TECHNICAL SPECIFICATIONS

1. STANDARDS

BOS Item / System	Applicable BIS /Equivalent IEC Standards / Applicable MNRE Specifications		
	Standard Description		Standard Number
	I	Crystalline Silicon Terrestrial PV modules poly/ mono	IEC 61215/ IS14286
	ii	Solar PV module safety qualification requirements	IEC 61730 (P1 – P2)
	iii	PV modules to be used in a highly corrosive atmosphere (Coastal area etc,) must qualify Salt Mist corrosion Testing	IEC 61701/ IS 61701

2. SOLAR PV MODULES

Type	Crystalline silicon – Poly or Mono
Origin	Manufactured in India
Module Efficiency	>= 15.2%
Fill factor	>= 70%
Power warranty	25 years limited warranty on power output & 5 years product warranty
Performance Warranty	Should not be less than 90% of designed nominal power at the end of 10 years and 80% of designed nominal power at the end of 25 years.
Module frame	Anodized aluminum. Non-corrosive and electrolytically compatible mounting structure
Mounting structure	Metallic mounting structure. Hot dip Galvanized with 70 microns thickness
Module minimum rated power	The nominal power of a single PV module shall be >=240Wp.
RF Identification tag for each solar module	Must be able to withstand environmental conditions and last the life of the solar module and shall be kept inside the module laminate.
RF Identification tag data	a) Name of the manufacturer of PV Module b) Name of the Manufacturer of Solar cells c) Month and year of the manufacture (separately for solar cells and module) d) Country of origin (separately for solar cells and module) e) I-V curve for the module f) Wp, Im, Vm and FF for the module g) Unique Serial No and Model No of the module h) Date and year of obtaining IEC PV module qualification certificate i) Name of the test lab issuing IEC certificate j) Other relevant information on traceability of solar cells and module as per ISO 9000 standard
Power output rating	To be given for standard test conditions (STC). I-V curve of the sample module should be submitted.

3. SOLAR PV MODULE MOUNTING STRUCTURE

The PV modules shall be mounted on fixed metallic structures of adequate strength and appropriate design, which can withstand the load of the modules and high wind velocities up to 150 km per hour.

a. The module mounting structure will be designed in such a way that it will occupy minimum space without forfeiting the output from SPV panels & shall be designed to allow easy replacement of any module.

b. Bidder may design foundation (RCC and PCC) and structure considering the wind loads and structural load bearing capacity of the building. The System integrator must ensure proper water proofing in case of any modifications to the roof.

c. Detailed specifications for the mounting structure are given below:

Wind velocity withstanding capacity	150 km / hour
Structure material	Structural materials shall be corrosion resistant and electrolytically compatible with the materials used in the module frame, its fasteners, nuts and bolts. Hot dip galvanised steel with galvanisation thickness of min 70 micron or aluminium alloy.
Bolts, nuts, fasteners, panel mounting clamps	Stainless steel SS304
Mounting arrangement for flat roofs	With Removable concrete ballast made of Pre-fabricated PCC(1:2:4), M15
Installation	The structures shall be designed for simple mechanical on-site installation
Minimum distance between roof edge and mounting structure (Horizontal Clearance)	>= 0.60 m
Minimum clearance between lowest part of panel and mounting structure (Vertical Clearance)	Shall not be less than 100mm
Access for panel cleaning and maintenance	All solar panels must be accessible from the top for cleaning and from the bottom for access to the junction box
Panel tilt angle	North – south orientation with a fixed tilt angle depending on location (south facing)
Spares	Required numbers of spare structures must be provided.
Warranty	The structure must have a free replacement warranty for 10 years.

The prospective Installer shall specify installation details of the solar PV modules and the support structures with lay-out drawings and array connection diagrams. The work shall be carried out as per the designs approved by concerned tender inviting authority .

4. ARRAY JUNCTION BOX (♣)

The array junction boxes are free of dust, vermin, and waterproof and made of Thermo Plastic. The terminals will be connected to copper bus-bar arrangement of proper sizes. The array junction boxes will have suitable cable entry points fitted with cable glands of appropriate sizes for both incoming and outgoing cables.

Technical Specification – Junction Boxes	
Material Thermoplastic	Dust, Vermin & Water proof
Hardware SS 304	Cable Gland Thermoplastic
Protection	IP 65 enclosures with transparent covers with Surge Protection Device (SPD) class-I/II, DC Fuse with holder and string disconnector.

Surge Protection Device (SPD): Internal surge protection shall consist of three MOV/GDT (glass discharge tube) type arrestors connected from +ve and –ve terminals to earth (via Y arrangement) for higher withstand of the continuous PV-DC voltage during earth fault condition. SPD shall have safe disconnection and short circuit interruption arrangements through integrated DC inbuilt bypass fuse (parallel) which should get tripped during failure mode of MOV, extinguishing DC arc safely in order to protect the installation against fire hazards.

a. A surge protection device in each sub-array line shall be provided to prevent the high current transients from entering into the DC bus. Busbar must be made from tinned plated copper.

b. It must be with DC disconnect switch and DC fuses positive side shall have a voltage rating of 1000V DC, current rating as required.

5. DC Distribution Box (♣)(optional)

A DC distribution box shall be mounted close to the solar grid inverter. The DC distribution box shall be of the thermo plastic IP65 DIN rail mounting type and shall comprise the following components and cable terminations:

Incoming 2 core (Positive and negative DC) cables from the DC Combiner Box;

DC circuit breaker, 2 pole (the cable from the DC Combiner Box will be connected to this circuit breaker on the incoming side);

DC surge protection device (SPD), class 2 as per IEC 60364-5-53;

Outgoing 2 core cable(Positive and negative DC) to the solar grid inverter.

As an alternative to the DC circuit breaker a DC isolator may be used inside the DC Distribution Box or in a separate external thermoplastic IP 65 enclosure adjacent to the DC Distribution Box. If a DC isolator is used instead of a DC circuit breaker, a DC fuse shall be installed inside the DC Distribution Box to protect the DC cable that runs from the DC Distribution Box to the Solar Grid Inverter.

DC and AC CABLES:
For the DC cabling, XLPE insulated and PVC sheathed, UV stabilized single core flexible copper cables shall be used. Multi-core cables shall not be used.

For the AC cabling, PVC or XLPE insulated and PVC sheathed single or multi-core flexible copper cables shall be used. Outdoor AC cables shall have a UV-stabilised outer sheath.

The total voltage drop on the cable segments from the solar PV modules to the solar grid inverter shall not exceed 2.0%.

The total voltage drop on the cable segments from the solar grid inverter to the building distribution board shall not exceed 2.0%

The DC cables from the SPV module array shall run through a UVstabilised PVC conduit pipe of adequate diameter with a minimum wall thickness of 1.5mm.
Cables and wires used for the interconnection of solar PV modules shall be provided with solar PV connectors and couplers.

All cables and conduit pipes shall be clamped to the rooftop/ walls/parapet with thermo-plastic clamps at intervals not exceeding 50 cm.

The minimum DC cable size shall be 4.0 mm2 copper. The minimum AC cable size shall be 4.0 mm2 copper. In three phase systems, the size of the neutral wire size shall be equal to the size of the phase wires.

Cables and conduits that have to pass through walls or ceilings shall be taken through a PVC pipe sleeve.

Cable conductors shall be terminated with tinned copper end-ferrules to prevent fraying and breaking of individual wire strands. The termination of the DC and AC cables at the Solar Grid Inverter shall be done as per instructions of the manufacturer, which in most cases will include the use of special connectors.

Only copper cables of appropriate size and of reputed-make shall have to be used. However aluminum cables can be used on A.C side.

a) All connections should be properly terminated, soldered and/or sealed from outdoor and indoor elements. Relevant codes and operating manuals must be followed. Extensive wiring and terminations (connection points) for all PV components is needed along with electrical connection to lighting loads.

b) All the Cu/Al. PVC or XLPE insulated Armored. Sheathed cables required for the plant will be provided by the manufacturer.

c) Only terminal cable joints shall be accepted. No cable joint to join two cable ends shall be accepted. All cable/wires shall be marked with good quality letter and number ferrules of proper sizes so that the cables can be identified easily.

All Cables shall confirm relevant IS/ IEC standards

All cables shall be supplied in the single largest length to restricting the straight through joints to the minimum number.

AC Distribution Box

An AC distribution box shall be mounted close to the solar grid inverter. The AC distribution box shall be of wall / rail mounting type and shall comprise of following components :

- Incoming 3 core cable from the solar grid inverter
- AC circuit breaker, 2 pole / 4 pole
- AC surge protection device (SPD), class 2 as per IEC 60364-5-53
- Outgoing cable to the building electrical distribution board.

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 be locked by the utility personal.

6. GRID INVERTER AND BI-DIRECTIONAL METER - Only BESCOM empanelled shall be used

7. STANDARDS FOR OTHER COMPONENTS

Cables	i	General Test and Measuring Method PVC insulated cables for working voltage upto and including 1100 V and UV resistant for outdoor installation for A.C. cables. (It is suggested to use D.C. rated, UV resistant Photovoltaic cable having plug and play capability cables)	IEC 60227 / IS 694 IEC 60502 / IS 1554 (part I & II)
Earthing	i	Grounding	IS 3043: 1986
Switches/ Circuit Breakers/ Connectors	i	General Requirements Connectors -safety A.C. /D.C.	IEC 60947 Part I,II, III / IS 60947 Part I,II, III / EN 50521
Junction Boxes/ Enclosures for Charge Controllers/ Luminaries	i	General Requirements	IP 65 (for outdoor)/ IP 21 (for indoor) As per IEC 529

Balance of system materials:

8. DATA LOGGER:

- ✓ The communication local to the Solar Energy Generator shall follow Industry Standard like RS232 or RS485 or RJ45 LAN
- ✓ Communication between the Solar Energy Generator and the Application running on the Server shall be based on GSM/GPRS.
- ✓ Battery backup for data logger system is mandatory
- ✓ The data to be logged and made available as follows:-
    - o Instantaneous DC Voltage
    - o Instantaneous DC Current
    - o Instantaneous AC Voltage
    - o Instantaneous AC Current
    - o Conversion Efficiency
    - o Voltage graph showing Volts in Y-axis and Time-of-Day on X-axis. Similarly Current graph
    - o Total AC Power generated per day, per week and per month showing Power Generation Profile graphs
    - o Peak Power generated
    - o Monthly Power generation charts showing the total power generated in each month.

a) PV array energy production: Digital Energy Meters to log the actual value of AC/ DC Voltage, Current & Energy generated by the PV system shall have to be provided.

b) Solar Irradiance: An integrating Pyranometer (Class II or better) shall be provided, with the sensor mounted in the plane of the array. Readout shall be integrated with data logging, system.

c) Wind Speed: An integrated wind speed measurement unit shall be provided.

d) Temperature: Temperature probes for recording the Solar panel temperature and ambient temperature shall be provided.

A data logging system for plant control and monitoring shall be provided.

9. EARTHING PROTECTION

1. Earthing protection: A minimum of two separate dedicated and interconnected earth electrodes must be used for the earthing of the solar PV system support structure with a total earth resistance not exceeding 5 ohms.
   (i) Equipment earth (DC) and
   (ii) System earth (AC)

   Both equipment earth (DC) and system earth (AC) shall be checked for proper earthing.

   - Equipment earth (DC): All the non-current carrying metal parts such as PV modules, DCDB are bonded together and connected to earth to prevent shocks to the manpower and protection of the equipment.
   - System earth (AC): All the non-current carrying metal parts such as ACDB, Lightening Arresters are bonded together and integrated to existing earth.

   - Earthing shall be done in accordance IS 3043-1986, provided that earthing conductors shall have a minimum size of 6.0 mm2 copper wire or 10 mm2 aluminium wire or 3mm2 X 70 mm2 hot dip galvanized iron flat. Unprotect aluminium or copper-clad aluminium conductors shall not be used for final underground connections to earth electrodes.

   - The earth electrodes shall have a pre-cast concrete enclosure with a removal lid for inspection and maintenance. The entire earthing system shall comprise non-corrosive components.

10. CAUTION SIGNS

In addition to the standard caution and danger boards or labels as per Indian Electricity Rules, the AC distribution box near the solar grid inverter and the building distribution board to which the AC output of the solar PV system is connected shall be provided with a noncorrosive caution label with the following text:

WARNING – DUAL POWER SOURCE
SECOND SOURCE IS SOLAR SYSTEM

The size of the caution label shall be 105mm (width) x 20mm (height) with white letters on a red background.

11. METERING SCHEME:

The bi-directional (import kWh and export kWh) meter shall be fixed at the point of grid connectivity (the "Solar Service Connection Meter") for the purpose of net-metering as per below diagram

The existing meter shall be rewired to record total solar generation.

Both bi-directional and solar generation side meter shall be in same vicinity.

The bi-directional meter shall comply with the requirements of CEA Regulations on Installation and Operation of Meters.

Meter must also display on demand, instantaneous, AC system voltages and currents, frequency, reactive power with sign.

For 1-5kW : Single phase Bi-directional whole current meter class I
5-17kW : Three phase Bi-directional whole current meter class I
17to 50kW : Three phase 3 X 5 A, CT operated, 0.5s class, Bi-directional meter

Above 50kW i.e For all HT installations – 0.2S class meter, 0.2 class CT's of suitable ratio and 0.2 class PT's 11kV / √3 /110V / √3

Note: For HT installations, if the existing meter cubicle is having 2 element system of 2 CTs, 2 PTs and metering with three wire system, it shall be replaced by 3 element system of 3 CTs, 3 PTs and metering with four wire system.

12. CONNECTION TO BUILDING ELECTRICAL SYSTEM

The AC output of the solar grid inverter shall be connected to the building's electrical system after the BESCOM service connection meter at the consumer busbar by providing suitable capacity manual disconnector. The solar grid inverter output shall be connected to a dedicated module in the Main Distribution Board (MDB) of the building. It shall not be connected to a nearby load or socket point of the building. The connection to the electrical system of the building shall be done as shown in below diagram.

Note: Any system up gradation in the infrastructure required to connect to grid shall be carried out by the consumer.

Single Line Diagram of Rooftop Facility