Specification of Solar panel Jacks

1. Technical specification

SPECIFICATION AND CERTIFICATION REQUIREMENTS FOR THE 1 kW_p STAND ALONE SOLAR PV POWER PLANTS

DEFINITION

1.1 The stand alone solar PV power plant system comprises of solar PV modules with inbuilt array optimiser or panel MPPT optimiser, lead acid battery bank, intelligent online inverter which feeds uninterrupted quality AC power to electrical loads taking energy from PV or battery bank as the case may be. Batteries will be charged from solar energy by charge controller integrated in the inverter or by an external charge controller.

DUTY CYCLE

1.2 The system should be capable for operating as per the nominal duty cycle mentioned with each configuration.

LOAD

1.3 The system should be connected to the load of 1 kW through a change-over switch. The change-over switch shall be used by the beneficiary to connect the load to the utility grid (where available), in case the battery is deep discharged. The inverter is not expected to charge the batteries from the utility grid.

SPV MODULES

1.4 Only **indigenous modul**es are allowed to be used. Imported modules do not qualify for this programme.

1.5 The solar PV module should have IEC 61215 / IS14286 qualification certification.

1.6 In addition, the module must conform to IEC 61730 part-1 requirements for construction & Part-2 requirements for testing for safety qualification.

1.7 PV modules must also qualify salt mist corrosion testing as per IEC 61701.

1.8 The PV modules(s) shall contain crystalline silicon solar cells.

1.9 Shading correction / bypass for optimizing array output is to be incorporated and shading optimization to be provided.

1.10 Each PV module used in any solar power project must use a RF identification tag (RFID), which must contain the following information. The RFID can be inside or outside the module laminate as per MNRE conditions, but must be able to withstand harsh environmental conditions.

i. Name of the manufacturer of PV Module

ii. Name of the manufacturer of Solar cells

iii. Month and year of the manufacture (separately for solar cells and module)

iv. Country of origin (separately for solar cell and module)

v. I-V curve for the module

vi. Peak Wattage, I_m, V_m and FF for the module

vii. Unique Serial No. and Model No. of the module

viii. Date and year of obtaining IEC PV module qualification certificate

ix. Name of the test lab issuing IEC certificate

x. Other relevant information on traceability of solar cells and module as per ISO 9000 series

1.11 The logo of ANERT and support of MNRE with details of the scheme (to be specified in the empanelment order) shall be provided on the PV module, and also on display boards placed near the PV array and the inverter/ battery room.

1.12 The PV modules must be tested and approved by one of the MNRE authorised test centres for IEC/ IS certification. Test certificates can be from any of the NABL/ BIS accredited Testing / Calibration Laboratories.

1.13 The power output of the module(s) under STC should be a minimum of 1000 W_p

1.14 PV modules used in solar power plants/ systems must be warranted for their output peak watt capacity, which should not be less than 90% at the end of 10 years and 80% at the end of 25 years.

1.15 Operating voltage for the output shall be suitable for 12 / 24 / 48/… volt DC applications

BATTERY BANK

1.16 Battery bank comprising of batteries conforming to IEC 61427,or IS 13369 or IS 1651 BIS specification, and meeting the following specification should be supplied, installed, and commissioned:
Type – Lead acid batteries: Flooded tubular/ VRLA/ Gel

1.17 The battery bank will have a minimum rating of 7200 watt hour ± 4%, to meet the dc system voltage with 12 or 6 or 2 volt batteries. Battery capacity is rated C/10 discharge rate at 27°C
1.18 75% of the rated capacity of the battery should be between fully charged & load cut off conditions.
1.19 Self dischargeless than 3% per month at 30°C.
1.20 Suitable ceramic vent plugs with float level indicators will be provided with the flooded type batteries
1.21 Distilled water topping up should be done once in 3 months for tubular flooded type batteries
1.22 It will be installed on a suitable metal stand duly painted with acid resistant paint to cover less space.
1.23 The following additional information on the batteries to be supplied:

i. Overcharge voltage

ii. Load disconnect voltage

iii. Modules reconnect voltage

iv. Float voltage

v. Temperature compensation required for proper operation

vi. Ampere hour efficiency/ Watt hour efficiency

Power Conditioning Unit

1.24 Power Conditioning Unit (PCU) shall comprise of charge controller and MPPT unit with power optimiser, inverter, voltage stabilizer, and distribution panel along with necessary displays, indicators and alarms.

Charge Controller & MPPT

1.25 The charge controller and MPPT should confirm to applicable standards for requisite AC/DC Inputs

1.26 Operational Voltage Range: 12/24/48/... volt according to the battery bank and panel array

1.27 Series disconnect, PWM type

1.28 Controlling element: IGBTs or MOSFET

1.29 The Charge controller/MPPT units should conform to:

i. Design Qualification: IEC 62093, if charge controller is not in-built in the inverter

ii. Environmental Testing: IEC 60068-2 (1, 2, 14, 30)/ Equivalent BIS Std.

1.30 Solid State MPPT based series pulse width modulation charger with three stages (bulk, absorb and float)

1.31 Current rating as required for panel array and battery bank

1.32 Both calibrated scales and test points to allow precise adjustments and setting verification.

1.33 Electronic protection for

i. Short circuit

ii. Overload

iii. Over temperature

iv. Reverse polarity

1.34 Auto resetting electronic over current protection

1.35 LCD Digital display with back lighting and continue display of

i. Battery voltage

ii. DC charge/ discharge current

iii. LED/LCD indications for state of charge

Inverter

1.36 A 12/ 24/ 48 ... volt DC to 230 volt sine wave inverter

1.37 Inverter/ Power Conditioning Unit will have following features preferably from Indian Manufacturer:

i. Conform to IEC 61683 / IS 61683 for efficiency measurements, and IEC 60068-2 (1, 2, 14, 30) equivalent BIS standard for environmental testing

ii. Type: IGBT/ MOSFET based

iii. Output voltage: 230±2%, 1ϕ

iv. Output frequency: 50 Hz

v. THD: Less than (<) 3%

vi. Efficiency: 85% at full load and 75% at half-load

vii. Ambient temperature: 0 to 50°C

viii. Relative humidity: 90% non-condensing

Protections:

1.38 Short circuit (circuit breaker & electronic protection against sustained fault)

1.39 Over-load protection

1.40 Under voltage & Over-voltage of Battery (automatic shut down)

1.41 Auto/ Manual re-connect provision

1.42 Reverse polarity protection both for the PV array and Battery bank (DC)

Cooling:

1.43 Air cooled

Other Features:

1.44 Load detection threshold: less than 3%

1.45 Surge Protection: 150% of the rated capacity for a period of 10 seconds

1.46 Acoustic Noise Level ≤ 50 dB

Indicators / Displays / Alarms

1.47 Digital Display(s) of input DC SPV voltage & current, AC output voltage, frequency , power and current, along with Energy Meter at the inverter output before the manual change-over switch

1.48 Separate indication for SPV charging

1.49 Battery Low indicator and Alarm / cut off

1.50 Overload Alarm / cut off

1.51 System Cut off Indicator

1.52 System reset button

Operating Modes

1.53 The following operating modes are to be made available:

Standby mode: Where the control system continuously monitors the output of the solar generator until pre-set value is exceeded (typically 10 watts)

Operational or max. Power Point (MPP) tracking mode: The control system continuously adjust the voltage of the generator to optimize the power available. The power conditioner must automatically reenter standby mode when input power reduces below the standby mode threshold. Front Panel display should prove the status of the Inverter, including AC Voltage, Current, Power output & DC Current, Voltage and Power input, power factor and fault indication (if any)

Electrical safety, earthing and protection

1.54 Internal Faults: In-built protection for internal faults including excess temperature, commutation failure, overload and cooling fan failure (if fitted) is obligatory.

1.55 Over Voltage Protection: Over Voltage Protection against atmospheric lightning discharge to the PV array is required. Protection is to be provided against voltage fluctuations in the load circuit itself and internal faults in the power conditioner, operational errors and switching transients.

1.56 Cabling practice: Cable connections must be made using PVC insulated copper cables, as per BIS specifications. All cable connections must be made using suitable terminations for effective contact.

1.57 Fast acting semiconductor type current limiting fuses shall be provided in PCU, and ELCB and MCB should be provided at the panel board fed by the PCU to protect from the load short circuit and earth leakage contribution.

1.58 The inverter shall include an easily accessible emergency OFF button located at an

appropriate position on the unit.
1.59 The inverter shall include ground lugs for equipment and PV array grounding. Inverter and PV array grounding shall be as per BIS standards.
1.60 All exposed surfaces of ferrous parts shall be thoroughly cleaned, primed and painted or otherwise suitably protected to survive nominal 30 years design life of the unit.
1.61 The inverter enclosure shall be weatherproof and capable of surviving climatic changes and should keep the inverter intact under all conditions in the room where it will be housed. The inverter shall be located indoor and should be either wall/ pad mounted. Moisture condensation and entry of rodents and insects shall be prevented in the inverter enclosure. Components and circuit boards mounted inside the enclosures shall be clearly identified with appropriate permanent designations.
1.62 All doors, covers, panels and cable exists shall be gasketed or otherwise designated to limit the entry of dust and moisture.
1.63 All doors shall be equipped with locks. All openings shall be provided with grills or screens with openings not larger than 0.95 cm.
1.64 In the design and fabrication of the inverter the site temperature (max 50°C), incident sunlight and the effect of ambient temperature on component life shall be considered carefully.
1.65 The Junction boxes, enclosures for inverters/ Charge controllers should meet general requirements as per IP 54 (for outdoor)/ IP 21 (for indoor) as per IEC 529.

Distribution Boards

1.66 DC Distribution panel to receive the DC output from the array field with analog measurement panel for voltage, current from different miniature circuit breaker (MCBs) so as to check any failure in the array field. DC DPBs shall have sheet from enclosure of dust & vermin proof. The bus bars are to be made of copper of desired size. Suitable capacity MCBs control is provided for controlling the DC power output to the inverter along with necessary surge arrestors.

1.67 AC Distribution Panel Board (DPB) shall control the AC power from inverter and should have necessary surge arrestors.

1.68 Switches/ Circuits Breakers/ Connectors shout meet general requirements and safety requirements as per IS 60947 Part I, II, III and EN 50521 for AC/DC

Cabling

1.69 PVC insulated copper cables with current rating suitable for AC and DC as per National Electrical Code, and meeting:

- General test and measuring method as per IEC 60227 / IS 694
- PVC insulated cables for working voltage up to and including 1100 V and UV resistant for outdoor installation as per IEC 60502/ IS 1554 (Pt. I & II)

1.70 All cables supplied should have proper current carrying capacity.

1.71 All cables shall be adequately supported.

1.72 Outside of terminal/ panels/ enclosures shall be protected by conduits.

1.73 Cables shall be provided with dry type compression glands wherever they enter junction boxes, panels, enclosures.

1.74 Cable Marking: All cable/wires are to be marked in proper manner by good quality ferule or by other means so that the cable can be easily identified.

1.75 Selected cable should carry a current density of minimum 1.2 A/sq.mm.

Mechanical Components – Array Support Structure

1.76 Suitable number of PV panel structures shall be provided. Structures shall be of flat plate design either of I or L section.

1.77 Structural material shall be corrosion resistant and electrolytically compatible with the materials used in the module frame, its fasteners, nuts and bolts. Galvanizing should meet ASTM A-123 hot dipped galvanizing or equivalent, which provides at least spraying thickness of 70 microns on steel as per IS 5905, if steel frame is used. Aluminium frame structures with adequate strength can also be used.

1.78 Structures shall be supplied complete with all members to be compatible for allowing easy installation at the site.

1.79 The structures shall be designed to allow easy replacement of any module.

1.80 Each structure shall have its angle of inclination to the horizontal as per the site conditions. Solar module should be inclined towards south direction and installed at an angle of 10-15° from the horizontal.

1.81 Each panel frame structure shall be so fabricated as to be fixed on the rooftop column/ wall structures. The structure should be capable of withstanding a wind load of 200 km/hr after grouting & installation. The lower end of the solar array must be above the rooftop. Grouting material for SPV structures shall be as per M15 (1:2:4) concrete specification.

1.82 The structures shall be designed for simple mechanical and electrical installation.

1.83 The array structure shall support SPV modules at a given orientation and absorb and transfer the mechanical loads to the rooftop column properly. All nuts and bolts shall be of very good quality stainless steel.

Warranty

1.84 5 years warranty for the entire system should be provided by the supplier as per the conditions of the contract.

1.85 The Warranty Card to be supplied with the system must contain the details of the system supplied, as per format to be prescribed by ANERT

1.86 PV modules used in solar power plants/ systems must be warranted for their output peak watt capacity, which should not be less than 90% at the end of 10 years and 80 % at the end of 25 years

Factory Testing

1.87 Operation of all controls, protective and instrumentation circuit shall be demonstrated by direct test if feasible or by simulation operation conditions for all parameters that cannot be directly tested.

1.88 Operation of start up, disconnect and shutdown controls shall also be tested and demonstrated. Stable operation of the inverter and response to control signals shall also be tested and demonstrated.

1.89 Factory testing shall include measurement of phase currents, efficiencies, harmonic content and power factor. All tests shall be performed at 25, 50, 75 and 100 percent of the rated nominal power.

1.90 A Factory Test Report (FTR) shall be supplied with the unit after all tests. The FTR shall include detailed description of all parameters tested qualified and warranted.

1.91 Factory testing of the Inverter/ Inverters shall be carried out and beneficiary/ ANERT representative may be allowed to witness it at the manufacturer’s premises, if so required.

Installation details

1.92 The supplier shall agree to provide installation details of the PV modules and the support structures with appropriate diagrams and drawings. Such details shall include, but not limited to, the following,

i. Determination of true south at the site
ii. Array tilt angle to the horizontal, with permitted tolerance
iii. Details with drawings for fixing the modules
iv. Details with drawings for fixing the junction/ terminal boxes
v. Interconnection details inside the junction/ terminal boxes
vi. Structure installation details and drawings
vii. Electrical grounding (earthing as per BIS specifications)
viii. Inter-panel/ Inter-row distances with allowed tolerances; and
ix. Safety precautions to be taken

Operation Manual

1.93 An Operation, Instruction and Maintenance Manual, in English and Malayalam, should be provided with the system.

1.94 The following minimum details must be provided in the manual:

- About Photovoltaic
- About solar power plant – its components and expected performance.
- About PV module
- About battery
- About electronics
- About charging and significance of indicators
- DO's and DON'T's
- Clear instructions on regular maintenance and trouble shooting of solar power plant
- Name and address of the contact person in case of non-functionality of the solar power plant.

Bill of Material

1.95 The bidder should provide the bill of material mentioning the quantity of each of the item consisting in one system, along with the offer (format as per Annexure II-D).

Minimum Technical requirements summary

S/N	System Component	Capacity/ rating	Minimum Technical Compliance
1.	Solar panel	1000 W_p	IEC 61215 / IS14286; IEC 61730 Part 1 & II; IEC 61701

S/N	System Component	Capacity/ rating	Minimum Technical Compliance
2.	Battery	7200Whr ± 4%	IS1651/IS13369 /IEC 61427/IS15549
3.	Power conditioning Unit	1 kW	IEC 61683 / IS 61683 IEC 60068-2 (1, 2, 14, 30) / Equivalent BIS Std Efficiency 85% and above
4.	Cables		IEC 60227 / IS 694 IEC 60502 / IS 1554 (Pt. I & II
5.	Switches/ Circuit Breakers/ Connectors		IEC 60947 part I,II, III / IS 60947 Part I,II,III EN 50521
6.	Junction Boxes/Enclosuresfor Inverters/ ChargeControllers		IP 54 (for outdoor)/ IP 21(for indoor) as per IEC 529