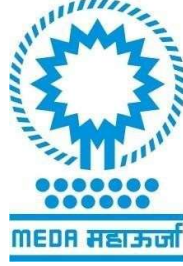


**MAHARASHTRA ENERGY DEVELOPMENT AGENCY (MEDA),
DIVISIONAL OFFICE, PUNE.**



(A GOVERNMENT OF MAHARASHTRA INSTITUTION)

QUOTATION CALL FOR

SURVEY, DESIGN, FABRICATION, SUPPLY, INSTALLATION, TESTING, COMMISSIONING WITH NET METERING AND REMOTE MONITORING SYSTEM OF 15 KW ON-GRID SOLAR ROOFTOP SYSTEM AT GOVT POLYTECHNIC, GANESHKHIND RD, DIST-PUNE, MAHARASHTRA WITH COMPREHENSIVE MAINTENANCE CONTRACT FOR A PERIOD OF 5 YEARS

Quotation Reference No.: - MEDA/DOP/GPGRP/GCRT/24-25/

QUOTATION DOCUMENT

Divisional General Manager (Pune)

**MAHARASHTRA ENERGY DEVELOPMENT AGENCY,
Aundh Road, Near Commissionerate of Animal Husbandry,
Opposite Spicer College, Aundh, Pune-411007
Phone No: - 02035000450**

Website – www.mahaurja.com

E-mail ID: domedapune@mahaurja.com, dgpmpune@mahaurja.com

Quotation Call

To,
(Supplier/Developer/Contractor/Integrator)

Sub: Survey, Design, Fabrication, Supply, Installation, Testing, commissioning with Net metering and Remote Monitoring System of 15 kW On-Grid Solar Rooftop System at Govt Polytechnic, Ganeshkhind rd Dist-Pune, Maharashtra with Comprehensive Maintenance Contract for a period of 5 years– Invitation to Quote

With reference to subject matter, we would like to invite your quotes in sealed envelope for undertaking the said work with given technical specifications and technical standards with following terms and conditions –

• **Details and Dates:** -

1	System details	15 kW On-Grid Solar Rooftop System (Consumer no. 160220033209)
2	Site location	Govt Polytechnic, Ganeshkhind rd, Dist-Pune - 411016, Maharashtra.
3	Estimated Cost	Rs. 7,83,223/- (Inclusive of all taxes and charges)
4	Date and time for submission of quotations.	From 27/02/2025; 10:00 Hrs to 05/03/2025 18:00 Hrs
5	Date and time for opening of quotations.	06/03/2025; 11:00 Hrs
6	Security Deposit	Rs. 23,497/- (to be deposited by online mode in favor of Maharashtra Energy Development Agency, Pune)
7	Address for communication	Maharashtra Energy Development Agency, Divisional Office Pune, Aundh Road, Near Commissionerate of Animal Husbandry, Opposite Spicer College, Aundh, Pune-411007

➤ **ELIGIBILITY CRITERIA** –

The manufacturer/ supplier shall be eligible to quote for this work provided fulfilment of following.

1. Shall have a registered firm/company with GST registration.
2. Shall provide brief information in prescribed format (enclosed).
3. Shall not be black listed in any govt and/or other organizations.
4. Shall provide documentary proof about having experience of supply, installation and commissioning of minimum 30 kW On-grid Solar Power Plant and above.
5. Preference will be given to the bidders those have Successfully Commissioned Projects in Nodal Agency/ Govt. and Semi-Govt. Organization etc.
6. Shall have an Average annual turnover of minimum 20 Lakh during last three years duly certified by chartered accountant.

7. Shall provide self-attested copy of IT returns of last three years.
8. Is a manufacturer of SPV system or System Integrator and shall provide the test certificate of SPV system issued by MNRE or its authorized test centers.
9. Shall have arrangement of providing after sales service in Pune division.

➤ **TERMS AND CONDITIONS –**

- 1) Location for installation of Solar PV Systems shall be assigned immediately by the user agency to the selected manufacturer/ supplier to get the work done in stipulated time.
- 2) The installation of Solar PV Systems should be done in excellent manner and meet technical standards prescribed by the MEDA.
- 3) As per the technical criteria set by the Ministry of New and Renewable Energy, Govt. of India the solar modules should fulfill the IEC standards and shall be procured from manufacturer providing module with RFID tag.
- 4) The manufacturer/ supplier shall provide valid test certificate of Solar PV Systems and other equipment's/ component from govt. approved test centers.
- 5) The manufacturer/ supplier shall provide Solar Modules from the approved Manufacturers which are enlist in MNRE's ALMM list and should prefer higher capacity SPV modules.
- 6) The Solar module should be engraved with name of company supplying the same along with installation date etc.
- 7) If the Solar PV Systems doesn't function as per given standards then the loss incurred shall be borne by the supplier and paid to Govt Polytechnic, Ganeshkhind rd, Dist-Pune.
- 8) If contractor fails to complete the work then Security Deposit will be forfeited and contractor shall be blacklisted.
- 9) Supplier shall give training of system operation to a person duly nominated by user agency and same shall be informed to Divisional office MEDA Pune.
- 10) The Contractor/ Agency should successfully complete the project within time frame set out by the MEDA.
- 11) The manufacturer/ supplier shall provide the user manual, warranty card to the user agency and same shall be informed to Divisional office MEDA Pune.
- 12) The manufacturer/ supplier shall visit the site and ensure scope of work before submission of quote against the enquiry. In this context, it is mandatory to the manufacturer/ supplier should submit the Site Visit Report with photographs in given prescribed format along with this quote.
- 13) The Contractor shall provide the detailed information about Company/ firm in attached Format (Contractor's Information sheet)
- 14) **The manufacturer/ supplier shall submit their quotations in two different sealed envelopes i.e. First envelop shall contains documents as per the technical eligibility criteria and Second envelop shall contain Financial details (quoted rate).**
- 15) **The manufacturer/ supplier should mention the subject on each sealed envelope i.e. Technical Envelop and Financial Envelop.**
- 16) **The financial envelop of technically qualified bidders will only be opened.**

➤ **COMPREHENSIVE MAINTENANCE CONTRACT (CMC)**

- i. The complete Solar PV Systems must be warrantee against any manufacturing/ design/ installation defects for a minimum period of 5 years.

- ii. During the CMC period, timely cleaning of SPV panels (once in fortnight) of system shall bound to beneficiary.
- iii. During the CMC period, successful supplier should visit the site quarterly (after each 03 months) and ensure the successful working of Solar PV Systems. Also supplier shall maintain the visit log book at the site. If any problem occurs in working of Solar PV Systems; supplier shall attend the system within 48 hours and rectify the problem immediately.
- iv. In case if supplier fail to provide service during the CMC period, the Performance Bank Guarantee should be forfeited and Contractor/ Supplier shall be blacklisted.

➤ **INSURANCE:**

1. The manufacturer/ supplier shall provide complete insurance of Solar PV Systems coverage ex-factory until commissioning of project and acceptance for replacement or repair of any part of the consignment due to Natural calamity, theft, damage, fire, burglary.
2. It is the responsibility of successful manufacturer/ supplier to draw the complete insurance of Solar PV Systems in the name of MEDA Pune on behalf of user agency (name of the user agency to be mentioned in insurance policy) from the date of commissioning up to 05 Years period covering the natural calamity, theft, burglary, fire and damage of project.
3. The Successful manufacturer/ supplier should pay the necessary insurance premium for the said project.
4. The Bidder shall be responsible and take an Insurance Policy for transit-cum-storage-cum-erection for all the materials to cover all risks and liabilities for supply of materials on site basis, storage of materials at site, erection, testing and commissioning. The bidder shall also take appropriate insurance during O&M period, if required.
5. The Bidder shall also take insurance for Third Party Liability covering loss of human life including students (User), engineers and workmen and also covering the risks of damage to the third party/ material/ equipment/ properties during execution of the Contract.
6. Before commencement of the work, the bidder will ensure that all its employees and representatives are covered by suitable insurance against any damage, loss, injury or death arising out of the execution of the work or in carrying out the Contract. Liquidation, Death, Bankruptcy etc., shall be the responsibility of bidder.
7. Any complaint registered due to Natural calamity, theft, damage, fire, burglary by user agency shall be attended by the manufacturer/ supplier and claims be settled with insurance company accordingly.
8. In case of any loss encountered by the project due to natural calamities, theft, burglary, fire and damage etc. the manufacturer/ supplier shall be responsible for filing the insurance claim with the respective insurance company and ensure to get compensation for loss in the project equipment.

➤ **TERMS OF PAYMENT:**

Payment of the said project will be released after receipt of funds from District Planning Development council (DPDC), Pune. In line with this successful bidder must give the undertaking on Rs.500 stamp paper about acceptance of this payment condition at the time of acceptance of work order.

A. Release of 80% of total project cost:

It shall be released after supply, installation & successful commissioning with Net meter of the On-grid Solar systems and duly certified by authorized representative of User Agency, Officer of Division office MEDA, Pune & authorized person of developer along with following documents:

- Joint Inspection Report duly signed by User Agency, MEDA official and your company

Authorised Representative along with system photographs.

- System Photograph with Geo-coordinates accompanying MEDA official taken during joint inspection.
- Submission of undertaking of comprehensive contract (CMC) for 5 years from date of commissioning on your letter head.
- Warranty/ Guaranty Certificate of materials used in project.
- Serial Wise Test Reports of Panel comprising I-V curve and detail parameters of each panel.
- IEC/ IE/ BIS test certificate of Equipment's used the project.
- Complete Insurance policy documents of SPV Solar System (covering Natural calamity, damage, fire, burglary) effective from date of installation up to five-year period from date of commissioning.
- MEDA official at its discretion may ask developer to submit document other than above mentioned; failing which General Manager, Divisional Office, Pune shall have right to hold the payment of the project.

B. Release of 20% of total project cost:

- 20% of the total cost shall be released on receipt of three-month successful performance report generated automatically through Remote Monitoring System (RMS) as well as manually which should be duly certified by Officer of MEDA, authorized person of User Agency and submission of performance bank guarantee of 10% amount of project cost from any Nationalized Bank valid for period of 5 years from date of commissioning of project.
- Performance Bank Guarantee shall be released after 5 years on submission of latest report of system functioning at Govt Polytechnic, Ganeshkhind rd, Dist-Pune Maharashtra. duly certified by authorized person of User Agency.
- In case if "Bidder" does not provide service during the warrantee period, PBG will be forfeited and "Bidder" will be blacklisted (in case of "Consortium": all the partners be blacklisted)
- MEDA official at his discretion may ask developer to submit documents other than above mentioned; failing which General Manager, Division office, Pune shall have right to hold the payment of the project.

➤ **DEDUCTION: -**

- i. The TDS at the source will be deducted as per the Govt. rule and regulations.
- ii. MEDA will issue necessary certificates of TDS deduction.
- iii. C' / 'D' form will not be issued by MEDA.

➤ **SECURITY DEPOSIT –**

1. The Bidder shall furnish security deposit at 3% of the total contract value within 10 days from the date of issue of work order (including Sunday and public holiday) by online mode in favor of Maharashtra Energy Development Agency, Pune.
2. If the contractor fails to execute the work in given time or terminates the order prematurely then the security deposit will be forfeited and no excuses will be entertained.

3. The security deposit will be returned to the contractor without interest after successful commissioning of system and receipt of commissioning report duly signed by user agency, MEDA official and representative of the contractor.

➤ **PENALTY –**

- A penalty of 1/2% of the total project cost shall be imposed on the contractor against a delay of one week in project completion subject to a maximum of up to 10% of the total project cost. In case the penalty exceeds 10% of the total project cost, the given order will be canceled & the security deposit will be forfeited and the Contractor/ Supplier shall be blacklisted.

➤ **TIME FRAME:**

- a) The successful Bidder will be required to complete the project installation work within the 90 Days from the date of issue of work order.
- b) If project not installed or commissioned within the given time then contractor shall seek the time extension from MEDA by mentioning the valid reasons thereof.

➤ **EXTENSION**

- a) If project is not commissioned within the given time frame due to any inevitable reasons then contractor shall seek the time extension for the project at least 07 Days in advance before expiry of project completion period (90 Days) by giving satisfactory reasons for same.
- b) However, if the time extension is not taken before the project completion period then the penalty clause of work order shall be effective till the request is applied for the extension with MEDA.

➤ **CHECK LIST OF DOCUMENTS TO BE FURNISHED WITH BELOW QUOTATION**

- PAN and GST Details.
- Copy of IT Returns.
- Declaration on company letter head.
- Contractors Information Sheet.
- Annual Turnover Certificate.
- Work Experience Details.
- Site Visit Report.

We look ahead to seek your sealed quotation on or before 05/03/2025 till 18 Hrs.

Thanking you,

SD/-
Divisional General Manager
MEDA, Divisional Office, Pune

Encl: -

1. Contractor Information Sheet.
2. Declaration Format.
3. Annual Turn Over certificate format.
4. Site Survey Form.
5. Technical Specifications of Solar PV Water Pumping Systems.

CONTRACTOR'S INFORMATION

Sr. No	Particulars	
1	Name of Firm	
2	Details of Mailing Address	
3	Firm Status (PSU/ Incorporate/ Ltd/ Pvt. Ltd/ LLP/ Partnership/ Proprietary)	
4	Name & Designation of Contact Person	
5	Contact No.	
6	E-mail Address for correspondence	
7	Firm website Address	
8	Firm registration No/ ROC Establish Year of firm	
9	PAN No.	
10	GST No.	
11	Turnover (in Rs.) of last 3 years	
12	Skilled manpower	
13	*Experience in Solar PV Water Pumping Systems.	

Authorized Sign and Stamp

* Enclose documentary evidence accordingly.

DECLARATION

(On company's letter head)

To,

Divisional General Manager,

Divisional Office Pune,

Maharashtra Energy Development Agency

(A Government of Maharashtra Institution)

Address: Aundh Road, Near Commissionerate of Animal Husbandry,
Opposite Spicer College, Aundh, Pune-411007

Respected Sir/ Madam,

1. We have carefully read and understood all the terms and conditions of the quotation and hereby convey our acceptance to the same.
2. The information / documents furnished along with our offer are true and authentic to the best of my knowledge and belief, we are well aware of the fact that furnishing of any false information/ fabricated document would lead to rejection of our quotation at any stage besides liabilities towards prosecution under appropriate law.
3. We have apprised our self fully about the job to be done during the currency of the period of agreement and also acknowledge bearing consequences to of non-performance or deficiencies in the services on our part.
4. We have no objection, if enquiries are made about the work listed by us.
5. We have not been barred or blacklisted by any Government Agency/ Department/ PSU or any such competent Government authority, organization where we have worked. Further, if any of the partners/ directors of the organization/ firm is blacklisted or having any criminal case against them, our quote shall not be considered. At any later point of time, if this information is found to be false, Divisional General Manager, Divisional Office Pune, Maharashtra Energy Development Agency, may terminate the assigned contract immediately.
6. We have not been found guilty by a court of law in India for fraud, dishonesty or moral turpitude.
7. We agree that the decision of Divisional General Manager, Divisional Office Pune, MEDA in selection of quotation and shall final and binding to us.

For
(Company Name)

Name of signing authority / Designation / Place / Date

Annual Turnover

Each Contractor must fill in this form including private/ public limited company.

- **Annual Turnover Data for the FY 2021-22, 2022-23 and 2023-24**
- **Name of Company:**

Year	Rs in Lacs
2021-22	
2022-23	
2023-24	

The information supplied should be the Annual Turnover of the Contractor in terms of the amounts billed to clients for each year for work in progress or completed.

Signature of Applicant

Certified by chartered accountant.

(Affix Stamp)

SITE VISIT REPORT

(To be submitted on letterhead of contractor)

Date: _____

To,
The Divisional General Manager,
Divisional Office Pune,
Maharashtra Energy Development Agency (A
Government of Maharashtra Institution)
Address: Aundh Road, Near Commissionerate of Animal Husbandry,
Opposite Spicer College, Aundh, Pune-411007

Sub.: Site Visit Report for Survey, Design, Fabrication, Supply, Installation, Testing, Commissioning with net metering and Remote Monitoring System of 15 kW On-Grid Solar Rooftop System at Govt Polytechnic, Ganeshkhind rd, Dist-Pune, Maharashtra with Comprehensive Maintenance Contract for a period of 5 years.

Ref.: Quotation Call Date:

Sir,
This has reference to above referred quotation call for Installation and Commissioning of 15 kW On-Grid Solar Rooftop System at Govt Polytechnic, Ganeshkhind rd, Dist-Pune, Maharashtra with Comprehensive Maintenance Contract for a period of 5 years.

- I/ We hereby declare that we have visited the site.
 - I/ We have made my ourselves acquainted with site conditions, approach to site, requirement of area, availability of water, requirement of quotation conditions etc.
 - I/ We have verified all details required to execute the project.
 - I/ We have no problems in undertaking the project and complete them in the given time period.
- Thanking you

Yours faithfully,

(Signature of Contractor)

Name of Contractor -----
Designation -----
Seal -----

TECHNICAL SPECIFICATIONS

Grid Tied Solar Rooftop Photovoltaic (SPV) Power Plant

1. DEFINITION: -

A Grid Tied Solar Rooftop Photovoltaic (SPV) power plant consists of SPV array, Module Mounting Structure, Power Conditioning Unit (PCU) consisting of Maximum Power Point Tracker (MPPT), Inverter, and Controls & Protections, interconnect cables, Junction boxes, Distribution boxes and switches. PV Array is mounted on a suitable structure. Grid tied SPV system should be designed with necessary features to supplement the grid power during day time. Components and parts used in the SPV power plants including the PV modules, metallic structures, cables, junction box, switches, PCUs etc., should conform to the BIS or IEC or international specifications, wherever such specifications are available and applicable. Solar PV system shall consist of following equipment's / components.

- Solar PV modules consisting of required number of Crystalline PV cells.
- Grid interactive Power Conditioning Unit with Remote Monitoring System
- Mounting Structures
- Junction Boxes.
- Earthing and lightening protections.
- IR/UV protected PVC Cables, pipes and accessories

1.1. SOLAR PHOTOVOLTAIC MODULES: -

1.1.1. The PV modules used should be made in India.

1.1.2. SPV array contains specified number of same capacities, type and specifications modules connected in series or parallel to obtain the required voltage or current output.

1.1.3. 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 (Mono-Crystalline Solar Panel) IEC 61215/IS14286 or equivalent National or International / Standards. In addition, the modules must conform to EC 61730 Part-1 - requirements for construction & Part 2 – requirements for testing, for safety qualification or equivalent IS. STC performance data supplied with the modules shall not be more than one year old.

- a) For the PV modules to be used in a highly corrosive atmosphere throughout their lifetime, they must qualify to IEC 61701.
- b) The name plate of SPV module shall conform to IS 14286/IEC 61215.
- c) The minimum module efficiency should be minimum 19 percent and fill factor shall be more than 75 percent.
- d) The total solar PV array capacity should not be less than allocated capacity (kWp) and should comprise of solar crystalline modules of minimum 300 Wp and above wattage. Module capacity less than minimum 300 Wp shall not be accepted.
- e) Modules must qualify to IS 170210 (Part 1) for the detection of potential-induced degradation - Part 1: Crystalline silicon (Mandatory in case the SPV array Open Circuit voltage is more than 600 V DC)
- f) The SPV modules must be warranted for output wattage, which should not be less than 90% of the rated wattage at the end of 10 years and 80% of the rated wattage at the end of 25 years.
- g) Adequate protective devices against surges at the PV module shall be provided. Low voltage drop bypass diodes shall be provided.
- h) PV modules must be tested and approved by one of the IEC authorized test centers.
- i) The module frame shall be made of corrosion resistant materials, preferably having anodized aluminium.

- j) The RFID tag shall be placed inside the glass laminate of the SPV modules.
- k) SPV plant shall be carefully designed & accommodate requisite numbers of the modules to achieve the rated power. MEDA/owners shall allow only minor changes at the time of execution.
- l) Other general requirement for the PV modules and subsystems shall be the Following:
 - I. The rated output power of any supplied module shall have tolerance within +/-3%.
 - II. The peak-power point voltage and the peak-power point current of any supplied module and/or any module string (series connected modules) shall not vary by more than 2 (two) per cent from the respective arithmetic means for all modules and/or for all module strings, as the case may be.
 - III. The module shall be provided with a junction box with either provision of external screw terminal connection or sealed type and with arrangement for provision of bypass diode. The box shall have hinged, weather proof lid with captive screws and cable gland entry points or may be of sealed type and IP- 65 rated.
 - IV. I-V curves at STC should be provided by Project developer.

SOLAR PV MODULES: -

1.1.4. Modules deployed must use a RF identification tag. The following information must be mentioned in the RFID used on each module. This should be inside the laminate only.

- a) Name of the manufacture of the PV module
- b) Name of the manufacture of Solar Cells.
- c) Month & year of the manufacture (separate for solar cells and modules)
- d) Country of origin (separately for solar cells and module)
- e) I-V curve for the module Wattage, Im, Vm and FF for the module
- f) Unique Serial No and Model No of the module
- g) Date and year of obtaining IEC PV module qualification certificate.
- h) Name of the test lab issuing IEC certificate.

1.1.5. Other relevant information on traceability of solar cells and module as per ISO 9001 and ISO 14001

1.1.6. WARRANTIES: -

- a) Material Warranty:
 - i. Material Warranty is defined as: The project developer should warrant the Solar Module(s) to be free from the defects and/or failures specified below for a period not less than five (05) years from the date of sale to the original customer ("Customer")
 - ii. Defects and/or failures due to manufacturing
 - iii. Defects and/or failures due to quality of materials
 - iv. Non-conformity to specifications due to faulty manufacturing and/or inspection processes. If the solar Module(s) fails to conform to this warranty, the project developer will repair or replace the solar module(s), at the Owners sole option.
- b) Performance Warranty:
 - i. The predicted electrical degradation of power generated not exceeding 20% of the minimum rated power over the 25-year period and not more than 10% after ten years period of the full rated original output.

1.2. ARRAY STRUCTURE: -

- a) 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. Each structure should have angle of inclination as per the site conditions to take maximum insolation. However, to accommodate more capacity the angle inclination may be reduced until the plant meets the specified performance ratio requirements.

- b) 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 and submit wind loading calculation sheet to MEDA. Suitable fastening arrangement such as grouting and calming should be provided to secure the installation against the specific wind speed.
- c) The mounting structure steel shall be as per latest IS 2062: 1992 and galvanization of the mounting structure shall comply of latest IS 4759.
- d) Structural material shall be corrosion resistant and electrolytically compatible with the materials used in the module frame, its fasteners, nuts and bolts. Aluminium structures also can be used which can withstand the wind speed of respective wind zone. Necessary protection towards rusting need to be provided either by coating or anodization.
- e) Aluminium frames should be avoided for installations in coastal areas.
- f) 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.
- g) Regarding civil structures the Project developer need to take care of the load bearing capacity of the roof and need arrange suitable structures based on the quality of roof.
- h) The total load of the structure (when installed with PV modules) on the terrace should be less than 60 kg/m².
- i) The minimum clearance of the structure from the roof level should be 300 mm.
- j) Ballast type structures can be used only for plants for capacity more than 40kWp.

1.3. JUNCTION BOXES (JBs) :-

- a) The junction boxes are to be provided in the PV array for termination of connecting cables. The J. Boxes (JBs) shall be made of GRP / FRP / Powder Coated Aluminium /cast aluminium alloy with full dust, water & vermin proof arrangement. All wires / cables must be terminated through cable lugs. The JB's shall be such that input & output termination can be made through suitable cable glands.
- b) Copper bus bars / terminal blocks housed in the junction box with suitable termination threads conforming to IP65 standard and IEC 62208 Hinged door with EPDM rubber gasket to prevent water entry. Single / double compression cable glands. Provision of earthing's. It should be placed at 5 feet height or above for ease of accessibility.
- c) Each Junction Box shall have High quality Suitable capacity Metal Oxide Varistors (MOVs) / SPDs, suitable Reverse Blocking Diodes. The Junction Boxes shall have suitable arrangement monitoring and disconnection for each of the groups.
- d) Suitable markings shall be provided on the bus bar for easy identification and the cable ferrules must be fitted at the cable termination points for identification.
- e) All fuses shall have DIN rail mountable fuse holders and shall be housed in thermoplastic IP 65 enclosures with transparent covers.

1.4. DC DISTRIBUTION BOARD: -

- a) DC Distribution panel to receive the DC output from the array field.
- b) DC DPBs shall have sheet from enclosure of dust & vermin proof conform to IP 65 protection. The bus bars are made of copper of desired size. Suitable capacity MCBs/MCCB shall be provided for controlling the DC power output to the PCU along with necessary surge arrestors.

1.5. AC DISTRIBUTION PANEL BOARD: -

- a) AC Distribution Panel Board (DPB) shall control the AC power from PCU/ inverter, and should have necessary surge arrestors. Interconnection from ACDB to mains at LT Bus bar while in grid tied mode.
- b) All switches and the circuit breakers, connectors should conform to IEC 60947, part I, II and III/ IS 60947 part I, II and III.

- c) The changeover switches, cabling work should be undertaken by the Project developer as part of the project.
- d) All the Panel's shall be metal clad, totally enclosed, rigid, floor mounted, air - insulated, cubical type suitable for operation on three phase / single phase, 415 or 230 volts, 50 Hz
- e) The panels shall be designed for minimum expected ambient temperature of 45 degree Celsius, 80 percent humidity and dusty weather.
- f) All indoor panels will have protection of IP54 or better. All outdoor panels will have protection of IP65 or better.
- g) Should conform to Indian Electricity Act and rules (till last amendment).
- h) All the 415 AC or 230 volts devices / equipment like bus support insulators, circuit breakers, SPDs, VTs etc., mounted inside the switchgear shall be suitable for continuous operation and satisfactory performance under the following supply conditions

Variation in supply voltage	+/- 10 %
Variation in supply frequency	+/- 3 Hz

1.6. PCU / ARRAY SIZE RATIO: -

- a) The combined wattage of all inverters should not be less than rated capacity of power plant under STC.
- b) Maximum power point tracker shall be integrated in the PCU/inverter to maximize energy drawn from the array.

1.7. PCU / INVERTER: -

As SPV array produce direct current electricity, it is necessary to convert this direct current into alternating current and adjust the voltage levels to match the 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, to the power conditioning unit/inverter should also be DG set interactive. If necessary. Inverter output should be compatible with the grid frequency. Typical technical features of the inverter shall be as follows:

Switching devices	IGBT/ MOSFET
Control	Microprocessor/ DSP
Nominal AC output voltage and frequency	415V, 3 Phase, 50 Hz (In case single phase inverters are offered, suitable arrangement for balancing the phases must be made.)
output frequency	50 Hz
Grid Frequency Synchronization range	+ 3 Hz or more
Ambient temperature considered	-20° C to 50° C
Humidity	95 % Non-condensing
Protection of Enclosure	IP-20(Minimum) for indoor. IP-65(Minimum) for outdoor.
Grid Frequency Tolerance range	+ 3 or more
Grid Voltage tolerance	-0.20.15
No-load losses	Less than 1% of rated power
Inverter efficiency(minimum)	>93% (In case of 10 kW or above with in-built galvanic isolation) >97% (In case of 10 KW or above without in-built galvanic isolation)
Inverter efficiency (minimum)	> 90% (In case of less than 10 kW)
THD	< 3%

- a) Three phase PCU/ inverter shall be used with each power plant system (10kW and/or above) but in case of less than 10kW single phase inverter can be used.
- b) PCU / inverter shall be capable of complete automatic operation including wake- up, synchronization & shutdown.
- c) 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.
- d) Built-in meter and data logger to monitor plant performance through external computer shall be provided.
- e) **Anti-islanding** (Protection against Islanding of grid): The PCU shall have anti islanding protection in conformity to IEEE 1547/UL 1741/ IEC 62116 or equivalent BIS standard.
- f) Channel Partner shall be responsible for galvanic isolation of solar roof top power plant (>100kW) with electrical grid or LT panel.
- g) In PCU/Inverter, there shall be a direct current isolation provided at the output by means of a suitable isolating transformer. If Isolation Transformer is not incorporated with PCU/Inverter, there shall be a separate Isolation Transformer of suitable rating provided at the output side of PCU/PCU units for capacity more than 100 kW.
- h) The PCU/ inverter generated harmonics, flicker, DC injection limits, Voltage Range, Frequency Range and Anti-Islanding measures at the point of connection to the utility services should follow the latest CEA (Technical Standards for Connectivity Distribution Generation Resources) Guidelines.
- i) The power conditioning units / inverters should comply with applicable IEC / equivalent BIS standard for efficiency measurements and environmental tests as per standard codes IEC 61683/IS 61683 and IEC 60068-2 (1,2,14,30)/ Equivalent BIS Std.
- j) The MPPT units environmental testing should qualify IEC 60068-2 (1, 2, 14, 30)/ Equivalent BIS std. The junction boxes/ enclosures should be IP 65 (for outdoor)/ IP 54 (indoor) and as per IEC 529 specifications.
- k) The PCU / inverters should be tested from the MNRE approved test center's / NABL / BIS / IEC accredited testing- calibration laboratories. In case of imported power conditioning units, these should be approved by international test houses.

2. INTEGRATION OF PV POWER WITH GRID: -

The output power from SPV would be fed to the inverters which converts DC produced by SPV array to AC and feeds it into the main electricity grid after synchronization. In case of grid failure, or low or high voltage, solar PV system shall be out of synchronization and shall be disconnected from the grid. Once the DG set comes into service, PV system shall again be synchronized with DG supply and load requirement would be met to the extent of availability of power. 4 pole isolation of inverter output with respect to the grid/ DG power connection need to be provided.

3. DATA ACQUISITION SYSTEM / PLANT MONITORING: -

- i. Data Acquisition System shall be provided for each of the solar PV plant.
- ii. Data Logging Provision for plant control and monitoring, time and date stamped system data logs for analysis with the high quality, suitable PC. Metering and Instrumentation for display of systems parameters and status indication to be provided.
- iii. Solar Irradiance: An integrating Pyranometer/ Solar cell-based irradiation sensor (along with calibration certificate) provided, with the sensor mounted in the plane of the array. Readout integrated with data logging system.
- iv. Temperature: Temperature probes for recording the Solar panel temperature and/or ambient

- temperature to be provided complete with readouts integrated with the data logging system.
- v. The following parameters are accessible via the operating interface display in real time separately for solar power plant:
 - a. AC Voltage.
 - b. AC Output current.
 - c. Output Power
 - d. Power factor.
 - e. DC Input Voltage.
 - f. DC Input Current.
 - g. Time Active.
 - h. Time disabled.
 - i. Time Idle.
 - j. Power produced
 - k. Protective function limits (Viz-AC Over voltage, AC Under voltage, Over frequency, Under frequency ground fault, PV starting voltage, PV stopping voltage.
 - vi. All major parameters available on the digital bus and logging facility for energy auditing through the internal microprocessor and read on the digital front panel at any time) and logging facility (the current values, previous values for up to a month and the average values) should be made available for energy auditing through the internal microprocessor and should be read on the digital front panel.
 - vii. PV array energy production: Digital Energy Meters to log the actual value of AC/ DC voltage, Current & Energy generated by the PV system provided. Energy meter along with CT/PT should be of 0.5 accuracy class.
 - viii. Computerized DC String/Array monitoring and AC output monitoring shall be provided as part of the inverter and/or string/array combiner box or separately.
 - ix. String and array DC Voltage, Current and Power, Inverter AC output voltage and current (All 3 phases and lines), AC power (Active, Reactive and Apparent), Power Factor and AC energy (All 3 phases and cumulative) and frequency shall be monitored.
 - x. Computerized AC energy monitoring shall be in addition to the digital AC energy meter.
 - xi. The data shall be recorded in a common work sheet chronologically date wise. The data file shall be MS Excel compatible. The data shall be represented in both tabular and graphical form.
 - xii. All instantaneous data shall be shown on the computer screen.
 - xiii. Software shall be provided for USB download and analysis of DC and AC parametric data for individual plant.
 - xiv. Provision for instantaneous Internet monitoring and download of historical data shall be also incorporated.
 - xv. Remote Server and Software for centralized Internet monitoring system shall be also provided for download and analysis of cumulative data of all the plants and the data of the solar radiation and temperature monitoring system.
 - xvi. Ambient / Solar PV module back surface temperature shall be also monitored on continuous basis.
 - xvii. Simultaneous monitoring of DC and AC electrical voltage, current, power, energy and other data of the plant for correlation with solar and environment data shall be provided.
 - xviii. Remote Monitoring and data acquisition through Remote Monitoring System software at the owner / MEDA location with latest software/hardware configuration and service connectivity for online / real time data monitoring / control complete to be supplied and operation and maintenance / control to shall be provided.
 - xix. The Project developer shall be obligated to push real-time plant monitoring data on a specified interval (say 15 minute) through open protocol at receiver location (cloud server) in XML/JSON format, preferably.

4. TRANSFORMER “IF REQUIRED” & METERING: -

- a) Dry/oil type relevant kVA, 11kV/415V, 50 Hz Step up along with all protections, switchgears, Vacuum circuit breakers, cables etc. along with required civil work.
- b) The Bi-Directional electronic energy meter (0.5 S class) shall be installed for the measurement of import/Export of energy.
- c) The Project developer must take approval/NOC from the Concerned DISCOM for the connectivity, technical feasibility, and synchronization of SPV plant with distribution network before commissioning of SPV plant.
- d) Reverse power relay shall be provided as per the local DISCOM requirement.

5. POWER CONSUMPTION:

- a) Regarding the generated power consumption, priority need to give for internal consumption first and thereafter any excess power can be exported to grid. Finalization of tariff is not under the purview of MEDA or MNRE. Decisions of appropriate authority like DISCOM, state regulator may be followed.

6. PROTECTIONS: -

The system should be provided with all necessary protections like earthing, Lightning, and grid islanding as follows:

6.1 LIGHTNING PROTECTION: -

- a) The SPV power plants shall be provided with lightning & overvoltage 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. The entire space occupying the SPV array shall be suitably protected against Lightning by deploying required number of Lightning Arrestors. Lightning protection should be provided as per IEC 62305 and IEC 63227 standards including its amendments and updated versions. The protection against induced high-voltages shall be provided by the use of metal oxide varistors (MOVs) and suitable earthing such that induced transients find an alternate route to earth.
- b) An external lightning Rod, of height sufficient to meet the requirement of Lightning Protection System (LPS) designed to comply with the class III or higher (Class-I / Class-II), based on the site requirement including the area-specific lightning activity, shall be installed.
- c) The cross-section of the metal sub-structures used for the connection of the lightning arrester to the earth electrode should be no less than 16 mm² Cu or 25 mm² Al or GI of equivalent current carrying capacity should be used, which will also depend upon the class of the Lightning protection system.

6.2 SURGE PROTECTION: -

- a) For SPDs IEC 63227 and its updated versions or amendments should be followed.
- b) Internal surge protection shall consist of three MOV type surge-arrestors connected from +ve and -ve terminals to earth (via Y arrangement).
- c) At the DC Input side of the controller, it should have protection from an External Surge Protection Device of Type-2 or higher (i.e. Type-1) in accordance with the IEC 61643-31.
- d) The rated voltage of SPDs on the DC side, depends on the type of protective circuit and the magnitude of the maximum operating voltage of the SPV modules.

6.3 EARTHING PROTECTION: -

- a) Each array structure of the PV yard should be grounded/ earthed properly as per IS:3043-1987. In addition, the lightning arrester/masts should also be earthed inside the array field. Earth Resistance shall be tested in presence of the representative of Department/owner as and when required after earthing by calibrated earth tester. PCU, ACDB and DCDB should also be earthed properly.

- b) The Earthing system should be designed in such a way that it should be able to restrict the potential of each conductor according to the level of insulation applied and magnitude of the current conducted through human body should be less than the value that can cause ventricular fibrillation of heart.
- c) Earth connections shall be done in such a way that they are visible for inspection and all the earth electrodes can easily be tested at any point of time.
- d) Earth resistance shall not be more than 5 ohms. It shall be ensured that all the earthing points are bonded together to make them at the same potential.
- e) All the materials, fittings etc. used for doing earthing shall conform to the Indian standard, wherever exists.
- f) For the maintenance of the earth electrode and measurement of the Earth electrode resistance the provisions of IS 3043 shall be referred.

6.4 GRID ISLANDING: -

- a) In the event of a power failure on the electric grid, it is required that any independent power-producing inverters attached to the grid turn off in a short period of time. This prevents the DC-to-AC inverters from continuing to feed power into small sections of the grid, known as "Islands." Powered Islands present a risk to workers who may expect the area to be unpowered, and they may also damage grid-tied equipment. The Rooftop PV system shall be equipped with islanding protection. In addition to disconnection from the grid (due to islanding protection) disconnection due to under and over voltage conditions shall also be provided.
- b) A manual disconnect 4-pole isolation switch beside automatic disconnection to grid would have to be provided at utility end to isolate the grid connection by the utility personnel to carry out any maintenance. This switch shall be locked by the utility personnel.

7 CABLES: -

Cables of appropriate size to be used in the system shall have the following characteristics:

- i. Shall meet IEC 60227/IS 694, IEC 60502/IS1554 standards
- ii. Temp. Range: -10°C to $+80^{\circ}\text{C}$.
- iii. Voltage rating 660/1000V
- iv. Excellent resistance to heat, cold, water, oil, abrasion, UV radiation
- v. Flexible
- vi. Sizes of cables between array interconnections, array to junction boxes, junction boxes to Inverter etc. shall be so selected to keep the voltage drop (power loss) of the entire solar system to the minimum (2%)
- vii. For the DC cabling, XLPE or, XLPO insulated and sheathed, UV-stabilized single core multi-stranded flexible copper cables shall be used; Multi-core cables shall not be used.
- viii. For the AC cabling, PVC or, XLPE insulated and PVC sheathed single or, multi-core multi-stranded flexible copper cables shall be used; Outdoor AC cables shall have a UV-stabilized outer sheath.
- ix. The cables (as per IS) should be insulated with a special grade PVC compound formulated for outdoor use. Outer sheath of cables shall be electron beam cross-linked XLPO type and black in color.
- x. The DC cables from the SPV module array shall run through a UV-stabilized PVC conduit pipe of adequate diameter with a minimum wall thickness of 1.5mm.
- xi. Cables and wires used for the interconnection of solar PV modules shall be provided with solar PV connectors (MC4) and couplers.
- xii. 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 4.0 mm^2 copper; the minimum AC cable size shall be 4.0 mm^2 copper. In three phase systems, the size of the neutral wire size shall be equal to the size of the phase wires.

- xiii. Cable Routing / Marking: All cable/wires are to be routed in a GI cable tray and suitably tagged and marked with proper manner by good quality ferule or by other means so that the cable easily identified. In addition, cable drum no. / Batch no. to be embossed/ printed at every one meter.
- xiv. Cable Jacket should also be electron beam cross-linked XLPO, flame retardant, UV resistant and black in color.
- xv. All cables and connectors for use for installation of solar field must be of solar grade which can withstand harsh environment conditions including High temperatures, UV radiation, rain, humidity, dirt, salt, burial and attack by moss and microbes for 25 years and voltages as per latest IEC standards. DC cables used from solar modules to array junction box shall be solar grade copper (Cu) with XLPO insulation and rated for 1.1kV as per relevant standards only.
- xvi. The ratings given are approximate. Project developer to indicate size and length as per system design requirement. All the cables required for the plant shall be provided by the Project developer. Any change in cabling sizes if desired by the Project developer shall be approved after citing appropriate reasons. All cable schedules/ layout drawings shall be approved prior to installation.
- xvii. Multi Strand, Annealed high conductivity copper conductor PVC type 'A' pressure extruded insulation or XLPE insulation. Overall PVC/XLPE insulation for UV protection Armored cable for underground laying. All cable trays including covers to be provided. All cables conform to latest edition of IEC/ equivalent BIS Standards as specified below:
BoS item / component Standard Description Standard Number Cables General Test and Measuring Methods, PVC/XLPE insulated cables for working Voltage up to and including 1100 V, UV resistant for outdoor installation IS /IEC 69947.
- xviii. The total voltage drop on the cable segments from the solar PV modules to the solar grid inverter shall not exceed 2.0%.
- xix. The total voltage drop on the cable segments from the solar grid inverter to the building distribution board shall not exceed 2.0%.

8 CONNECTIVITY: -

The maximum capacity for interconnection with the grid at a specific voltage level shall be as specified in the Distribution Code/Supply Code of the State and amended from time to time. Following criteria have been suggested for selection of voltage level in the distribution system for ready reference of the solar suppliers.

Plant Capacity	Connecting voltage
Up to 10 kW	240V-single phase or 415V-three phase at the option of the consumer
Above 10kW and up to 100 kW	415V – three phases
Above 100kW	At HT/ EHT level (11kV/33kV/66kV) as per DISCOM rules

- a) The maximum permissible capacity for rooftop shall be 1 MW for a single net metering point.
- b) Utilities may have voltage levels other than above, DISCOMS may be consulted before finalization of the voltage level and specification be made accordingly.
- c) For large PV system (Above 100kW) for commercial installation having large load, the solar power can be generated at low voltage levels and stepped up to 11 kV level through the step-up transformer. The transformers and associated switchgear would require to be provided by the SPV bidders.

9 TOOLS & TACKLES AND SPARES: -

- a) After completion of installation & commissioning of the power plant, necessary tools & tackles are to be provided free of cost by the Project developer for maintenance purpose. List of tools and tackles to be supplied by the Project developer for approval of specifications and make from MEDA/ owner.
- b) A list of requisite spares in case of PCU/inverter comprising of a set of control logic cards, IGBT driver cards etc. Junction Boxes. Fuses, MOVs / arrestors, MCCBs etc along with spare set of PV modules be indicated, which shall be supplied along with the equipment. A minimum set of spares shall be maintained in the plant itself for the entire period of warranty and Operation & Maintenance which upon its use shall be replenished.

10 DANGER BOARDS AND SIGNAGES: -

- a) Danger boards should be provided as and where necessary as per IE Act. /IE rules as amended up to date. Three signage shall be provided one each at battery-cum-control room, solar array area and main entry from administrative block. Text of the signage may be finalized in consultation with owner.

11 FIRE EXTINGUISHERS: -

The firefighting system for the proposed power plant for fire protection shall be consisting of:

- a) Portable fire extinguishers in the control room for fire caused by electrical short circuits.
- b) Sand buckets in the control room.
- c) The installation of Fire Extinguishers should confirm to TAC regulations and BIS standards. The fire extinguishers shall be provided in the control room housing PCUs as well as on the Roof or site where the PV arrays have been installed.

12 DRAWINGS & MANUALS: -

- a) Two sets of Engineering, electrical drawings and Installation and O&M manuals are to be supplied. Project developer shall provide complete technical data sheets for each equipment giving details of the specifications along with make/makes along with basic design of the power plant and power evacuation, synchronization along with protection equipment.
- b) Approved ISI and reputed makes for equipment be used.
- c) For complete electro-mechanical works, Project developer shall supply complete design, details and drawings for approval to owners before progressing with the installation work.

13 PLANNING AND DESIGNING:

- a) The Project developer should carry out Shadow Analysis at the site and accordingly design strings & arrays layout considering optimal usage of space, material and labour. The Project developer should submit the array layout drawings along with Shadow Analysis Report to owner for approval.
- b) MEDA reserves the right to modify the landscaping design, Layout and specification of sub- systems and components at any stage as per local site conditions/requirements.
- c) The bidder shall submit preliminary drawing for approval & based on any modification or recommendation, if any. The bidder submits three sets and soft copy in CD of final drawing for formal approval to proceed with construction work.

14 DRAWINGS TO BE FURNISHED BY PROJECT DEVELOPER AFTER AWARD OF CONTRACT FROM BENEFICIARY: -

- a) The Project developer shall furnish the following drawings Award/Intent and obtain approval
- b) General arrangement and dimensioned layout.
- c) Schematic drawing showing the requirement of SV panel, Power conditioning Unit(s)/

- inverter, Junction Boxes, AC and DC Distribution Boards, meters etc.
- d) Structural drawing along with foundation details for the structure.
 - e) Itemized bill of material for complete SV plant covering all the components and associated accessories.
 - f) Layout of solar Power Array
 - g) Shadow analysis of the roof

15 SOLAR PV SYSTEM ON THE ROOFTOP FOR MEETING THE ANNUAL ENERGY REQUIREMENT: -

The Solar PV system on the rooftop of the selected buildings will be installed for meeting upto 90% of the annual energy requirements depending upon the area of rooftop available and the remaining energy requirement of the buildings will be met by drawing power from grid at commercial tariff of DISCOMs.

16 SAFETY MEASURES: -

The Project developer shall take entire responsibility for electrical safety of the installation(s) including connectivity with the grid and follow all the safety rules & regulations applicable as per Electricity Act, 2003 and CEA guidelines etc.

17 DISPLAY BOARD: -

The Project developer has to display a board at the project site (above 10 kWp) mentioning the following:

- a) Plant Name, Capacity, Location, Type of Renewable Energy plant (Like solar wind etc.), Date of commissioning, details of tie-up with transmission and distribution companies, Power generation and Export FY wise.
- b) Financial Assistance details from MEDA/MNRE/Any other financial institution apart from loan. This information shall not be limited to project site but also be displayed at site offices/head quarter offices of the successful bidder
- c) The size and type of board and display shall be appropriate.

18 REMOTE MONITORING SYSTEM (RMS)

The Remote Monitoring System shall be capable of providing and handling the following:

- a) Solar System Performance: DC Voltage, DC current, AC output Current, Power, Drive frequency, Energy, etc.
- b) RMS Performance: % of Device Connectivity, % of Data Availability, etc.
- c) Geo Location: Real time latitude and longitude should be captured with an accuracy of less than 10m horizontal. This is required to ensure that system is not moved from its original location.
- d) Remote Server and Software for centralized Internet monitoring system shall be also provided for download and analysis of cumulative data of all the plants and the data of the solar radiation and temperature monitoring system.
- e) Bidder shall ensure that the sim activation charges are paid regularly for 5 yrs. from date of project commissioning.

LIST OF REFERRED INDIAN STANDARDS

456:2000	Plain and reinforced concrete - Code of practice (Fourth Revision)
811:1987	Specification for cold formed light gauge structural steel sections (Second Revision)
822:1970	Code of procedure for inspection of welds
IS 875: Part 1: 1987	Code of practice for design loads (Other Than Earthquake) for buildings and structures: Part 1 dead loads - Unit weights of building materials and stored materials (Second Revision)
694:2010	Polyvinyl Chloride Insulated Unsheathed--And Sheathed Cables/cords With Rigid And-Flexible Conductor for Rated Voltages-Up To And Including 450/750 V
1079:2017	Hot rolled carbon steel sheet, plate and strip - Specification (Seventh Revision)
1161:2014	Steel tubes for structural purposes - Specification (Fifth Revision)
1239 (Part 1):2004	Steel tubes, tubulars and other wrought steel fittings - Specification: Part 1 steel tubes (Sixth Revision)
2062:2011	Hot rolled medium and high tensile structural steel - Specification (Seventh Revision)
2629:1985	Recommended practice for hot-dip galvanizing of iron and steel (First Revision)
2633:1986	Method for testing uniformity of coating on zinc coated articles (Second Revision)
3043:2018	Code of Practice for Earthing
3444:1999	Corrosion resistant high alloy steel and nickel base castings for general applications-Specification
4091:1979	Code of practice for design and construction of foundations for transmission line towers and poles (First Revision)
4759:1996	Hot - Dip zinc coatings on structural steel and other allied products - Specification (Third Revision)
5624:2021	Foundation bolts - Specification (First Revision)
6403:1981	Code of practice for determination of bearing capacity of shallow foundations
6745:1972	Methods for determination of mass of zinc coating on zinc coated iron and steel articles
6911:2017	Stainless steel plate, sheet and strip-Specification
7215:1974	Tolerances for fabrication of steel structures
9968 (Part 1):1988	Specification for elastomer insulated cables: Part 1 for working voltages up to and including 1100 volts (First Revision)
IS/IEC61701: 2011	Salt mist corrosion testing of photovoltaic (PV) modules First Revision
IS 17210 (Part 1):	Photovoltaic (PV) Modules — Test Methods for the Detection of Potential-Induced Degradation Part 1 Crystalline Silicon
IS/IEC 61683:1999	Photovoltaic System-Power Conditioners — Procedure for Measuring

IS 14286: 2010 /IEC 61215 : 2005	Crystalline Silicon Terrestrial Photovoltaic (Photo Voltaic (PV)) modules - Design Qualification and Type Approval (First Revision)
IS/IEC 61730-1: 2016	Photovoltaic (PV) Module Safety Qualification Part 1 Requirements for Construction
IS/IEC 61730-2: 2019	Photovoltaic (PV) Module Safety Qualification Part 2 Requirements for Testing
IEC 60068-2-6:2007	Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)
IEC 60068-2-30:2005	Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 + 12h cycle)
IEC 62305-1/2/3/4	Lightning Protection
IEC 63227	Lightning and Surge Voltage Protection for photovoltaic (PV) power supply systems
IEC 61643-31	Low-voltage surge protective devices
IS/IEC 60947: PART 1: 2007	Low - Voltage switchgear and control gear: Part 1 general rules (First Revision)

Note: - The latest editions of the indicated standards shall be considered