Commissioning Form

SYSTEM INSTALLATION & COMMISSIONING CHECKS AND ACCEPTANCE TESTS

Upon completion of the installation and commissioning and prior to field verification by the Utility, EPC Contractor will carry out the following PV system installation & commissioning checks and then, following Utility field verification, run the performance ratio test. EPC Contractor will provide advance notice to the Client that the commissioning checks and acceptance test are to be performed. The Client has the option upon prior written notice of having a representative present during any and all testing.

1. Before commencing any system checking and testing, EPC Contractor will ensure that:
    - non-current carrying metal parts (such as array frames, metal boxes, etc.) are grounded properly; and
    - all labels and safety signs specified in the plans and by the NEC are in place.
2. Photovoltaic Array - General Checks – EPC Contractor will conduct the following checks of the photovoltaic array and record the results:
    - Visually inspect the array for damaged modules.
    - Check to make sure panels are mounted properly and securely to the racking system or mounting means.
    - Confirm that the alignment of the array is as straight, neat, and pleasing as possible.
    - Check to see if modules are properly grounded.
    - Check that all source circuits are properly labeled.
    - Check to see that all wiring is neat and secure.
    - Visually inspect plug and receptacle connectors between modules to ensure they are fully engaged.
3. Photovoltaic Combiner Box Tests - For repetitive source circuit wiring, the following procedure must be followed for each source circuit in a systematic approach, i.e., east to west or north to south. All data are to be recorded on a combiner box check list. The following testing will take place around noon on a cloudless day:
    - Inspect the combiner boxes to ensure that all wiring is correctly and securely installed.
    - Check open-circuit voltage (Voc) of each of the source circuits to verify that it provides the manufacturer‘s specified voltage in full sun. Verify the polarity of each source circuit in the DC string combiner box by paying particular attention that there is NEVER a negative measurement.
    - Check Max Power Point current (IMPP) of each of the source circuits to verify that each provides the manufacturer‘s specified current in full sun.
    - Confirm that no ground faults are present in the DC wiring.
    - Test the Insulation Resistance of the DC conductors from the combiner boxes to the Inverters to ensure a minimum resistance of 20 megohms or less at 1 min between conductors and from each conductor to ground.
4. DC Disconnect Inspection:
    - Inspect DC disconnects and document identifying information.

- Check that DC disconnects are properly grounded.
- Check that DC disconnects are properly labeled.
- Check that all wiring is neat and secure.
- Check that incoming and outgoing wires sizes are correct.
- Inspect the fuses, if present, for correct size and mounting.

5. AC Inspection:
   - Inspect AC disconnects and document identifying information.
   - Check to see if all AC disconnects are properly grounded.
   - Check that AC disconnects are properly labeled.
   - Check to see that all wiring is neat and secure.
   - Check that incoming and outgoing wire sizes are correct.
   - Inspect the fuses, if present, for correct size and mounting.
   - Test the Insulation Resistance of the AC conductors from the inverters to the interconnection point to ensure a minimum resistance of 20 megohms in 1 min or less between conductors and from each conductor to ground
   - Confirm that the Utility interconnection point and over current protection are according to the electrical drawings.
6. Inverter Start-Up Tests:
   - Inspect the inverter and document identifying information.
   - Check that all inverters are properly grounded.
   - Check that all inverters are properly labeled.
   - Check that all incoming and outgoing conductors are secure.
   - Check that incoming and outgoing wires sizes are correct.
   - Start the inverters following the proper start-up procedure according to the manufacturer's manual.
   - Document the time of day and the irradiance level.
   - Record operating parameters from the inverter display.
7. System Monitoring Test:
   - Document the system monitoring identifying information.
   - The monitoring equipment will be inspected for good mounting and wiring.
   - Check sensor equipment, if any, for proper mounting and location (i.e., irradiance, temperature and wind speed sensors).
   - Turn on PV and monitoring systems, per manufacturer’s specifications.
   - Record operating parameters from the inverter display.
   - Contact the monitoring service to verify that the monitoring system is communicating properly. Record the system parameters being transmitted.
   - Compare inverter data to data being transmitted to monitoring service to ensure proper operation.

Check data from each monitoring system sensor by comparing readings from calibrated, hand-held sensors to monitoring system output readings; all readings should be within ±5% of the hand-held readings.

8. System Acceptance Evaluation Test Procedure - The following Acceptance Test will preferably be run around noon on a cloudless day:
   - Activate the System and allow it to run for two (2) hours before taking any performance measurements.

- Calculate the expected peak DC power output of the System, WattsDC-estimated, at the measured cell temperature by multiplying the System DC nameplate capacity by (1 - KCTA), which is the DC power adjustment due to cell temperature difference from the standard test condition, 25 C, where KCTA = (25- Tcell) times the Temperature Coefficient of Maximum Power for the module (from the module specification datasheet, %/deg C) and Tcell = module cell temperature, deg C, measured at the time the System power reading is taken. [Example: SunTech 280 lists its Max Power Temp Coeff as -0.47. So, for Tcell = 10 deg C, then (1 - KCTA) = 1 + 7.05% = 1.0705]
- Calculate the expected peak AC power output of the System, WattsAC-estimated, by multiplying WattsDC-estimated in (ii) by 0.77 (the standard PVWatts DC-AC derate factor),
- After allowing for fifteen (15) minutes of full sun exposure, obtain a real-time solar irradiance measurement at the array (W/m2) using the precision spectral pyranometer provided with the system or, if not available, with a calibrated, hand-held meter
- Calculate the percent of peak irradiance under the test conditions by dividing the measured irradiance by 1000 W/m2 (the peak irradiance level at which the modules are tested).
- Record the total System AC power output, WattsAC-measured, from the revenue grade energy production meter or from the inverter(s).
- Divide the WattsAC-measured by the percent peak irradiance, as determined under (v), above. This yields the corrected rated AC peak power output of the system, WattsAC-corrected. This value will be at least 90% of the WattsAC-estimated value calculated in step (iii) above.

9. Provide the Client with the initial startup test report when everything has been verified and checked to ensure proper operation.

Qualified Personnel _____

Name & Title _____

Dated _____