SECTION-IV

TECHNICAL SPECIFICATION OF SPV POWER PLANT:

1. PV MODULES:

a. The PV modules must conform to the latest edition of any of the following / equivalent BIS Standards for PV module design qualification and type approval:

• Crystalline Silicon Terrestrial PV Modules IEC 61215 / IS14286

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

c. Identification and Traceability:

Each PV module must use a RF identification tag (RFID), which must contain the following information:

(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 cells and module)

(v) I-V curve for the module

(vi) Peak Wattage, Im, Vm 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.

It may be noted that from 1st April 2013 onwards; RFID shall be mandatory placed inside the module laminate

2. BATTERY BANK:

The batteries shall be solar photovoltaic batteries of flooded electrolyte, low maintenance, lead Acid and made of hard rubber container. VRLA/GEL batteries as per the relevant BIS standards & MNRE specifications can be used.

Storage batteries should conform IEC 61427 / IS 1651 / IS 13369 as per specifications.

The batteries shall use 2V and battery capacity is to be designed at C/10 rate with end cell cut off voltage of 1.85 V per cell.

Battery terminal shall be provided with covers.

Batteries shall be provided with micro porous vent plugs with floats.

Charging instructions shall be provided along with the batteries.

Suitable carrying handle shall be provided.

A suitable battery rack with interconnections & end connector shall be provided to suitably house the batteries in the bank. The features and dimensions of the battery rack shall be provided along with the bid document.

The batteries shall be suitable for recharging by means of solar modules via incremental / open circuit regulators.

Bidder shall mention the design cycle life of batteries at 80%, 10% and 20% depth of discharge at 27 deg. C.

The batteries shall be designed for operating in ambient temperature of site in the state of Maharashtra.

The self discharge of batteries shall be less than 3 % per month at 20 deg. C and less than 6% per month at 30 deg. C

The charge efficiency shall be more than 90% up to 70% state of charge.

The topping up frequency shall be 12 – 18 months.

The batteries shall consist of individual cells, which can be carried separately with ease while transporting.

Offered batteries shall comply to the following:

10 % of DOD: 7200 cycles

50 % of DOD: 3000 cycles

80 % of DOD: 1200 cycles

The Battery Bank shall be designed to provide 1 day autonomy. Bidder to provide battery sizing details along with their offer. The distance between two batteries may be kept 6 inches & vice versa.

There will be battery bank comprising of capacity as per follows:

Table No. 1

Capacity	**Battery Bank**	
kWp	**V**	**Ah**
1	24	250
	48	150
2	24	500
	48	250
3	24	800
	48	400
4	24	1050
	48	500
5	48	650
	96	350
6	48	800
	96	400
7	48	900

Capacity	Battery Bank	
kWp	**V**	**Ah**
	96	450
8	48	1050
	96	500
9	48	1150
	96	600
10	96	650
	120	500
11	96	700
	120	550
12	96	800
	120	650
13	96	850
	120	700
14	96	900
	120	750
15	120	800
	240	400
16	240	400
17	240	450
18	240	450

Capacity	Battery Bank	
kWp	**V**	**Ah**
19	240	500
20	240	500

The batteries should be of tubular plate lead acid & low maintenance type and shall have long service life. The cells should confirm IEC 61427 / IS 1651 / IS 13369 and as per specification given below shall be provided.

Battery protection panel

The battery protection panel shall be made of CRCA sheet having two incoming and two outgoing terminals. There shall be 2 Nos. HRC fuses of suitable rating with fuse holder/base etc as required. 2 poles MCB/ MCCB can also be used for isolation purpose in stead of fuses, if required.

Container	Polypropylene Co-polymer / hard rubbers with carrying handle.
Cover	Protective cover of polypropylenes against dirt & possible short circuit.
Terminals	Made of lead alloy suitable for bolted connection. The terminals should be greased with petroleum gel.
Electrolyte	Battery grade Sulphuric acid
Self Discharge	Less than 3% per month at 30 degree C
Life expectancy	1500 cycle duty at 27degree C at 80% depth of discharge 3000 cycle duty at 50% discharge.
Voltage	2 Volt
Approval	Batteries shall have to be approved by ERTL or CPRI or SEC or any MNRE approved test centres
Service Life	Should perform satisfactory for a minimum period of 5 year under operating conditions as mentioned.

Each battery bank will contain suitable wooden rack, hydrometer, thermometer, cell tester and connecting leads etc.

3. BALANCE OF SYSTEM (BoS) ITEMS/ COMPONENTS:

Details of Power Conditioning Units:

a. General:

As SPV array produce direct current electricity, it is necessary to convert this direct current into alternating current and adjust the voltage levels before powering equipment designed for nominal mains AC supply. 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" OR simply PCU. In addition, the PCU shall also house MPPT (Maximum Power Point Tracker), an interface between Solar PV array & the Inverter, to maximize Solar PV array energy input into the System. PCU should conform IEC 61683, IEC 60068 as per specifications.

PCU refers to combination of charge controller, inverter and AC charger and shall be supplied as integrated unit or separate units.

Power Conditioning Unit (Solar Charge Controller + Inverter)	
Switching device	MOSFET/IGBT
Type	MPPT based PWM charger to charge 240 V battery bank
Input voltage from PV array	As per Table no. 1 (The voltage variation shall be as per change in array output)
Protections	Short circuit protection Input under voltage / Deep discharge of battery Input surge voltage protection Over current Battery reverse polarity protection Solar array reverse blocking diode (provided in array junction box) DC rated fuse at input and AC rated fuse at output with suitable

	contactor/solid-state switches for safe start-up & shutdown of system Load surge current Over temperature Under / Over output voltage Under / Over frequency Automatic / manual isolation at input & output Suitable protection for solid-state switching devices
Dielectric strength	1.1kV between input/output and ground with EMI protections removed
Cooling	Solar natural and Forced air cooling with temperature sensitive fan operation
Ambient operation (max)	50° C
Relative humidity	95% maximum
Assembly & mounting	As per normal industry practice
Finish	Epoxy powder coating
Cable entry	From rear 200mm above ground level
Load test at factory	Minimum 6 hours at full load
Features	Stand-alone and hybrid mode of operation. High quality with high efficiency and reliability Microprocessor based intelligent controller Self monitoring capability. Integral design with MPPT solar charge controller and inverter Highly reliable & efficient solid-state switching devices

	Rated for continuous operation at full load High over-load capability of 200% surge for 10 seconds Inverter output power factor of 0.8 lag Automatic re-start facility after over load triggered shutdown
Efficiency	90% at rated load and normal operating conditions 85% (min) at 25% load and nominal input voltage with UPF load
%THD	Sine-wave output with 3% THD at full load UPF and nominal input voltage
Output voltage	415 (+12.5-20%)V AC
Output frequency	50Hz ± 0.5Hz
%Regulation	5% against input voltage and load variation
Indications	As many as possible with relevance
AC charger input	240 V AC, 50 Hz from AC mains grid
Enclosure	IP 22 (For indoor application)
Weight / Dimension	The details of the inverter will be provided in the specification / user manual
Battery type	Tubular lead acid /VRLA GEL type

b. Remote Monitoring Facilities:

Provision for Online as well as Offline remote monitoring of the installed power plants must be made in the controllers or the inverters through an integral as well as externally fitted arrangement. It should be possible to ascertain the daily power generated by the SPV power plant, Number of days the plant was under operation and breakdown / repairs.

There should be the provision for auto generated email of monthly energy generation (from SPV power plant) in prescribed format with consultation of MEDA.

c. Maximum Power Point Tracker (MPPT)

Maximum power point tracker shall be integrated into the PCU to maximize energy drawn from the Solar PV array. The MPPT should be microprocessor / micro-controller based to minimize power losses. The details of working mechanism of MPPT shall be mentioned.

The efficiency of the Charge controller (MPPT based with data logger) shall not be less than 94% and shall be suitably designed to meet array capacity.

MPPT must conform IEC 62093, IEC 60068 as per specifications.

d. Inverter

Inverters shall be of very high quality having high efficiency and shall be completely compatible with the charge controller and distribution panel.

Inverter should conform IEC 61683, IEC 60068 as per specifications.

The inverter shall be designed for continuous, reliable power supply as per specifications. The inverter shall have high conversion efficiency from 25 percent load to the full rated load. The efficiency of the inverter shall be more than 90% at full load and more than 88% at partial load (50%-75%). The supplier shall specify the conversion efficiency in the offer.

The inverter shall be designed for extreme temperatures.

The Inverter shall have internal protection arrangement against any sustained fault in the feeder.

The dimension, weight, foundation details etc. of the inverter shall be clearly indicated in the detailed technical specification.

Each solid-state electronic device shall have to be protected to ensure long life of the inverter as well as smooth functioning of the inverter.

Supplier shall indicate tripping voltage & start up voltage for the inverters & this should be perfectly matched with the recommendation of battery manufacturers.

The PCU shall be mounted on a suitable reinforced concrete pad inside control room not susceptible to inundation by water. All cable entry to and from the PCU

shall be fully sheathed to prevent access of rodents, termites or other insects into the PCU from bottom/top of the PCU in form of a detachable gland plate.

For the Monitoring of Unit generated provision of Ah meters at input side shall be accomplished with Energy meter and voltmeters at suitable place and included in the technical specification clearly.

Provision for the Equalizing Charging of battery periodically shall be made and state clearly in the technical details.

The bidder shall furnish details of proper operation, maintenance and trouble shooting details to MEDA.

The bidder shall intimate MEDA prior to dispatch of the inverter for inspection. Shop tests on the inverter shall be conducted in the presence of the authorized representative of MEDA in order to verify the capacity and proper working of all control and protection arrangement.

The inverter will be highly efficient. The inverter should conform IEC 61683 / IEC 60068 and should be based on PWM technology and using IGBT. Inverters would display its own parameters and also the parameters of battery bank connected to the inverter. The inverter's capacity should be minimum 25 KVA for 20 KW SPV power plants. The inverters should be designed to be completely compatible with the charge controllers and distribution panels and are of integrated design.

Salient features of the Inverters shall be as follows:

Nominal Capacity	Equal to plant capacity or above
Input / Voltage	As per table no. 1 The voltage variation shall be as per change in array output.
Regulation	From minimum to maximum voltage 1%
Output frequency	50 Hz +/- 0.5 Hz
Overload Capacity	200% for 30 Second.
Efficiency	80% at 50% of load and More than 92% at full load 0.8 PF

Short Circuit Protection	Circuit Breaker and Electronics protection against sustained fault.
Low Battery Voltage	Automatic Shut Down
Total Harmonic Distortion	Less than 3%
Over Voltage	Automatic Shut Down
AC over Current/Load	Automatic Shut Down
Protection	Over Voltage both at Input & Output Over Current both at Input & Output Over Frequency Surge voltage inducted at output due to external source.
Protection Degree	IP65
Instrumentation & Indication	Input & Output voltage, Input & Output Current, Frequency, Power output, different status of inverter, kind of fault by audio signal.

MAIN FEATURES & OPERATING MODE:

i. The PCU shall operate on hybrid mode.

ii. In case of grid failure: Stored power from batteries shall be used to feed the dedicated load less than plant capacity.

iii. Grid power shall be the last priority to feed the load. During such time, the PCU shall feed the load directly through grid and shall also charge the batteries.

Load Side Monitoring:

(Meter 1 M-1) Dual Source RS 485 complied Energy meter should be provided in Solar AC distribution board to remotely monitor the Solar Energy Supplied to load and or Exported to Grid.

(Meter 2 M-2) Bidirectional Energy Meter so there should be provision to monitor Energy supplied to load from grid in absence of solar Energy

e. Junction Boxes

The junction boxes shall be dust, vermin and waterproof and made of FRP / Thermo Plastic. The terminals shall be connected to copper bus bar arrangement of proper sizes. The junction boxes shall have suitable cable entry points fitted with cable glands of appropriate sizes for both incoming and out going cables. Suitable markings shall be provided on the bus bar for easy identification and cable ferrules shall be fitted at the cable termination points for identification. Each main junction box shall be fitted with appropriate rating blocking diode. The junction boxes shall be of reputed make and should be as per IP 65 (for outdoor), IP 21 (for indoor) & as per IEC 62208.

The junction boxes shall have suitable arrangement for the Following:

Combine groups of modules into independent charging sub-arrays that shall be wired to the controller.

Provide arrangement for disconnection for each of the groups.

Provide a test point for each sub-group for quick fault location.

To provide group array isolation.

The rating of the JB's shall be suitable with adequate safety factor to inter connect the Solar PV array.

f. Charge Controller Unit:

The Charge Controller shall be dual input type; however the input is fed from a SPV panel only for battery charging. A selector switch shall be provided for choosing between those modes. The charge controller shall be preferably PWM type employing IGBT switching elements.

Charge controller should conform IEC 62093 / IEC 60068 as per specification.

The charging sequence from SPV array or external AC source shall be as follows:

Salient features of the Charge Controller shall be as follows:

Switching elements IGBT

Type of Charger PWM

Input :

From PV As per table no. 1

Output Voltage: As per table no. 1

Protections :Short Circuit, Deep Discharge, Input Surge Voltage, Over Current (load), Battery Reverse Polarity, Solar array reverse polarity.

Indication :String 'ON', Main 'ON', Charging 'ON', 80% Charged, 100% Charged, Charger Overload, Battery On Trickle.

Battery disconnected / Fault Battery Reverse Polarity, Low Solar Power, System Fault and Charger over Temperature and Input Over / Under Voltage (for AC).

MIMIC Diagram : To indicate power flow and operation of the charge controller/ battery charger; shall have provision for visual indications of existing power input/output through MIMIC diagram.

Bidder may design Power Conditioning Unit (PCU), which consists of a solar charge controller & inverter as per design mentioned above. In addition, it should have a Grid Charger.

It provides the facility to charge the battery bank through Solar only. The PCU continuously monitors the state of Battery Voltage, Solar Power output and the loads. Due to sustained usage of power, when the Battery Voltage falls below a preset level, the PCU will automatically transfer the load to the grid power.

g. Cables & Wirings:

All cables shall be supplied conforming to IEC 60227/ IS 694 & IEC 60502/ IS 1554. Voltage rating: 1,100V AC, 1,500V DC

For the DC cabling, Solar Cables, XLPE or XLPO insulated and sheathed, UV stabilised 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 DC cables from the SPV module array shall run through a UV stabilised 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 (MC4) and couplers.

All cables and conduit pipes shall be clamped to the rooftop, walls and ceilings with thermo-plastic clamps at intervals not exceeding 50 cm. The minimum DC cable size shall be 6.0 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. The following colour coding shall be used for cable wires:

− DC positive: red (the outer PVC sheath can be black with a red line marking)

− DC negative: black

− AC single phase: Phase: red; neutral: black

− AC three phase: Phases: red, yellow, blue; neutral: black

− Earth wires: green

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.

All wiring in the control room shall be carried out with minimum four sq. mm. PVC insulated copper conductor in surface/recessed steel conduct in control room & solar hut. All wiring shall be done with an appropriate size Cu conductor as earth wire. All wirings whether it is indoors or outdoors are to be casing capping system. As and when required flexible pipe may be used.

Buried underground cables shall be armoured. Unarmored buried underground cables shall be enclosed with suitable conduits. Unless, otherwise, specified, all other interconnecting cables shall be armoured.

Conductor size of cables and wires shall be selected based on efficient design criteria such that the overall electrical energy loss in any section of cable or wire is shall be less than 2% under the designed operating conditions. Conductor size of less than 6 sq. mm shall not be accepted.

Cable/wire connections shall be soldered, crimp-on type or split bolt type. Wire nut connections shall not be used.

All cables shall be adequately supported. Outside of the terminals / panels / enclosures shall be protected by conduits. Cables shall be provided with dry type compression glands wherever they enter junction boxes/panels/enclosures.

The wiring must be carried out in casing capping only.

h. Solar Distillation Plant:

Approved quality solar distillation Plant of 1000 mm X 1000 mm shall be installed on suitable GI structure. Supply of Solar Distillation Plant includes construction of suitable foundation for the distillation plant. Atleast two numbers of plastic pots and one funnel are to be supplied along with each of the two water Distillation plants.

i. Distribution System:

Single line diagram of the AC Distribution line shall be attached along with general point wiring diagram of sample room with the Technical details.

Details of cable used for the distribution and transmission purpose along with their current carrying capacity and make shall be enclosed.

Supply installation of Energy meter from reputed company. The energy meter shall be tested by State Electricity Board (SEB) and sealed by SEB. Testing certificate shall be submitted.

j. Earthing and lightning protection:

Earthing is essential for the protection of the equipment & manpower. Two main grounds used in the power equipments are:

- System earth
- Equipment earth

System earth is earth which is used to ground one leg of the circuit. For example in AC circuits the Neutral is earthed while in DC supply +ve is earthed.

In case of equipment earth all the non-current carrying metal parts are bonded together and connected to earth to prevent shock to the man power & also the protection of the equipment in case of any accidental contact.

To prevent the damage due to lightning the one terminal of the lightning protection arrangement is also earthed. The provision for lightning & surge protection of the SPV power source is required to be made.

In case the SPV Array can not be installed close to the equipment to be powered & a separate earth has been provided for SPV System, it shall be ensured that all the earths are bonded together to prevent the development of potential difference between ant two earths.

Earth resistance shall not be more than 1 ohm. It shall be ensured that all the earths are bonded together to make them at the same potential.

The earthing conductor shall be rated for the maximum short circuit current. & shall be 1.56 times the short circuit current. The area of cross-section shall not be less than 1.6 sq mm in any case.

The array structure of the PV modules shall be grounded properly using adequate numbers of earthing pits. All metal casing/ shielding of the plant shall be thoroughly grounded to ensure safety of the power plant.

The Earthing for array and distribution system & Power plant equipment shall be made with GI pipe, 4.5 m long 10 mm diameter including accessories and providing masonry enclosures with cast iron cover plate having locking arrangement, watering pipe using charcoal or coke and salt as required as per provisions of IS:3043. Necessary provision shall be made for bolted isolating joints of each Earthing pit for periodic checking of earth resistance.

Each array structure of the SPV yard shall be grounded properly. The array structures and the lightning conductors are to be connected to earth through 25 mm X 5mm GI strip.

The inverters and battery charger and all equipment inside the control room and battery room to be connected to earth through 25 mm X 5mm tinned copper strip including supplying of material and soldering. As earth bus is provided inside the control room with 25 mm X 5mm tinned copper strip.

In compliance to Rule 61 of Indian Electricity Rules, 2004 (as amended up to date), all non-current carrying metal parts shall be earthed with two separate and distinct earth continuity conductors to an efficient earth electrode.

Lightning: The SPV Power Plant shall be provided with lightning & over voltage protection. The main aim in this protection shall be to reduce the over voltage to a tolerable value before it reaches the PV or other sub system components. The source of over voltage can be lightning, atmosphere disturbances etc.

Metal oxide variastors shall be provided inside the Array Junction Boxes. In addition, suitable MOV’s also shall be provided in the Inverter to protect the inverter from over voltage.

k. Lightning & Over Voltage Protection System:

The SPV power plant should be provided with Lightning and over voltage protection. Connected with proper earth pits. The main aim of over voltage protection is to reduce the over voltage to a tolerable level before it reaches the PV or other sub-system components. The source of over voltage can be lightning or other atmospheric disturbance.

The lightning Conductors shall be made of 25 mm diameter 1000 mm long GI spike as per provisions of IS 3070. Necessary concrete foundation for holding the lightning conductor in position to be made after giving due consideration to maximum wind speed and maintenance requirement at site in future. The lightning conductor shall be earthed through 20 mm X 3 mm thick GI flat earth pits/earth bus made with 25 mm X 5 mm GI flats.

4. MAIN FEATURES & OPERATING MODE

PCU should gives preference to the solar power as the first input to load and extra energy produced by solar is used to charge the battery bank. The second preference is given the battery. In the absence of both solar and battery the power from grid will be feed to the load.

The PCU always gives preference to the solar power and will use Grid power only when the solar power / battery charger is insufficient to meet the load requirement.

5. MODULE MOUNTING STRUCTURE

Hot dip galvanized iron mounting structures may be used for mounting the modules / panels / arrays. These mounting structures must be suitable to mount the SPV modules / panels / arrays on the roof top, on the ground or on the poles / masts, at an angle of tilt with the horizontal in accordance with the latitude of the place of installation.

The Mounting structure shall be so designed to withstand the speed for the wind zone of the location where a PV system is proposed to be installed (wind speed of 150 km/ hour). It may be ensured that the design has been certified by a recognized Lab/ Institution in this regard.

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 with thickness of 80 microns as per IS 5905. All fasteners shall be of Stainless steel - SS 304.

The foundation for Module Mounting structures shall be 1:2:4 PCC Construction. There shall be minimum necessary clearance between ground level and bottom edge of SPV modules.

6. ORIENTATION AND TILT OF PV MODULE

Modules alignment should be due south and tilt angle shall be 26 - 30 degrees with horizontal.

7. DC DISTRIBUTION BOARD (DCDB)

A DCDB shall be provided in between PCU and Solar Array. It shall have MCCB of Suitable rating for connection and disconnection of array section. It shall have meters for measuring Array voltage and Array current.

8. AC DISTRIBUTION LINE

The generated electricity from these Power Plants will be utilized for illumination of Streets / Indoor Lighting, Fans, Computers, Internet modem, Printer within allowable practice limit. Necessary electric cable / connection shall be supplied / made by the bidder for illumination of existing streetlights / indoor lights.

9. OPERATION MANUAL

An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the Solar PV Power Plant and detail of Wiring and Connection Diagrams will also be provided with the manual.

10. COMPREHENSIVE MAINTENANCE CONTRACT (CMC)

- The complete Solar PV Power Plant must be guaranteed against any manufacturing/ design/ installation defects for a minimum period of 5 years.
- PV modules used in Solar PV Power Plant must be guaranteed for their output peak watt capacity, which should not be less than 90% at the end of 12 years and 80% at the end of 25 years.

- During the CMC period, MNRE / MEDA / users will have all the rights to cross check the performance of the Solar PV Power Plant. MEDA may carry out the frequent inspections of the Solar PV Power Plant installed and randomly pick up its components to get them tested at Govt. / MNRE approved any test centre. If during such tests any part is not found as per the specified technical parameters, MEDA will take the necessary action. The decision of MEDA in this regard will be final and binding on the bidder.

11. TEST REPORTS

Test certificates from MNRE approved test centres only will be considered valid.

12. OTHER FEATURES

- The supplier must fulfil all the technical & other requirements as per provisions under JNNSM, MNRE, GoI.
- A strip containing the following details should be laminated inside the module to be clearly visible from the front side:
    a. Name of the Manufacturer or distinctive Logo
    b. Model or Type No.
    c. Serial No.
    d. Year of make.