

## DHARAMPET M. P. DEO MEMORIAL SCIENCE COLLEGE NAGPUR

### 7.1.2: The Institution has facilities for alternate sources of energy and energy conservation measures

1. **Solar Energy:** 50kVA On-Grid solar panels have been installed since 2018. Electricity bills for the entire year span have been drastically reduced. The initiative towards green environment is also taught to the students as and when required.
2. **Biogas Plant:** We are already using the green waste to convert into useful compost for plantation. However, we are planning to have the biogas plant in in near future.
3. **Whiling to Grid:** Our entire solar plant of 50 kVA is On-grid type.
4. **Sensor-based energy conservation:** Mostly the devices such as refrigerators, drinking water coolers, air conditioners and other electronic devices are automatic with inbuilt thermostat/ temperature controllers which can be efficiently lowering the electric consumption. However, lights, fans, electric water pumps are to be automated in the near future.
5. **Use of LED bulbs/ power efficient equipment:** We have already made a policy to install LED bulbs when the earlier CFCs/ Tube lights gone faulty or fused. Many LED bulbs are installed till today. The CRT tube-based computer systems are also replaced with the LED/ LCD monitors. The CRTs were handed over to the recycling firms and environment friendly disposal/reuse. Invertor mode devices are preferred while new purchase.



**Prof. Pitambar Humane**  
IQAC Co-ordinator

**CO ORDINATOR**  
INTERNAL QUALITY ASSURANCE CELL  
DHARAMPETH, M. P. DEO MEMORIAL &  
SCIENCE COLLEGE, NAGPUR



**Dr. Akhilesh Peshwe**  
Principal

**PRINCIPAL**  
DHARAMPETH M. P. DEO  
MEMORIAL SCIENCE COLLEGE  
NAGPUR

MAHARASHTRA ENERGY DEVELOPMENT AGENCY (MEDA)

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REN/ SOLAR-DHARMPETH/54 /2019-20/ 649

Dtd. 02.08.2019

Work Order

To,  
M/s. Green Life Solutions Pvt. Ltd.  
Plot no.36, Afrey Layout,  
Pratap Nagar,  
Nagpur- 440022

Subject:- WORK ORDER FOR DESIGN, FABRICATION, SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF 20KW ON MAIN BUILDING, 15KW ON HOME SCIENCE BUILDING AND 40KW ON POLYTECHNIC BUILDING GRID-CONNECTED SOLAR PV POWER PLANT UNDER ROOF-TOP NET METERING WITH 05 YEARS OF COMPREHENSIVE OPERATION AND MAINTENANCE INCLUDING PLANT CLEANING SYSTEM AND RMS MONITORING SYSTEM ALONG WITH INSURANCE OF PROJECT FOR 5 YEARS AT DHARAMPETH EDUCATION SOCIETY (DHARAMPETH COLLEGE), NAGPUR.

Reference: - 1. Tender No. - REN/ SOLAR-DHARMPETH/54 /2019-20

2. Your offer Dated 02.08.2019

Dear Sir,

The MAHARASHTRA ENERGY DEVELOPMENT AGENCY (MEDA) is pleased to place work order for Design, Fabrication, Supply, Installation, Testing And Commissioning Of 20kw On Main Building, 15kw On Home Science Building And 40kw On Polytechnic Building Grid-Connected Solar PV Power Plant Under Roof-Top Net Metering With 05 Years Of Comprehensive Operation And Maintenance Including plant Cleaning System and Rms Monitoring System Along With Insurance Of Project For 5 Years At Dharampeth Education Society (Dharampeth College), Nagpur.

Your order value is as follows:

Sr. No.	Name & Address of Site	Capacity	Total Cost in Rs.
1	Dharampeth Education Society (Dharampeth College), Nagpur	20kw On Main Building (Grid Connected)	Rs. 3308250 /-
2		15kw On Home Science Building (Grid Connected)	
3		40kw On Polytechnic Building (Grid Connected)	

The cost is inclusive of all taxes, insurance of project for 5 years, octroi, VAT, GST other duties, cost of civil construction, module mounting structures, Electrical Wiring works, Installation & commissioning with 5 years OMC etc.

• SCOPE OF WORK :-

- Design, Fabrication, Supply, Installation, Testing And Commissioning Of 20kw On Main Building, 15kw On Home Science Building And 40kw On Polytechnic Building Grid-Connected Solar PV Power Plant Under Roof-Top Net Metering With 05 Years Of Comprehensive Operation And Maintenance Including plant Cleaning System and Rms Monitoring System Along With Insurance Of Project For 5 Years At Dharampeth Education Society (Dharampeth College), Nagpur in the state of Maharashtra on "Turnkey" Contract Basis and as described in the Tender Document.
- Free replacement of defective components of systems within Comprehensive Maintenance Contract period (CMC) of 5 years after commissioning for efficient running of the Grid-connected Solar Photovoltaic Power Plants.
- Successful Bidder(s) will be responsible to register these projects by operation and management arrangements and rules, regulations and modalities as per MNRE and as established by MEDA and mutually agreed between MEDA and the contractor for effective implementation of the project.
- The Works are to be carried out Dharampeth Education Society (Dharampeth College), Nagpur in the State of Maharashtra.
- You shall be required to complete the works within the stipulated time as specified in the tender document. The bidder shall ensure that at site Solar Photovoltaic Power Plants should be installed and commissioned within **30 Days** from the date of receipt of work order.
- Selected bidder is bound to operate and maintain the system as per the rules and regulations and modalities as prescribed by MNRE and MEDA for effective functioning of the project.
- Bids shall be complete and cover all Works described in the tender. However if any item of works required for completing the projects shall be deemed to be included in bidder's scope irrespective of whether it is specifically mentioned or not in the tender document.
- You shall be responsible for providing 'NET-METERING' system from respective DISCOM. Installation of Net-Metering is your responsibility, for this you have to submit the application with all necessary documents and fees to respective DISCOM. You shall provide sealed & tested energy meter at consumption side & generation side of SPV Power Plant along with bidirectional meter. Bidder should obtain statutory permissions from statutory bodies wherever required for execution of works.



- The "Technical Specification" is to be strictly adhered while installation of the project. Any deviation from the same if observed will lead to alteration as per norms provided in "Technical Specification" or as per site requirement.
- Acquiring all permissions regarding installation and commissioning of solar system will be responsibility of the bidder.
- The bidder must acknowledge that all the work of the project must be in the observance of licensed electrical contractor. The responsibility of electrical works, safety precautions and safety parameters of the project will be of licensed electrical contractor and awarded bidder, which must as per standards specified.
- The bidder shall provide insurance coverage of Complete Project documents effective from date of commissioning of the project for period of 05 years covering damage by force majeure.
- Acquiring all permissions regarding installation and commissioning of solar roof top system will be responsibility of the bidder.
- Provision for internet monitoring and download of data shall be also incorporated. Software shall be provided for USB download and analysis of DC and AC parametric data for the plant. The date 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.

**Danger plates:**

The bidder shall provide Danger Notice Plate:: at each project site of 200 mm X 150 mm made of mild steel sheet, minimum 2 mm thick and vitreous enameled white on both sides and with inscription in signal red colour on front side as required. The inscription shall be in English and local language.

**Insurance:**

- 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.
- The Bidder shall also take insurance for Third Party Liability covering loss of human life, engineers and workmen and also covering the risks of damage to the third party / material / equipment /properties during execution of the Contract. 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

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in carrying out the Contract. Liquidation, Death, Bankruptcy etc., shall be the responsibility of bidder.

- The bidder shall provide insurance coverage ex-factory until commissioning and acceptance for replacement or repair of any part of the consignment due to damage or loss.
- Complete Project Insurance policy documents effective from date of commissioning of the project for period of 05 years covering damage by force majeure.

• **TERMS AND CONDITIONS :-**

- Price escalation or increase in cost for any reasons whatsoever will not be considered for the said work during contract period.
- The material used for the work shall be new & best quality available and work should be carried out as per the specification given Annexure-1. The material used shall be as per IS / IEC wherever applicable.
- **You shall be responsible for any accidents mechanical/electrical during execution of the project.**
- You should provide appropriate tools and equipments to the workers and ensure that those are in proper working condition. The workmen use the appropriate tools and take precaution "PLEASE NOTE THAT ANY ACCIDENT TO THE WORKMEN / PUBLIC / ANIMALS / PROPERTY BOTH MOVABLE AND IMMOVABLE SHALL BE ENTIRE AND SOLE RESPONSIBILITY OF YOU AND ANY PROCEEDING ARISING OUT OF THE SAME SHALL BE AT YOURS RISK AND COST. MAHARASHTRA ENERGY DEVELOPMENT AGENCY (MEDA) OR ITS EMPLOYEES WILL NOT BE RESPONSIBLE FOR ANY SUCH INCIDENT".
- You should provide necessary manufacture's test certificates for materials being used for the work. You should provide facilities and bear the cost for the same. Power curve of all the panels erected by you shall be provided to the MEDA.
- It will be your responsibility to ensure the satisfactory performance of the systems.
- Please note that for any discrepancy observed during the period of installation and commissioning, conditions specified by MNRE / MEDA shall be final.
- You shall comply with the provision of contract labour, (Regulation and Abolition) Act 1970, minimum wages Act, 1948, payment of the wages Act, 1963 Workmen's Compensation Act, 1961, the contract labour (Regulation and Abolition) Act, 1979 and all other related Acts and any modification thereof or any law relating there to and rules made there under from time to time.
- MEDA shall not pay any interest on any amount due from MEDA.

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- In the event of any dispute during installation & commissioning of the systems, related to the work and documents, decision of the Divisional General Manager, MEDA, Nagpur shall be final.
- It should be noted that Divisional General Manager, MEDA, Nagpur has right to terminate the work order, if you failed to complete the work within given time.
- MEDA at its discretion may visit your factory for testing / inspection of the material, which will be utilized for work. The testing shall be carried out in manufacturer's premises and / or at appropriate testing laboratory or as per directions given by Divisional General Manager, MEDA, Nagpur or his authorized representative. However, inspection of material at site will be considered as final inspection.
- Rest of the conditions remains unchanged as per Tender No REN/ SOLAR-DHARMPETH/54 /2019 20

INSPECTION :-

- You shall inform Divisional General Manager, MEDA, Nagpur in writing when any portion of the work is ready for inspection giving sufficient time to enable MEDA to appoint representative to inspect the same without affecting the further progress of the work. The work shall not be considered in accordance with the terms of the contract until the competent person from MEDA certifies in writing to that effect.
  - Approval of materials or workmanship or approval of part of the work during the progress of execution shall not bind the Divisional General Manager, MEDA, Nagpur or in any way affect him even to reject the work which is alleged to be completed and to suspend the issue of his certificate of completion until such alternation and modifications or reconstruction have been effected at your cost as shall enable him to certify that the work has been completed to his satisfaction.
- **PAYMENT TERM:-**

a. Release of 50% of total project cost:

It will be released after supply, installation & successful commissioning of the systems duly certified by Bidder, Officer of Division office MEDA, Nagpur & authorized person of Beneficiary, along with following documents:

- Joint Inspection Report duly signed by beneficiary, Bidder representative, MEDA official.
- Submission of Complete Project Insurance policy documents effective from date of commissioning of the project for period of 05 years covering damage by force majeure.
- System Photograph accompanying MEDA official taken during joint inspection.
- Warranty/Guaranty Certificate of materials used in project.
- Serial Wise Test Reports of Panel comprising I-V curve and detail parameters of each panel.



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- Test Report of inverter and batteries (if applicable)
- Comprehensive Maintenance Contract (CMC) document as per clause mentioned in section IV "Technical Specification of SPV Solar Plant" for 5 years on the letter head of bidder.
- RFID Reader must be carried at the time of inspection. The report generated from RFID Tag of each panel at the time of inspection is to be compulsorily submitted.
- Duly signed "Affidavit" for system guarantee as given in the tender.

MEDA official at their discretion can ask bidder to submit document other than above mentioned, failing to submit the required and above mentioned document, MEDA will have the rights to hold the payment for 15% of total project.

- b. Release of 30% of total project cost ( If not released from CFA Fund):

Two month successful performance report in prescribed format of day/date wise generated automatically through Remote Real Time Monitoring System from commissioning.

- c. Release of 20% of total project cost:

It shall be released on submission of following documents and subjected to availability of fund from State Govt.:

- Submission of Performance Bank Guarantee of 15% of total project cost from any Nationalized/Schedule Bank in favour of Maharashtra Energy Development Agency valid for 5 years
- Next three month successful performance report in prescribed format of day/date wise generated automatically through Remote Real Time Monitoring System.
- Guaranteed Generation: Before release of last 20% payment, a guaranteed generation during this three months operation period will be verified.

A guaranteed automatic generation report in day/date wise format of minimum 4 units (KWh)/ kW/day calculates to monthly guaranteed generation as  $4 \text{ units} * 320 \text{ days} * 20 \text{ KW} = 15600$  and  $4 \text{ units} * 320 \text{ days} * 15 \text{ KW} = 19200$ ,  $4 \text{ units} * 320 \text{ days} * 40 \text{ KW} = 51200$  from SPV power project is expected for a period of 5 years. if the total generation pertaining to this period (initial six months) observed to be less, than penalty of Rs. 6/unit will be levied and the supplier/bidder will have to pay penalty amount in the form of D.D. Payable to Maharashtra Energy Development Agency.

After completion of one year period from the date of installation of the project, total generated units will be counted and if those units are found less, necessary penalty as mentioned above will be levied. The penalty amount will be paid to the beneficiary in the form of Demand Draft. However if the generated units are above than expected (minimum 4 units (KWh)) per KWP per day from SPV power plant in a year, then, in such case, the penalty amount paid by the supplier/bidder will be refunded to the concerned by MEDA.

For rest of the years till expiry of CMC period is up to 5 years, necessary bank guarantee submitted by the bidder will be considered to take care of active guaranteed generation of the project which will be expected as 4 units (KWh)/ KW/ day. If generation in these years found to be less, then penalty will be levied as Rs.6/ unit.

**The provision of Wi-Fi/Internet for online monitoring system over the duration of 1 year will be responsibility of bidder.**

• **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 issued by MEDA.

**Bidder should provide insurance against Labour and Material mandatorily.**

a) **Payment Terms for Comprehensive Maintenance Contract (CMC) :-**

- 5 years CMC cost will be released against submission of Performance Bank Guarantee valid for 5 years from the date of completion of project work. The submission of performance Bank Guarantee is mandatory for successful bidder. For releasing the 5 years CMC cost the bidder has to submit following documents along with his claim.
  - a. Performance Bank Guarantee equivalent to 15% of the project cost from any Nationalized/Scheduled Bank valid up to 5 years from date of completion of the project.
  - b. Latest report of systems functioning at Dharampeth education Society ( Dharampeth College) Nagpur duly certified by authorized person of User Agency.

b) **GUARANTEED GENERATION :-**

- **A guaranteed generation of minimum 4 units \* 320 days \* 20 KW = 15600 and 4 units \* 320days \* 15 KW = 19200, 4 units \* 320 days \* 40 KW = 51200 unit/annum at Dharampeth education Society ( Dharampeth College) Nagpur from SPV Power Plant during Comprehensive Maintenance Contract period has to be ensured by you.**

c) **PENALTY :-**

If the systems are not installed and commissioned within the stipulated period as mentioned in the work order the Bidder shall be required to pay penalty of 1/2% (half percent) of work order amount per week, maximum up to 10% of the total cost of the systems and the amount shall be recovered either from the amount due to the Bidder or from Security Deposit.



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- d) If the systems are not installed and commissioned within the stipulated period as mentioned in the work order total security deposit will be forfeited and work order may be cancelled at any stage of work.
- e) If Successful bidder is not able to complete the project in due time the same shall be got done through other contractor and the Successful bidder has to bear all the cost incurred against the balance work left by him for the completion of project.

**D) SECURITY DEPOSIT :-**

- g) The Bidder shall furnish Security Deposit at 3% of the total contract value i.e 99248/-. SD must be submitted by demand draft of nationalized/scheduled bank in favour of Maharashtra Energy Development Agency, Nagpur within 07 days from the date of work order.
- h) Failure to comply with the terms of security deposit shall result into cancellation of work order without any further reference to the Bidder and the EMD shall be forfeited.
- i) The security deposit shall be liable to be forfeited wholly or partly at the sole discretion of the MEDA, if the Bidder either fails to execute the work of above projects or fails to fulfill the contractual obligations or fails to settle in full his dues to the MEDA.
- j) In case of premature termination of the contract, the security deposit will be forfeited and the MEDA will be at liberty to recover the losses suffered by it & if additional cost is to be paid, the same shall be recovered from the Bidder.
- k) The MEDA is empowered to recover from the security deposit for any sum due and for any other sum that may be fixed by the MEDA as being the amount or loss or losses or damages suffered by it due to delay in performance and / or non-performance and / or partial performance of any of the conditions of the contract and / or non-performance of guarantee obligations.
- l) The security deposit shall be released to the Bidder only after contract is completed to the satisfaction of the MEDA.

**m) BILLS TO BE ON PRINTED FORMS :-**

- You shall submit all bills in triplicate to the Divisional General Manager, MEDA, Nagpur as per "Terms of Payment" mentioned in the work order.

**n) PRICE VARIATION :-**

- Under any circumstances, for any reasons, escalation in the contract value will not be considered by MEDA.

9) JURISDICTION :-

- In case of any dispute, in the documentation and during implementation, commissioning, completion and CMC period, all the matter will be resolved under Nagpur Jurisdiction only.

TECHNICAL SPECIFICATION

A Grid Tied Solar Rooftop or ground mounted Photo Voltaic (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 and switches. PV Array is mounted on a suitable structure. Grid tied SPV system is without battery and 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.

General System

1. The operating life of the plants shall be minimum 25 years.
2. The plant shall feed AC power to the Low Tension (LT) / High Tension (HT) distribution grid power supply through adjacent substation.
3. The plants shall monitor solar generated energy using plant DC / AC energy meter/Bidirectional energy meter independent of load energy monitoring. Remote monitoring facility must be made available.
4. The plant shall consist of PV array, fixed PV array support structure, String/Array combiner boxes, DC cabling, DC distribution box, Inverter, AC cabling, AC distribution box, plant AC energy meter, load energy meter and data acquisition system.
5. The individual Solar PV array shall be installed on existing roof top of the building using fixed PV array support structure or on the ground.
6. The individual string / array combiner boxes and DC cabling shall be installed on roof top of the building.
7. The inverter shall be installed in the control room / open space provided in the building.
8. The DC and AC distribution boxes, DC and AC cabling, energy meters and data acquisition system shall be installed in the control room / open space provided in (or near) the building.

PV Array

The total solar PV array capacity should not be less than 20 kWp on Main Building , 15KW on Home Science & 40KWp on Polytechnic at Dharampeth Education Society Nagpur comprise of solar polycrystalline modules with minimum capacity of 325Wp and above wattage. Module capacity less than minimum 325Wp should not be supplied. The module type must be qualified as per IEC 61215 latest edition for polycrystalline silicon or IEC 61646 for other latest technology. SPV module conversion efficiency should be equal to or greater than 16% under STC. Modules must qualify to IEC

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61730 Part I and II for safety qualification testing. Certificate for module qualification from IEC or equivalent should be uploaded. Self undertaking must be submitted from manufacturer/ supplier that the modules being supplied are as per above.

1. The PV modules used should be made in India.
2. The peak power rating of the Solar PV array under Standard Temperature Conditions (STC) shall be equal to the peak power rating of the plant.
3. The PV array shall consist of framed multi-crystalline.
4. Individual PV modules rating should be of minimum 325 Wp at STC.
5. The rated maximum power rating of PV modules should have positive tolerance in range of 0 to +3%. And negative temperature co-efficient of power for PV modules should be less than or equal to 0.45% per degree C. 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 more than 3 (three) percent from the respective arithmetic means for all modules and/or for all module strings, as the case may be.
6. A suitable number of Solar PV modules shall be connected in a series string. A suitable number of series strings shall be connected in parallel to formulate a series parallel array.
7. The PV Array shall be designed to match the inverter input specifications.
8. The module shall be provided with junction box with provision of min. 3 Nos. of by-pass diodes and external MC4 type or equivalent plug-in connectors. The junction box should have hinged, weatherproof lid with captive screws and cable gland entry points & should be IP 65 rated.
9. The front surface of the module shall consist of impact resistant, low iron and high transmission toughened glass.
10. The module frame shall be made of corrosion resistant material electrically compatible with structural material used for mounting the modules.
11. Each PV module manufactured in India must have RF identification tag (RFID) compatible with MNRE requirements. (Traceability requirement)
12. DC negative conductor shall be bonded to the ground via Ground Fault Detector Interrupter (GFDI). The grounding point shall be as close as possible to the PV Array.
13. 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 by-pass diode. The box shall have hinged, weather proof lid with captive screws and cable gland entry points or may be of sealed type and IP65 rated.
14. Necessary I-V curves at 250C, 450C, 600C and at NOC are required to be furnished. Offers to provide PV module warranty of 25 years with not more than 20% degradation in performance/output over 25 years.
15. The PV module must have 10 years free replacement guarantee against material defect or craftsmanship.
16. Name of the manufacturer of PV module; name and manufacturer of the solar cell; month and year



of manufacture: I-V curve, wattage, Im, Vm, FF for the module; unique serial no & model no, date & year of obtaining IEC PV module qualification certificate are required to be furnished

**Warranties:**

**Material Warranty:**

- i. Material Warranty is defined as: The manufacturer 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 manufacturer will repair or replace the solar module(s), at the Owners sole option

**Performance Warranty:**

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.

**Inverter**

The PCU required shall be of 20 kVA on Main Building , 15KVA on Home Science & 40KVA on Polytechnic at Dharampeth Education Society in Nagpur, to convey DC power produced by SPV modules into AC power and adjust the voltage & frequency levels to meet the local grid conditions.

**Common Technical Specification**

Control Type: Voltage source, microprocessor assisted, output regulation.

Output voltage: 3 phase, 415 V AC (+12.5%, -20% V AC)

Frequency: 50 Hz (+3 Hz, -3 Hz)

Continuous rating: 20KVA for Main Building, 15KVA For Home Science & 40KVA For Polytechnic Building with net metering/off Import/Export meters

Normal Power: 20KVA, 15KVA & 40 KVA for Main Building , Home Science & POLYTECHNIC Building

Total Harmonic Distortion: less than 3%

Operating temperature Range: 0 to 55 deg C

Humidity: 95 % Non-condensing

Housing cabinet: PCU to be housed in suitable switch cabinet, IP-20(Minimum) for indoor IP-65(Minimum) for outdoor

PCU efficiency: 98% and above at full load.

PF: > 0.9

**Other important Features/Protections of PCU:**

1. Mains (Grid) over-under voltage and frequency protection.

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2. Over load capacity (for 10 sec) should be 200% of continuous rating.
3. The PCU shall be self commuted and shall utilize a circuit topology and components suitable for meeting the specifications listed above at high conversion efficiency and with high reliability.
4. The PCU shall be provided with MPPT (Maximum Power Point Tracing) features, so that maximum possible power can be obtained from the PV module.
5. The PCU shall be self commuted and shall utilize a circuit topology/ DSP technology to meet the specifications listed above at high conversion efficiency and with high reliability. The PCU shall be Hybrid One and shall give the preference to feed the Loads from Solar Energy being produced and shall draw the additional power from mains to meet the load requirements in the case load is more than solar energy being produced. Conversely it should feed the solar power to the Grid if the load is less than the solar energy generated.
6. Full proof protection against grid islanding which ensures that the PV power and the grid power get disconnected immediately in the event of grid failure.
7. 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.
8. The charge controller (if any) / 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.
9. The PCU / inverters should be tested from the MNRE approved test centres / NABL / BIS / IEC accredited testing- calibration laboratories. In case of imported power conditioning units, these should be approved by international test houses.
10. The PCU shall be capable of operating in parallel with the grid utility service and shall be capable of interrupting line-to-line fault currents and line-to-ground fault currents.
11. The PCU shall be able to withstand an unbalanced output load to the extent of 50%.
12. The PCU shall go to the shut down/standby mode with its contacts open under the following conditions before attempting and automatic restart after an appropriate time delay in insufficient solar power output.
13. (a) Utility-Grid Over or Under Voltage  
The PCU shall restart after an over or under voltage shutdown when the utility grid voltage has returned to within limits for a minimum of two minutes.
- (b) Utility-Grid Over or Under Frequency  
The PCU shall restart after an over or under frequency shutdown when the utility grid voltage has returned to the within limits for minimum of two minutes. The permissible level of under/over voltage and under/over grid frequency is to be specified by the tenderer.
- (c) The PCU shall not produce Electromagnetic interference (EMI) which may cause malfunctioning of electronic and electrical instruments including communication equipment, which are located within the facility in which the PCU is housed.

14. Communication Modbus protocol with LAN / WAN options along with remote access facility and SCADA package with latest monitoring systems.
15. The inverter with MPPT shall be used with the power plant.
16. The sine wave output of the inverter shall be suitable for connecting to 415V, 3 phase AC LT voltage grid.
17. The inverter shall incorporate transformer isolated output (transformer-less inverters shall be used with suitable external transformers), grid islanding protection disconnection of grid & PV power in case of failure of Grid supply suitable DC / AC fuses / circuit breakers and voltage surge protection. Fuses used in the DC circuit shall be DC rated.
18. The inverter shall have internal protection against any sustained faults and/or lightning in DC and mains AC grid circuits.
19. The peak inverter efficiency inclusive of built-in isolation transformer shall exceed 94%. (Typical commercial inverter efficiency normally more than 97%, and transformer efficiency is normally more than 97%)
20. The kVA ratings of inverter should be chosen as per the PV system wattage.
21. The output power factor should be of suitable range to supply or sink reactive power.
22. Inverter shall provide panel for display of PV array DC voltage, current and power, 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. Remote monitoring of inverter parameters should also be available.
23. The inverter shall include adequate internal cooling arrangements (exhaust fan and ducting) for operation in a non-AC environment.

Factory Testing:

1. The PCU shall be tested to demonstrate operation of its control system and the ability to be automatically synchronized and connected in parallel with a utility service, prior to its shipment.
2. Operation of all controls, protective and instrumentation circuits shall be demonstrated by direct test if feasible or by simulation operation conditions for all parameters that cannot be directly tested.
3. Special attention shall be given to demonstration of utility service interface protection circuits and functions, including calibration and functional trip tests of faults and isolation protection equipment.
4. Operation of start up, disconnect and shutdown controls shall also be tested and demonstrate. Stable operation of the PCU and response to control signals shall also be tested and demonstrated.
5. Factory testing shall not only be limited to measurement of phase currents, efficiencies, harmonic content and power factor, but shall also include all other necessary tests/simulation required and requested by the Purchasers Engineers. Tests may be performed at 25%, 30%, 75% & 100% of the rated nominal power.



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6. 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.

PROTECTIONS:

LIGHTNING PROTECTION

The SPV power plants 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 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 NFC 17-102.2011 standard. 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.

SURGE PROTECTION

Internal surge protection shall consist of three MOV type surge-arrestors connected from +ve and -ve terminals to earth (via Y arrangement)

Earthing

1. PV array, DC equipment, Inverter, AC equipment and distribution wiring shall be earthed as per IS: 3043 - 1987.
2. Equipment grounding (Earthing) shall connect all non-current carrying metal receptacles, electrical boxes, appliance frames, chassis and PV panel mounting structures in one long run. The grounding wire should not be switched, fused or interrupted.
3. The complete earthing system shall be electrically connected to provide return to earth from all equipment independent of mechanical connection.
4. The equipment grounding wire shall be connected to PV power plant.
5. A separate grounding electrode shall be installed using earth pit per power plant. Test point shall be provided for each pit.
6. An earth bus and a test point shall be provided inside each control room.
7. Earthing system design should be as per the standard practices.

CABLES & WIRES

Cabling in the yard and control room: Cabling in the yard shall be carried out as per IE Rules. All other cabling above ground should be suitably mounted on cable trays with proper covers.

- Wires: Only FRLS copper wires of appropriate size and of reputed make shall have to be used.
- Cables Ends: All connections are to be made through suitable cable/lug/terminals: crimped properly & with use of Cable Glands.

- 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. Any change in cabling schedule/sizes if desired by the bidder/supplier be got approved after citing appropriate reasons. All cable schedules/layout drawings have to be got approved from the purchaser prior to installation. All cable tests and measurement methods should confirm to IEC 60189.

#### Electrical Safety, Earthing Protection

##### Electrical Safety

- Internal Faults: In built protection for internal faults including excess temperature, commutation failure and overload and cooling fan failure (if fitted) is obligatory.
- Over Voltage Protection: Over Voltage Protection against atmospheric lightning discharge to the PV array is required. Protection is to be provided against voltage fluctuations and internal faults in the power conditioner, operational errors and switching transients.
- Earth fault supervision: An integrated earth fault device shall have to be provided to detect eventual earth fault on DC side and shall send message to the supervisory system.
- Cabling practice: Cable connections must be made using PVC Cu cables, as per BIS standards. All cable connections must be made using suitable terminations for effective contact. The PVC Cu cables must be run in GL trays with covers for protection.
- Fast acting semiconductor type current limiting fuses at the main bus bar to protect from the grid short circuit contribution.
- The PCU shall include an easily accessible emergency OFF button located at an appropriate position on the unit.
- The PCU shall include ground lugs for equipment and PV array grounding.
- All exposed surfaces of ferrous parts shall be thoroughly cleaned, primed, and painted or otherwise suitably protected to survive a nominal 30 years design life of the unit.
- The PCU enclosure shall be weatherproof and capable of surviving climatic changes and should keep the PCU 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 PCU enclosure.
- Components and circuit boards mounted inside the enclosures shall be clearly identified with appropriate permanent designations, which shall also serve to identify the items on the supplied drawings.
- All doors, covers, panels and cable exits shall be gasket or otherwise designed to limit the entry of dust and moisture. All doors shall be equipped with locks. All openings shall be provided with grills or screens with openings no larger than 0.95 cm. (about 3x8 inch).
- In the design and fabrication of the PCU the site temperature (5° to 55°C), incident sunlight and the effect of ambient temperature on component life shall be considered carefully. Similar

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consideration shall be given to the heat sinking and thermal for blocking diodes and similar components.

EARTHING PROTECTION

Each array structure of the PV yard should be grounded properly. In addition the lightning arrester/masts should also be provided inside the array field. Provision should be kept be provided inside the array field. Provision should be kept for shorting and grounding of the PV array at the time of maintenance work. All metal casing/shielding of the plant should be thoroughly grounded in accordance with Indian electricity Act. /IE Rules. Earth resistance should be tested in presence of the representative of NRHM after earthing by calibrated earth tester. PCU ACDB & DCDB should be earthed properly.

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

Balance of Systems (BoS)

1. String / Array combiner boxes shall incorporate DC string circuit breakers, DC array disconnect switch, lightning and over voltage protectors, any other protection equipment, screw type terminal strips and strain-relief cable glands.
2. All DC and AC cables shall be terminated using suitable crimped cable lugs/sockets and screw type terminal strips. No soldered cable termination shall be accepted.
3. Only terminal cable joints shall be accepted. No cable joint to join two cable ends shall be accepted.
4. Suitable Ground Fault Detector Interrupter (GFDI) shall be incorporated either with the inverter or with the array combiner box.
5. String/Array combiner boxes shall be secured onto walls or metal structures erected separately on the terrace.
6. Conduits / concealed cable trays shall be provided for all DC cabling on the Roof top. Conduits / concealed cable trays shall be adequately secured onto the roof top / wall.
7. The AC cable type shall be PVC / XLPE insulated, suitably armoured, 1100V grade multi-stranded copper conductor. Appropriate colour coding shall be used.
8. 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.
9. The DC and AC cables of adequate electrical voltage and current ratings shall be also rated for 'in conduit wet and outdoor use'.
10. The total DC cable losses shall be maximum of 2% of the plant rated DC capacity over the specified ambient temperature range.
11. The DC and AC cable size shall be selected to maintain losses within specified limits over the entire lengths of the cables.



12. DC cables from array combiner box on the rooftop to DC distribution box in the control room and DC/ AC cabling between inverter and distribution boxes shall be laid inside cable duct where available or secured with conduits/concealed cable trays where duct is not available.
13. The DC and AC distribution boxes shall be wall mounted inside control room/open space.
14. DC distribution box shall incorporate DC disconnect switch, lightning surge protectors, any other protection equipment, screw type terminal strips and strain-relief cable glands.
15. AC distribution box shall incorporate AC circuit breaker, surge voltage protectors, any other protection equipment, plant energy meter, screw type terminal strips and strain-relief cable glands.
16. The total AC cable losses shall be maximum of 1% of the plant AC output over the specified ambient temperature range.
17. All cable conduits shall be GI/HDPE type.
18. All cable trays shall be powder coated steel or GI or equivalent.

#### Civil

1. For structural purpose, the panels plus support system that works as a distortion-free integral structural unit.
2. The panel assembly should at most 5m x 5m in plan area. The max height of panel above roof surface does not exceed 1.2 m.
3. The vertical projection area of the longer side of the panels does not exceed  $W/100$  in sq m where W is the gross load of the panel assembly in kg (weight of panels, connections, frames, bracings, pedestals, wiring, circuitry etc.).
4. PV array shall be installed in the space free from any obstruction and / or shadow.
5. Drainage and roof treatment should not be affected by the installation.
6. PV array shall be installed utilizing maximum space to minimize effects of shadows due to adjacent PV panel rows. The gross weight of the panel assembly should at most 45 kg/sq m (W divided by the plan area).
7. Adequate spacing shall be provided between two panel frames and rows of panels to facilitate personnel protection ease of installation, replacement, cleaning of panels and electrical maintenance. There is at least 1m clear spacing all around the panel assembly (panel edge to panel edge between assemblies, and panel edge to parapet wall / room on sides).
8. The maximum column spacing should be 8.5 m c/c or less. The pedestal is placed directly on the roof, over existing roof treatment, without making any structural connection to the roof surface.
9. The panel assembly should have at least 4 pedestal supports. The minimum spacing between pedestals is 2.0 m c/c in any direction. Each pedestal is made of cement concrete. Each pedestal can transmit at most 200 kg load on roof. The plan dimension of pedestal does not exceed 450mm x 450 mm, and height does not exceed 300mm.
10. Ample clearance shall be provided in the layout of the inverter and DC / AC distribution boxes for adequate cooling and ease of maintenance.

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11. The Supplier will supply and install required size of Water Tank, pump, pipe etc. for cleaning the PV modules
12. The supplier shall specify installation details of the PV Panel assembly with appropriate diagrams and drawings. Such details shall include, but not limited to, the following:
  - a) Determination of true south at the site;
  - b) Array tilt angle to the horizontal, with permitted tolerance;
  - c) Details with drawings for fixing the modules;
  - d) Details with drawings of fixing the junction/terminal boxes;
  - e) Interconnection details inside the junction/terminal boxes;
  - f) Structure installation details and drawings;
  - g) Electrical grounding (earthing);
  - h) Inter-panel / Inter-row distances with allowed tolerances; and
  - i) Safety precautions to be taken.

The array structure shall support SPV modules at a given orientation and absorb and transfer the mechanical loads to the roof top columns properly. All nuts and bolts shall be of very good quality stainless steel. The panel support and panel-to-support connection both must be designed by vendor to withstand adequately high wind forces. Civil Works permission does not guarantee safety against flying/falling panels in the event of a storm or any other accident.

Mechanical

1. PV panel assembly may consist of different number of modules with maximum of 10 PV modules.
2. Each panel assembly shall incorporated one bird repellent spike at a level higher than the panel upper edge. The location of the spike should be selected for minimum shadow effect.
3. Support structure of panel assembly shall be fabricated using corrosion resistant GI or anodized aluminium or equivalent metal sections.
4. Array support structure welded joints and fasteners shall be adequately treated to resist corrosion.
5. The support structure shall be free from corrosion when installed.
6. PV modules shall be secured to support structure using screw fasteners and/or metal clamps. Screw fasteners shall use existing mounting holes provided by module manufacturer. No additional holes shall be drilled on module frames. Module fasteners / clamps shall be adequately treated to resist corrosion.
7. The support structure shall withstand wind loading of up to 150 km/hr.
8. Adequate spacing shall be provided between any two modules secured on panel assembly for improved wind resistance.
9. The structure shall be designed to withstand operating environmental conditions for a period of minimum 25 years.
10. It is required to design the grid structure (on which PV module will be installed) in such a way that all loads are transferred to the existing columns of the buildings. Such grid design should be



presented to MEDA, which will be certified by structural engineers.

11. The panel assembly structure should be installed in a manner to leave sufficient space for repair and maintenance aspects of the roof tops, particularly for leakages.
12. Installation of panel assembly should not tamper with the water proofing of roofs.

#### ARRAY STRUCTURE

- a) Hot dip galvanized (minimum of 100 Microns) MS mounting structures may be used for mounting the modules / panels / arrays. 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. Suitable fastening arrangement such as grouting and caulking 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 be in compliance 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) 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.
- f) The bidder need to supply suitable structures based on the quality of roof and considering the load bearing capacity of the roof / civil structures of the proposed building.

#### Electrical:

1. LT distribution grid specifications 415V +/- 5%, 50Hz and frequency variation as per IE rules.
2. The output of the inverter shall be transformer isolated and shall be fed into 415V, 3 phase AC LT grid supplied via LT Air circuit Breaker.
3. The inverter output shall be connected to LT line prior to the LT/DG changeover switch. The mandatory islanding protection provided by inverter shall isolate the Solar PV power plant.
4. The time of day (TOD) 3 phase, digital AC load energy meter shall be installed in the Main Distribution Box to monitor energy drawn by building load and in the AC distribution box to monitor energy generated by Solar PV power plant.
5. The load energy meter operation shall be completely independent of the plant AC energy meter.
6. The energy meters shall be provided with communication interface and necessary data cables for remote monitoring.



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Data Acquisition System

1. Data Acquisition System shall be provided for both Grid connected solar PV plants.
2. 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.
3. 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.
4. The time interval between two sets of data shall not be more than 3 minutes. (A minimum of 20 samples of data shall be recorded per hour)
5. Data Acquisition System shall have real time clock, internal reliable battery backup and data storage capacity to record data round the clock for a period of minimum one year.
6. Computerized AC energy monitoring shall be in addition to the digital AC energy meter.
7. 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.
8. All instantaneous data shall be shown on the computer screen.
9. Software shall be provided for USB download and analysis of DC and AC parametric data for the plant.
10. Provision for internet monitoring and download of data shall be also incorporated.
11. Software for centralized internet monitoring system shall be also provided for download and analysis of cumulative data of the plant and the data of the solar radiation and environment monitoring system.
12. A data logging system (Hardware and Software) for plant control and monitoring shall be provided.
13. Remote Supervisory Control and data acquisition through SCADA or equivalent software at the purchasers 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 be ensured by the supplier.
14. Disconnection and Islanding: Disconnection of the PV plant in the event of loss of the main grid supply is to be achieved by in built protection within the power conditioner, this may be achieved through rate of change of current, phase angle, unbalanced voltage or reactive load variants.
15. Operation outside the limits of power quality as described in the technical data sheet should cause the power conditioner to disconnect the grid. Additional parameters requiring automatic disconnection are: Neutral voltage displacement, Over current, Earth fault and reverse power in case of the above cases, tripping time should be less than 15 seconds. Response time in case of grid failure due to switch off or failure based shut down should be well within seconds. In case of use of two PCUs, suitable equipment for synchronizing the AC output of both the PCUs to the ACDB/ Grid should be provided.  
Automatic reconnection after the grid failure should restore.

16. PCU shall have the facility to reconnect the PCU automatically to the grid, following restoration of grid, subsequent to grid failure condition. And also the facility to connect the system with load at grid failure condition for essential power supply.

Operating Environment

1. Temperature: 5 to 55 Deg. C.
2. Relative Humidity : 100% @ 40 Deg. C
3. Precipitation : 2.46 mm per day (Annual average)
4. Clearness Index : 0.62 (Annual average)
5. Wind Speed: up to 150 km/hr. /
6. Corrosion : high
7. Dust : moderate to high
8. Bird Interference : high
9. Bird Droppings : frequent and large
10. Trees: large and in abundance.

Plant cleaning system

Plant cleaning system needs to be provided for easy cleaning of solar panels, complete with supply, transportation, insurance, installation and commissioning along with 10 yrs comprehensive maintenance at site.

This also includes

Providing adequate water storage facility for min 2 cleaning cycles at site. Laying of pipe line of adequate size and capacity from the point of supply of water to the location of storage is also to be arranged by bidder.

Providing pressure pump – 2 no. one for use and 2nd stand by, complete with necessary electrical controls and allied wiring and installation.

Providing pipe line of adequate size and length along the structure and cleaning mechanism.

Any allied work related to mechanical, civil, electrical, plumbing job for successful functioning of the plant cleaning system as per the specific requirements of the manufacturer.

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
20 KW at Main Building , 15KW at Home Science & 40KW at Polytechnic , Dharampeth Education Society in Nagpur	230V/ 440V

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Utilities may have voltage levels other than above; DISCOMS may be consulted before Finalization of the voltage level and specification is made accordingly.

Testing, Certification and Approval Schedule

All components, sub-assemblies and system test parameters shall be verified on site to ensure they meet the specifications.

Plant Power Performance Ratio Testing

The successful bidder shall be required to meet minimum guaranteed generation with Performance Ratio (PR) at the time of commissioning and related Capacity Utilization Factor (CUF) as per the GHI levels of the location during the O&M period. PR should be shown minimum of 75% at the time of inspection for initial commissioning acceptance to qualify for release of applicable incentive. Minimum CUF of 15% should be maintained for a period of 5 years. Correction shall be applied based on available solar radiation.

Plant Energy Performance Ratio Testing

The overall energy performance ratio of the system shall exceed 75%. (Sum total of the system energy losses shall not exceed 25%). For global solar insolation in the Plane of Array (PoA) of 5 kWh/ m<sup>2</sup> (5 Peak Sun Hours) for the day. 20 kWp, 15KWP & 40KWP PV power plant AC energy output shall be minimum of 75 kWh, 56.25 KWH and 150KWH (20 kW x 0.75 x 5 hrs, 15KWx0.75x5Hrs and 40KWx0.75x5Hrs) for the day at Dharampeth Education Society Nagpur

Operation and Maintenance (O&M)

1. Cleaning of solar PV modules with soft water, wet and dry mops : Weekly
2. DC String / Array and AC Inverter monitoring: Continuous and computerized.
3. AC Energy monitoring: Continuous and computerized.
4. Visual Inspection of the plant : Monthly
5. Functional Checks of Protection Components and Switchgear: Quarterly.
6. Spring Clean PV Array and Installation Area: Quarterly.
7. Inverter, transformer, data acquisition, energy meters and power evacuation checks: Half Yearly.
8. Support structure and terrace water-proofing checks: Yearly.
9. O & M log sheet shall be provided and maintained.
10. The repair/replacement work shall be completed within 48 hours from the time of reporting the fault.
11. A half yearly performance report of the plant inclusive of energy generation data shall be provided as per approved format.
12. All recorded data for the first 5 years shall be preserved in both manual and computer format and submitted at hand over.



## 2. COMPREHENSIVE MAINTENANCE CONTRACT (CMC)

- (i) The complete Solar PV Power Plants must be guaranteed against any manufacturing / design/ installation defects for a minimum period of 5 years.
- (ii) PV modules used in Solar PV Power Plants 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.
- (iii) During the CMC period, MNRE / MEDA / users will have all the rights to cross check the performance of the Solar PV Power Plants, MEDA may carry out the frequent inspections of the Solar PV Power Plants 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.

### Warranties and Guarantees

1. Solar Modules: Workmanship/ product replacement for 10 years.
2. Solar Modules: 90% power output for 10 years & 80% power output for 25 years.
3. Inverter: Workmanship/product replacement for 5 years, service for 25 years
4. Power Evacuation and Metering Equipment: Workmanship/product replacement for 10 years, service for 25 years
5. BoS: Parts and Workmanship for 10 years, service for 25 years.
6. Power Plant Installation : Workmanship for 10 years, service for 25 years
  1. PV Array Installation : Structural for 25 years
  2. Power plant power performance ratio-min 75%
  3. Power plant energy performance ratio-min. 75%

### Standards and Compliance

4. IEC 60364-7-712: Electrical Installations of Buildings: Requirements for Solar PV power supply systems.
5. IEC 61727 or similar: Utility Interface Standard for PV power plants > 10 kW.
6. IEC 62103, 62109 and 62040 (UL 1741): Safety of Static Inverters – Mechanical and Electrical safety aspects.
7. IEC 62116: Testing procedure of Islanding Prevention Methods for Utility-Interactive PV Inverters.
8. PV Modules : IEC 61730- Safety qualification testing, IEC 61701 – Operation in corrosive atmosphere
9. IEC 61215 : Crystalline Silicon PV Modules qualification
10. String/array junction boxes : IP65, Protection Class II, IEC 60439-1, 3.

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- 11 Surge Protection Devices. Type 2, DC 1000V rated.
- 12 PV module / string / string combiner box interconnects: MC4 compatible. DC 1000V rated.
13. The central inverter shall be rated for IP54.
14. The DC/AC distribution boxes shall be rated IP54.
15. The data acquisition systems shall be rated for IP54.
16. All DC and AC cables, conduits, cable trays, hardware: relevant IS.
- 17 Earthing System: relevant IS.
18. PV array support structure: relevant IS.
19. Quality Certification, Standards and Testing for Grid-Connected Rooftop Solar PV Systems/ Power Plants should be maintained.

**TIME FRAME :-**

- The time frame for the completion of work will be 30 days from the date of issue of work order.
- The CMC period for all systems shall be Upto the five years from the date of successful commissioning of the project.

**You are requested to submit the security deposit of Rs 99248/- in form of DD or through RTGS within 7 days from this work order.**

Bank Details for SD:

Account Name:	MAHARASHTRA ENERGY DEVELOPMENT AGENCY	
Bank Name:	Bank of Maharashtra	
Account No.:	60277208983	
Branch Name & IFSC Code:	Vidarbha Irrigation Dev. Corp.(1321), Civil lines, Nagpur	MAHB0001321

*Received copy*

*[Signature]*  
Divisional General Manager  
MEDA, Nagpur

Accepted By:  
Signature:  
Name:  
Designation:  
Company Seal:

*[Signature]*

✓ Copy to: Dharampeth Education Society ( Dharampeth College) Nagpur.

You need to submit following details to carry out the work:

- 1) Sheet of physical technical specifications and description of actual materials which are to be used in the project.
- 2) Structural design approved by structural engineer/auditor.
- 3) Civil load bearing capacity of building approved by PWD/structural engineer of the specified building.
- 4) Undertaking of Guaranteed Generation Certificate on Rs. 100/- stamp paper.
- 5) Documents of licensed Electrical Contractor who will be supervising the project.
- 6) Details of Office and Staff responsible for carrying the CMC for 5 years.
- 7) You shall submit Security Deposit (SD) of 3% security deposit to the Bank details mentioned below.
- 8) Submission of labour and material insurance at "Directorate of Insurance" of 1% contract value along with consent of deduction





## Material Delivery Report

1.	Name of the work	:	Design, Fabrication, Supply, Installation, Testing And Commissioning Of 20kw On Main Building, 15kw On Home Science Building And 40kw On Polytechnic Building Grid-Connected Solar Pv Power Plant Under Roof-Top Net Metering With 05 Years Of Comprehensive Operation And Maintenance Including plant Cleaning System, Cctv, Rms Monitoring And Weather Monitoring System Along With Insurance Of Project For 5 Years At dharampeth Education Society (Dharampeth College), Nagpur
2.	Name of the Contractor	:	M/s Green Life Solutions Pvt. Ltd. Nagpur.
3.	Work order No. & Date	:	REN/SOLAR-DHARAMPETH/54/2019-20/649, Dt :02/08/2019
4.	Name of the beneficiary	:	Dharampeth Education Society, Dharampeth Nagpur
5.	Proposed System	:	Solar Power Plant
6.	Capacity (in KW)	:	20kw
7.	Date of Commissioning	:	

S.N.	Components	Std. Specification as per W.O.	Observation/Remarks
1.	Solar PV modules	The Modules shall contain (Solar PV) Crystalline Silicon Solar Cell Modules and they must be IEC 61215 / IS 14286 standard	Capacity :- 325Wp Make :- ICON
		No. of Module (in Nos.)	61Nos
		SPV Module Capacity (in Wp)	325 Wp
		Project Capacity (in KW)	20 KW
		RFID Tag	Yes
2.	Module Mounting structure	Hot dip galvanized MS mounting structures may be used for mounting the modules / panels / Arrays. Minimum thickness of galvanization should be at least 80 microns.	Yes



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S.N.	Components	Std. Specification as per W.O.	Observation/Remarks
		It shall withstand the wind speed of respective wind zone (wind speed of 150 km/ hour). 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. (as per Eol specifications)	Yes
3.	Junction Boxes	<ul style="list-style-type: none"><li>The junction boxes shall be made of GRP / FRP / Powder Coated Aluminum /cast aluminum alloy with full dust, water and vermin proof.</li><li>The JB's shall be such that Input &amp; output termination can be made through suitable cable glands. All wire/cables must be terminated through cable lugs.</li><li>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. Provision of earthlings.</li><li>Each Junction Box shall have High quality Suitable capacity metal oxide Varistors (MOVs)/ SPDs, suitable Reverse Blocking Diodes.</li></ul>	Yes Yes Yes
		<ul style="list-style-type: none"><li>Make of JB:</li></ul>	M/s Green Life Solutions Pvt. Ltd.
4.	DC DISTRIBUTION BOARD	<ul style="list-style-type: none"><li>It shall have sheet from enclosure of dust &amp; vermin proof conform to IP 65 protection.</li></ul>	Yes
5.	Battery Bank (If Any).	<ul style="list-style-type: none"><li>The cells must be as per IEC Standard &amp; MNRE approved.</li><li>Make:</li></ul>	NA
6.	MNRE approved Charge Controller unit (If Any)	<ul style="list-style-type: none"><li>Capacity: Voltage-.....V Amp -.....Ah</li></ul>	Inbuilt



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S.N.	Components	Std. Specification as per W.O.	Observation/Remarks
7.	MNRE approved Grid Inverter Make: THEA	<ul style="list-style-type: none"><li>• <b>Nominal Capacity:</b> 20 Kw</li><li>• <b>Input Voltage-</b> 440V DC Nominal, The voltage variation shall be as per change in array output,</li><li>• <b>Output Voltage</b> - 440V, 50 Hz, 3<math>\phi</math>, <b>Regulation:</b> From minimum to maximum voltage 1%, <b>Output Frequency:</b> 50 Hz, + 0.5 Hz, 200% for 30 Second, <b>Efficiency:</b> 98% and full load <math>&gt; 0.9</math> PF.</li><li>• Protection against Islanding of grid as per IEEE 1547/UL 1741/ IEC 62116 or equivalent BIS standard.</li></ul>	Capacity- 20 Kw  Sr. No.
8.	AC Distribution Panel Board	<ul style="list-style-type: none"><li>• All switches and the circuit breakers, connectors should conform to IEC 60947, part I, II and III/ IS 60947 part I, II and III.</li><li>• AC Distribution Panel Board should have necessary surge arrestors.</li></ul>	Yes
		<ul style="list-style-type: none"><li>• Cables must properly align and insulated.</li></ul>	Yes
9.	Danger Notice Plates for system having capacity 2KW or above.	<ul style="list-style-type: none"><li>• Danger boards should be provided as and where necessary as per IE Act. /IE rules as amended up to date.</li><li>• The inscriptions shall be in local language, Hindi and English.</li></ul>	Yes
10.	Earthing Systems.	<ul style="list-style-type: none"><li>• The Earthing system for array and distribution system &amp; SPV Power Plant</li><li>• Each array structure of the PV yard should be grounded/ earthed properly as per IS:3043-1987</li></ul>	Yes





Maharashtra Energy Development Agency (MEDA), Pune

S.N.	Components	Std. Specification as per W.O.	Observation/Remarks
11.	Tools kit	<ul style="list-style-type: none"><li>Necessary tools kit is to be provided along with the each Power Plant for any routine maintenance or immediate repair</li></ul>	Yes
12.	Training, Operation Manual & Display Board	<ul style="list-style-type: none"><li>Training to the user for operation and maintenance of the system.</li></ul>	Yes
		<ul style="list-style-type: none"><li>Supply of manual for Operation and Maintenance in two languages i.e. in English and in Marathi to Beneficiary.</li></ul>	Yes
		<ul style="list-style-type: none"><li>Display Board of size 3 ft x 3 ft which gives detailed circuit diagram of the system with its description.</li></ul>	Yes
13.	Net Meter	<ul style="list-style-type: none"><li>Details of net meter and Date of commissioning. (Get the details of release order from utility with details of meter.)</li></ul>	Make : Sr. No. : Commissioning Date :
14.	Lightening arrester	Lightning protection should be provided as per IEC 62305 Standards.	Yes
15.	Comprehensive Maintenance Contract (CMC)	Yes / No	Yes
16.	Load	Total Load : 15KW	20 kw

The above system is handed over to the beneficiary/user agency.

Sign of Beneficiary

Name: Dharampeth  
Date: Science college,  
Mugher  
27.9.2019.



Sign of Manufacturer

Name:  
Date:

Sign of MEDA Official

Name:  
Date:



Maharashtra Energy Development Agency (MEDA), Pune

Home Science

## Material Delivery Report

1.	Name of the work	:	Design, Fabrication, Supply, Installation, Testing And Commissioning Of 20kw On Main Building, 15kw On Home Science Building And 40kw On Polytechnic Building Grid-Connected Solar Pv Power Plant Under Roof-Top Net Metering With 05 Years Of Comprehensive Operation And Maintenance Including plant Cleaning System, Cctv, Rms Monitoring And Weather Monitoring System Along With Insurance Of Project For 5 Years At dharampeth Education Society (Dharampeth College), Nagpur
2.	Name of the Contractor	:	M/s Green Life Solutions Pvt. Ltd. Nagpur.
3.	Work order No. & Date	:	REN/SOLAR-DHARAMPETH/54/2019-20/649, Dt :02/08/2019
4.	Name of the beneficiary	:	Dharampeth Education Society, Dharampeth Nagpur
5.	Proposed System	:	Solar Power Plant
6.	Capacity (in KW)	:	15kw
7.	Date of Commissioning	:	

S.N.	Components	Std. Specification as per W.O.	Observation/Remarks
1.	Solar PV modules	The Modules shall contain (Solar PV) Crystalline Silicon Solar Cell Modules and they must be IEC 61215 / IS 14286 standard	Capacity :- 325Wp Make :- ICON
		No. of Module (in Nos.)	46Nos
		SPV Module Capacity (in Wp)	325 Wp
		Project Capacity (in KW)	15KW
		RFID Tag	Yes
2.	Module Mounting structure	Hot dip galvanized MS mounting structures may be used for mounting the modules / panels / Arrays. Minimum thickness of galvanization should be at least 80 microns.	Yes



Maharashtra Energy Development Agency (MEDA), Pune

S.N.	Components	Std. Specification as per W.O.	Observation/Remarks
		It shall withstand the wind speed of respective wind zone (wind speed of 150 km/ hour). 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. (as per EoI specifications)	Yes
3.	Junction Boxes	<ul style="list-style-type: none"><li>The junction boxes shall be made of GRP / FRP / Powder Coated Aluminum /cast aluminum alloy with full dust, water and vermin proof.</li><li>The JB's shall be such that Input &amp; output termination can be made through suitable cable glands. All wire/cables must be terminated through cable lugs.</li><li>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. Provision of earthlings.</li><li>Each Junction Box shall have High quality Suitable capacity metal oxide Varistors (MOVs)/ SPDs, suitable Reverse Blocking Diodes.</li></ul>	Yes Yes Yes
		<ul style="list-style-type: none"><li>Make of JB:</li></ul>	M/s Green Life Solutions Pvt. Ltd.
4.	DC DISTRIBUTION BOARD	<ul style="list-style-type: none"><li>It shall have sheet from enclosure of dust &amp; vermin proof conform to IP 65 protection.</li></ul>	Yes
5.	Battery Bank (If Any).	<ul style="list-style-type: none"><li>The cells must be as per IEC Standard &amp; MNRE approved.</li><li>Make:</li></ul>	NA
6.	MNRE approved Charge Controller unit (If Any)	<ul style="list-style-type: none"><li>Capacity: Voltage-.....V Amp -.....Ah</li></ul>	Inbuilt





Maharashtra Energy Development Agency (MEDA), Pune

S.N.	Components	Std. Specification as per W.O.	Observation/Remarks
7.	MNRE approved Grid Inverter Make: THEA	<ul style="list-style-type: none"><li>• <b>Nominal Capacity:</b> 15 Kw</li><li>• <b>Input Voltage-</b> 440V DC Nominal, The voltage variation shall be as per change in array output,</li><li>• <b>Output Voltage</b> - 440V, 50 Hz, 3<math>\phi</math>, <b>Regulation:</b> From minimum to maximum voltage 1%, <b>Output Frequency:</b> 50 Hz, + 0.5 Hz, 200% for 30 Second, <b>Efficiency:</b> 98% and full load <math>\rightarrow</math> 0.9 PF.</li><li>• Protection against Islanding of grid as per IEEE 1547/UL 1741/ IEC 62116 or equivalent BIS standard.</li></ul>	Capacity- 15Kw  Sr. No.
8.	AC Distribution Panel Board	<ul style="list-style-type: none"><li>• All switches and the circuit breakers, connectors should conform to IEC 60947, part I, II and III/ IS 60947 part I, II and III.</li><li>• AC Distribution Panel Board should have necessary surge arrestors.</li></ul>	Yes
		<ul style="list-style-type: none"><li>• Cables must properly align and insulated.</li></ul>	Yes
9.	Danger Notice Plates for system having capacity 2KW or above.	<ul style="list-style-type: none"><li>• Danger boards should be provided as and where necessary as per IE Act. /IE rules as amended up to date.</li><li>• The inscriptions shall be in local language, Hindi and English.</li></ul>	Yes
10.	Earthing Systems.	<ul style="list-style-type: none"><li>• The Earthing system for array and distribution system &amp; SPV Power Plant</li><li>• Each array structure of the PV yard should be grounded/ earthed properly as per IS:3043-1987</li></ul>	Yes



Maharashtra Energy Development Agency (MEDA), Pune

S.N.	Components	Std. Specification as per W.O.	Observation/Remarks
11.	Tools kit	<ul style="list-style-type: none"><li>Necessary tools kit is to be provided along with the each Power Plant for any routine maintenance or immediate repair</li></ul>	Yes
12.	Training, Operation Manual & Display Board	<ul style="list-style-type: none"><li>Training to the user for operation and maintenance of the system.</li></ul>	Yes
		<ul style="list-style-type: none"><li>Supply of manual for Operation and Maintenance in two languages i.e. in English and in Marathi to Beneficiary.</li></ul>	Yes
		<ul style="list-style-type: none"><li>Display Board of size 3 ft x 3 ft which gives detailed circuit diagram of the system with its description.</li></ul>	Yes
13.	Net Meter	<ul style="list-style-type: none"><li>Details of net meter and Date of commissioning. (Get the details of release order from utility with details of meter.)</li></ul>	Make : Sr. No. : Commissioning Date :
14.	Lightening arrester	Lightning protection should be provided as per IEC 62305 Standards.	Yes
15.	Comprehensive Maintenance Contract (CMC)	Yes / No	Yes
16.	Load	Total Load : 15KW	15 kw

The above system is handed over to the beneficiary/user agency.

Sign of Beneficiary



Sign of Manufacturer

Sign of MEDA Official

Name: Dharamfeth Science

Date: College, Dhule

27.9.2019

Name:

Date: