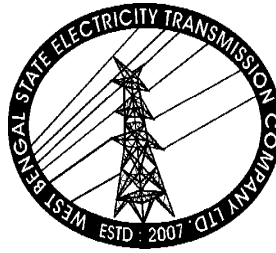


SOLAR ROOFTOP PHOTOVOLTAIC POWER PLANT



September 2020

Engineering Department

WEST BENGAL STATE ELECTRICITY TRANSMISSION COMPANY LIMITED

পশ্চিমবঙ্গ রাজ্য বিদ্যুৎ সংবহন কোম্পানি লিমিটেড

(পশ্চিমবঙ্গ সরকারের একটি উদ্যোগ)

Regd. Office: VidyutBhawan, Block – DJ, Sector-II, Bidhannagar, Kolkata – 700091.

CIN: U40101WB2007SGC113474; Website: www.wbsetcl.in

GENERAL TECHNICAL SPECIFICATION

SOLAR ROOFTOP PHOTOVOLTAIC POWER PLANT

1 GENERAL

The specification covers, the design manufacture, testing and supply of roof top solar photo voltaic grid interactive system with associated components.

These systems shall be complete with mono-crystalline Photovoltaic modules, array mounting structures, inverter, generation & net metering, junction boxes, AC, DC distribution boards, cables, communication interface, Data logger/PC based monitoring system with laser jet A4 printer, grounding, lightning protection, civil works and any other equipment necessary for safe and efficient operation of the plant. It should be noted that PV module supporting structures shall be mounted on RCC blocks.

The work shall include synchronizing with the grid and interconnection of the plant with the grid.

2 STANDARD TECHNICAL PARAMETERS

SL	DESCRIPTION	VALUES / INFORMATIONS
1	PV cell type	Mono Crystalline
2	Power Rating of one module	250Wp or above
3	Mounting	Fixed Type with Seasonal tilting provision
4	Location	As mentioned at Tender
5	Inverter Output Voltage	415V AC
6	Inverter Input DC Voltage	To be decided by bidder
7	Frequency	50 Hz
8	Inverter efficiency	Minimum 94%
9	Inverter no load losses	Within 1%
10	Accuracy of Output voltage from Inverter	±1%
11	Photo electrical conversion efficiency of the plant	More than 14%
12	Guaranteed life of PV module	95% of its rated power for 10 years
13	Fill factor of the module	More than 0.70
14	Site Altitude	1,000 metres
15	Ambient Temperature	-5°C to +50°C
16	Humidity	95 % non- condensing
17	SPV Power Plant Output	As per BOQ

3 STANDARDS

The quality of equipment supplied shall be in line with the latest edition of standards and codes listed below -

- i IEEE 928: Recommended Criteria for terrestrial PV power systems.
- ii IEEE 929 Recommended practice for utility interface of residential and intermediate PV systems.
- iii IEEE 519 Guide for harmonic control and reactive compensation of Static Power Controllers.
- iv National Electrical NFPA 70-1990 (USA) or equipment national standard.
- v National Electrical Safety Code ANSI C2 (USA) or equipment national standard.
- vi IEC : 61215 / IS 14286 - Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval
- vii IEC: 61730 -1, -2 Photovoltaic (PV) module safety qualification Part 2: Requirements for testing
- viii IEC: 60904-1(2006) Photovoltaic Devices - Part-I: Measurement of Photovoltaic current-Voltage Characteristic
- ix IEC 61701 – for PV modules to be used in a highly corrosive atmosphere
- x IS 9000 Basic environmental testing procedure for Electronic and electrical items.

4 SPECIFIC REQUIREMENT

Solar PV system shall consist of following equipment -

- i. Solar PV modules consisting of required number of Monocrystalline PV cells
- ii. Power Conditioning Unit/ Inverters
- iii. SCADA (data logger) with CPU, LCD monitor, UPS, laser jet A4 printer
- iv. Mounting structures (Fixed Type)
- v. Cables, hardware, earthing & lightning protection materials
- vi. Junction box and distribution boxes
- vii. Earthing kit
- viii. Surge protective device, Type-II
- ix. PVC pipes and accessories
- x. Tool kit
- xi. Civil pedestals
- xii. Spares for 3 years
- xiii. Metering

5 EQUIPMENT MAKERS LIST

- i. Solar Mono crystalline PV Module: Loom Solar, TATA Solar, Vikram Solar, Luminous.
- ii. Inverter: ABB, Delta, Fronius, Luminous, SMA, Solar Edge

For other equipment, WBSETCL general Makers List may be followed. And for the items not covered under WBSETCL recommended list, prior approval is to be taken by submitting the relevant documents.

6 EQUIPMENT DESCRIPTIONS

A. SOLAR PHOTOVOLTAIC MODULES

- i The PV modules used must qualify to the latest edition of IEC PV module qualification test or equivalent BIS standards Crystalline Silicon Solar Cell Modules IEC 61215/IS14286.
- ii The total solar PV array capacity should not be less than allocated capacity (kWp) and should comprise of solar crystalline modules of minimum 250 Wp and above wattage.
- iii Adequate protective devices against surges at the PV module shall be provided. Low voltage drop bypass diodes shall be provided to minimize power drop caused by shade.
- iv PV modules must be tested and approved by one of the authorized test centres.
- v The PV modules shall be suitable for continuous outdoor use.
- vi The module frame shall be made of corrosion resistant materials, preferably having anodized aluminium.
- vii The PV module shall use lead wire with weatherproof connector for output terminal.
- viii The terminal box on the module should have a provision for opening for replacing the cable, if required.
- ix Each string voltage, current and power shall be measured at data logger.
- x I-V curves at STC should be provided.
- xi The module must use a identification tag inside the laminate with the following information clearly visible from the front side.
 - a) Name of the Manufacturer of PV module and Solar cell
 - b) Name of the Customer
 - c) Model or Type No.
 - d) Serial No.
 - e) Month and Year of manufacture.
 - f) Module ratings and other details as per standard

B. INVERTER / PCU

- i. As Solar Photovoltaic array produce direct current electricity, it is necessary to convert this direct current into alternating current and adjust the voltage levels to match the three phase 415V AC grid voltage. Conversion shall be achieved using an electronic Inverter and the associated control and protection devices. All these components of the system are termed the "Power Conditioning Unit (PCU)". In addition, the PCU shall also house MPPT (Maximum Power Point Tracker), an interface between Solar PV array & the Inverter. The power conditioning unit/inverter should also be DG set interactive. Inverter output should be compatible with the grid frequency.

- ii. Power generated from the solar system during the daytime is utilized fully by powering the building loads and feeding excess power to the grid as long as grid is available. In cases, where solar power is not sufficient due to more demand or cloud cover etc. the building loads shall be served by drawing power from the grid. The inverter should always give preference to the Solar Power and will use Grid/DG power only when the Solar Power is insufficient to meet the load requirement.
- iii. The output of the inverter must synchronize automatically its AC output to the exact AC voltage and frequency of the grid.
- iv. **SYNCHRONISATION:** PCU / Inverter shall continuously monitor the condition of the grid. In the event of grid failure, solar PV system shall be disconnected from the grid and out of synchronization for a period DG supply is not restored. PV system shall be synchronized with the DG supply after DG is started. The solar system is resynchronized with the grid after the restoration of grid.
- v. Grid voltage shall also be continuously monitored and in the event of voltage going below a preset value and above a preset value, the solar system shall be disconnected from the grid within the set time. Both over voltage and under voltage relays shall have adjustable voltage and time settings (0 to 5 seconds).
- vi. Surge protective devices, type-II shall also be provided on DC and AC side of the inverter.
- vii. The output of power factor of PCU inverter is suitable for all voltage ranges or sink of reactive power, inverter should have internal protection arrangement against any sustainable fault in feeder line and against the lightning on feeder.
- viii. The inverter shall be a true sine wave inverter for a grid interactive PV system.
- ix. The degree of protection of the outdoor inverter panel shall be at least IP-65.
- x. Built-in meter and data logger to monitor plant performance through external computer shall be provided.
- xi. PCU / inverter shall be capable of complete automatic operation including wake-up, synchronization & shutdown.
- xii. Operation Mode:
 - a. Night or sleep mode: where the Inverter is almost completely turned off, with just the timer and control system still in operation, losses shall be less than 2 W per 5 kW
 - b. Standby mode: where the control system continuously monitors the output of the solar generator until pre-set value is exceeded (typically 10 W).
 - c. Operational of MPP tracking mode: the control system continuously adjust the voltage of the generator to optimize the power available.

The power conditioner shall automatically re-enter standby mode when input power reduces below the standby mode threshold. Front panel shall provide display of status of the inverter.

C. ARRAY STRUCTURE

- i Hot dip galvanized MS mounting structures may be used for mounting the modules / panels / arrays. Minimum thickness of galvanization should be at least 120 microns.
- ii Each structure should have angle of inclination as per the site conditions.
- iii The Mounting structure shall be designed to withstand the speed for the wind zone of the location where a PV system is proposed to be installed. Suitable fastening arrangement such as grouting etc should be provided to secure the installation against the specific wind speed.
- iv The mounting structure steel shall be as per latest IS 2062: 1992 and galvanization of the mounting structure shall be in compliance of latest IS 4759.
- v Structural material shall be corrosion resistant and electrolytically compatible with the materials used in the module frame, its fasteners, nuts and bolts.
- vi The fasteners used should be made up of stainless steel. The structures shall be designed to allow easy replacement of any module. The array structure shall be so designed that it will occupy minimum space without sacrificing the output from the SPV panels.
- vii The minimum clearance of the structure from the roof level should be 300 mm.
- viii The total load of the structure (when installed with PV modules) on the terrace should be less than 60 kg/m².

D. JUNCTION BOX AND STRING MONITORING UNIT

Dust, water and vermin proof, IP 65 junction boxes of adequate rating and adequate terminal facility made of fire resistant Plastic (FRP) shall be provided for wiring.

Each PV string shall be provided with fuses of adequate rating to protect the solar arrays from accidental short circuit.

Each Series Junction Box (SJB) shall house string monitoring unit which shall give operational status of each string by current, voltage & power through shunt based sensors. SMU shall have RS 485 port for communication with data logger. Foot print of PV strings showing the location of each SMU shall be displayed as screen shot on the monitor so that faulty SMU and string can be easily identified.

7 PROTECTION, CONTROL, MONITORING AND METERING

- i. PV systems shall be provided with - adequate rating fuses, fuses on inverter input side (DC) as well as output side (AC), overload & short circuit protection and disconnecting switches to isolate the DC & AC system for maintenances are needed. Fuses of adequate rating shall also be provided in each solar array module to protect them against short circuit.
- ii. A manual disconnect switch beside automatic disconnection to grid would have to be provided at utility end to isolate the grid connection by the utility personal to carry out any maintenance. This switch shall have the be locking arrangement.
- iii. Metering is required to measure the Solar Gross Generation on continuous basis and register cumulative energy as per present norms. The average voltage and power factor based on 15 minute interval must also be recorded.
- iv. Meter must also display on demand, instantaneous, AC system voltages and currents, frequency, reactive power with sign, total harmonics current and voltage distortion etc.
- v. Meters shall comply with the requirements of CEA Regulations on "Installation and Operation of Meters".
- vi. The following parameters shall be measured and displayed continuously:
 - a. Solar system temperature
 - b. Ambient temperature
 - c. Solar irradiation / isolation
 - d. DC current and Voltages
 - e. DC injection into the grid (one time measurement at the time of installation)
 - f. Efficiency of the inverter
 - g. Solar system efficiency
 - h. Display of I-V curve of the solar system
 - i. Current, voltage and power in each string
- vii. Data logger with PC based monitoring system must record these parameters for study of effect of various environmental & grid parameters on energy generated by the solar system and various analysis would be required to be provided through bar charts, curves, tables etc. The communication interface shall be an integral part of inverter and shall be suitable to be connected to supplied computer.

8 POWER QUALITY REQUIREMENTS

- i. DC Injection into the grid: The injection of DC power into the grid shall be avoided by using an isolation transformer at the output of the inverter. It is proposed to limit DC injection within 1% of the rated current of the inverter as per IEC 61727.
- ii. Harmonics on AC side - The limits for harmonics shall be as stipulated in the CEA Regulations on grid connectivity which are as follows:
 - a. Total Voltage harmonic Distortion= 5%
 - b. Individual Voltage harmonics Distortion=3%

- c. Total Current harmonic Distortion=8%
- iii. Voltage Unbalance-The Voltage Unbalance in the grid shall not exceed 3.0%
- iv. Voltage Fluctuations
 - a. The permissible limit of voltage fluctuation for step changes which may occur repetitively is 1.5%.
 - b. For occasional fluctuations other than step changes the maximum permissible limits is 3%.

9 EARTHING AND LIGHTNING PROTECTION:

- i Each array structure of the PV yard should be grounded / earthed properly as per IS:3043-1987. The lightning arrester / masts should also be earthed. Earth Resistance shall be tested in presence of the representative of Department as and when required after earthing by calibrated earth tester. Earth resistance shall be less than 1 ohms.
- ii It shall be ensured that all the earthing points are bonded together to make them at the same potential to ensure safety of the power plant.

10 TEST AND TEST REPORTS

- i Type test certificates for Solar PV modules and the component parts shall be submitted by the Bidder during detailed engineering.
- ii The Supplier shall carry out all routine and acceptance tests as specified in relevant standards on all major components in presence of the purchaser's representative at works before despatch and furnish copies of test reports for purchaser's approval.
- iii. Supplier shall carry out all field functional tests at site on the assembled SPV Plant with all accessories of the equipment in the presence of the Purchaser's representative.

11 DRAWINGS, MANUALS AND TRAINING

The Contractor shall furnish the following drawings / documents for approval / review:

- a. General arrangement and dimensioned layout
- b. Schematic Block Diagram for the solar plant
- c. Data sheets, Schematic Drawing and General arrangement drawings of SV panel, Inverter, Data logger, Junction Boxes, AC and DC Distribution Boards, meters, String Monitoring unit etc.
- d. Structural drawing along with foundation details for the structure

- e. Bill of material for complete SV plant covering all the components and associated accessories
- f. Overall layout showing SV Plant
- g. Interconnection block diagram showing inverters, data logger, CPU, monitor, printer etc.
- h. Two copies of Instruction and Operation & Maintenance Manual & catalogues / leaflets in English should be provided. These should cover all aspect of installation, commissioning, transport, do's & don'ts, spares, drawings & diagrams, maintenance schedules, safety precautions, trouble shootings and diagnostics etc.
- i. Bidder shall provide necessary training at site for mutually agreed duration and number of persons to enable the purchaser to maintain the system.

12 PERFORMANCE GUARANTEE

- i. The Bidder shall warrant that the goods are new and of high quality and that the goods will be free of defects in design. If within the expiry of the stipulated guarantee period the subject goods or any parts thereof are found defective because of design, workmanship or materials, the Bidder at his own expense, repair or furnish and install / replace parts of design, workmanship and material approved by the Purchaser. The guarantee period for replaced parts or repair work shall be the same as above.
- ii. The Bidder shall obtain similar guarantees from each one of his Sub- contractor. However, the overall responsibility shall lie with the Bidder.
- iii. The guarantee period shall be for 24 months form the date of successful commissioning / handover whichever is later.