

- A safe means of access to the work area/ roof top shall be ensured. They shall be kept free from obstructions, substances and materials.
  - The supervisor of the contractor must ensure the workers are provided with the necessary Personnel Protective Equipments before the work starts. He shall also ensure that they use it appropriately.
  - The Contractor shall inform the workers about the CSL HSE requirements to the workers through Tool Box Talk.
  - There will be CSL Supervision during the period of work.
11. The array yard should have permanent water line system for cleaning the entire module. The cleaning system involves valve and heavy duty rubber hose. All pipes to be used in the system should be of heavy duty PVC.
12. **Contractors are expected to visit CSL site to design the mounting structure and other related parameters for the solar power plant to be installed in the roof top of Executive Enclave Panampilly Nagar for Site Study.**
13. The work involves:
- a) Supply and installation of Solar PV modules, Power Conditioning Units, array junction boxes, AC distribution board, power and control cables including terminations, net metering , earthing & lightning protection system, data acquisition system with remote monitoring facilities, water pipe line system etc.
  - b) Transportation, loading, unloading, loading and storage of all equipments / materials is also under the scope of the contractor.
  - c) Contractor shall be responsible for obtaining all statutory clearances/approvals from Electrical Inspectorate/ CEA/ KSEBL for the new grid connected solar power plant installed at **Samudrika Panampilly Nagar.**

Note: Unless otherwise indicated/specified, the quantity required shall be shown as per the design parameters/ requirement projected by the contractor for the plant. Any other items other than the above required for the successful commissioning and satisfactory performance of the system must be explicitly mentioned.

### **APPROVAL OF SYSTEM DESIGN:**

The bidder to ensure proper system designing that would include his own independent studies on peak sunshine data, resulting in the correct sizing of equipment for the solar energy system. It is therefore very important to form proper design procedures and component sizing before actual implementation. The design procedures and component sizing shall be as per internationally acceptable standards. The concept plan/ design of each subsystem shall be submitted to CSL for prior approval. Quality Assurance Plan should include design control, process control, quality control, testing of sub-system, integration and bill of material intended to be used.

### **Errors and Omissions:**

- a) The contractor shall be responsible for all discrepancies, errors and omissions in the drawings, documents or other information submitted by him, irrespective of whether these have been approved, reviewed or otherwise accepted by CSL or not.
- b) The contractor shall take all corrective measures arising out of discrepancies, errors and omissions in drawings and other information within the time schedule and without extra cost

- c) The Contractor shall also be responsible for any delay and/or extra cost if any, in carrying out engineering, and site works by other agencies arising out of discrepancies, errors and omissions stated in above as well as of any late revisions of drawings and information submitted by the Contractor.

### **INSTALLATION & COMMISSIONING:**

- a) The installation shall be done by the contractor, who is responsible for its performance and direction of installation & ensures structural stability. The contractor shall conduct a detailed site assessment. The PV installer shall obtain data specific to the site, rather than relying on general data. While making foundation design, due consideration shall be given to weight of the module assembly, maximum wind speed at the site etc.
- b) The SPV panel shall be mounted facing south where being used for optimum performance.
- c) The supporting structure should incorporate only corrosion resistant hard wares for all external connections.
- d) Sufficient ventilation/space should be provided at the time of PCU installation and as per the instruction manual of the item.
- e) Laying of cable/ earth strip through wall/floor by providing SS saddles/clamps at a distance of 400mm and inter connection should be provided as per drawing, IEA & CEA regulation.
- f) Giving connection, testing and commissioning of cable as per IEA.
- g) Installation of the maintenance free earth electrode after drilling/digging pit, refilling, providing earth pit chamber with bricks/RCC, cover etc. is also to the contractor's scope.
- h) Installation of earthing and lightning protection as per IEA.
- i) All materials required for successful completion of the work are under the scope of contractor.

### **INSPECTION AND TESTING:**

- a) The contractor shall bear all costs of any and all inspections and tests.
- b) In case any equipment fails in inspection/tests or the test reports are not satisfactory, CSL shall reject or demand rectification/re-inspection. Re-inspection/retest shall be carried out only after necessary rectification work/replacement by the Contractor.
- c) On completion of the work all materials and temporary structure of any sort or kind used for the purpose or connected with the erection/installation work shall be removed by the contractor and all pits and excavations to be filled up and handover the site in a tidy and workmanlike condition.

### **TRAINING:**

- a) The Contractor shall arrange training for CSL persons about working procedures and systems covering working norms and quality standards.
- b) The Contractor shall supply all training manuals, instructions and other connected literature in 3 copies to CSL in English language along with the detailed training program.

## **WARRANTY:**

**The contractor has to provide 5 years comprehensive warranty for the 9 kWp solar power plant.**

- a) PV Modules used in solar power plants/system must be warranted for their output peak watt capacity, which should not be less than 90% at the end of 10 years and 80 % at the end of 25 years. In case of any deviation observed during operations from the performance guarantee parameters cited, the contractor shall be informed in writing by CSL. The contractor shall be responsible to rectify the same within 5 days of notification without any extra cost to CSL.
- b) The Power Conditioning Units (PCU), whole part of mounting structures, data logging system, electrical cables, junction boxes, AC & DC distribution boards, bidirectional & unidirectional energy meters, water sprinkler system, circuit breakers, switchgear etc. and all materials included in the solar power plant/systems must be warranted against any manufacturing/design/installation defects for a minimum period of 5 years. In case of any deviation observed during operations from the warranty cited, the contractor shall be responsible to rectify the same within 5 days of notification without any extra cost to CSL.
- c) The systems offered shall be warranted (including consumables) by the manufacturer for use and services for a period of 5 years from the date of commissioning and solar modules shall have warranty for minimum 25 years. Free replacement warranty should be provided on spare parts against manufacturing defects for 5 years.
- d) The respond time to commence the rectification work shall be within 24 Hours on receipt of intimation either by telephone/e-mail/letter.
- e) If the contractor does not commence the rectification either by repair or replacement/does not complete the said rectification of such defects within the stipulated time from the date of notice, CSL may, at his option, rectify the defects at the contractor's expense and the entire expenditure to that will be realized from the security deposit.
- f) All repaired/replaced parts/equipments shall be subjected to inspection & tests as per approved quality assurance plan and inspection & test procedure mentioned elsewhere in the contract.

**The contractor should provide direct warranty certificates from the manufacturer/agency, those materials used in the solar power plants.**

## **MAINTENANCE DURING WARRANTY PERIOD:**

After successful commissioning of the solar power plant contractor must done the following maintenance works once in Two months.

- a) Cleaning of the SPV module, inverters and all electrical equipments.
- b) Tightening of the connections & structure bolts.
- c) Checking of all equipments/materials of the entire system.

**The entire work should be done to the full satisfaction of the engineer in charge deputed for this work from CSL.**



### **SUB-CONTRACTS:**

The contractor shall not sub-contract the work in whole to third parties for the performance of this contract. The contractor may sub-contract a portion of the contract work to third parties with the prior written approval of the CSL. In this respect the contractor shall follow the recommended suppliers list of the CSL, forming part of the Technical Specification.

### **REJECTION OF DEFECTIVE PLANT:**

If the completed plant, or any portion thereof, before final take over, is found to be defective or fails to fulfill the requirements of the contract, CSL shall give the contractor notice setting forth particular of such defects or failure and the contractor shall forthwith make the defective plant good, or alter the same to make it comply with the requirements of the contract. Should he fail to do so within a period of time as deemed reasonable by CSL and stated in the said notice, CSL may reject and replace at the risk and cost of the contractor, the whole or any portion of the plant, as the case may be, which is defective or fails to fulfill the requirements of the contract. However, such rejection/replacement by the CSL shall not absolve the contractor of any of his responsibilities under this contract.

For Cochin Shipyard Limited



Assistant General Manager (U&M)

सेफुदीन ए एस/SAIFUDEEN A S  
वरिष्ठ प्रबन्धक/ Senior Manager  
कोचीन शिपयार्ड लिमिटेड  
Cochin Shipyard Ltd.  
कोच्ची / Kochi-682 015

Signature and Seal of the Contractor(s)

**Annexure – 3**

Tender No.: U&amp;M/MRS/T/012/20-21

Date: 14.08.2020

**TECHNICAL SPECIFICATIONS**

Sl.No.	System Component	Capacity/ rating	Minimum Technical Compliance
1	Solar panel	As per the requirement mentioned at each site	IS 14286 - Design Qualification and Type Approval for Crystalline Silicon Terrestrial Photovoltaic (PV) Modules IEC/IS 61730 : Part I & II; IS 16170 : Part I IS/IEC 61701- Salt Mist Corrosion Testing of Photovoltaic (PV) Modules
2	Grid Tied Inverter	As per the rating system selected	IS 16221: Part 1 & 2 - Safety of Power Converters for use in Photovoltaic Power Systems IS 16169 - Test Procedure of Islanding Prevention Measures for Utility-Interconnected Photovoltaic Inverters
3	Cables	As required to meet the specifications	IEC 60227 / IS 694 IEC 60502 / IS 1554 (Pt. I & II)
4	Switches/ Circuit Breakers/ Connectors	As required	IEC 60947 part I,II, III IS 60947 Part I,II,III EN 50521
5	Junction Boxes/Enclosures for Inverters/ Charge Controllers	As required	IP 54 (for outdoor) or IP 65 / IP 21(for indoor) as per IEC 529
6	Energy Meter for Recording Solar Electricity Generated		As per CEA regulations
7	Two way meter for Distribution Licensee grid connection		As per CEA regulations
8	Electrical Grounding (Earthing)	Module array and the PCU	As per IS 3043

## **SPV MODULES**

- Only crystalline silicon cell PV modules of 325W<sub>p</sub> or higher capacity should be used in the power plant.
- Shading correction/ bypass for optimizing array out to be incorporated in each solar module or panel level and shading optimization to be provided.
- Each PV module used in any solar power project must use a RF identification tag (RFID), which must contain the following information. The RFID can be inside or outside the module laminate, but must be able to withstand harsh environmental conditions.
  - i. Name of the manufacturer of PV Module
  - ii. Name of the manufacturer of Solar cells
  - iii. Month and year of the manufacture (separately for solar cells and module)
  - iv. Country of origin (separately for solar cell and module)
  - v. I-V curve for the module
  - vi. Peak Wattage, I<sub>m</sub>, V<sub>m</sub> and FF for the module
  - vii. Unique Serial No. and Model No. of the module
  - viii. Date and year of obtaining IEC PV module qualification certificate
  - ix. Name of the test lab issuing IEC certificate
  - x. Other relevant information on traceability of solar cells and module as per ISO 9000 series
- The following details should be provided on the module
  - i. Name of the manufacturer
  - ii. Month and year of manufacture
  - iii. Rated Power at STC
  - iv. V<sub>mp</sub>, I<sub>mp</sub>, V<sub>oc</sub>, I<sub>sc</sub>
- The PV modules must qualify (enclose Test Reports/Certificates from IEC/NABL accredited laboratory) as per relevant IEC standard. The Performance of PV Modules at STC conditions must be tested and approved by one of the IEC/NABL Accredited Testing Laboratories.
- PV modules used in solar power plants/ systems must be warranted for their output peak watt capacity, which should not be less than 90% at the end of 10 years and 80% at the end of 25 years.

**POWER CONDITIONING UNIT (PCU)**

Output voltage	3 phase, 415 VAC Inverter/ PCU should be capable of synchronise with grid voltage between 110% and 80% of the rated output. Beyond this system has to stop generating.
Over Voltage / Under Voltage trip	When Voltages reaches above 110% or below 80% respectively, with clearing time up to two seconds for reconnection.
Frequency	50 Hz. Inverter/ PCU should be capable to synchronise with grid for a variation of frequency between 50.5 Hz and 47.5 Hz. Beyond this system has to stop generating.
Over and Under frequency Trip	High frequency at 50.5 Hz and low frequency at 47.5 Hz clearing time up to 0.2 seconds.
Continuous rating	Rated capacity of the configuration.
Nominal Power	Rated power should not be less than the rated capacity of the SPV array at STC.
Standard conformation	IS 16221 (Part 1,2) IS 16169:2014 (Procedure for Islanding prevention measures for Utility Connected PV Inverters)
Total Harmonic Distortion	Less than 5%
Operating temperature Range	-50 to 600 C
Housing cabinet	PCU to be housed in suitable switch cabinet, Within IP 21 (Indoor)/ IP 54 (Outdoor)
PCU efficiency	95% and above at full load.
Power Control	MPPT
Harmonic Current Injections	Shall not exceed the limits specified in IEEE519
Direct Current Injection	Less than 0.5 % of the full rated output at the interconnection point.
Flicker	Should be within the limits specified in IEC 61000



Synchronization	Automatic (Built into the inverter )
Hysteresis required for reenergizing	Sixty seconds at stabilized condition.
Power Factor	The PCU power factor at the point of distribution Licensee service connection shall be 0.95 lagging or leading when operating at above 25 percent of the rated output.
Maximum time for cease to Energize in the case of formation of an unintended Island	2 Seconds

- 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.
- The PCU shall have an appropriate display on the front panel to display the instantaneous AC power output and the DC voltage, current and power input. Each of these measurement displays shall have an accuracy of 1 percent of full scale or better. The display shall be visible from outside the PCU enclosure. Operational status of the PCU, alarms, trouble indicators and AC and DC disconnect switch positions shall also be communicated by appropriate messages or indicator lights on the front of the PCU enclosure.
- 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 weather proof 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 PCC 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.
- Maximum Power Point Tracker (MPPT) - MPPT shall be integrated in the PCU to maximize the energy drawn from the array. The MPPT should be microprocessor based to minimize the power losses.



## **ELECTRICAL SAFETY, EARTHING AND PROTECTION**

- Internal Faults: In built protection for internal faults including excess temperature, commutation failure, over load 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 in the grid itself 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.

## **FACTORY TESTING**

- PCU shall be tested prior to shipment and factory test certificate for relevant parameters should be provided with the PCU supplied. CSL or authorised representative of CSL may be allowed to witness the tests if required.
- 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, 50, 75 and 100 percent of the rated nominal power.

## **PLANT METERING/ DATA LOGGING**

- Net meter as per CEA standards approved by the utility as per accuracy class has to be supplied and installed.
- A separate Energy Meter shall be provided at the output of PCU to record the energy generation from the solar system. (This energy meter should not be integrated with PCU). This has to calibrate and installed nearer to the Consumer meter board so that meter reader from Electrical utility could access while.
- Web based monitoring system for the performance of the system should be provided and the link for access has to be provided to CSL. GSM Modem/ Wi-Fi Modem in case GSM connectivity is used or Wireless Router + Modem in case Ethernet connection is being used for remote access must be provided.
- In case GSM modem is to be used, the SIM is to be procured in the name of the bidder and the expense for the same is to be borne by the bidder for the entire period of warranty. The username and password for web monitoring should be shared with the CSL along with the submission of invoice

- All major parameters should be available on the digital bus and logging facility for energy auditing through the internal microprocessor and can be read on the digital front panel at any time the current values, previous values for up to a month and the average values.

## **ARRAY SUPPORT STRUCTURE**

- Wherever required, suitable number of PV panel structures shall be provided. Structures shall be of flat-plate design using minimum size of C (75 x 40 x 5mm) or L (55 x 55 x 5mm) or I (60x 40x 4mm) sections or higher dimensions for respective sections.
- Structural material shall be corrosion resistant and electrolytically compatible with the materials used in the module frame, its fasteners, nuts and bolts. Galvanizing should meet ASTM A-123 hot dipped galvanizing or equivalent, which provides at least spraying thickness of 70 microns on steel as per IS 5905, if steel frame is used. Aluminium frame structures with adequate strength and in accordance with relevant BIS standards can also be used.
- Structures shall be supplied complete with all members to be compatible for allowing easy installation at the site. Additional Structures/Frames for required for the installation of modules if any need to be provided by the bidder.
- The structures shall be designed to allow easy replacement of any module.
- Each structure shall have a provision to adjust its angle of inclination to the horizontal as per the site conditions. Solar module should be inclined towards south direction and installed at an angle of 10° to 15° from the horizontal.
- Each panel frame structure shall be so fabricated as to be fixed on the roof top column/ wall structures/ground. The structure should be capable of withstanding a wind load of 200 km/hr after grouting and installation. The front end of the solar array must be 50 cm above the roof top. Grouting material for SPV structures shall be as per M15 (1:2:4) concrete specification. If the module arrays are installed on ground, proper PCC foundation to be provided and the bottom of the array should be elevated to a height of 1 meter from the ground.
- The contractor shall specify installation details of the PV modules and the support structures with appropriate diagrams and drawings. Such details shall include, but not limited to, the following;
  - 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 for fixing the junction/ terminal boxes
  - e) Interconnection details inside the junction/ terminal boxes
  - f) Structure installation details and drawings
  - g) Electrical grounding (earthing as per BIS specifications) and surge protections.