

SPECIFICATION SECTION 48 14 00 PHOTOVOLTAIC SYSTEM

PART 1 -GENERAL

1.01 RELATED DOCUMENTS

- A. The Contract and any design-build bridging documents.
- B. Section 26 00 00 General Electrical Specifications
- C. Section 05 90 02 Solar PV Canopy Structures Specification
- D. Section 05 90 04 Solar PV Roof-Mount Structures Specification
- E. Other relevant Judicial Council Specifications

NOTE: Where this specification and other specifications or bridging-documents are in conflict, the more stringent shall apply. Contractor shall identify conflicts and confirm recommended equipment or procedures with the Judicial Council.

1.02 CODES & REFERENCES

- A. The design and installation shall conform to all requirements as defined by the applicable codes, laws, rules, regulations and standards of applicable code enforcing authorities (Latest Edition unless otherwise noted). The following are key standards that shall be followed. The Architect/Engineer of Record and Contractor shall ensure all applicable codes are followed:
 - 1. ASTM International (ASTM) (www.astm.org), including:
 - a. E3010, Standard Practice for Installation, Commissioning, Operation, and Maintenance Process (ICOMP) of Photovoltaic Arrays
 - 2. American National Standards Institute (ANSI)
 - 3. California Building Code (CBC), with State of California Amendments
 - 4. California Energy Commission Title 24 Building Energy Efficiency Requirements
 - 5. California Department of Forestry and Fire Protection, Office of the State Fire Marshal – Solar Photovoltaic Installation Guidelines
 - 6. Institute of Electrical and Electronics Engineers (IEEE)
 - 7. International Electrotechnical Commission (IEC), including:
 - a. 62446-1 Photovoltaic (PV) systems – Requirements for testing, documentation and maintenance. Part 1: Grid connected systems – Documentation, commissioning tests and inspection.
 - 8. International Electrical Testing Association (NETA)
 - 9. Local Fire Permit Requirements
 - 10. National Electrical Manufacturers Association (NEMA)
 - 11. National Fire Protection Association (NFPA), National & California Electrical Code
 - 12. Underwriters Laboratory (UL), including:
 - a. UL 2703 – Standard for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for use with Flat-Plate Photovoltaic Modules.
 - 13. Utility company standards and requirements
 - 14. For projects under the Purview of the Division of the State Architect (DSA)
 - a. DSA IR-16-8 (most recent) Guidelines
 - b. DSA PL-07-02 (most recent) Guidelines

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15. American Concrete Institute (ACI)
16. American Institute of Steel Construction (AISC)
17. American Society of Civil Engineers (ASCE)
18. National Institute of Standards and Technology (NIST)
19. National Roofing Contractors Association (NRCA)
20. National Renewable Energy Laboratory (NREL)
21. Occupational Safety and Health Administration (OSHA)
22. Structural Engineers Association of California (SEAC)
23. Unified Facilities Criteria (UFC)
24. Unified Facilities Guide Specifications (UFGS)
25. Judicial Council Specifications and Requirements
26. All other applicable Codes and Ordinances

1.03 GENERAL

- A. "Judicial Council" shall refer to Judicial Council of the State of California, owner of the site(s) where project will be located, regardless of system ownership, and include any representative of the site Judicial Council, such as independent engineers, consultants or inspectors. "Contract" refers to the design-build and/or construction contract and any associated design-build bridging documents, inclusive of requirements outlined in the request for proposals (RFP). "Contractor" refers to the entity performing the work, inclusive of Engineer(s) and Architect(s) of Record for design-build contracts, post construction system operator, and financier. This is a design-build project and includes the design and construction of complete Photovoltaic Systems (PV), including all AC, DC and balance of system components. The design and installation shall conform to all requirements as defined by the applicable codes, laws, rules, regulations and standards as specified in the Contract.
- B. The Contractor shall include all items and all work reasonable required to complete the System in accordance with the Agreement. If the Contractor is in doubt as to the intent of any portion of these specifications, or necessary information is omitted, the Contractor shall notify the Judicial Council in writing for clarifications or corrections to be provided by addendum.
- C. All design documents, cut sheets, shop drawings, and technical specifications shall be submitted, reviewed and accepted by the Judicial Council per the guidelines specified in the Contract and any bridging documents.

1.04 WORK INCLUDED

- A. The work shall include the design, engineering, materials, labor, equipment, installation, testing, services, and incidentals necessary to install complete Photovoltaic (PV) Systems in conformity with the Contract, applicable codes and professionally recognized standards. The Contractor shall generate safe and reliable electricity from solar photovoltaic (PV) system(s) sited on over the contract life. The electricity shall feed into the Judicial Council electrical distribution systems on the "customer side" of the utility meter. The Contractor will design and construct, own, and operate the solar PV system(s) built and operated on-site.
- B. The system shall convert solar radiation into AC electric power at a voltage compatible with the local utility grid power distribution system and acceptable to the local utility distribution company. At a minimum, each system shall consist of:

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1. A solar PV generation system consisting of arrays of framed photovoltaic modules.
 2. All necessary support structures and mounting provisions.
 3. All necessary reinforcement of the existing support structure.
 4. Terminal boxes and combiner boxes.
 5. Quick-connect electrical connectors.
 6. DC wiring and conduits.
 7. DC disconnects.
 8. Utility interactive inverters
 9. AC disconnects.
 10. AC feeders and conduits.
 11. Transformers.
 12. AC circuit breakers.
 13. AC panel boards / switchgear.
 14. All metering and control equipment.
 15. Complete data acquisition and monitoring systems, data retrieval subsystem, and monitoring and data services for the term of contract
 16. Ground and arc fault protection and alarming
 17. An electrical grounding subsystem
 18. Everything necessary to interconnect with the site electrical distribution system
 19. Any other equipment described or inferable from the Contract.
- C. The PV systems shall be utility grid connected as net energy metering (NEM or NEM-A) or RES-BCT project. The Contractor shall be responsible for all interconnection coordination during design and construction, including review of any previous interconnect applications, utility company coordination, revisions to interconnect applications as-needed, inspections, permits, and final approval for the complete interconnection of the PV systems with the utility company grid, including bi-directional utility meters at each location. The Contractor shall ensure that the design and construction does not void any tariff grandfathering achieved by the initial interconnect applications submitted with the utility.
- D. The Contractor shall ensure adequate clearance and equipment space within the allotted areas and existing building and site conditions. All equipment and sizes / clearances shall be coordinated with the Judicial Council prior to rough-in.
- E. The Contractor shall provide for the disconnection, disposition, and proper disposal of all existing equipment to be replaced.
- F. The Contractor shall provide all incidentals required, such as any electrical distribution system impact studies and needed modifications, permits, approvals, environmental and historic compliance, freight, financing, procurement, monitoring, inspection, and billing as necessary to design, construct, operate the complete solar PV systems, described hereinafter.
- G. If any existing drawings, engineering studies, or reports are provided through this solicitation from the site information package or directly from a Judicial Council representative, the Contractor shall independently verify all information provided.
- H. As the project develops, it may evolve and change as new information is discovered. Minor changes in the project shall be expected, and the Contractor shall make necessary adjustments

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accordingly. However, in the event of major or material changes, then the Contracting Officer shall follow FAR 52.236-2 procedures.

- I. The Contractor shall be responsible for preparation time, documents, drawings, calculations, and costs of permits and licenses.

1.05 QUALITY ASSURANCE

- A. All equipment shall be listed to Underwriters' Laboratories (UL) standards as applicable.
- B. Installer Qualifications – The installation contractor shall be familiar with the equipment to be installed and have the necessary training to install in the equipment, inclusive of a California Class A or Class B and C-10. The installation crew shall include at least one NABCEP "PV Installation Certified" installer. The goal of this requirement is to ensure that the Contractor follows industry best practices in regard to the installation, operation, and health and safety of the PV system.
- C. All architectural and engineering (A-E) services shall be performed by design professionals licensed in the state in which the project is being built, with responsible control for each respective design discipline. Upon request by the Judicial Council, all design and/or coordination meetings shall be attended by the A-E licensed design professionals, at no additional cost to the Judicial Council.
- D. The Contractor shall be responsible for the professional quality, technical accuracy, and coordination of all investigations, studies, drawings, testing, cost estimating, submittals, written reports, construction, operations, and deliverables, as required by this document or as required to complete the work of this contract. The Contractor shall ultimately be responsible for the completeness, accuracy, and coordination of all submittals but may delegate the preparation of submittals in whole or in part to subcontractors or suppliers.

1.06 MATERIALS, DELIVERY, STORAGE, AND HANDLING

- A. All materials shall be delivered new, undamaged and without defects. The Judicial Council shall not accept used, reconditioned, after-market, or grey-market products or equipment. The Contractor may be held responsible for damages to the Judicial Council if the Contractor supplies used, reconditioned, after-market, or grey-market products.
- B. All equipment and panels shall be handled with care so as not to damage the delivered products. All equipment shall be installed in new and neat condition.
- C. Appropriate protective clothing shall be worn when handling the equipment.
- D. Where PV systems will be installed on a roof or overhead, all materials stored on the roof shall be distributed so as not to overload the roof at any point. All materials stored on roof shall follow the guidelines of the roofing system manufacturer including protection boards, pallets and/or mats to prevent damage to the roof system and insulation assemblies. All roof top construction, construction related traffic and staging areas shall have protection boards in place to prevent damage to the roofing system and insulation assemblies.
- E. Materials shall be designed to withstand the year-round temperatures and conditions to which they are exposed (sunlight, heat, rain, cold, wind, seismic activity, salt air, fog, marine corrosiveness, etc.)

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PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Acceptable system manufacturers/vendors shall be as specified in other sections of the Contract. Manufacturers shall provide their latest line of equipment, meeting all current industry standards, utility requirements and criteria set forth in the Contract. The Judicial Council seeks equipment from proven, industry leading manufacturers in solid financial standing, producing “tier-one” financeable equipment.
- B. Contractor proprietary products shall have an ICC report or a testing report stamped and signed by a licensed California engineer.

2.02 EQUIPMENT AND MATERIALS

- A. PV MODULES AND RACKING SHALL MEET THE FOLLOWING:
 - 1. Module manufacturer that has produced no less than 250MW of modules in the prior year.
 - 2. Modules are from a field-tested product line that has been commercially available for no less than three years.
 - 3. Module manufacturer shall provide a 25-year warranty on the solar modules with at least 80 percent power output guaranteed at 25 years. The solar module manufacturer shall confirm that the warranty applies on an “as installed basis,” i.e., the warranty will confirm the panels were installed according to its requirements and specifications for installation.
 - 4. Modules used shall have a minimum of a 25-year performance warranty as measured using the linear module warranty methodology.
 - 5. No module will be warranted to or in actuality generate less than 97% of its Standard Testing Conditions (STC) rated output in year one. No module shall depreciate more than 0.9% for each year of the required minimum 25-year module warranty period.
 - 6. For third-party owned systems: If and when Judicial Council exercises a Fair Market Value (FMV) buyout of the PV systems(s), any remaining component-level warranties shall be transferred to the Judicial Council. Any equipment warranty registries or certificates shall be renamed showing the Judicial Council as owner and provided to the Contracting Officer. Contractor shall provide a list of existing warranties, dates effective/expiring, and contacts for warranty service to the Contracting Officer at the time of FMV purchase.
 - 7. Contractor shall ensure replacement modules meet both the physical dimensions and address electrical mismatch issues.
 - 8. Have a minimum 25-year design life, designed for normal, unattended operation.
 - 9. Specify PV panels and rail/rack systems that have UL 1703 and UL 2703 listing (as applicable), and an ICC AC 428 evaluation report. UL listed for the specified voltage (typically 1000 V-DC).
 - 10. Meet IEC 61215 (crystalline silicon PV modules) or IEC 61646 (thin film PV modules) standards.
 - 11. Meet California SB1 Guidelines for Eligibility.

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12. Any sites that meet the DOE FEMP definition of severe weather requirements shall comply with the FEMP standards for solar system design.
13. Deflection and torsional bending of the underlying rack framing shall be highlighted and addressed by a structural engineer to prevent undue stress on the modules mounted above.
14. PV Modules shall be tested per ASTM E1830-15, which prescribes test parameters for loading (snow and wind) of solar modules (front and back sides). For best protection against physical damage, the Contractor shall consider modules that are rated for "Very Severe Hail" as per ANSI 4473.

B. INVERTERS SHALL MEET THE FOLLOWING:

1. String-type inverters.
2. Integrated AC and DC disconnects
3. Include a 10-year warranty.
4. Manufacturer produced no less than 250 MW of inverters in the prior fiscal year.
5. Field-tested product line that has been commercially available for no less than 2 fiscal years.
6. Comply with the following:
 - a. UL 1741 listed, inclusive of UL 1741-SA requirements.
 - b. IEEE 1547, including testing to IEEE 1547.1 and IEEE C62.45.
 - c. IEEE C62.41.2 and CSA107.1-01.1.
 - d. California Rule 21, CEC approved and utility line interactive type.
7. Incorporate disconnect switch for main DC power disconnect in compliance with applicable codes and utility requirements.
8. Sized as required to support the PV module production load within the rating of the equipment, together with all other components. Sizing shall not exceed 1.35 DC:AC ratio without approval by Judicial Council.
9. Meet the following requirements:
 - a. Nominal AC Voltage (Three-phase, + 10%): 208, 240, or 480 VAC (as required per site)
 - b. Nominal AC Frequency (+ 0.5 Hz): 60 Hz
 - c. Line Power Factor (Above 20% rated power): >0.99
 - d. AC Current Distortion (At rated power): <5% THD
 - e. Maximum Open Circuit Voltage DC: 1,000 VDC
 - f. Maximum Ripple Current (% of rated current): <5%
 - g. Minimum Inverter Efficiency: >96%
 - h. Temperature Range Ambient: -4º F to 122º F (-20º C to 50º C)
 - i. Enclosure Environmental Rating (minimum): NEMA 3R (NEMA 4X within 5 miles of a marine environment or high dust area)
 - j. Relative Humidity (non-condensing): 0-95%
 - k. Sound level: <85 dBA
 - l. Capable of producing reactive power to operate between a power factor of 0.9 lagging to 0.9 leading (as adjusted on the inverter equipment).

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- m. Protective Functions: Standard wakeup voltage, wakeup time delay, shutdown power, shutdown time delay, AC over / under voltage and time delays, AC over / under frequency and time delays, ground over current, over-temperature, AC and DC over current, DC over voltage
 - n. User Display: Standard-LCD with on/off capability and physical screen cover or other means of protection from UV exposure.
 - o. DC Disconnect: 1,000 VDC load break rated (or higher where DC voltage is higher).
 - p. Seismic Rating appropriate for the site and installation method.
 - q. Internal combiner panel option to allow connections of sub-arrays at the Inverter without the use of additional equipment.
- C. All equipment costs shall include all known and future duties, tariffs, export tariffs, customs, demurrage, and shipping costs.
- D. No substitution for contracted equipment shall be made without the written consent of Judicial Council.
- E. Upon connection of the new PV systems, provide a placard on the respective Main Switchboard to identify the two sources of power feeding the equipment.
- F. Combiner boxes (where used) shall be NEMA 3R rated (minimum, NEMA 4X shall be used within 5 miles of a marine environment) and shall include fuses for string inputs and a bus bar to combine the strings into sub-arrays, for input into the Inverter system. Minimum combiner box output bus ampacity shall be 156% of the rated short circuit current available to be carried on the bus (the sum from all strings to the bus).]
- G. All AC interconnecting feeders shall be sized per applicable sections of CEC Articles 310, 690 and 705. Conduit fill to 40% max. Include temperature derating as required for the ambient temperatures and roof conditions per CEC. Provide equipment grounding conductor in each conduit.
- H. All roof and exterior mounted raceways shall be designed and installed to accommodate expansion and contraction due to heating affects, including adequate cable length and listed expansion couplings. All expansion couplings or installations shall include grounding bonding jumpers as required by code.
- I. All AC circuits are to be 3-wire or 4-wire + ground, as required by inverter manufacturer's installation manual based on the site's electrical system. All grounding per CEC 690, Part V.
- J. All DC circuits and feeders sized to CEC table 310.15(B)(16) (90-degree column). The minimum ampacity shall be 156% of the rated short circuit current available to be carried on the specific conductor. Conduit fill to 40% max. Include temperature derating as required for the ambient temperatures and roof conditions per CEC, and conduit fill derating as required. Provide equipment grounding conductor in each conduit.
- K. All DC circuits to be 2-wire + ground.
- L. AC conductors in raceways shall be Type THWN-2 or XHHW-2 for wet and dry locations. AC conductors shall be installed in raceways.
- M. DC PV string conductors shall be Type PV or USE-2/RHW-2 marked minimum 1000V and sunlight resistant.

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- N. Above ground exposed conduit shall be rigid (RMC) or intermediate (IMC) galvanized steel with threaded fittings except where AHJ and other applicable codes or specifications specifically allow for the use of EMT conduit. All conduit shall meet CEC Code, AHJ Guidelines and any applicable standards. Exterior installations shall have watertight fittings. All conduit shall be rated for exposed installation and a minimum design life equivalent to the solar panels. Paint all visible exposed raceways and boxes to match adjacent surface finish after installation. Colors to be selected and approved by the Judicial Council.
- O. All conduits and stub-ups under canopies shall be encased within concrete caissons or piers. Where conduits or stub-ups are not at canopy base, they shall be protected from vehicle strikes with appropriately sized bollards if protection is required by code or the electrical engineer.
- P. All interior conduit to be EMT with steel set-screw fittings (no cast fittings).
- Q. Microgrid Ready Controls
 1. The PV system shall comply with the National Electrical Code (NEC), Underwriters Laboratories (UL) 1741 "Standard for Inverters, Converters, Controllers, and Interconnection System Equipment for Use with Distributed Energy Resources," IEEE 1547[1] "IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems," IEEE 1547.1 "IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems," and all other interconnection requirements specified by the Judicial Council and . The inverters shall be certified by an OSHA Nationally Recognized Testing Laboratory (NRTL) to comply with UL 1741 tests for inverters. If there is a system disturbance (voltage and frequency outside the parameters of IEEE 1547) under normal grid-connected circumstances, the inverters shall turn off and cease to produce power.
 2. The inverter shall be capable of curtailing its output in logical steps in response to communication from the system controller. One option is to have the capability to shed individual strings in addition to full curtailment.
 3. The inverter shall have adjustable trip limit and time-delay capability as defined by UL 1741, and advanced power control functionality including reactive power capability (source VARs), power increase ramp rate control (and power decrease rate control if storage is available), and curtailment set points.
 4. In some instances, the power system controller set points may be set outside of the UL 1741 and IEEE 1547 requirements, with mutual agreement between the Judicial Council, the utility, the Contractor (and others such as a fire marshal) to allow for adjustment of the cease-to-energize limits and time delays specified in UL 1741/IEEE 1547, including adjustments to the low-voltage ride through (LVRT), low-frequency ride through (LFRT), high-voltage ride through (HVRT), and high-frequency ride through (HFRT) specifications.
 5. The inverter shall be able to change settings via a remote power system controller and appropriate power analytics software and be capable of real-time monitoring, diagnostics, and management in the grid-interactive mode and microgrid (intentional island) mode.
 6. In some instances, the power system controller set points may be set outside of the UL 1741 and IEEE 1547 requirements, with mutual agreement between the Judicial Council, the utility, the Contractor (and others such as a fire marshal) to allow for adjustment of the

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- cease-to-energize limits and time delays specified in UL 1741/IEEE 1547, including adjustments to the low-voltage ride through (LVRT), low-frequency ride through (LFRT), high-voltage ride through (HVRT), and high-frequency ride through (HFRT) specifications.
7. The inverter shall be able to change settings via a remote power system controller and appropriate power analytics software and be capable of real-time monitoring, diagnostics, and management in the grid-interactive mode and microgrid (intentional island) mode.
 8. In addition to connecting and operating in a grid-interactive mode, the Contractor's proposed PV system shall be capable of being included in a future microgrid that can operate when the utility grid is unavailable. This microgrid could include conventional (engine) generators, other renewable resources, and/or energy storage. For the purposes of this RFP, this requirement shall also be met by the following:
 - a. PV inverters shall be multi-mode DC-to-AC inverters capable of switching between grid-interactive mode and microgrid (intentional island) mode. The inverters shall comply with the IEEE 1547.4 "Guide for Design, Operation, and Integration of Distributed Resource Island Systems with Electric Power System" standard. While in the grid-interactive mode, the inverters shall be capable of four-quadrant operation (real and reactive power in and out of the inverter).
 - b. If there is no isochronous generator in the system that sets frequency and voltage to the microgrid, an inverter with battery storage needs to be selected to do this. Other inverters in the system will synchronize to this master inverter.
 9. The Contractor shall install spare communications conduit in the trenches that could be used to route future communications cabling to a point of common coupling from the inverter(s). The communications conduit shall be capable of connecting the inverter with a remote power system controller and any other pertinent equipment. The duct bank shall include spacers to separate communications from power conduits. The Contractor shall coordinate with the Judicial Council to ensure that the installed equipment meets microgrid ready needs, within the budget established by the Contractor in its proposal.
 10. The Contractor shall also consider space-planning issues such as pad space for batteries, as needed.
 11. The Contractor shall cooperate with the site when requested to determine the necessary equipment and other changes required to meet future microgrid requirements. The Contractor's proposal shall include hours for this microgrid coordination work. If additional effort is required, the Contractor will be compensated separately. Microgrid configuration changes will be funded by the Judicial Council. The Contractor's proposal also shall include details regarding how the proposed equipment meets the above requirements, how the equipment differs from a PV system that would only operate in the grid-interactive mode, and any other important considerations.
 12. For third-party owned systems: The third-party owner will be compensated for all power generated during microgrid operation, using the same pricing schedule as other generation.

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2.03 WIRE MANAGEMENT

- A. All wiring methods must meet or exceed current industry standards for wire management, strain relief and fastening.
- B. All DC string wire management shall use stainless steel or galvanized steel cable clips, Heyco or similar. Use of purpose-built hangers or stainless steel ties or other stainless or galvanized hardware shall be used in wire management. UV rated cable ties shall be used minimally and only in locations where the use of cable clips is impossible.
- C. Wiring shall not be routed over sharp edges of structural members, equipment or modules.
- D. Wiring shall be routed under the modules of the array wherever possible to avoid direct exposure to the sun or elements.
- E. Wiring shall be secured under the array so as to prevent excessive slack resulting in wire motion, and to minimize visibility of inter-module and home run wiring to the public.
- F. Excess slack in the wire shall be secured such that it is in the module channel or secured to the junction box of the module. Factory-installed wire leads for modules can be wrapped around the junction box of the module.
- G. Where exposed, wires, cables and conductors shall be managed in a neat and orderly manner. Where exposed to environmental conditions (e.g., sunlight, rain, wind, etc.) and visible from below, wires shall be fastened in a uniform and discrete fashion.
- H. All conductors and conduits between separate arrays shall be routed underground. Wiring shall be routed down columns, encased in piers/caissons, routed underground between arrays or carports, and up the nearest column on the adjacent array. Under no circumstance shall circuits, conduits, or chaseways be mounted overhead between separate structures, including seismic gaps. Wire shall not lie exposed directly on the roof surface or ground. Long horizontal conduit runs shall have expansion unions every 30' in order to reduce wire abrasion caused by fixed couplings.
- I. Strain relief and drip loops shall be utilized at all entrances to and from conduit bodies, junction boxes, weather heads, switchgear, inverters, and panelboards etc. Conductors shall be strapped with strain relief as not to stress panel leads, home runs or mechanically crimped connections within the array. Sufficient slack shall be provided at both ends of cables to allow service and re-termination, and to prevent thermal expansion and contraction from stressing connections.
- J. Conduit routing and fittings must be selected to prevent water intrusion into all electrical equipment. Conduit must connect through the bottom of enclosures (where possible) and provide fittings to allow water to drain prior to entering the electrical enclosure.
- K. Wire in switchboards, panelboards, meter cabinets, pull boxes, and other cabinets shall be neatly grouped and tied in bundles with nylon ties rated for the temperature rating of the electrical equipment at 10-inch intervals. In switchboards, panels and terminal blocks, wires shall be fanned out to terminals and trained for straight entry into the terminals. At no point shall nylon ties be used on bussing or bussing used in any manner to support other materials including but not limited to circuit conductors.
- L. All exterior wiring downstream of combiner boxes or string inverters must be in conduit.

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- M. All exterior housings must be continuously welded, NEMA 4 (or better), fully gasketed, continuously hinged (piano hinge) with three-point door closure clamps, and designed to prevent water intrusion from hose down, splashing water, and wind-driven rain. Gaskets must be molded and of one continuous shape, with no seams.
- N. Maintain the conductor required bending radius per NEC and manufacturer specifications.
- O. Wires shall not be installed until debris and moisture is removed from conduits, boxes, and cabinets. Wires stored at site shall be protected from physical damage until they are installed, and walls are completed.
- P. Wire-pulling compounds furnished as lubricants for installation of conductors in raceways shall be compounds approved and listed by UL, NRTL, or equal. Oil, grease, graphite, or similar substances are not permitted. When pulling conductors, do not exceed the manufacturer's recommended values.
- Q. Conductor Color Codes
 - 1. AC Circuits (<600V): Conductors must be color-coded by phase and voltage as required by NEC, the AHJ, and the utility.
 - 2. DC Circuits, grounded

<u>Conductor</u>	<u>Color</u>
Positive	Red
Negative	White
 - 3. DC Circuits, ungrounded

<u>Conductor</u>	<u>Color</u>
Positive	Red
Negative	Black
 - 4. For phase and neutral conductors 6 gauge or larger, permanent thermoplastic-colored tape may be furnished to mark conductor end instead of coded insulation. Tape shall cover not less than 2 inches of conductor insulation within enclosure.
- R. Conductor Identification
 - 1. All conductors, including DC homerun circuits, shall be labeled at each point the conduit run is broken by a cabinet, box, gutter, etc. Where terminal ends are available, identification shall be by means of heat shrink wire markers.
 - 2. Labels shall indicate circuit or string and phase in accordance with the project drawings.
- S. Tape and Splice Kits
 - 1. Wire splice kits shall be UL listed for their manner of use, such as direct burial or wet operation. Splices, joints, and connectors joining conductors in dry and wet locations shall be covered with listed insulation approved by the manufacturer for use with the splice, or as contained in the listed splice kit. Free ends of conductors connected to energized sources shall be taped.
 - 2. Thermoplastic insulating material approved by UL, NRTL, or equal for installation as sole insulation of splices shall be furnished and shall be installed according to manufacturer's

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printed specifications. Standard electrical tape shall not be the sole insulation material for splices unless explicitly listed for use in the application and meeting the temperature rating of the insulation requirements for the splicing connection.

T. Terminations

1. Terminations of conductors shall be performed to the requirements and recommendations listed within the manufacturer manuals of the termination hardware and equipment where the termination shall occur.
2. Conductors shall be terminated with minimal exposure of the bare conductor.
3. Conductors cannot exceed the size and quantity restrictions of the lug. Contractor to verify equipment lugs supplied will accept the size and quantity of conductors shown in the project drawings.
4. Full engagement of the conductor within the lug must be maintained.
5. Provide necessary coating of anti-oxidation coating on all exposed conductor ends entering the lug.
6. Where mechanical connectors are used, torque all terminations to manufacturer specifications with a calibrated torque wrench and indicate with torque marks. Torquing electrical connectors "hand tight" is not allowed.
7. Where compression connectors are used, they must be installed with compression tools and dies approved by the manufacturer for use with the connector.
8. Ensure the final portion of the conductor before entering the termination is not part of a conductor bend (straight on entry).
9. Terminations of aluminum conductors cannot be made within 18 inches of earth/grade.
10. Termination fittings, connectors, and lugs must be rated and listed for the conductor metal type connected.

2.04 MISC. SYSTEM REQUIREMENTS

- A. All exterior equipment to be sunlight and UV resistant as well as rated for elevated temperatures at which they are expected to operate (on roofs in hot sunlight).
- B. Unless noted otherwise, all materials furnished for the project shall have an expected service life of thirty (25) years or more.
- C. No dissimilar metals are allowed to contact each other (use deox, joint compound, plastic or rubber washers) with the exception of anodized aluminum module frames in contact with galvanized carport purlins. Best practices shall be used to avoid corrosion.
- D. No aluminum in contact with concrete or masonry materials.
- E. Bolted connections shall be non-corrosive and include locking devices designed to prevent twisting over the design life of the PV system.
- F. Environmental impact of system equipment containing hazardous materials shall be disclosed, as well as maintenance and disposal instructions for equipment at the end of its useful life.

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G. PV Module Mounting and Grounding Devices

1. Contractor shall submit proposed method for mounting and grounding PV modules to the canopy structure. The proposed method shall meet AHJ requirements and utilize either of the following:
 - a. UL 2703 listed module mounting and grounding clamps and devices.
 - b. Direct bolting of the module to the canopy steel structural purlins and UL listed PV module grounding devices.
2. If PV modules are mounted to the canopy structure with module mounting clamps, the clamps must be approved for this purpose by their manufacturer as part of a UL 2703 listed assembly. Clamps shall be listed for PV module grounding to galvanized steel substrate, and their installation shall comply with the clamp installation manual and the PV module installation manual.
3. If PV modules are direct bolted to the canopy steel structural purlins, mounting bolt size and specification must be written and detailed in the canopy structural drawings. Mounting bolt size must comply with the PV module installation manual, and be compatible with the module mounting hole diameter.
4. Washer-type PV module grounding devices shall be listed for grounding PV modules to galvanized steel substrate, and shall be installed according the manufacturer's installation manual with appropriate bolt size and clearance hole size.
5. All PV modules shall be bonded to each other and to the canopy galvanized steel structural purlins with listed PV module grounding devices and equipment grounding conductors. The canopy galvanized steel structural purlins shall be bonded to the structural beams, unless a welded structural connection exists between the purlins and beams. An equipment grounding conductor shall ground the PV array to the PV inverter ground bar, and a grounding electrode conductor shall ground the PV inverter to the canopy grounding electrode.
6. Where PV modules and steel purlins are grounded and bonded, contact between dissimilar metals such as copper and galvanized steel shall be avoided. Where contact cannot be avoided, outdoor-rated deox or conductive joint compound shall be applied between the interfacing metal surfaces.
7. Components in the array grounding system shall consist only of copper, brass, and stainless steel componentry. Under no circumstances shall grounding lugs be mounted using standard carbon steel fasteners. Grounding lug set screws must be of the same metal as the lug or stainless steel to prevent galvanic corrosion.
8. Racking rails shall be mounted portrait (perpendicular to the long side of module), with spacing as prescribed by the module manufacturer (Figure 1).

Three-Rail Racking System

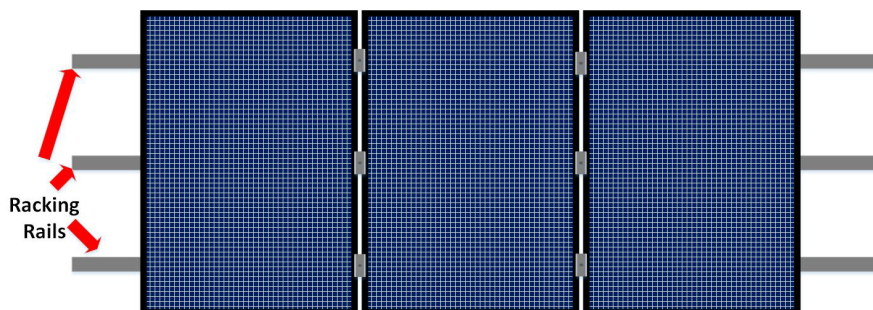


Figure 1

9. The Contractor shall consult with module and rack manufacturers to select the module clamps, clamp locations, and quantity of clamps to achieve the greatest durability under wind, hail, and snow loading.
10. The Contractor, when possible, shall:
 - a. Ensure that the racking manufacturer or project engineer specifies a torque rating on the fasteners.
 - b. Utilize friction module clamps of the "U" and "H" shape, as seen in Figure 3 below. The intent is to prevent total loss of all modules in a row due to domino effects.

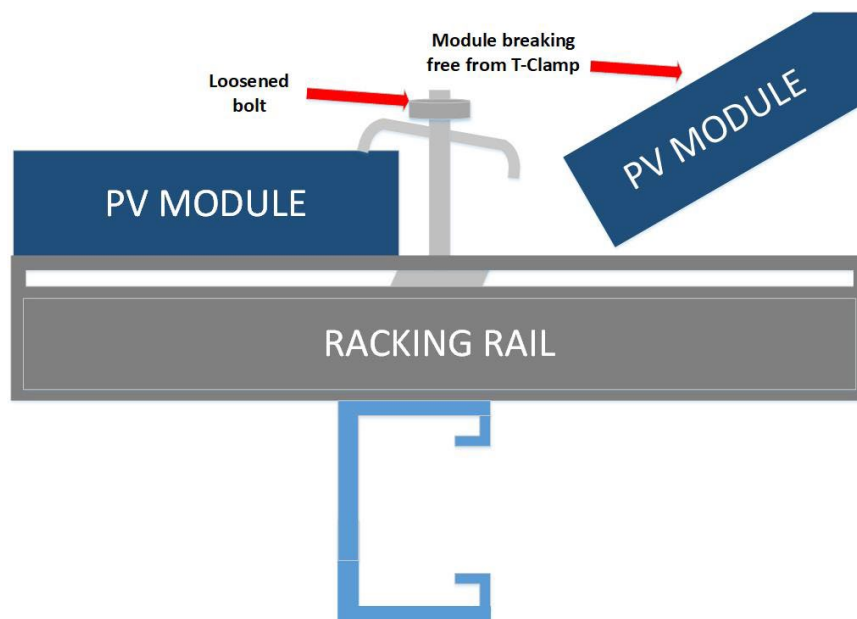


Figure 2

- c. The Contractor shall not utilize simple friction clamps, as seen in Figure 2, as this may lead to "domino effect" loss of an entire row of modules.
- 11. The Contractor, when possible, shall:
 - a. Utilize through bolts on the modules at the end of the rows.
 - b. Utilize bolts paired with a nut and/or washer to enable fastener system to meet DIN 25201 locking standards.
 - c. Ensure that the racking manufacturer or project engineer specifies a torque rating on the fasteners.
 - d. Utilize friction module clamps at least 3" in length.

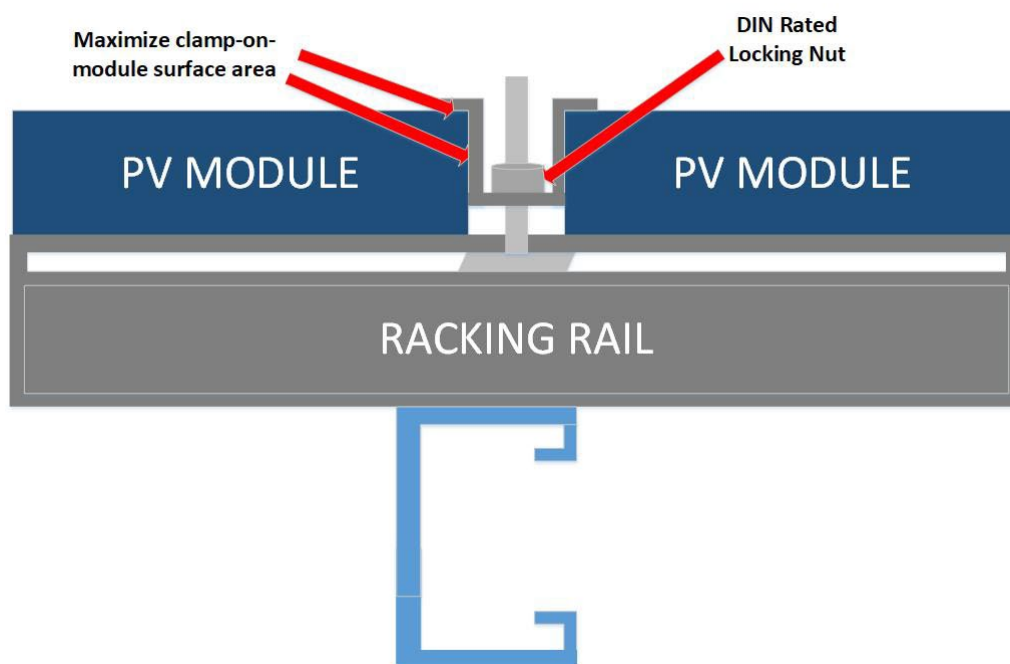


Figure 3

- 12. The Contractor shall consult with module and rack manufacturers to select the module clamps, clamp locations, and quantity of clamps to achieve the greatest durability under wind, hail, and snow loading.
- 13. Each subassembly shall be torqued to manufacturer's specification using torque wrenches or drivers designed to provide calibrated and metered forces and be rated by ISO 6780-2. For field-assembled components of disparate manufacturers or from custom fabrications, a structural engineer shall specify torque ratings and field assembly procedures to be included in submittals and construction drawings. These torque ratings and procedures shall be included in operations and maintenance manuals for later use. For fasteners holding friction or clamping forces, Section 3.3 of ICC AC 428, 2012 shall apply.
- 14. The Contractor shall utilize an established torque auditing procedure.

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15. Under no circumstances shall clamping systems be used to hold underlying structural frame members together.
16. Under no circumstances shall self-tapping sheet metal screws of any grade be used to hold PV system structural elements together or to mount conduit, electrical enclosures, metering, or weather station components.
17. All PV hardware and rack components shall be of corrosion-resistant material, such as stainless-steel SAE grade 316. Aluminum and hot-dipped galvanized steel may be used for non-marine environments under ASTM A123 specifications. Fasteners shall be compliant with ASTM F2329.

2.05 SYSTEM ELECTRICAL

- A. The modules shall be interconnected using cable assemblies. The pigtails shall be quick-connect electrical wiring connections rated for the application (90-degree rated). DC string connectors for homerun wires and jumpers provide by the Contractor must match the make and model of the connectors supplied with the PV module or must be UL listed as compatible with the connectors supplied with the PV module.
- B. Raceway system shall be installed in a manner that prevents water from draining into electrical equipment.
- C. Full specifications of the inverter shall be supplied as part of the system submittal.
- D. All major components of the systems and the installation procedures shall meet National Electrical Code requirements, including Articles 690 and 705.
- E. The PV system shall be designed to automatically drop offline when normal utility power is lost to avoid unintentional islanding effects as required by the local utility. Exceptions may be made by Judicial Council where PV system is part of an emergency power/battery backup allowed by Utility and AHJ.
- F. All electrical system equipment shall be properly rated to withstand and interrupt (in the case of over current protection devices) the available fault current at the point of use.
- G. All required overcurrent protection and electrical bussing sizes per CEC 690.
- H. Means of system grounding to be approved by professional Electrical Engineer of record and GFCI protection shall be in accordance with latest CEC requirements.
- I. Arc-fault protection where applicable per CEC 690.11.
- J. Add Rapid shut-down capability as applicable in compliance with CEC 690.12 requirements (Rapid Shutdown of PV Systems on Buildings)
- K. For PV system supply side interconnection, the Contractor shall inspect the existing main service switchgear to confirm suitability of the switchgear supply side bus for interconnection of the PV system. Where required by the AHJ, any modification of the existing switchgear necessary to construct the supply side connection shall be approved by the switchgear manufacturer or a Nationally Recognized Testing Laboratory. Where a NRTL approves modification of the switchgear, a field labeling report shall be provided to the Judicial Council. The Contractor is

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responsible for obtaining switchgear manufacturer approval of any modification required to accommodate the supply side connection, or NRTL approval and report.

- L. Outdoor grounding connections between dissimilar metals (such as aluminum lugs and copper wire) will be protected against galvanic corrosion by the application of outdoor-rated deox or conductive joint compound between the interfacing metal surfaces.
- M. Each transformer must have external and lockable disconnects, one on the primary side and a separate one on the secondary side.
- N. Any new transformers installed as part of the project shall be high-efficiency transformers. All such transformers shall comply with "NEMA Premium Efficiency" and be of amorphous steel core with bio-based oil.
- O. The Contractor shall coordinate with the Contracting Officer's Technical Representative (COTR) regarding locations and appearance of all equipment, including PV modules, conduit, inverters, disconnect switches, wire ways, and control and monitoring equipment. The COTR must approve all locations prior to installation.

2.06 MONITORING

- A. Contractor shall provide the following monitoring instrumentation:
 - 1. PRODUCTION METER – A PV system production meter measuring the output of the solar array on a minimum 15-minute interval.
 - 2. CONSUMPTION METER - A separate consumption meters shall be provided for each utility account on a minimum 15-minute reporting interval. Consumption meters shall be synced with PV meter production intervals. Consumption metering shall provide for clear disaggregation of PV production and site consumption.
 - 3. WEATHER STATION - A weather station shall be provided at all sites. The station shall provide at a minimum: solar irradiation (coplanar and horizontal), ambient temperature and any other data relevant to weather correction of solar PV system performance. These weather stations, at a minimum, shall provide wind speed, array temperature, and solar radiation information.
- B. A Data Acquisition and Monitoring System (DAS) shall be provided for all points of interconnect. The DAS shall include, but not be limited to, the measurement, calculation, display, and reporting of the following items:
 - 1. PV production in 15-min reporting intervals.
 - a. Kilowatt DC (kW) production
 - b. Kilowatt AC (kW) production
 - c. Kilowatt-hour (kWh) production
 - 2. Site consumption in 15-min reporting intervals.
 - a. Kilowatt (kW) consumption
 - b. Kilowatt-hour (kWh) consumption
 - 3. System Status – On or Off

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4. Communication status – reporting or not reporting.
5. Alarming Functionality
 - a. Text or email
 - b. Inverter(s) offline
 - c. Inverter fault
 - d. Weather Corrected Performance Ratio (WCPR) or Performance Ratio (PR) under limits
6. System Information
 - a. Direct Current (DC) system rating – Kilowatt – Photovoltaic Test Conditions
 - b. Array type
 - c. Date brought online
 - d. Tilt
 - e. Azimuth
 - f. Module manufacturer
 - g. Inverter manufacturer
 - h. Installer contact info
 - i. O&M Provider contact info
7. The dashboard should allow the Judicial Council to view more than one site and system if the Judicial Council has more than one PV system on the same internet-based monitoring platform.
8. Weather data in 15-min reporting intervals
9. Varying levels of summary data, including daily, weekly, monthly, and yearly intervals.
10. A minimum of 1-year of 15-min interval data shall be downloadable in a single instance.
11. System electrical functions (instantaneous and accumulated power output (kW and kWh), AC and DC system voltage and amperage, and peak value tracking with associated time stamps).
12. Pounds of CO₂ emissions avoided from the generation of PV energy at the site (compared to local utility fuel mix electric carbon content). CO₂ avoidance factor shall be readily customizable for the local utility.
13. Capable of outputting data in the Western Renewable Energy Generation Information System (WREGIS) format sufficient for registering Renewable Energy Credits (RECs) from each system.
14. Lifetime logging and access to data reported by DAS, including database-level, “unprocessed” data for lifetime of system operation.
15. DAS shall provide access to all data through an open data exchange protocol (FTP Push or Application Program Interface (API)) to Judicial Council and Judicial Council’s Third-Party Designee at no additional cost. This data shall, at a minimum, include PV production data, energy consumption data, inverter production data, inverter AC power data, inverter current data, inverter voltage data, weather station and/or satellite data, weather-adjusted expected production data, and alarm status readings. All data shall be available over

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multiple timescales, ranging from 15-min intervals to annual intervals and shall include both real-time and historic data.

16. All data collected into a clouded server and stored is the exclusive property of the Judicial Council. The Contractor must seek the Judicial Council's written permission if data are to be disseminated to any entity not party to this contract.
- C. Cellular data shall be used for communications with the DAS and metering systems. In the absence of cellular service availability, the Judicial Council may, at its own discretion, provide internet connections on a site-by-site basis. Regardless of the source of data, connectivity is to be provided for the Term of the Agreement.
- D. Contractor shall load software (as applicable) on Judicial Council provided computers and train Judicial Council in operation and maintenance of software or cloud-based systems and related monitoring functions.
- E. All PV system monitoring and control equipment installed at Judicial Council sites must be granted Authorization To Operate (ATO) through agency cybersecurity officials. There are three aspects of cybersecurity agency requirements that Contractors shall anticipate:
 1. Secure network connections between the site hardware (data acquisition equipment, meters, sensors, instruments) and third-party data collection servers.
 2. A secured website that hosts the Judicial Council's data dashboard.
 3. A secure data storage and retrieval means.
- F. For third-party owned systems: For billing and performance monitoring purposes, the Contractor shall place meter(s) at the point of common coupling to the Judicial Council's electrical distribution system. The Contractor shall install a revenue-grade meter (RGM) that meets the American National Standards Institute (ANSI) Standard C12.1-2008, at 0.5% accuracy.
 1. The billing utility-grade metering equipment is to be furnished, installed, maintained, repaired, calibrated, read, and reported by the Contractor at its expense. When more than a single meter is installed at a service location, the readings thereof may be billed conjunctively, if appropriate. The meter shall be located on the output side of the inverter (measured in AC) and support interval metering for real energy delivery, registering entries every 15 minutes. Identification and location of equipment being monitored must correspond with the submitted and approved drawings. If the inverter is configured to source reactive power, the metering system shall meter power factor as well as real power, although external monitoring of power factor or power quality may not be allowed at all sites.
 2. The meter shall be a solid-state advanced meter with non-volatile memory capable of storing measured data. If connected, the electrical metering shall be compatible with the software currently used by each facility. However, due to the security considerations and different IT management in each building, the Contractor shall assume that access to the Judicial Council's network services will not be available, and that it may have to employ other communications means to collect data from metering systems. No meter shall be placed in service or allowed to remain in service that does not meet the accuracy standards

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of ANSI C12.20. Meters shall be tested for accuracy and certified in accordance with ANSI C12.20 at the Contractor's expense, with the following schedule based on system size:

PART 3 - EXECUTION

3.01 REQUIRED PLACARDS

- A. All placards shall be machine generated phenolic type with red background and white lettering, affixed to equipment with stainless steel screws or with permanent adhesive where set screws are not feasible. Minimum lettering size to be 1/4" unless otherwise noted or required for legibility.
- B. Provide a placard clearly visible at each main service panel to identify both sources of power, with the following wording in 1/4" high lettering per CEC 690.64(B)(4): "Warning - This Service Is Fed by Two Sources Of Power – The Utility Service Main Disconnect And The PV System Main Disconnect – Both Services Must Be Disconnected To Remove Power From The Switchboard".
- C. Provide a placard on each PV system input circuit breaker (where used) at the main panel with the following wording in 1/4" high lettering per CEC 690.64(B)(7): "Warning – Inverter Output Connection – Do Not Relocate This Overcurrent Device".
- D. Provide a placard on all disconnects with the following wording in 1/4" high lettering per CEC 690.17: "Warning - Electric Shock Hazard - Do Not Touch Terminals - Terminals On Both The Line and Load Sides May Be Energized In The Open Position".
- E. Provide a placard on the Main PV System Disconnect (adjacent to each main service panel) with the following information in 1/4" high lettering per CEC 690.53: "Photovoltaic Power Source Disconnect - Operating Current: X Amps; Operating voltage: XX VAC; Maximum System Voltage: XX VAC; Short-Circuit Current: XXX Amps", where X is the operating current, XX is the system voltage, and XXX is the maximum short circuit current contribution of the generating facility at the point of interconnection with the utility system.
- F. Provide a placard at each Main Switchboard with the following information in 1/4" High lettering per CEC 690.54: "Caution - Possible Backfeed From Photovoltaic Power System – X VAC, XX Amps", where X is the system voltage and XX is the maximum AC amperes of the installed system.
- G. Provide a placard on each PV System Inverter with the following information in 1/4" high lettering: "Photovoltaic Power Source Inverter Rating - Operating Current: XX Amps; Operating voltage: XXX VDC; Maximum System Voltage: 1,000 VDC; Short-Circuit Current: XXXX Amps", where XX is the maximum DC amperes of the installed system, XXX is the operating voltage DC, and XXXX is the short circuit current that the Inverter can provide (from all strings in parallel).
- H. Provide utility-required System Directory placard and utility safety switch Identification placard as required by local utility company, to identify all system components.
- I. Provide a placard for all Combiner Boxes to read: "DC Combiner Box [XXX]– [System Voltage] VDC Maximum".
- J. Strict conformance to system marking requirements of PV systems and their components is crucial for the safety of operators, service personnel, emergency responders, and others.

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General PV system labeling requirements, as per CEC 690 Ch. VI and specific requirements from Articles 690 and 705. Include all required and desired labeling language in the design drawings for agency review.

- K. Electrical equipment and components used in PV systems shall have markings that identify the manufacturer, size, type, ratings, hazard warnings, and other specifications. Equipment markings shall never be removed and shall be able to withstand the environmental conditions in which the equipment is installed (e.g., "UV rated" for outdoor labels). Markings must be visible or easily accessible during and after installation. The Contractor shall be responsible for all field-applied markings as required by local, state, and federal codes.

3.02 UTILITY INTERCONNECTION

- A. All tie-ins/shutdowns for interconnection shall be assumed to occur during unoccupied facility hours and with minimum disruption to the relevant court's operating hours. State of California court facilities are closed per the holiday schedule available at: <https://www.courts.ca.gov/holidays.htm> Court facilities are typically closed on weekends. Contractors shall assume a rolling phased approach and provide information on their project approach regarding schedule and amount of parking spots that would be closed and for how long. All roof construction shall occur between the hours of 6:00PM and 6:00AM or on weekends. Parking area construction causing significant noise shall be limited to the same working hours as listed for roof work.
- B. Where electrical service rating (A) Information is not available, assume a line side tap can be accommodated.
- C. The Contractor shall complete the submissions for the utility interconnection agreement with the Judicial Council's approval. The Contractor shall submit the required authorization form with the utility to act on behalf of the Judicial Council. In the event that the Judicial Council has already submitted interconnection applications, the Contractor shall take all responsibility for the interconnect process upon contract execution. The Contractor shall promptly review any past applications and begin coordination with the Utility for any proposed modifications to the system design. The Contractor shall ensure that any tariff grandfathering or other milestone achieved by the initial application is maintained. Should an issue arise that may jeopardize tariff grandfathering, some other utility milestone, substantially increase interconnection costs or the ability to interconnect the project, the Contractor shall promptly notify the Judicial Council and seek approval from Judicial Council before making any changes to the interconnect application.
- D. The PV system at each Site shall not be interconnected with the Utility's distribution facilities until written authorization from the Utility Company has been obtained. Unauthorized interconnections may result in injury to persons and damage to equipment or property for which the installing contractor may be liable.
- E. There are two sets of interconnection requirements that the Contractor is required to meet: (1) requirements related to Judicial Council-owned electrical distribution systems and (2) requirements governing connection to franchise utility systems. It is the sole responsibility of the Contractor to meet these requirements, which include, but are not limited to, needed switchgear, system impact studies, telemetry hardware, recurring monthly telecom carrier fees, franchise utility equipment upgrades, and recurring operations and maintenance fees.

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- F. For system impact studies where the Judicial Council operates or owns the electrical distribution system, the Contractor is responsible for:
 - 1. A load flow protection coordination study, with the objective of revealing any existing protection equipment incompatibilities and/or unprotected lines.
 - 2. A study to identify existing distribution system components that are incompatible with the reliable, stable, and safe distribution of power generated by solar PV systems.
 - 3. Modifications or upgrades to the electrical system required to interconnect the PV systems.
 - 4. Service panel upgrades in cases where panel condition and capacity are insufficient to accommodate and where line-side connections are impractical.
- G. Presence of Sensitive Electronic Equipment
 - 1. In instances where solar PV systems are commonly coupled to a Judicial Council-owned electrical distribution system that serves sensitive electronic equipment, the following precautions must be implemented in collaboration with the Contracting Officer's Representative.
 - 2. The Contractor will work with the Contracting Officer's Representative to confirm the location, manufacturer/model, and quantity of the sensitive equipment to produce a "sensitive equipment inventory."
 - 3. The Contractor will confirm with the Contracting Officer's Representative that the sensitive equipment is protected with uninterruptible power supplies (UPS) or other protection hardware as specified by the equipment manufacturer. The Judicial Council is responsible for procuring and installing UPS systems.
 - 4. Inverters will be set per IEEE 1547 Category 1 trip settings; IEEE 1547 "response to abnormal voltages and voltage ride-through requirement."
- H. Managing Resulting Facility Power Factor
 - 1. If in any situation where the solar PV system is sufficiently large relative to site loads to cause an increase in reactive power (reduction in power factor), then inverters must be adjusted to adequately source and sink VARs, as a means to maintain minimum power factor levels. Minimum power factors levels are those provided by the serving utility tariff schedule.
- I. Interconnection to Franchise Utility-Owned Electrical Distribution Systems
 - 1. The Contractor must meet all requirements from the local utility, public utilities commission, FERC, and any governing operating region organization (Cal-ISO).
 - 2. The Contractor is responsible for complying with all electric utility interconnection requirements, including upgrades, telemetry, interconnection applications, and funding any required interconnection studies to be performed by or on behalf of the electric utility.

3.03 INSTALLATION STANDARDS

- A. System Installation shall conform to the equipment manufacturer's Installation Manual(s) and requirements or guidelines.

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- B. All Local, State, and CEC codes shall be observed, including all industry standards related to the installation, operation, and maintenance of photovoltaic power systems.
- C. The Contractor is responsible for locating all existing underground utilities prior to excavation and for utilizing the "Call Before You Dig" hotline to confirm with any potentially affected public utility company. Any damage done to existing underground utility systems is the sole responsibility of the Contractor.
 - 1. Any site utility drawings provided by the Judicial Council, utility companies, municipal and county agencies, and prior Judicial Council contractors are for informational purposes only and are to be considered incomplete and inaccurate. The Contractor is responsible for confirming the exact location, depth, and type of underground utilities present.
 - 2. Underground utilities that may be found traversing the proposed array areas might include but are not limited to: telecommunications trunks; cable TV lines; electrical distribution conductors; water mains; oil, steam, propane, and natural gas lines; access and security camera systems; waste water and/or storm water drain pipes; traffic and/or street light power; and communications cabling.
- D. The Contractor shall use a minimum of a 100-year flood level as set by the United States Geological Services (USGS) when choosing the equipment pad elevations.
- E. The Contractor shall involve the local fire marshal or authority having jurisdiction for fire protection to provide design approval. The Contractor shall review the design of the system with the fire marshal and observe design guidelines regarding firefighter access in the International Association of Fire Fighters and the CEC.
- F. The installation shall conform with the National Environmental Policy Act (NEPA).
- G. Construction Phase Environmental Management:
 - 1. Hazardous Materials/Due Diligence: The Contractor shall indicate if any hazardous materials will be disturbed, encountered, or used in the construction of the solar PV system. The Contractor shall provide all appropriate mitigation measures, if required, to reduce the impacts to insignificant levels.
 - 2. Noise Pollution: The Contractor shall provide a description of construction activities and mitigation to reduce noise related to construction.
 - 3. Traffic Impacts: The Contractor shall provide mitigation measures to reduce traffic impacts on local streets during construction (road/sidewalk closures, use of cranes, etc.).
 - 4. Jurisdictional Approvals: The Contractor shall provide required development approvals from the county and/or municipality. It is understood that conformance to all applicable approvals is at the sole cost and expense of the Contractor.
 - 5. Storm water Runoff Management: The Contractor shall provide sufficient documentation to demonstrate that the requirements of the Energy Independence and Security Act (EISA) Section 438 are being met. The Contractor shall not change the pattern of storm water amounts or runoff. If the project involves digging/trenching in soil of an area more than 50 linear feet, the Contractor must provide an erosion and sediment control plan.

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- H. Per FCC CFR Title 47 Part 15B, the PV system shall not emit electromagnetic interference (EMI) that interferes with other communications, and incoming EMI shall not cause problems with the control or performance of the PV system. If the PV system emits EMI, the Contractor shall turn off the system and take sufficient measures to eliminate the emission of EMI prior to restarting the system.
- I. The Contractor shall specify FCC Title 47 Part 15 Class A compliant equipment and implement a 250-foot setback (minimum) from the PV system to any existing radar equipment to minimize physical blocking or reflection of the radar signals. If siting near any existing Very High Frequency (VHF) Omnidirectional Range (VOR) equipment, the Contractor shall reference FAA Order 6820.10. For more information, please see NREL's publication "Photovoltaic Systems Near Airfields: Electromagnetic Interference."

3.04 TESTING

- A. After the franchise utility provides permission (interim for testing) to operate in parallel with the grid, the Contractor shall complete commissioning and acceptance testing, in accordance with Judicial Council safety plans, its own quality-control plan, manufacturer's recommendations, franchise utility interconnection requirements, IEC 62446 Grid Connected Photovoltaic Systems Minimum Requirements for System Documentation, Commissioning Tests, and Inspection. The Contractor shall document all performance measurements.
- B. The Contractor shall provide all work required for testing, start-up, and commissioning as required by the following requirements:
 - 1. As part of the commissioning process, Contractor to follow both IEC 62446 and IEC 61724 (Weather Corrected Performance Ratio).
- C. A Judicial Council manager or representative may request to be present during any or all phases of the start-up and testing activities.
- D. The system shall be started up and tested in accordance with the regulations of the applicable interconnection standards.
- E. Request and coordinate with the utility company and Judicial Council for acceptance and certification of the PV system and permission to operate.
- F. Set and adjust circuit protection devices according to the short circuit and coordination study.
- G. Commissioning shall include the Contractor's Data Acquisition System (DAS).
- H. The Contractor shall notify the Judicial Council not less than ten (10) Business Days prior to the anticipated date of System Acceptance Testing. The Judicial Council shall have the right, but not the obligation, to be present at and observe the System Acceptance Testing, at the Judicial Council's sole cost. The System Acceptance Testing shall be witnessed by the utility if required for interconnection approval, and the Contractor shall meet the utility's test notification requirements.
- I. Photovoltaic modules shall be tested in the factory for design performance and results shall be included in the Operation and Maintenance manuals.
- J. Inverters shall be factory tested for performance and the results shall be included in the Operation and Maintenance manuals.

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- K. System testing of the installed photovoltaic array shall be performed on all system strings and recorded in commissioning documentation and the Operation and Maintenance manuals.
- L. Performance testing to ASTM E2848-13 standard. Contractor shall define methodology within the protocol and obtain Judicial Council's acceptance and notify Judicial Council before performing testing.
- M. Commissioning of PV Systems shall adhere to IEC 62446-1 requirements and shall include the following at a minimum:
 - 1. CONDUCTORS
 - a. AC & DC conductor inspection / megger, when possible. Insulation resistance and DC hi-pot testing of each AC and DC conductor, phase-to-phase and phase-to-ground.
 - b. Wire management check
 - c. DC string polarity, Voc & Isc, when possible, testing and recording
 - d. Confirm all conduits & junction boxes are installed properly/watertight
 - 2. Inspection of DC fusing and disconnects
 - 3. Inspection of AC components: AC Disconnect, Main Switch Board, AC Combiner Panel Boards, Breakers, Fuses, Terminations, Phasing, OCPD operation, etc.
 - 4. Grounding & bonding system inspection and continuity testing
 - 5. INVERTERS
 - a. Inverter inspections and tests per manufacturer instructions
 - b. Inverter start-up and confirm proper inverter settings
 - c. Inverter output tests - Confirm PV system AC output as expected based on design, insolation and inverter readings
 - 6. IV Curve Trace, Performance testing and recording, when possible
 - 7. As-built sun access measurement at the corners of all arrays, minimum.
 - 8. THERMAL IMAGING
 - a. Check all electrical components while systems are energized
 - b. Spot check, Modules, Inverters, Disconnects, AC system, etc.
 - 9. Torque spot check on all mechanical and electrical terminations
 - 10. Inspection of corrosion control measures
 - 11. Confirm signage and placards meet plans
 - 12. Workmanship evaluation
 - 13. Inspection of DAS / CT metering and monitoring equipment
 - 14. Weather station component inspection and performance audit
 - 15. Confirm web-based monitoring interface operations
 - 16. LIGHTING CONTROLS
 - a. Confirm canopy lighting levels match photometric design

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- b. Verify component installations
 - c. Confirm lighting controls function as specified
- 17. Commissioning of any other major electrical infrastructure installed on the project per manufacturer requirements
- 18. Medium voltage equipment tested to NETA requirements
- N. Testing to be performed per CPUC Electric Rule 21 testing procedures and requirements. All testing to be done on “no-cloud” days to avoid system fluctuation by passing clouds. Contractor to provide all testing and certification / commissioning.
- O. System start-up procedure shall be as outlined by the Manufacturer’s Installation Manual(s).

3.05 DOCUMENTATION

- A. All commissioning and testing reports shall be provided to the Judicial Council within 15 days of completion of testing.
- B. Provide drawings for each discipline required (electrical, roofing, structural, etc.), with separate plans for new work and demolition as well as special types of drawings where necessary, such as enlarged plans, equipment curbing and flashing details, ground mounting and roof penetration details, etc. Detailed drawings shall be provided showing the base and structural supports (i.e., footers, pylons, supports, etc.) planned for supporting the array. Drawings shall clearly distinguish between new and existing work. Each drawing shall indicate project title, official title block, project number, building name, building address, A/E firm, A/E's address and/or phone number, contract number, drawing title, drawing type, and drawing number. A cover sheet shall be provided and shall include a list of the drawings, legend, in addition to all items required for each drawing. Each A/E submission shall be clearly dated and labeled. Each drawing sheet submitted to the Judicial Council shall include a graphic scale in the lower right-hand portion of the sheet. The final set shall be stamped by a registered engineer and/or registered architect licensed for the jurisdiction in which the project is located. Restrictive markings must be affixed to all drawings in accordance with each agency's document security policies. Drawings shall not be copyrighted by the Contractor or Contractor's designer. Provide drawings sent for comment in hard copy and pdf in quantities requested by the contracting officer.
- C. A final set of as-built drawings shall be submitted as part of the final acceptance process. The as-built drawings shall be submitted in both dwg and pdf formats and at a minimum shall include the following:
 - 1. One sheet showing the array field with each module, circuit (DC and AC), combiner box, and inverter designated on the drawing under a numbering scheme, with each item correspondingly labeled in the field. The sheet shall show locations of major balance-of-system components, transformers, switchgear, weather station, and any building management systems.
 - 2. Show all Judicial Council-approved design changes made during the design and construction and commissioning phases. All relevant drawing sheets shall be updated showing changes made to structural, electrical, and geotechnical elements.
 - 3. A single-line electrical drawing showing all DC and AC circuits. The drawing shall highlight the location of critical disconnect switches.

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4. Any underground utilities discovered as part of this project that are in and around the array area.
- D. A drawing title block will be provided by the contracting officer.
- E. The Contractor shall keep a record of post permit for construction design changes in the form of "red line" drawings, RFIs, and submittals. These changes shall be approved by EOR and the Judicial council. Upon completion of construction, the Contractor shall submit final design documents, including, at a minimum, drawings that are updated to reflect all changes, with details of the PV system structural support, electrical single-line diagrams, and complete product literature for review by the Judicial Council.
- F. Contractor shall submit comprehensive closeout documentation as specified in Section 01 33 01: Design-Build Process & Submittals and Section 01 77 00, Closeout Procedures.

3.06 FINAL ACCEPTANCE

- A. The following requirements must be fulfilled before final acceptance:
 1. The PV system equipment has been commissioned per IEC 62446, and other requirements as specified above.
 2. System Acceptance Testing has been completed, with the PV system having generated electric energy for thirty (30) continuous days at energy and power production levels consistent with the proposed PV system's estimated production with 100% system availability, measured with applicable instruments and meters.
 3. The PV system has been approved for interconnected operation by the utility (with a signed interconnection agreement).
 4. Submission of as-built drawing.
 5. Training fulfillment documentation.
- B. Then the Contractor shall send a Completion Notice and a copy of the System Acceptance Testing to the Contracting Officer so that the Judicial Council can complete its final acceptance. The Judicial Council shall have ten (10) Business Days after receipt of the Completion Notice to review the System Acceptance Testing results and verify that the PV system installation is complete, safe, aesthetically acceptable, functional, constructed to all code requirements, does not interfere with Judicial Council or tenant operations, and otherwise meets all other requirements. The Contracting Officer will notify the Contractor in writing of System Acceptance.
- C. If any of these requirements are not met, then the Judicial Council shall provide the Contractor with a detailed notice of such failure (a "Rejection Notice") within the ten (10) Business Day period, with details regarding the required remedy (including repeat of either partial or full System Acceptance Testing, if appropriate, at the discretion of the CO or COR), and the time allowed to complete the remedy. The Contractor shall promptly remedy at Contractor's cost the items identified in the Rejection Notice and conduct the required System Acceptance Testing (if required by the Rejection Notice) until the System Acceptance Testing indicates that the PV system meets the contract requirements. In each such case, the Contractor shall send a new

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Completion Notice to the Judicial Council with a copy of the results of the new System Acceptance Testing as provided above, and the foregoing procedures shall be repeated.

- D. Written acceptance shall be final and conclusive, except as regards latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards the Judicial Council's right under any warranty or guarantee, subject to the system performance warranty.

Judicial Council END OF SPECIFICATION SECTION 48 14 00