Interconnected Electric Power Production Sources; Article 250 – Grounding; and Article 110 – Requirements for Electrical Installations; UL1741 – Standard for Static Inverters and charge Controllers for Use in PV Power Systems.
- C. All construction related permits necessary for this Scope of Work shall be acquired by Contractor. The equipment includes, but is not limited to: PV modules, inverters, disconnects,

wire, conduit, junction boxes, mounting hardware and monitoring equipment. The system shall be utility grid connected. Contractor shall be responsible for all required local utility coordination, approval, and applications for the complete interconnection of the PV system with the local utility grid, including bi-directional utility meter if required.

IV. Major Equipment

- A. Solar Panels manufactured by LG, Panasonic, or SunPower and listed on the CEC list of Eligible Equipment (<https://www.gosolarcalifornia.ca.gov/equipment/index.php>).
- B. Inverters listed on the CEC list of Eligible Equipment (<https://www.gosolarcalifornia.ca.gov/equipment/index.php>).

V. Warranty

- A. In accordance with the General Conditions of the Sample Contract Article 3.4, Warranty, Contractor warrants that all Work shall be free from deficiencies in design, materials, and workmanship for a minimum period of one (1) year from the date of Final Completion.
- B. The following manufacturers' warranties apply to equipment installed under this Agreement:

PV Modules	Minimum 20 years on Production (at a minimum of 80% of rated power output)
Inverter	Minimum 10 years

- C. Contractor shall respond to all warranty issues within 24 hours of notification.
- D. Establish Contractor and Owner points of contact (name and phone number) for use by both parties in providing response to equipment failures during the warranty period.
- E. Maintenance and Service for Operational Equipment During Implementation:
 - 1. Contractor shall maintain and service all newly installed equipment until such time that all Work is Substantially Complete and the Owner has been provided system training.
 - 2. Contractor shall be responsible for such equipment operation, maintenance, repair and shall respond to service/repair calls as follows:
 - a. Non-emergency telephone response within four (4) hours.
 - b. Non-emergency on-site response within one (1) business day.
 - c. Emergency telephone response within two (2) hours.
 - d. Emergency on-site response within eight (8) hours.

VI. Contractor Design Services Description

A. General Design Submission Requirements

- 1. Engineering design documentation shall include electronic format for interim submissions. All drawings shall be done in electronic format, AutoCAD 2010 or later version drawing files for drawings and PDF for equipment/material cut sheets as required. These drawings shall convey the Scope of Work to the design/build contractors for installation.
- 2. Contractor shall prepare all design drawings, including Electrical, Structural and Architectural Drawings required to obtain the MID Interconnect Agreement and to obtain design approval and building permit from the Division of State Architect (DSA).
- 3. Design submissions shall be submitted to Owner as outlined in Section I.F.1 Schedule of Deliverables.
- 4. Contractor's drawings shall be stamped by a Professional Engineer licensed in the State of California, and be included on the California Division of State Architect (DSA) pre-check (PC) list. Each discipline shall have a licensed engineer overseeing the design work.

5. The Contractor shall be responsible for code evaluation and conformance to all applicable codes and standards, including all codes and guidelines applicable to the State of California.
6. Owner shall coordinate with Contractor to ensure all available site specific information required for a complete design is obtained. Contractor is expected to become familiar with the site, requiring site visits before and during the design phase. Contractor is required to acquire additional information as needed from the site. Contractor shall field verify conditions and locations of all existing components, equipment and services and, if necessary, revise the design accordingly. If drawings are not available, it will be the Contractor's responsibility to create backgrounds sufficient enough to clearly convey the design intent.
7. Contractor shall be responsible for equipment selection and design calculations. The Contractor shall be responsible for performing calculations for the system to produce the projected electricity output.
8. The Contractor shall verify the equipment selection (selected by Owner during preliminary design) to ensure the final selection does not adversely affect the intent.
9. Contractor shall provide complete Construction Specification Institute (CSI) format Specifications (book type) for all disciplines.
10. Owner shall respond to Contractor's requests for information and prepare written responses on Contractor forms.
11. Contractor's design package shall be provided to design/build Contractors for permitting and installation of the proposed measure. The Contractor shall maintain the design intent of the preliminary scope of work prepared by Owner. Contractor shall not issue drawing changes, which impact project cost, unless reviewed and approved by Owner.

B. 75% Design Phase

Contractor shall submit to Owner for review, in accordance with the Schedule of Services Deliverables outlined in Section I.F.1, the following design deliverables at a minimum:

1. System production calculations using PV Watts, Helioscope, Aurora, or other Owner-approved program.
2. Electrical Drawings (minimum size 24"x 36") which shall include the following:
 - a. Scaled site plans showing all utility tie-ins, equipment location and general conditions (minimum scale shall be 1/8" = 1'-0").
 - b. Electrical plans identifying equipment locations, power connections, etc.
 - c. Electrical one-line drawings, which clearly identify the existing system, new work and points of connection.
 - d. Electrical three-line diagrams (as required by utility)
 - e. All applicable details required for a complete installation (i.e. lighting, underground conduit, mounting, grounding and lightning protection details)
 - f. Specifications.
 - g. Riser diagram of monitoring system and weather station
 - h. All applicable calculations:
 - i. Equipment feeder and panel board sizing.
 - ii. PV System output based on Standard Test Conditions (STC), both annual production and peak power.
- 1) Architectural Drawings (minimum size 24"x 36") which shall include, but is not limited to, the following:
 - a. Evaluate the shading structure construction and provide any details needed to address the required building modifications.
 - b. Roof sections.
 - c. Shading structure penetrations.
 - d. Specifications.
- 2) Structural Drawings (minimum size 24"x36") which shall include, but is not limited to, the following:
 - a. Equipment anchoring plan (including soils report for ground-mount)
 - b. Specifications.

C. 100% Design Submission Requirements

This phase shall be referred to as the 100% Design. The Consultant shall incorporate Owner's 75% Design review comments into this submission.

1. The 100% Design shall include the following:
 - a. Complete electrical design drawings including details, schedules, and specifications.
 - b. Complete structural drawings including details and specifications.
 - c. Complete architectural plans including details, schedules, and specifications (if required).
 - d. All miscellaneous details and specifications required for all general conditions.
2. Final design calculations if modifications were made to the 75% Design submission.
3. This submission will be stamped and signed by the appropriate licensed professional.

D. 100% Design Submission to Division of State Architect (DSA)

1. This submission shall incorporate all Owner's comments from the 100% Design submission.
2. This submission will be stamped and signed by the appropriate licensed professional.
3. Contractor shall submit all necessary drawings and calculations for each system and obtain approval from the DSA.
4. Contractor shall be responsible for Permit application and review fees.

E. Final "As-Built" Drawing Submission Requirements

1. Contractor shall maintain a set of the one hundred percent (100%) drawings throughout construction that will show all red-lined changes. Contractor shall convert the red-lined drawings to As-Built record drawings. The Contractor will incorporate all changes into the original electronic version of the one hundred percent (100%) drawings.
2. The Contractor shall provide both reproducible hard copies and electronic copies of the record drawings as outlined in the Schedule of Deliverables in Section I.F.1. Owner will require record drawings to be stamped with California PE license.

VII. Contractor Construction Services Description

- A. Contractor shall provide all labor, equipment, field material for installation and interconnection, installation testing, and supervision required to install shade structure and structure-mounted photovoltaic systems listed in the Scope of Work per the approved design performed by Contractor.
- B. Equipment procured and installed shall include, but is not be limited to, the following:
 1. Photovoltaic panels.
 2. Inverters
 3. Roof mounted systems as required to meet the wind exposure classification required by code
 4. All wiring, raceways, disconnect switches, over-current protection devices, direct current (DC) combiner and re-combiner boxes, junction boxes, and hardware as required.
 5. Switchgear and electrical hardware as is necessary to properly connect the solar system to the existing electrical gear at each shade structure where the PV is mounted.
 6. Corrosion resistant mounting hardware.
 7. Inverter output to tie into building's existing electrical switchgear.
 8. Transfer of all equipment warranties to Owner.
 9. Electric utility inspection coordination.
- C. Training
 1. Owner Personnel Training for: Thirty (30) days prior to Substantial Completion, the Contractor shall train Owner personnel and/or Owner's Operations and Maintenance

(O&M) contractors as required to operate, maintain, and repair new PV equipment and systems in the event of emergencies. Contractor shall submit for Owner's approval a training binder as per the Schedule of Deliverables in Section I.F.1.

2. The Contractor shall prepare a revised written work procedure and checklist for written acceptance by the Owner as per the Schedule of Deliverables in Section I.F.1. The Contractor shall train personnel in the operations work procedures.
3. Training Program - General Requirements: The Contractor shall provide a site specific training program for Owner personnel and/or Owner O&M contractors. The program shall provide instruction on operation, troubleshooting, maintenance, and repair of the system. The course material shall include the O&M Manuals. Training shall be conducted at the project site.
 - a. Contractor shall provide a knowledgeable and trained instructor as necessary to give full direction to designated personnel on the operation of the system(s) installed.
 - b. Contractor shall provide all students with a student binder containing product-specific training modules for the system(s) installed.
 - c. Contractor shall provide training to Owner which shall include the following:
 - i) Explanation of any documents and O&M manuals.
 - ii) Walk-through of the Project to locate equipment and control components.
 - iii) Operator control functions and field panel programming.
 - iv) Explanation of adjustment, calibration, and replacement procedures.
 - v) Explanation of override procedures.
 - vi) Provide Student binder with training modules.
 - d. Contractor shall provide documentation and training covering the operation and maintenance of the installed systems. The documentation shall cover, but is not limited to, the following:
 - i) Review O&M of all equipment.
 - ii) Troubleshooting of all newly installed equipment.
 - iii) Provide overview of scheduled preventive maintenance.
 - iv) Provide overview of non-scheduled maintenance.
 - v) Repair procedures.
 - vi) Emergency shutdown procedures.
 - vii) Warranty procedures and contact information.
 - viii) Walk-through and system component identification.