



Sample of ENGIE scope of work description -- not actual Adams Solar specifications

Electrical Work

Provide all labor, materials, equipment and taxes necessary to perform the electrical work as described herein, including but not limited to the furnishing and installing the AC and DC collection systems including cables, combiner boxes and harnesses, grounding and fiber loops; installation of the inverter skids, commissioning and testing. Note the Substation and solar plant SCADA system is being constructed on a design/build basis in another bid package.

1. *Procurement of Cables*
 - a) Provide all DC cables as specified between the combiner boxes and inverters.
 - b) Provide grounding cables as specified at inverter pads and from inverter pads to tracker rows and combiner boxes.
 - c) Provide all AC cables as specified from inverter pads to switchgear at substation.
 - d) Provide all fiber optic cables in panduit for fiber loops as specified.
2. *Procurement of Combiner Boxes*
 - a) Provide 24 string combiner boxes as shown. Acceptable manufactures are Shoals, Bentek, TEAL, or engineer approved equal. Include in your proposal the manufacturer's specification of the combiner box you propose to use.
 - b) There is a total of 1,377 combiner boxes.
3. *Procurement of String Harnesses and String Wiring Materials*
 - a) Include in this line item the cost to supply wiring harnesses to complete the string wiring work.
 - b) String wiring is to be completed using pre-manufactured harnesses using Sunter connectors provided by Owner.
 - c) Sunter connectors for the connection between the solar panel strings and wiring harnesses will be provided by solar panel manufacturer. Furnishing all other Sunter connectors shall be by Contractor.
 - d) The drawings show a 3-string harness that includes necessary fusing. Methodology for completing the string wiring is Contractors choice and shall be performed on a design/build basis in accordance with the requirement outlined in the drawing set.
 - e) Include in your proposal a clarification on your methodology for completing this work and include manufacturer's specification and drawings as necessary depicting how you propose to accomplish this work.
4. *Provide Excavations, Trenching, and Backfilling for AC and DC Collection Systems and Fiber*
 - a) Provide all excavations and backfilling at equipment pads as shown and required. Piles for inverter skids may or may not be installed prior to this work. Coordinate sequencing with pile installation Contractor.

- b) Provide all trenching and backfill as shown for AC and DC collection systems, and fiber loops including bedding, warning tape, and flowable fill (where shown). Note that the fiber loops will follow the AC circuiting for the most part but there are some areas where separate trenching for fiber is required.
- c) Screened native material or sand can be used for cable bedding. Native materials can be used for backfill, as indicated in the Geotechnical report.
- d) Backfill materials shall be moisture conditioned to within 3% of optimum and compacted to 90% proctor.
- e) When trenching along or through roads that have been constructed by Civil Contractor, Contractor shall carefully place and manage excavated materials to avoid contaminating rock placed by Civil Contractor. Contractor is not responsible for placing back rock in the areas immediately above trenches. That work will be done by Civil Contractor. Repair and replacement of rock contaminated by Contractor that could have been avoided by careful spoils management will be the responsibility of Contractor.

5. *Install Conduits for AC and DC Collection Systems and Fiber*

- a) Provide and install all conduits and risers at inverter pads as shown. Work includes all conduits necessary for AC, DC and fiber systems.
- b) Provide all conduit risers at row ends and combiner boxes for DC Cable transitions and string wire harness transitions from above to below grade.
- c) Conduits for MV homeruns from MV switchgear at substation to just outside the substation yard will be furnished and installed by substation Contractor.
- d) Conduits for fiber loop homeruns from control building to just outside substation yard will be furnished and installed by substation Contractor.

6. *Install Cables for AC and DC Collection Systems, Fiber and Grounding*

- a) Install and terminate all DC cables from combiner boxes to inverters.
- b) Install and terminate all AC cables from inverters to inverters to MV switchgear at substation. Provide and install load break elbows at transformers and switchgear.
- c) Install fiber loops from control building at substation to inverters and back to control building. Terminations and testing will be performed by substation contractor.
- d) Install fiber run from inverters to inverters to control building at substation.
- e) Furnish and install ground rods and grounding loops at inverter pads.
- f) Furnish and install ground cables from inverter pad ground loops to combiner boxes and last pile in each tracker row including all jumpers, ground braids and c-clamps.

7. *Install DC String Wiring, Module to Module Jumpers, and String Wire Management*

- a) Install string wiring harnesses along trackers, from solar panels to combiner boxes.
- b) Connect module to module jumpers. Whips on the Solar Panels will be of sufficient length to enable the "skip wiring" method. Jumpers required to span the tracker row drive assembly will be provided by Owner.
- c) All wire harnesses and module whips shall be fastened to either the modules or the structure with UV resistant zip-ties. Assume 2 zip ties per module for module whips and a zip tie every 3' along the tracker rows. No wires shall be left loose or hanging down.
- d) All wires shall be neatly managed.
- e) All string wiring cables exposed to direct sunlight shall be protected by UV resistant split-loom or similar. This includes the gap between sets of 8 modules at each tracker row, the section along the tracker row drive assembly and any exposed cables between the tracker row and the combiner box. No connectors are allowed to be covered by split loom, and no connectors will be allowed to be exposed to direct sunlight.

- f) To establish acceptable standards, contractor shall install wire management means on one tracker row for inspection and approval by Owner. Owner shall inspect tracker row and either approved the wire management methodology or instruct Contractor to make corrections. Contractor shall make corrections as directed by Owner. Once completed and approved by Owner, the approved row will be the basis for inspecting all the other rows on the jobsite.

8. *Install Inverter Skids*

- a) Receive, unload, inventory, inspect, stage, protect and install inverter skids as shown. Inverter skids will be furnished and delivered to site by Owner.
- b) Contractor shall be responsible for receiving inverter skid delivery trucks at site entrance and directing them to the installation or staging locations. It is expected that inverter skids will be unloaded directly onto the pile foundations upon arrival to site.
- c) Prior to executing a Contract, the number of trucks to be received per day and the amount of time within which the trucks must be unloaded shall be agreed upon.
- d) Weld inverter skids to skid support piles as shown.

9. *Furnish and Install Weather Stations, Pyranometers, and Temperature Sensors*

- a) Furnish and install 3 each freestanding weather stations, as specified below, or approved equal.
 - 1. Weather Station – WXT536 – including 15m shielded cable welded onto connector, and mounting accessory for mast. Stations shall include:
 - a) Two GHI pyranometers
 - b) One wind vane and one anemometer
 - c) One rain gauge
 - d) One ambient temperature sensor
 - e) One hygrometry sensor
 - f) One air pressure sensor
 - g) RS232/RS485 with ASCII, NEMEA, and SDI12 protocols.
 - 2. Steel Cabinet with 120/240VAC input, circuit breaker, and grounding cable.
 - 3. Pyranometer – SMP 10 pyranometer, ISO secondary standard, with 10m cable (2 per weather station).
 - a) Pyranometers will be Kipp & Zonen Class A or equivalent, secondary standard type
 - 4. Data Logger –
 - a) EURO THERM T2550 SIMPLEX including implementation of communication application ASCII towards WXT536
 - b) AI3 module for T2550 (2 Analog entries for irradiation)
 - c) Relay module 4 entries for T2550
 - d) Switch – Router 5 ports MOXA
 - e) Transmitter for battery voltage measurement
 - f) AO2 replicating module for 4...20mA signal of tilted pyranometer
 - 5. Solar power supply – battery 2x18 Ah, 2x55W solar panel with cable, support and regulator
 - 6. Communication – Modem 3G + outdoor antenna (no SIM card) + 10m low impedance extension cable.
 - 7. Support Structure – Triangular lattice structure, welded, 3m, SEC-3mHEAD with mounting brackets.
 - 8. Foundation – Furnish and installed poured in-place concrete foundation; 3'x3'x2' depth with #4 rebar at 12" on-center each way.
 - 9. Weather station shall be located within 50' of an inverter skid – coordinate with Owner.
 - 10. Provide power and communication cabling from adjacent inverter to weather station.
- b) Furnish and install 15 each pyranometers on tracker structures where directed by Owner.

1. Pyranometers shall be as specific in item a.3 above; or approved equal.
 2. Pyranometers shall be located within 30' of inverter skid. Exact locations to be determined with Owner.
 3. Provide communication cabling from adjacent inverter to pyranometers.
- c) Furnish and install 15 sets of 2 each back-of-module temperature sensors.
1. PT1000-K050
 - a) PT1000 OHMS at 0°C 1/3DIN, 1x3 fils mounting, 3 conductor probes or equivalent with IP65 UV resistant cabling
 - b) 304L Ø stainless steel protector and Lg – 50mm with triple annular crimping
 - c) Stainless steel plate 30x15x0.5 mm laser welded on protector
 - d) 25-meter silicone/silicone cable (no armor)
 - e) Temperature range -10°C and 100°C with a maximum tolerance ±1°C
 - f) Pyranometer mounting kit
 - g) All sensors shall have a range compliant with IEC 61724—1:2017
 2. ETA-PT1000 – Individual calibration method by comparison at one point: 25°C. Calibration certificate. Each sensor will be identified by a serial number.
- d) Furnish and install three (3) soiling measurement stations.
1. The soiling measurement station will be Atonometrics RDE300 Series or equivalent
 2. The soiling station shall have a range compliant with IEC 61724—1:2017

10. Conduits for Fiber and Electric Service to O&M Building

- a) Provide conduits for permanent power and communications cabling from site entrance at County Road 185 to within 5' of Operations and Maintenance Building.
- b) Install 1 each - 3" and 2 each - 6", schedule 40 PVC conduits. Install pull boxes at 500' on center.
- c) Pull strings/ropes and cables will be furnished and installed by others.

11. Conduits from O&M Building to Substation Control Building

- a) Provide conduits for power and communications cabling from substation control building to Operations and Maintenance Building.
- b) Install 1 each x 2", and 2 each x 4", schedule 40 PVC conduits from substation fence to within 5' of Operations and Maintenance Building. You will be picking up the stubs installed by the Substation Contractor from the Control Building to the Substation Fence. Cap conduit ends and install location markers prior to backfilling.
- c) Pull strings and cables will be furnished and installed by others.

12. Power for Temporary Facilities

- a) Job trailers for all Contractors shall be located in a central location on the north side of County Road 186 on the northeast side of US-83.
- b) Furnish and install 120/240VAC temporary utility service for all trailers. Assume total demand is 1200 amps, and service is to up to 12 trailers.
- c) Provide for underground distribution from central distribution location to each trailer. Install conduits and cabling as necessary and connect each trailer to the temporary power source.
- d) Utility company fees will be paid for by Contractor and reimbursed by Owner without mark-up.
- e) All monthly utility fees will be paid by Owner.

13. Commissioning – Electrical Work

- a) To be provided by addendum.

14. Quality Assurance / Quality Control – Electrical Work

- a) General
 - 1. Quality control documents and logs shall be maintained using Procore software. Documents prepared in the field will be filled out using tablets and uploaded into Procore electronically.
 - 2. As part of the Quality Assurance / Quality Control process, the testing and inspection requirements listed below shall apply to the electrical scope of work. Contractor shall perform inspections as outlined and shall participate in inspections done by Owner's site management team. Include the cost of this work in this line item of the Bid Form.
 - 3. Contractor shall participate with Owner in developing the quality assurance / quality control report forms and logs to be used in Procore.
- b) The following testing and inspections will be performed.
 - 1. Megger test all AC and DC wiring that arrives on-site prior to installation. Exceptions will be granted on an individual basis.
 - 2. DC home runs from combiner boxes to inverter skids, and AC medium voltage runs from inverter skids to the substation will be megger tested following installation just prior to termination.
 - 3. DC string home runs will be tested for continuity prior to terminating to the combiner box.
 - 4. All DC fuses will be tested for continuity prior to installation. DC jumpers with fuses permanently installed will also be tested prior to termination.
 - 5. All test results will be documented in Procore. Any questionable or failing test results will be immediately brought to the Owner's attention.
 - 6. Any additional testing not identified herein may be required, based on the equipment manufacturer's recommendations, and should be reviewed with the Owner.

15. General Requirements

- a) Contractor shall be responsible for maintaining on-site facilities required for their work. Include all site management and temporary facilities costs in this line item.
- b) For other general requirements that apply to this section, see the General Requirements section at the end of this document.
- c) Submittals.
 - 1. Contractor shall provide submittals as least 10 days prior to ordering materials and allow 1 weeks for Owner's review and approval. Materials should not be ordered until submittals are reviewed and approved by Owner. Provide submittals as outlined below.
 - a. Combiner boxes
 - b. AC cables
 - c. DC cables
 - d. String harnesses

General Requirements

In general, Contractor will be responsible for providing all management, safety and temporary facilities for Contractor's work. Power to job trailers at site entrance, and temporary toilets will be furnished and paid for by Owner. Power for other temporary facilities about the site will be the responsibility of the Contractor.

Site security will be provided by Owner. All Contractor employees will be required to obtain a badge and shall be badged in and out of the site on a daily basis.