

SCOPE OF WORK AND TECHNICAL SPECIFICATIONS

SCOPE OF WORK

The scope of work includes design, supply, installation, commissioning of Solar Street Lighting Systems (LED based) including 05 years comprehensive warranty maintenance in various villages/ hamlets, institutions, individuals etc of various districts of Uttar Pradesh as directed by UPNEDA at sites identified by UPNEDA as per the conditions in this document and following specifications.

The scope of work also include **mandatory opening of Service Center in their name in concerned district through which servicing and maintenance may also be provided as stipulated quarterly in a year and with in 72 hours time as per Part 5 of this document.**

GENERAL TECHNICAL SPECIFICATION:

A Solar Street Light (LED based) consist of white LED luminary of maximum 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.

BROAD PERFORMANCE PARAMETERS

PV Module	Only indigenous modules shall be used in the project. SPV module 75 Wp at 16.4 ± 0.2 Volt if MPPT is not used with positive tolerance. Module Voc minimum of 21 V.
Battery	Lithium Ferro Phosphate (Li-Fe-PO4 or LFP) minimum 12.8 Volt, 30 Ah, at STC
Light Source	<ul style="list-style-type: none">• White Light Emitting Diode (W-LED) 12 Watt(LED +Driver)• Using LEDs which emits ultraviolet light will not be permitted
Light Out put	White colour (colour 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 Battery pack	Approx., 4.5 meter above the ground, Mounted at pole or bellow the mounting structure.
Average duty cycle	Dusk to dawn

MINIMUM TECHNICAL REQUIREMENTS / STANDARDS

1. DUTY CYCLE

- The LED solar street lighting system should be designed to operate for dusk to dawn.

2. SPV 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 at 16.4 ± 0.2 Volt at STC, if MPPT is not used with positive tolerance. 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.
- 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. The offered module shall be in accordance with the requirements of MNRE.
- vi. Latest edition of IEC 61215 edition II / IS 14286 for Crystalline and shall be certified by MNRE/NABL authorized test center. The bidder shall submit appropriate certificates.
- vii. PV modules must quality to IEC 61730 Part 1- requirements for construction & Part 2 – requirements for testing, for safety qualification.
- viii. 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.
- ix. IDENTIFICATION AND TRACEABILITY

Each PV module must use a 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
- (viii) Made in India

2. 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 or MNRE accredited test center, (Certificate Enclosed). The cell capacity should be 3.2 volt, 5AH/ 10AH.

1. Capacity of the battery shall not be less than 12.8 V (nominal), 30 Ah at STC, 384 Watt Hour.
2. The battery cycle life should be 2000 cycle at 95% discharge.

3. 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.

4. 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	Specifications
1	Battery Configuration	Minimum 12.8V- 30AH; Li-fe-PO4
2	Working Temperature Range (both for charging & discharging)	0-60 deg C
3	Storage Temperature Range	@ 0-25 Deg- 6 months
4	Cycle Life (Full charge to full discharge @ 25 deg 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

3. ELECTRONICS/CHARGE CONTROLLER :

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

Solar Charge Controller

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 \pm 0.2 v, if MPPT is not used with positive tolerance 36 Cell configuration Voc- > 21 Volts Vmp-16.4 volt \pm 0.2 at STC without MPPT
4	Load current Max @rated Voltage	2 Amps
5	Ideal current consumption (self-consumption)	< 30 mAmps
6	Maximum Efficiency	>90%
7	Battery Voltage Setting	Charging 14.4v \pm 0.2 Volts Battery Low Volt disconnect >10.5 Volts Load Reconnects-12.8V \pm 0.2Volts Low Battery Cutt of - 11.2 V \pm 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

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

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 are 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 to be incorporated.

4. 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 luminaire 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 out put distributed uniformly.
- x. The luminaire should be designed, manufactured and tested as per LM-79-08 or latest standard by the MNRE/NABAL accredited lab for such.
- xi. The luminaire should be tested for Electrical, Photometry and Color Parameters as per IEC LM-79: 2008 test methodology. It is also tested as per IS 10322 part-5 Sect. 3 or

IEC 60598 - 2-3 Standards. The test certificate should be from MNRE/ 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.
- ivx. The system supplied should have minimum 5% spare parts except Panel and Batteries to be kept at service center. Service Center should mandatory be opened before commissioning of systems and at least till warrantee period.
- xv. **For single light level: Minimum 24 Lux when measured at a point 4 meters below the light.**
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.

Lux Distribution

Luminare: 12w

Road width: 4m

Pole height: 5m

Tilt angle of bracket: 0 degrees

Maintenance factor: 0.85

xvi. Other Parameters :

- 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– upto 55 deg
 - Total electronics efficiency > =90 %
- xvii. 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.
 - xviii. Auto resettable reverse polarity protection shall be provided.
 - xiv. 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.
 - xv. The make, model number, country of origin and technical characteristics of white LEDs used in the lighting system must be furnished.
 - xvi. **In order make the system performance better and longer life a suitable micro controller dimmer must be provided to dim the light. First 04 Hours full light (Min. 24 Lux), rest of the time at lower light (50%, Min. 12 Lux) level.**

xvii. Luminous intensity distribution should follow the batwing patterns in polar curves. Require validation report using .ies 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 illuminance level and uniformity should comply with requirement as per IS 1944, wherever applicable.

The luminaire should be teste for all type tests as per IS 10322 Part 5 Sect 3 or IEC 60598-2-3 standards.

- Electronics should operate at 12.8V and the efficiency of DC-DC converter should be at least 90 %.
- Fuses should be provided to protect against short circuit conditions.
- 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.
- Full protection against open circuit, accidental short circuit and reverse polarity should be provided.
- Charge controller shall have automatic dusk-dawn circuit based on spv module as sensor for switching on/off the street light without manual intervention
- The self consumption of the charge controller shall not be more than 20 mA at rated voltage and rated current.
- Adequate protection shall also be incorporated under no-load conditions (i.e. when the system is ON & the load (LED Lamp is removed)
- 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.
- All capacitors shall be rated for max. temp of 105° C.
- Resistances shall preferably be made of metal film of adequate rating.
- Devices shall have adequate thermal margin at amb. temp. of 55° C
- Fiber glass epoxy of grade FR 4 or superior shall be used for PCB boards.

Technical Requirement/Standards

Item / System	Applicable BIS /Equivalent IEC Standard Or MNRE Specifications	
	Standard Description	Standard Number
Solar PV Systems	Crystalline Silicon Terrestrial PV Modules	IEC 61215 / IS14286 Test Certificates / Reports from IECQ / NABL accredited laboratory for relevant IEC / equivalent BIS standard. If IEC certificates are not available for 75 Wp capacity, qualification certificate from IEC / NABL accredited laboratory as per relevant standard for any of the higher wattage regular module shall be furnished. Further, the manufacturer should certify that the supplied module is also manufactured using same material design and process similar to that of certified PV module
Charge Controller/MPPT and Protections		IEC 62093 Equivalent BIS Std.
Storage Batteries	General Requirements & Methods of Testing LifePO4 Capacity Test, Charge/Discharge Efficiency Self-Discharge	As per IEC/BIS Standard.
Cables	General Test and Measuring Method PVC insulated cables for working voltage up to and including 1100 V UV resistant for outdoor installation	IEC 60189 IS 694/ IS 1554 IS/IEC 69947
LED	Lamps Luminary	LM -80-08 LM 79-08

6. 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 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.

(a) 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.

(b) Two 10 mm steel bar of 300 mm length should be inserted at the interval of 25 mm from bottom of the pole.

iii) 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

7. OTHER FEATURES

A toll free number (i.e. 1800 180 0005) of IVRS of UPNEDA and 14 digit UID number of minimum thickness 5mm and height of letter should be at least 25mm (issued/provided by UPNEDA) is to be embossed / punch/ nut-bolted strip on pole between 1-1.5 meter above from ground level by contractor/ bidder, which in case of non-working/ operational problems etc of system will be dialed by the beneficiary etc to lodge a complaint in respect of system problems. The suitable sign board of 500 mm x 300 mm size power coated, MS Sheet assigned by UPNEDA should be installed on pole under different schemes as per the requirement. The IVRS will divert the complaint to Contractor/ bidder through e-mail, SMS etc. The contractor/ bidder will have to rectify the same to make/ restore the system to working position within 72 hours in the warranty period of 5 years, failing which the system may be get rectified on contractor/ bidder cost and the cost will be recovered by contractor/ bidders pending claims what so ever and appropriate action as per noncompliance etc of agreement will be considered / taken.

8. **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. 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. Any minor items which are not specifically included in the scope of supply but required for proper installation and efficient operation of the SPV systems, is to be provided by the manufacturer as per standards.

9. **AUTHORIZED TESTING LABORATORIES/ CENTERS**

Test certificates of complete solar street lighting system should be from MNRE/NABL Accredited test Labs. Reports for components should be from any of the NABL/ IEC Accredited Testing Laboratories or MNRE approved test centers. The list of MNRE approved test centers will be reviewed and updated from time to time.

10. **WARRANTY**

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 must be warranted against any manufacturing/ design/ installation defects for a minimum period of 5 years.

11. **TRACEABILITY OF THE PRODUCT TO BE SUPPLIED**

In order to prevent the misuse of the product such as unauthorized sale or diversion to the open market, the following incorporation shall be made in the product.

- a) Engraving (or) Screen printing of UPNEDA at a suitable place on the main components viz., SPV Panel, LED Lighting Units to be used in the installation of the solar street lighting systems.
- b) The system unique ID number as provided by UPNEDA shall be **permanently embossed / punch on a metallic strip nut-bolted / riveted to or directly embossed/punch on pole of the system. The UID number painting or marking will not be allowed.**
- c) **sign board** as prescribed by UPNEDA should be fixed on pole.

(Signature of Bidder)
with seal

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