1. Introduction

2. Design basis

3. Transmission and distribution voltage

4. Scope of work

5. Operation of the system
   5.1 Theory of operation
   5.2 System features
   5.3 Technical specifications of major components of Solar PV power plant

6. Battery room and control room

7. Bill of materials

8. Spare parts

9. Installation and commissioning

10. Packing, shipping and marking

11. Insurance

12. After sales & service

13. Minimum criterion for bidding

14. Health, safety and environment

15. Experience of the bidder

16. Delivery of the power plants

17. Documentation

18. Tender evaluation procedure
1. Introduction

HPCL intends to ensure uninterrupted availability of power for its Retail Outlets (Petrol Stations) at locations where grid power supply interruption is too high thereby necessitating need for consistent power supply during the periods of interruptions.

With this objective and also with an objective to utilize non-conventional sources of energy, HPCL is proposing to set up environmental friendly Solar Power plant at petrol stations.

With this background the requirements for powering following loads through Solar PV System is proposed.

1. Dispensing Pump (4 DUs – 2 of 1 HP & 2 of 0.75 HP) (3.5 HP motor). – 4 hours/day on Solar
2. Fan (80 W) * 1 no – 10 hours/day
3. CFL (11W) * 6 nos. – 12 hours/day (for canopy)

5.94 kWp Solar PV Power System for COCO Outlets for powering,

Autonomy for the system shall be two days including one day of zero sunshine.

2. Design Basis

Solar PV Power plants shall be designed considering the following:

1. Loads: Total load that shall be supplied for option 1- by 5.94 kWp Solar PV Power plant having 6 kVA 230V, 1-ph, 50Hz inverter * 2 nos. The load usage indicated above shall be met by solar
2. Sun shine: 4.8 Peak hours
3. Battery bank shall be designed for 2 days (1 + 1 “No Sun Day”) of autonomy. See battery details below.
4. System voltage : 48V / 96V dc (nominal)

Vendors may quote for wattage and / or, capacities of the plant as well as inverter which shall be capable of meeting requirements as given in our requirement above.

3. Transmission and distribution voltage

The output voltage shall be 230 V, 1-ph, 50 Hz supplied by PCU.
4. Scope of Work

This job involves design, manufacture, supply, installation, commissioning of the Solar PV hybrid Power System as per specifications given in this tender document with 1 year warranty period followed by 3 years of comprehensive annual maintenance contract (AMC). AMC shall include a minimum of 4 visits/year for preventive maintenance and attending break-down maintenance as and when required.

The Scope of Work shall include the following,

a. Design, manufacture, supply of Solar PV Power Plant
b. Detailed planning of smooth execution of the project
c. Performance testing of the complete system & warranty of the system for 1 year faultless operation.
d. After sales service, directly or through local contractual arrangement
e. Risk liability of all personnel associated with the implementation realization of the project
f. Annual maintenance contract of the Power Plant for 3 Years after 1 year of warranty period.

5. Operation of the system

The schematic requirement of the Solar PV hybrid power plant is shown above. Solar Photovoltaic array produces DC electricity directly from the sun light. The Power Conditioning Unit (PCU) shall provide conditional output to support load. The power conditioning unit shall consist of MPPT charge controller and bi-directional inverter to supply continuous power to the dedicated local load with support (power) to the load coming either from the solar array, battery bank or grid/DG in that order of preference. Battery bank is required to support the load in case of longer power cuts or grid/DG un-availability.
5.1 Theory of Operation

The 1-phase system incorporating a bi-directional inverter shall be designed for capability to supply continuous power to a dedicated local load with the power to the load coming either from the solar array, battery bank or grid/DG in that order of preference. It shall be capable of operation in a “grid interactive or grid charging” mode and shall automatically change over to “stand alone” operation with no break in power in the event grid moves out of range in its individual phase voltages or frequency. When the grid does come back into range, the system shall change over to “grid interactive” mode. All the available solar power from the PV array shall be utilized by using a software based control algorithm on the DC input of the PCU.

GRID INTERACTIVE or GRID CHARGING MODE

- The battery bank shall be kept at its nominated float voltage with the required charge coming from the solar array or the grid.

- The local load, up to the full instantaneous available capacity of the solar array and limited to the maximum capacity of the inverter, shall be supplied from the inverter with the balance of the energy coming from the grid/DG.

STANDALONE MODE

- The local load shall be supplied directly from the inverter with the energy coming from the solar array and the battery bank in the event the load is greater than the available array power.

- In the event the local load being less than the available array power, battery charging shall occur until the float voltage is reached whereupon the array power shall be progressively offloaded.

- The load voltage and frequency shall be controlled to the inverter’s nominal specifications.

- Feeding grid is not envisaged

5.2 System requirements

- Maximum point power tracking (MPPT) of PV energy.

- No break in change over from ‘grid interactive/charging’ mode to ‘stand alone’ operation and vice versa.
• **Maximum use of Solar Energy (Priority of Solar over AC mains):** The grid charging shall be switched on **only when** battery reaches 30% DOD apx (1.9-1.95 V/cell depending on the type of the battery) and stopped when battery has reached 60-70% DOD (2.1-2.15 V/cell depending on the type of the battery) thus ensuring solar energy is fully utilized. i.e., after grid charging has stopped, solar will have to put another 30% -40% of energy into the battery.

• **When Solar, mains is available and battery is fully charged:** The load shall be supplied by solar energy. Battery will act as reservoir to support in case of temporary cloud coverage and/or less sun intensity. Grid charging shall not take place unless until battery voltage goes below 1.95V/cell.

• **When solar is not available but grid is available:** If battery is also charged, then energy shall be drawn from the battery till such time battery voltage reaches below 1.95V/cell. Below 1.95V/cell, AC mains shall supply the load along with charging the battery bank.

• **When battery is fully discharged and only solar is available:** A part load may be connected to the system, thereby ensuring load supply as well as battery charging.

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**5.3 Technical specifications of major components of Solar PV Power Plant**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Solar PV modules and array</td>
</tr>
<tr>
<td>2</td>
<td>Module mounting structures for Solar PV Modules</td>
</tr>
<tr>
<td>3</td>
<td>Junction Boxes</td>
</tr>
<tr>
<td>4</td>
<td>Power Conditioning Unit (MPPT solar charge controller+ Bi-directional Inverter)</td>
</tr>
<tr>
<td>5</td>
<td>Battery Bank with Accessories</td>
</tr>
<tr>
<td>6</td>
<td>Distribution Boards</td>
</tr>
<tr>
<td>7</td>
<td>Cables and installation accessories</td>
</tr>
<tr>
<td>8</td>
<td>Earthing and lightning protection</td>
</tr>
<tr>
<td>9</td>
<td>Battery and control room</td>
</tr>
</tbody>
</table>

**Solar PV modules and array**

Crystalline high power cells shall be used in the Solar Photovoltaic module. Each Solar module shall consist of 72(minimum) Photovoltaic cells redundantly interconnected and peak power rating shall not be less than 165 W. **The bidder offering single module with highest wattage shall be given preference provided all other things are equal.**

To connect the solar module interconnection cable shall be provided. Photo/electrical conversion efficiency of SPV module shall be greater than 12%. Module shall be made of high transmissivity glass front surface giving high encapsulation gain and hot butyl rubber edge sealant for module protection and mechanical support.
All materials used shall have a proven history of reliable and stable operation in external applications. It shall perform satisfactorily in relative humidity up to 100% with temperatures between -10 Deg C and +85 Deg C and with stand gust up to 200km/h from back side of the panel.

Solar module shall be crystalline type, employing lamination technology using established polymer (EVA) and Tedlar or Polyester laminate.

Sample modules, representative of the production processes employed in the manufacture of the offered module shall be in accordance with the requirements of IEC 61215 or UL or CE approval. Offered module may also be intrinsically safe for being used in retail outlets. The bidder shall submit appropriate certificates.

Other general requirements of PV module

- The rated output power of any supplied module shall not vary more than 3-5% from the average power rating of all modules.
- The module frame is made of corrosion resistant materials, which is electrolytically compatible with the structural material used for mounting the module.
- Protective devices against surges at the PV module shall be provided, if required. Low voltage drop bypass and / or blocking diode(s) may also be provided, if required.
- Module Junction box (weather resistant) shall be designed for long life outdoor operation in harsh environment.
- A minimum warranty of 10 years shall be given with degradation of power generated not exceeding 10% over the entire 10 year period.
- The solar modules shall have suitable encapsulation and sealing arrangements to protect the silicon cells from the environment. The arrangement and the material of encapsulation shall be compatible with the thermal expansion properties of the Silicon cells and the module framing arrangement/material. The encapsulation arrangement shall ensure complete moisture proofing for the entire life of the solar modules.
- Each module shall have low iron tempered glass front for strength and superior light transmission. It shall also have tough multi layered polymer back sheet for environment protection against moisture and provide high voltage electrical insulation.
- The fill factor of modules shall not be less than 0.70 (typical)
- **Array capacity & PCU Capacity shall not be less than the requirement stated. Depending on size of the power plant, number of modules required shall be worked out accordingly**
- Data sheet of the offered module shall be submitted along with the offer giving details of peak power, peak current, short circuit current, fill factor, open circuit voltage, peak power voltage etc.
Orientation and Tilt of PV Module

Modules alignment and tilt angle shall be calculated to provide the maximum annual energy output. This shall be decided based on the location of array installation.

Module mounting structure

- The array structure shall be made of hot dip galvanized MS angles of size not less than 50 mm x 50 mm x 6 mm size. The minimum thickness of galvanization shall be at least 70 microns. All nuts & bolts shall be made of very good quality stainless steel. The minimum clearance of the lowest part of the module structure and the developed ground level shall not be less than 500 mm. The structure shall have tilt span of 0 to 60 deg in steps of 5 deg.
- Leg assembly of module mounting structure made of different diameter galvanized tubes may be accepted. The work should be completed with supply, fitting fixing of clamps, saddles, nut & bolts etc. While quoting the rate, the bidder may mention the design & type of structure offered. All nuts & bolts shall be made of very good quality stainless steel.
- The structure shall be designed to allow easy replacement of any module and shall be in line with site requirements.
- The structure shall be designed for simple mechanical and electrical installation. It shall support SPV modules at a given orientation, absorb and transfer the mechanical loads to the ground properly. There shall be no requirement of welding or complex machinery at site.
- The array structure shall be so designed that it will occupy minimum space without sacrificing the output from SPV panels at the same time it will withstand wind speed as per IS 875.
- The supplier/manufacturer shall specify installation details of the PV modules and the support structures with appropriate diagrams and drawings.
- The drawings along with detailed design and calculations for wattage requirements shall be submitted to HPCL for approval before starting the execution work.
- PCC ARRAY FOUNDATION BASE: The legs of the structures made with GI angles will be fixed and grouted in the PCC foundation columns made with 1:2:4 cement concrete. The minimum clearance of the lowest part of any module structure shall not be less 500 mm from ground level. While making foundation design, due consideration shall be given to weight of module assembly, maximum wind speed as per IS 875 and seismic factors for the site.
• The bidder can visit the site before quoting rate for civil works. After taking in to consideration all aspects of the site, condition of soil etc., the bidder shall quote for civil works. No extra claim shall be entertained at post project stage. The foundation design of module structure design shall be submitted to HPCL for approval. The work will be carried out as per designs approved by HPCL.

Junction Boxes

The junction boxes shall be dust, vermin and waterproof and made of FRP. The terminals shall be connected to copper bus bar arrangement of proper sizes. The junction boxes shall have suitable cable entry points fitted with cable glands of appropriate sizes for both incoming and outgoing cables. Suitable markings shall be provided on the bus bar for easy identification and cable ferrules shall be fitted at the cable termination points for identification. The junction boxes shall have suitable arrangement for the following:

- Combine groups of modules into independent charging sub-arrays that shall be wired to the PCU.
- Provide a test point for each sub-group for quick fault location.
- To provide group array isolation.
- The rating of the JB’s shall be suitable with adequate safety factor to inter connect the Solar PV array.

Power Conditioning Unit

As SPV array produce direct current electricity, it is necessary to convert this direct current into alternating current and adjust the voltage levels before powering equipment designed for nominal mains AC supply. Conversion shall be achieved using an electronic Inverter and the associated control and protection devices. All these components of the system are termed the “Power Conditioning Unit” OR simply PCU. In addition, the PCU shall also house MPPT (Maximum Power Point Tracker), an interface between Solar PV array & the Inverter, to maximize Solar PV array energy input into the System.

PCU refers to combination of charge controller and bi-directional inverter and shall be supplied as integrated unit.

Maximum Power Point Tracker (MPPT)

Maximum power point tracker (electronic) shall be integrated into the PCU to maximize energy drawn from the Solar PV array. The MPPT shall be microprocessor / micro-controller based to minimize power losses. The efficiency of the MPPT shall not be less than 94% and shall be suitably designed to meet array capacity.
The PCU shall be microprocessor / micro controller based suitable for automatic grid interaction. The time delay for grid interfacing should be minimum possible.

**Main features of PCU**

- The PCU shall be capable of complete automatic operation, including wake-up, synchronization and shut down.
- The PCU shall be self commutated and shall utilize a circuit topology and components suitably for meeting the specifications listed above at low cost, high conversion efficiency and with high reliability.
- **The PCU shall be designed to withstand starting in-rush current when pump is started and provide trip free operation.**
- In PCU there shall be a direct current isolation provided at the output by means of a suitable isolating transformer.
- The PCU shall include appropriate self protective and self diagnostic features to protect itself and the PV array from damage in the event of PCU component failure or from parameters - beyond the PCU’s safe operating range due to internal or external causes. The self-protective features shall not allow any operation from the PCU front panel to cause the PCU to be operated in a manner which may be unsafe or damaging.
- The PCU generated harmonics measured at the point of connection to the utility service, when operating at the rated power shall not exceed a total harmonic distortion of 3 %.
- The high voltage and power circuits of the PCU shall be separated from the low voltage and control circuits. All conductors shall be made of stranded copper and suitable insulation shall be used for the power and control cables.
- The PCU shall withstand a high voltage test of 2 kV rms, between either the input or the output terminals and the cabinet (chassis).
- Full protection against accidental open circuit, short circuit and reverse polarity at the input shall be provided.
- 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 include ground lugs for equipment and PV array grounding. The DC circuit ground shall be a solid, single point ground connection in accordance with prevailing national standards.
- All exposed surfaces of ferrous parts shall be thoroughly cleaned, primed and painted or otherwise suitably protected to survive a nominal 15 year design life of the unit. The PCU enclosure shall be weatherproof and
capable of surviving intact under all ambient conditions. 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 have 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 not larger than 0.95 cm (about 3/8 inch).

- In the design and fabrication of the PCU the site temperature (0 to 50 degree C), incident sunlight and the effect of ambient temperature on component life shall be considered carefully. Similar consideration shall be given to the heat sinking of MOSFET’s, blocking diodes and similar components.

### PCU Specifications

<table>
<thead>
<tr>
<th>Solar Charge Controller + Inverter+ Battery Charger</th>
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<tbody>
<tr>
<td><strong>Switching device</strong></td>
</tr>
<tr>
<td><strong>Type</strong></td>
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<td><strong>Input voltage from PV array</strong></td>
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<tr>
<td><strong>Protections</strong></td>
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<td>Specifications</td>
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<tr>
<td>Under / Over output voltage</td>
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<tr>
<td>Under / Over frequency</td>
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<td>Automatic / manual isolation</td>
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<td>at input &amp; output</td>
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<tr>
<td>Suitable protection</td>
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<tr>
<td>for solid-state switching</td>
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<tr>
<td>devices</td>
</tr>
<tr>
<td>Dielectric strength</td>
</tr>
<tr>
<td>Cooling</td>
</tr>
<tr>
<td>Ambient operation (max)</td>
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<tr>
<td>Relative humidity</td>
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<tr>
<td>Assembly &amp; mounting</td>
</tr>
<tr>
<td>Finish</td>
</tr>
<tr>
<td>Cable entry</td>
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<tr>
<td>Load test at factory</td>
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<tr>
<td>Features</td>
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<td>Output voltage</td>
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<td>Output frequency</td>
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<tr>
<td>%Regulation</td>
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<tr>
<td>Battery charger</td>
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<tr>
<td>Indications</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td>Enclosure</td>
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<tr>
<td>Weight / Dimension</td>
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<tr>
<td>Battery type</td>
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</tbody>
</table>

**Battery Bank**

- The batteries shall be solar photo voltaic batteries of flooded electrolyte, low maintenance, lead Acid and made of hard rubber container.

- The batteries shall use 2V cells and battery capacity is to be designed at C10 rate with end cell cut off voltage of 1.80V / cell.

- The battery shall be designed for negative temperatures prevailing a site.

- Battery terminal shall be provided with covers.

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

- Charging instructions shall be provided along with the batteries.

- Suitable carrying handle shall be provided.

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

- The batteries shall be suitable for recharging by means of solar charge controller.

- Bidder shall mention the design cycle life of batteries at 80%, 40% and 20% depth of discharge at 25 deg. C. .
• The self discharge of batteries shall be less than 2 % per month.

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

• The topping up frequency shall be >12 months.

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

• Offered batteries shall comply to the following at 27 deg C:

  10 % of DOD: 7200 cycles
  50 % of DOD: 3000 cycles
  80 % of DOD: 1200 cycles

Battery Rack & Accessories

Battery interconnecting links shall be provided for interconnecting the cells in series and in parallel as needed. Connectors for inter cell connection (series / parallel) shall be maintenance free screws. Insulated terminal covers shall be provided.

DC Distribution Board (DCDB)

Solar array side breaker and battery side breaker shall be housed in enclosure. These can also be housed within the PCU to save space.

AC Distribution Board (ACDB)

• An ACDB shall be provided in between PCU and load/grid interface
• It shall have 32 A MCB of suitable rating for connection and disconnection of PCU from load.
• It shall have 6 A x 5 nos. MCB’s to supply power to the loads

Cables and accessories

All the cables shall be supplied conforming to IS 1554 / 694 Part 1 of 1988 & shall be of 650 V/ 1.1 kV grade as per requirement. Only polyethylene copper cables shall be used. The size of the cables between array interconnections, array to junction boxes, junction boxes to PCU etc shall be so selected to keep the voltage drop and losses to the minimum.
Cables shall be of either CCI/Universal/ Finolex make. Scope of the work also includes cable laying – including in trenches -, back-filling and restoration of excavated areas to original state.

The bidder shall supply installation accessories, which are required to install and successfully commission the power plant.

**Earthing and lightning protection**

**Earthing:** The array structure of the PV yard shall be grounded properly using adequate number of earthing kits. All metal casing / shielding of the plant shall be thoroughly grounded to ensure safety of the power plant. Earth resistance readings for each site must be measured by a qualified and licensed electrical contractor and submitted. Resistance values shall conform to either CCOE stipulations or that of IEE regulations.

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

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

**6. Battery room and control room**

The bidder shall give the details of array layout and control room/battery room layout along with the offer. The room shall be provided by HPCL to meet the space requirement to house PCU, Distribution Boards and Battery bank etc.

**7. Bill of Materials**

A complete Bill of Materials inclusive of Solar PV Modules, array Junction box, main junction box, cables, Battery bank, PCU, Array mounting structures etc shall be provided along with the offer. The numbers of each component proposed for supply shall be clearly specified. The items not listed in BOM but required for successful installation/commissioning of power plants shall also be added, as required at no extra cost to HPCL.

**8. Spare parts**
Bidder shall keep stock of essential spares at their nearest service center and/or at each site at their cost for 3 years of Comprehensive AMC including 1 year of warranty. However bidder shall list out spare parts required for power plant.

9. Installation and commissioning

- The quotation shall include cost for Installation and commissioning of power plant.
- The bidder is responsible for arranging all the accessories and measuring instruments required to smoothly commission the power plants.
- The plant shall be commissioned in the presence of HPCL authorized personnel or its nominated representative.
- An acceptance report shall be prepared and signed by all participating parties.

10. Packing, shipping and marking

The bidder shall be responsible for assuring that all commodities shipped are properly packed and protected to prevent damage or deterioration during shipment. Packaging and shipping costs shall be borne by the supplier. Customs clearance and all costs and actions associated with import duties, taxes and processing of documents within India are borne by the bidder.

11. Insurance

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. RATES QUOTED SHALL BE INCLUSIVE OF INSURANCE.

12. After sales & service

The bidder shall give the details of their service centers in the states where it is intended to install Solar PV systems and ensure that all the essential men and materials are placed to ensure quick and efficient after sales service. An animated CD of the whole system shall be supplied to each site to demonstrate the operation of the system- one copy of CD may be submitted to HQO of HPCL. Training and after sales service is an important component of supply. The terms and conditions for training and after sales supply and service are to be presented clearly in the proposal and the extent and duration of after sales support clearly defined. An explanation of preventative maintenance schedule, plan of operation, scope and implementation of the after sales service is to be defined.
13. **Minimum criterion for bidders**

Bidders must have following minimum criterion for bidding:

- a. The bidder must have ISO 9001.
- b. The bidder must have solar modules manufacturing facility in India and offered modules shall have IEC 61215 or UL or CE approval.
- c. The bidder must have experience of supplying, installing and commissioning Solar Photo Voltaic Power Plants for more than 5 years in India. The past record of installation of solar photo voltaic systems shall be substantiated by necessary certificates for satisfactory performance.
- d. The bidders must have their own office / service centre in different parts of India.
- e. The bidder must be total integrated system designer including Power Conditioning Units, structures.
- f. The vendor should have an average annual turnover during the last 3 financial years of minimum Rs 3.6 crore in similar business line of supply/installation of Solar PV System. Prospective vendors have to submit documentary proof in support of the financial criteria.
- g. Prospective vendors should have completed successfully during the last 7 years three similar works (in business line of supply, installation, testing and commissioning of Solar PV System) each costing not less than Rs.4.8 crores or two similar works each costing not less than Rs. 6 crores or one similar work costing not less than Rs. 9.6 crores.

14. **Health, Safety & Environment**

The bidder shall submit the following before starting the installation of the power plant:

- Safety and Environment policy of the Company
- HSE Manuals for Installation
- Emergency Management Plan

15. **Delivery of the power plants**

The entire delivery shall be completed in nine months from the date of placement of order. However, each individual sites shall be completed within four weeks of hand over of site.

16. **Documentation**

Two sets of installation manual / user manual shall be supplied along with the each power plant. The manual shall include complete system details such as array lay out, schematic of the system, inverter details, working principle etc.
Step by step maintenance and trouble shooting procedures shall be given in the manuals.

17. Tender evaluation procedure:
Bids are invited in two bid system – techno-commercial bid and price bid. Price bids of bidders, whose – techno-commercial offers are meeting technical and commercial parameters specified in this bid will be opened.

Other criteria for qualification of the offer
- Offers not conforming to the requirements specified shall be considered non-responsive and shall not be evaluated.
- Offers not providing technical and financial information as required by this tender are considered non-responsive and shall not be evaluated.
- Offers not providing PV modules warranty of 10 years with no more than 10% degradation in performance shall be assessed as non-responsive and shall not be evaluated.
- Offers not complying with delivery schedule shall be considered non-responsive and shall not be evaluated.
- Offers not providing clause by clause compliance shall be considered non-responsive and shall not be evaluated.
- Offers not providing minimum array capacity of designated rating (Wp) shall be considered non-responsive and shall not be evaluated.
- Price comparison shall include the cost of comprehensive AMC.
- A sample format of clause-wise statement for techno-commercial parameters is enclosed. Additional points of tender enquiry also need to be incorporated by bidders.
SPECIFICATIONS SOLAR YARD/STREET LIGHTING WITH SINGLE 11W CFL LAMP

SYSTEM SPECIFICATION
- 11W CFL giving 900 Lumen light output
- **Automatic Dusk to Dawn Operation**
- Independent standalone solar street lighting system
- Powered by a 74Wp (MINIMUM) of solar array
- A 12V, 75Ah@C10 battery backup providing 5 days autonomy
- 4m height pole

SOLAR MODULE
- High efficiency Mono / Multi crystalline silicon cells
- 1 No. or two Nos. of module/s per system
- Designed to withstand tough environment conditions

BATTERY
- Capacity 12V, 75 AH (@ C10)
- >90% Charge efficiency
- <3% per month self discharge
- Estimated life greater than 5 years
- Topping up frequency once in 6 months

LAMP
- 1 x PL11 compact fluorescent lamp
- 900 Lumens (Equivalent to 75W incandescent bulb)

ELECTRONICS

**Regulator:** 5A Series regulator with Nominal system voltage 12V DC.
Dusk to Dawn operation

**Voltage levels:**
- Array disconnect (Charge cut-Off) Voltage : 15.3 to 15.7V
- Array reconnect Voltage : 13.1 to 13.5V
- Battery low : 10.7 to 11.4V
- Battery reconnect : 12.1 to 12.8V
- Load On at array V : 2V to 3.5V
Load Off at array V : 4 to 7V

**Indications:**
- Green-ON Charge
- Red-ON - Load Cut

**Idle current** : <10 mA

**Inverter** : 4 Pin high efficiency inverter with preheating.

**Efficiency** : >80%

**Operating Temperature** : 0 to 50°C

**Humidity** : 95 % rh (N.C.)

**LUMINAIRE**
Aluminium Di-cast luminaire with transparent acrylic cover. Fitted with gasket & accessories for weather proof.

**POLE & STRUCTURE**
Made of MS, Painted with corrosion resistant paint.

**PROTECTIONS**
- Over charge & deep discharge disconnects
- Short circuit protection for lamp
- Over load
- Battery reverse connection
- Lightening
- Against discharge through array by blocking diode

**OTHER FEATURES REQUIRED :**
- The design must be rugged for operation under high temperature upto 50 degree C
- Integrated design
- Insect proof Luminaire
- 5 Mtrs Light spread
- Must meet MNES (Ministry of Non- conventional sources of Energy) specifications
- Providing suitable stable foundation must be in the scope of vendor.
- Civil work is in the scope of vendor and construction of foundation must be in line with the best practices of civil engineering.
Vendor must provide drawings for Solar yard light poles and also the foundation details.

Warranty for Solar Modules shall be for a minimum period of 10 years with degradation of power generated not exceeding 10% over the entire 10 year period.

Necessary cabling is also in the scope of the vendor.

**SPECIFICATIONS SOLAR YARD/STREET LIGHTING WITH TWIN 11W CFL LAMP**

**SYSTEM SPECIFICATION**
- 2nos of 11W CFL giving 1800 Lumen light output
- Automatic Dusk to Dawn Operation
- Independent standalone solar street lighting system
- Powered by 120Wp of solar array
- A 12V,150Ah@C10 battery backup providing 4 days autonomy
- 4m height pole

**SOLAR MODULE**
- High efficiency Mono / Multi crystalline silicon cells
- 2 Nos. or 3 Nos.of modules per system
- Designed to withstand tough environment conditions

**BATTERY**
- Capacity 12V, 150 AH (@ C10)
- >90% Charge efficiency
- <3% per month self discharge
- Estimated life greater than 5 years
- Topping up frequency once in 6 months

**LAMP**
- 2 x PL11 compact flourescent lamp
- 1800 Lumens (Equivalent to 150W incandescent bulb)

**ELECTRONICS**

**Regulator:** 5A Series regulator with Nominal system voltage 12V DC.
Dusk to Dawn operation

**Indications:**
Load On
Load Off
Battery High (Charged)

**Inverter**: 4 Pin high efficiency inverter with preheating.

**Efficiency**: >80%

**Operating Temperature**: 0 to 50°C

**Humidity**: 95 % rh (N.C.)

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Aluminium Di-cast luminaire with transparent acrylic cover. Fitted with gasket & accessories for weather proof.

**POLE & STRUCTURE**
Made of MS, Painted with corrosion resistant paint.

**PROTECTIONS**
- Over charge & deep discharge disconnects
- Short circuit protection for lamp
- Over load
- Battery reverse connection
- Against discharge through array by blocking diode

**OTHER FEATURES REQUIRED**:
- The design must be rugged for operation under high temperature upto 50 degree C
- Integrated design
- Insect proof Luminaire
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