ONGC TRIPURA POWER COMPANY LIMITED

(ANNEXURE-2 TO CONTRACT FOR SUPPLY, INSTALLATION AND MAINTENANCE OF 12W SOLAR BASED STREET LIGHTING SYSTEM)

TECHNICAL SPECIFICATIONS

FOR

SUPPLY, INSTALLATION AND MAINTENANCE

OF

12W SOLAR BASED STREET LIGHTING SYSTEM

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TECHNICAL SPECIFICATION

1.0 GENERAL

1.1 ONGC Tripura Power Company Limited (hereinafter referred as "**OTPC**" or "**Owner**"), a joint venture company promoted by Oil and Natural Gas Corporation Limited ("**ONGC**"), GAIL (India) Limited ("**GAIL**"), India Infrastructure Fund (II) ("**IIF**(**II**)") and Government of Tripura, is a public limited company incorporated under the Indian Companies Act, 1956 and having its registered office at Udaipur-Kakraban Road, P.O. Palatana, District Gomati, Tripura - 799105 (India), and one of its office at "Core 4, 10th Floor, Scope Minar, Nirman Vihar, Laxmi Nagar, Delhi, 110092 (India)". OTPC is operating a 2 x 363.3 MW combined cycle power plant at Palatana, which is located about 60 (sixty) km from the capital city of Agartala in the State of Tripura. The Site where the Plant is located is about 9 (nine) km from nearest town Udaipur.

1.2 OTPC intends to appoint a Contractor for design, supply, installation, commissioning of Solar Street Lighting System (LED based) with duty cycle of dust to dawn including five year compressive warranty maintenance in various villages in different districts of State of Tripura, India in the vicinity of OTPC Palatana Power Plant.

2.0 SCOPE OF WORK:

The scope of work shall include but not limited to design, supply, installation, commissioning of Solar Street Lighting System (LED based) with duty cycle of dust to dawn including five year compressive warranty maintenance in various village in different districts of Tripura in the vicinity of OTPC Palatana Power Plant as directed by OTPC as per condition in this documents and following technical specification:

The solar street lights shall be installed in different villages / locality with in the aerial radius of 10KM of OTPC Palatana Plant as follows:

1) Nos. of places to be installed – 10 nos.

2) Minimum nos. of solar lights to be installed at one location - 25 Nos.

3) Distance between the solar light to be maintained - 15 to 20 meters.

4) Total quantity of Solar Street Lights to be installed - 300 Nos

The Scope of work also includes Contractor to liaison with Gram Pradhan / BDO / SDM / PWD Department for smooth Implementation of the project and appraise OTPC time to time. Contractor shall be solely responsible for implementation of the project and NOC as required from the Govt agencies / Departments like Forest / PWD / Land need to be pursued and obtained by the concerned vendor.

The required 12 W capacity LED based Solar Street Light systems should consist of the following.

a. **LED Luminary:** 12 W LED luminary with inbuilt charge controller to operate dusk to dawn and with 2 core, 2.5 Sq mm copper cable of required length.

b. **Solar PV Module:** 75Wp (any IEC/BIS Certified make) along with suitable Solar PV module support Structure (Powder coated).

c. **Battery:** 12.8V / 30Ah Lithium Ferro Phosphate (LiFePO4) Battery (any IEC/UL certified make) integrated panel mounted battery

d. **Light Source:** White Light Emitting Diode (W-LED). 12 Watt, W-LED luminaire, dispersed beam, soothing to eyes with the use of proper optics and diffuser.

e. **Light Output:** The luminaire must use high efficacy W-LED with minimum 135 lumens per watt (and UV free). (A certificate to be submitted by the system supplier to the Test Lab during certification).

f. **Battery Box:** 250 X 250 X 200 mm of 2 mm thick battery box (Powder coated) with reinforcement as required to house the above battery along with fixing arrangement to GI pole.

g. **GI Pole:** Length of minimum 5 metre, 3 mm thick (Min 76 mm OD for circular pipe or 130 mm dia at bottom and 70 mm dia at top for octagonal pole) with minimum Galvanizing of 85 microns on hot dip Galvanizing process) along with suitable Luminary arm to fix luminary.

h. **Anchor Bolts & Base plate:** GI Anchor bolts of dia 20 mm X 600 mm length along with suitable base plate for making foundation to the GI Octagonal pole/ round pipe are to be supplied by the Contractor.

i. **Accessories:**
i) Hard ware such as GI Nut & Bolts (M10x90, M10x50 & M10x20) and SS Nut & Bolts (M6), for fixing Solar PV module and Battery box and Luminary arm as required.
ii) 2.5 Sq sq.mm copper lugs (Ring type).

j. **Civil Foundation:** The pole is to be installed on civil foundation. The civil foundation casting as required for installation is in the scope of Contractor. All the Civil Foundations will be laid down by Contractor as per the design and specifications to withstand the load of the SSL and wind speed of 150 KMPH, at their cost. The foundation shall be RCC pile foundation in CC (1:2:4).

3.0 GENERAL TECHNICAL SPECIFICATION

A Solar Street Light (LED based) consist of white LED luminary of minimum 12 Watt (LED + Driver) as per configuration along with solar PV modules and Li-Fe-PO4 battery of given capacity, necessary control electronics-inter connecting wires / cables, module mounting structures etc. to operate the load for dusk to dawn. The broad performance specifications of a White Light Emitting Diode (W-LED) light source based solar street lighting system are given below:

PV Module	**Only indigenous modules shall be used in the project**. SPV module 75 Wp to be used.
Battery	Lithium Ferro Phosphate (Li-Fe-PO4 or LFP) minimum 12.8 Volt, 30 Ah, at STC
Light Source	• White Light Emitting Diode (W-LED) 12 Watt (LED +Driver) • Using LEDs which emits ultraviolet light will not be permitted
Light Output	White Color (color temperature 5500-6500 K). Lumen efficacy of LED- min 135 lumens/Watt @350 mA. The illumination should be uniform without dark bands or abrupt variations, and soothing to the eye. Higher light output will be preferred.
Mounting of light, Controller and Batterypack	Approx. 5 meter above the ground, Mounted at pole or below the mounting structure.
Average duty cycle	Dusk to dawn

4.0 MINIMUM TECHNICAL REQUIREMENTS / STANDARDS

4.1 DUTY CYCLE:

The LED solar street lighting system should be designed to operate for dusk to dawn. Minimum 24 Lux when measured at a point 5 meters below the light during any time in duty cycle.

4.2 PV MODULES:

i. Only indigenous modules of IEC Tested shall only be used in the project. Crystalline high power/efficiency cells shall be used in the solar photovoltaic module. The power output of the module shall not be less than 75 Wp. The module efficiency should not be less than 14%.

ii. The open circuit voltage of the PV modules under STC should be at least 21.0 Volts.

iii. PV module must be warranted for output wattage, which should not be less than 90% at the end of 10 years and 80% at the end of 25 years. Warranty card shall be supplied with the system must contains details of the system.

iv. The terminal box on the module shall be designed for long life out door operation in harsh environment should have a provision for opening for replacing the cable, if required.

v. Latest edition of IEC 61215 edition II / IS 14286 for Crystalline and shall be certified by NABL authorized test center. The Contractor shall submit appropriate certificates.

vi. PV modules must quality to IEC 61730 Part 1- requirements for construction & Part 2 – requirements for testing, for safety qualification.

vii. Protective devices against surges at the PV module shall be provided. Low voltage drop bypass diodes shall be provided and if required, blocking diode(s) may also be provided.

viii. IDENTIFICATION AND TRACEABILITY

Each PV module must use an identification tag which must contain the following information:

(i) Name of the manufacturer with logo

(ii) Month and year of the manufacture

(iii) Unique Serial No

(iv) Model No of the module with voltage and rated wattage

(v) County of Origin / Manufacturing : Made in India.

4.3 LITHIUM-FERRO-PHOSPHATE (LI-FE-PO4) BATTERY:

The Battery pack should be got tested as per IEC 62133-2012 or latest BIS standard from BIS recognized labs. The cell capacity should be 3.2 volt, 5AH/ 10AH.

i. Capacity of the battery shall not be less than 12.8 V (nominal), 30 Ah at STC, 384 Watt Hour.

ii. The battery cycle life should be 2000 cycle at 95% discharge.

iii. BMS (Battery Management System) should be part of battery pack and battery pack enclosure should be as per standard. The battery pack should be integrated with the system in such way that it is theft proof and not removable from system. It should be installed with combination of module structure/luminaire. The height of battery pack will be approximate, 4.5 meters above the ground. The system must withstand wind velocity of 150 km/hr. The battery pack should be capable of high rate of heat dissipations. The battery box should be acid proof and corrosion resistant, hot dip galvanized metallic box (IP 65) with anti-theft locking arrangement.

iv. The battery should operate between temperature range of 0 degree C to 55 degree C. The other feature of the battery should be:

Sr. No.	Description	Specification
1	Battery Configuration	Minimum 12.8V- 30AH; Li-fe-PO4

Sr. No.	Description	Specification
2	Working Temperature Range (both for charging & discharging)	@ 0-25 Deg- 6 months
3	Storage Temperature Range	0-60 deg C
4	Cycle Life (Full charge to full Discharge @25deg C before capacity of battery falls below 75%)	More Than 2000 Cycles
5	Battery Warranty	5 years
6	Capacity of Individual Cells	3.2V cell of 5 AH, 10AH
7	Type of Cell	Prismatic/Cylindrical
8	Nominal Capacity	12.8 volt - 30AH
9	Nominal Voltage	12.8V
10	Voltage Range	10.5V - 14.6V
11	Total Energy	384 WHr
12	Rated Charging Current	15 Amps
13	Maximum Charging Current	20 Amps
14	Maximum Discharging Current	15 Amps
15	Discharge Cut off Voltage	>10.5V
16	Over Charge Cut off Voltage	14.4V+/- 0.2V
17	Charging Time	Around 5 - 5.5 Hours

4.4 ELECTRONICS/CHARGE CONTROLLER:

i. MPPT Charge controller to be used to maximize energy drawn from the solar PV array. The MPPT Charger should be microcontroller based. The charge controller should have following specifications:

Sr. No	Description	Specification
1	Charge controller Type	PWM/ MPPT type - Maximum Power point Tracking EN 50530: Performance evaluation of maximum power point tracking (MPPT)
2	Charge controller Rating @ Related Voltage	5 Amps
3	Module Rating	75 Wp @ 16.4 volt ± 0.2 v, if MPPT is not used with positive tolerance 36 Cell configuration Voc- > 21 Volts Vmp-16.4 volt ± 0.2 at STC without MPPT
4	Load current Max @rated Voltage	2 Amp

Sr. No	Description	Specification
5	Ideal current consumption (self-consumption)	< 30 mAmps
6	Maximum Efficiency	>90%
7	Battery Voltage Setting	Charging 14.4v ± 0.2 Volts Battery Low Volt disconnect >10.5 Volts Load Reconnects-12.8V± 0.2Volts Low Battery Cutt of - 11.2 V± 2%
8	LED indication with LCD display	GREEN LED for charging under Process and red for battery low
9	Protection	Over Charge / Deep Discharge Solar & Battery reverse protection Reverse current from battery at night

ii. Electronics should operate at 12.8V and the efficiency of DC-DC converter should be at least 90%.

iii. Full Protection against polarity reversal of PV array and battery, Over Current, Short Circuit, Deep Discharge, Input Surge Voltage, open circuit, accidental short circuit and night time leakage of current from battery to Module.

iv. The Lithium iron phosphate battery needs a very good "Battery Management System" BMS to ensure the proper charging and discharging of each cell of battery with proper protection of battery when temperature is reaching beyond battery permissible limits. This battery also needs constant current and constants voltage charging methodology related to upper voltage limit of batter. BMS primary focus is therefore on the safety and the protection of the battery, to minimize the risk of sudden failure and to maximize the life cycle of the battery. The secondary function of the BMS is to perform battery diagnostics, such as state of the charge (SOC) estimation, state of health (SOH) estimation and state of power (SOP) estimation. Hence a very good battery management system is to be incorporated.

4.5 LIGHT SOURCE:

i. The light source will be of white LED type The color temperature of white LEDs used in the system should be in the range of 5500 degree K – 6500 degree K. Use of LEDs which emits ultraviolet light will not be permitted. The temperature of heat sink should be not increase more than 20 degree centigrade above ambient temperature during the dusk to dawn operation.

ii. The illumination should be uniform without dark bands or abrupt variations, and soothing to the eye. Higher light output will be preferred. The light output from the white LED light source should be almost constant.

iii. The lamps, DC-DC driver and battery management system (BMS) should be housed in aluminum die-casted casing suitable for outdoor use and shall comply with IP 65. The temperature of heat sink should not increase more than 30 degree C above ambient temperature even after 48 hrs of continuous operation. This condition

should be complied for the dusk to dawn operation of the lamps while battery operating at any voltage between the load disconnect and charge regulation set point.

iv. High power LED of minimum 1 (one) watt each capacity capable to withstand maximum 1 amp driving current having optical lens angle greater than 120 degree shall be used. The LED of Having LM 80 and LM 79 test report shall only be used.

v. The LED efficacy should be 135 lumen per watt, the lumens output of luminaire should be >1500 lumen.

vi. The lumen depreciation of LED shall not be more than 30% even after 50,000 burning hours.

vii. Power consumption of the LED Luminaire / Lighting unit shall not be more than 12W (including LED and Driver power loss).

viii. The luminary should have Suitable UV Stabilized polycarbonate Diffuser.

ix. Luminaries, reflectors and LED's should be engineered in such a way to give the specified lumens output distributed uniformly.

x. The luminary should be designed, manufactured and tested as per LM-79-08 or latest standard by the NABL accredited lab for such.

xi. The luminary should be tested for Electrical, Photometry and Color Parameters as per IEC LM-79: 2008 or IS :16106:2012. The test certificate should be from NABL accredited lab.

xii. The PCB used in luminaries should have lead free-auto soldering and replaceable card type.

xiii. The firm should have in house test facilities for testing of the luminary.

xiv. Light Output

• For single light level: Minimum 24 Lux when measured at a point 5 meters below the light during any time in duty cycle. The illumination should be uniform without dark bands or abrupt variations, and soothing to the eye. Higher light output will be preferred. The luminaire shall be tested for Electrical, Photometry and Color parameters as per IES LM-79:2008 or IS: 16106:2012.

xv. <u>OTHER PARAMETERS:</u>

• LED DC current regulation – better than 3 %

• Input – 12.8 V DC

• Driver Type- DC-DC (as per IEC 62384)

• CRI > 70 % Typical

- Lighting quality- Free from glare, flickering and UV
- Ambient temp 0 to 55 deg
- Total electronics efficiency > =90 %

xvi. The connecting wires used inside the luminaries, shall be low smoke halogen free, fire retardant e-beam cable and fuse protection shall be provided at input side.

xvii. Auto resettable reverse polarity protection shall be provided.

xviii. LED lighting unit shall comply with LM 79-08 and LM 80-08 Standards and copy of test certificate from authorized lab should be submitted

xix. The make, model number, country of origin and technical characteristics of white LEDs used in the lighting system must be furnished.

xx. In order make the system performance better and longer life a suitable micro controller dimmer must be provided to dim the light.

xxi. Luminous intensity distribution should follow the batwing patterns in polar curves. Require validation report using i.e. file, which is generated during luminous intensity distribution test and using maintenance factor 0.9 and pole height of 4m, Road width 5m and pole span 15m. The average luminance level and uniformity should comply with requirement as per IS 1944, wherever applicable. The luminaire should be test for all type tests as per IS 10322 Part 5 Sect 3 or IEC 60598-2-3 standard.

xxii. Electronics should operate at 12.8V and the efficiency of DC-DC converter should be at least 90 %.

xxiii. Fuses should be provided to protect against short circuit conditions.

xxiv. A blocking diode should be provided as part of the electronics, to prevent reverse flow of current through the PV module, in case such a diode is not provided with the PV module.

xxv. Full protection against open circuit, accidental short circuit and reverse polarity should be provided.

xxvi. Charge controller shall have automatic dusk-dawn circuit based on SPV module as sensor for switching on/off the street light without manual intervention

xxvii. The self-consumption of the charge controller shall not be more than 20 mA at rated voltage and rated current.

xxviii. Adequate protection shall also be incorporated under no-load conditions (i.e. when the system is ON & the load (LED Lamp is removed)

xxix. The system should be provided with 2 LED indicators: a green light to indicate charging in progress and a red LED to indicate deep discharge condition of the battery. The green LED should glow only when the battery is actually being charged.

xxx. All capacitors shall be rated for Max. Temp. of 105° C.

xxxi. Resistances shall preferably be made of metal film of adequate rating.

xxxii. Devices shall have adequate thermal margin at Amb. Temp. of 55° C

xxxiii. Fiber glass epoxy of grade FR 4 or superior shall be used for PCB boards.

5.0 Technical Requirement/Standards

SI. No. (1)	Product (2)	Indian Standard Number (3)	Title of Indian Standard (4)
1	Crystalline Silicon Terrestrial Photovoltaic (PV) modules (Si wafer based)	IS 14286	Crystalline Silicon Terrestrial Photovoltaic (PV) modules - Design Qualification And Type Approval
2	Thin Film Terrestrial Photovoltaic (PV) Modules (a-Si, CiGs and CdTe)	IS 16077	Thin-Film Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval
3	PV Module (Si wafer and Thin film)	IS / IEC 61730 (Part 1)	Photovoltaic (PV) Module Safety Qualification Part 1 Requirements for Construction
		IS / IEC 61730 (Part 2)	Photovoltaic (PV) Module Safety Qualification Part 2 Requirements for Testing
4	Power converters for use in photovoltaic power system	IS 16221 (Part 1)	Safety of Power Converters for use in Photovoltaic Power Systems Part 1- General Requirements
		IS 16221 (Part 2)	Safety of Power Converters for Use in Photovoltaic Power Systems Part 2- Particular Requirements for Inverters
5	Storage batteries	IS 16270	Secondary Cells and Batteries for Solar Photovoltaic Application General- Requirements and Methods of Test

SI. No. (1)	Product (2)	Indian Standard Number (3)	Title of Indian Standard (4)
		IS 16046	Standard for Lithium ion battery
6	LED Lights & Luminaires	IS 16101	General Lighting - LEDs and LED modules - Terms and Definitions
		IS 16102	Self-Ballasted LED Lamps for General Lighting Services
		IS 16103	Led Modules for General Lighting
		IS 16107	Luminaires Performance

6.0 MECHANICAL HARDWARE

i. A metallic frame structure (hot dip galvanized with 35*35*5 mm angle) to be fixed on the pole to hold the SPV module(s). The frame structure should be fixed at 30 degree from horizontal facing true south.

ii. The pole structure shall be so designed to withstand the speed for the wind zone of the location where a panels is proposed to be installed (wind speed of 150 km/ hour. Suitable fastening arrangement such as grouting and calming should be provided to secure the installation against the specific wind speed.

iii. The pole should be hot dip galvanized pipe as per IS 1161 & IS 4736 i.e. Class B. with 76 mm outer diameter of 6 meter length. The pole should have the provision to hold the weather proof lamp housing individually as per case. SPV panel shall be mounted on pole. The mounting structure shall be fixed in the center of GI tubular pole made flat at fixing end, square angle adjusting plate of 115 mm size 5 mm thick shall be provided. So that SPV panel can be fixed at inclination of 30 degree from horizontal.

iv. The metallic arm for holding the light assembly should be set at a suitable angle to maximize uniform illumination of desired level over the specified area (4 meter wide road). The arm length of luminary holder from pole should be 0.6 meter for its easy approachability for repairing and replacement.

v. Two 10 mm steal bar of 300 mm length should be inserted at the interval of 25 mm from bottom of the pole.

vi. The module 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. The structure shall be designed to allow easy replacement of any module and shall be in line with site requirement.

vii. Nut & bolts, supporting structures including Module Mounting Structures shall have to be adequately protected from atmosphere and weather prevailing in the area. All fasteners shall be of stainless steel of grade SS 304.

viii. The Mounting structure shall be grounded properly using GI strips and maintenance free earthling kit.

7.0 ELECTRIC CABLE

The electric cable used shall be twin core PVC insulated water and UV resistance copper cable of minimum size 1.5 mm. Cable shall meet IS 1554 / 694 Part 1:1988 & shall be of 650 V/ 1.1 Kv.

8.0 CIVIL WORK FOR INSTALLATION OF SYSTEM

The system should be properly installed at site. The SPV module mounting structure along with pole should be properly grouted depending upon the location and requirement of the site. The grouting should be such that it must withstand the maximum wind speed /storm of 100 KMPH. The pole should be grouted with CC mixture of 1:2:4 of dia 300 mm having depth of 1000 mm and 200 mm above ground level with 200 mm dia. adequate space should be provided behind the PV module/array for allowing un-obstructed air flow for passive cooling. Cables of appropriate size should be used to keep electrical losses to a bare minimum. All wiring should be in a proper conduit or capping case. Wire should not be hanging loose.

9.0 ERECTION, TESTING, COMMISSIONING

The scope of work of the Contractor shall be complete erection of the equipment, cables, auxiliary systems and sub systems under the scope of work.

i. The Contractor shall make all arrangements to deliver the equipment at site by wagons/ trucks/ trailers, build his own stores (covered, uncovered, air-conditioned, if necessary) for the proper storage of equipment, maintain the stores and all related documents and records transport the equipment to site for erection purpose.

ii. The Contractor also shall make all security arrangements.

iii. The Contractor shall be responsible for proper, quick retrievable and neat storage and also undertake the conservation of all consignments including damaged boxes.

iv. During storage of equipment, the Contractor shall take into account deterioration and carry out the re-conservation of the complete equipment/parts/supplies as may be necessary as per the storage instructions of the Manufacturer of equipment/components if required.

v. The Contractor shall also supply the consumables required for such re-conservation work and repair/ replace parts required thereof for the proper functioning of the equipment after erection and commissioning.

vi. The Contractor shall retrieve the equipment/ materials from stores and transport the same to erection site.

vii. The Contractor shall unpack and do visual checking against physical damages to the equipment/cases, clean equipment before start of erection. Damage/ shortage, if any, shall be reported to the Employer/ Consultant and shall be rectified/replaced expeditiously, so as not to upset the erection and commissioning schedule.

viii. The Contractor shall provide all necessary erection equipment and tools & tackles including material handling equipment, cranes, compressors and other equipment and instruments and consumables, all commissioning equipment and instruments, welding equipment, winches, alignment tools, precision levels, etc., which may be required for carrying out the erection and commissioning work efficiently.

ix. All instruments shall be properly calibrated before use. Unless otherwise specified, the above erection equipment/ materials shall be the property of the Contractor. However, Employer's prior permission shall be required for removal of these erection equipment/ materials from the site.

x. The Contractor shall ensure that proper procedure and documentation is maintained at entry gate of OTPC premises for such items as might be carried back by the Contractor after completion of work.

xi. The Contractor shall provide all erection consumables like oxygen and acetylene gas, welding rods, solder lugs, oil, grease, kerosene, cotton waste, etc. required for erection of equipment and steel structures.

xii. The Contractor shall construct and maintain his own site offices and stores as required for the work and arrange for maintaining in the area placed at the Contractor's disposal in a neat manner.

xiii. The Contractor shall provide his scheme for mobilization with Bar Chart indicating clearly the resources, manpower and machinery proposed to be deployed to ensure timely completion of work and quality of workmanship.

xiv. On request, OTPC may help the Contractor by providing any special handling/construction equipment needed in the interest of work subject to availability and on payment of hire charges and other conditions of Employer. The charges shall be recovered from any bill of the Contractor due immediately thereafter.

xv. All safety, health and pollution control measures as required to be adopted as per the Statutory Regulations and the Safety conditions for Contractors issued along with the tender or otherwise required or implied by regulations or practices shall be strictly followed by the Contractor during the execution of the Contract. The Contractor shall set up a suitable safety organization of his own at site in this regard.

xvi. All the facilities to Contractor's Personnel / Workmen such as transportation, shelter, food shall be arranged by the Contractor.

xvii. As the time is essence of the contract, the Contractor shall deploy sufficient Supervising , erection, operating & maintenance personnel and all raw materials, utilities & services required for installation & commissioning for completion of work as per the contract condition .

xviii. The results of pre commissioning Test, start-up tests and commissioning report shall be recorded jointly by the Contractor and the OTPC and complete report shall be duly submitted by the Contractor.

xix. The Contractor shall rectify the defects observed during the Commissioning period promptly.

10.0 WARRANTY

i. The street lighting system (including the battery) will be warranted for a period of five years from the date of supply.

ii. The supplied Solar PV shall carry a warranty of minimum 25 year. The PV module(s) will be warranted for a minimum period of 25 years from the date of supply. The PV modules must be warranted for their output peak watt capacity, which should not be less than 90 % at the end of Ten (10) years and 80 % at the end of Twenty Five (25) years.

iii. The complete Solar PV based standalone LED Streetlights including the mechanical structures, electrical works including power conditioners /charge controllers/ maximum power point tracker units/DC circuit drivers/distribution boards/digital meters/ switchgear/ storage batteries, etc. and overall workmanship of the SPV power plants/ PV lighting systems installed and commissioned must be warranted against any manufacturing/ design/ installation defects for a minimum period of 5 years from the date of Commissioning.

iv. The warranty will be against breakages, malfunctions, non-fulfillment of guaranteed performance and breakdowns due to manufacturing defects or defects that may arise due to improper operation of electrical /electronic components of the system but do not include physical damages by the end users.

v. The above warranty shall take effect from the date on which the system is taken over by the purchaser after commissioning.

vi. The Contractor shall be liable to make good the loss by replacing the defective product during the warranty period for the entire system with free of cost.

vii. The warranty will cover all the materials and goods involved in the installation and commissioning of Solar PV based standalone LED Streetlights. The mechanical items, electrical/electronic items including Charge controller/batteries/LED luminary etc. and overall workmanship of the Solar PV based standalone LED Streetlights must be warranted against any manufacturing/design/ installation defects for a minimum period of 5 years.

viii. During the 5 years warranty and comprehensive AMC period, OTPC will have all the rights to cross check the performance of LED based solar streetlights. OTPC

may carry out the frequent inspections of the installed SSL and randomly pickup to get them tested at Government / MNRE approved any test centre. If during such test of the SSL or its any component is not found as per specified technical parameters, OTPC will take the necessary action to recover the losses and blacklist the firm. The decision of OTPC in this regard will be final and binding on the tenderer.

11.0 OPERATION AND MAINTENANCE MANUAL:

An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the Solar Street Lighting System. The following minimum details must be provided in the Manual:

(i) Basic principles of Photovoltaics.

(ii) A small write-up (with a block diagram) on Solar Street Lighting System - its components, PV module, battery, electronics and luminaire and expected performance.

(iii) Type, Model number, Voltage & capacity of the battery, used in the system.

(iv) The make, model number, country of origin and technical characteristics (including IESNA LM-80 report) of W-LEDs used in the lighting system.

(v) About Charging and Significance of indicators.

(vi) Clear instructions about erection of pole and mounting of PV module(s) and lamp housing assembly on the pole.

(vii) Clear instructions on regular maintenance and trouble shooting of the Solar Street Lighting System.

(viii) DO's and DONT's.

Name and address of the contact person for repair and maintenance, in case of non-functionality of the solar street lighting system.

12.0 AMC (Annual Maintenance Contract)

a. The party has to provide the support services for the solar street light system free of cost for a period of one year from the date of completion of installation and handover.

b. The AMC will be awarded for a period of five years and during which party has to maintain the solar street lighting system. This includes the removal of vegetation/creepers which surrounds the Pole.

c. The AMC will be awarded on year on year basis and the price will remain firm as quoted in the offer submission.

d. During AMC Party has to visit minimum 4 times, i.e, quarterly in a year and apart from that if there is any defects during the period party has to attend the same within two days.

e. The AMC Charges as quoted by the Party will be specified in the contract and which will remain firm for the AMC period, i.e, 5 years.