

INTEGRATED SOLAR LED ROAD LIGHTING SYSTEM**1. GENERAL**

1.1. An Integrated Solar Road LED Lighting System is an outdoor lighting system used for illuminating a road or an amenity. A basic solar road lighting component are:

- i. Solar Panel or Photovoltaic (PV) Module,
- ii. LED Luminaire,
- iii. Rechargeable Deep Cycle Battery,
- iv. Solar Charge Controller and
- v. Lighting Column.

1.2. The solar road lighting system shall be either Integrated luminaire system consists of solar panel, rechargeable deep cycle battery, solar charge controller, and light source are all-in-one enclosure or Modular type. The Solar Panel shall provide electricity to charge the battery during day time. The battery's charging shall be controlled by a Pulse Width Modulation (PWM) or Maximum Power Point Tracker (MPPT) charge controller. The operation of the luminaire shall be controlled by a control circuit either by using voltage or current sensor. All these components shall be fixed on a column. The solar panel shall be mounted at the top of the column to minimize the possibility of shading on the panels.

1.3. The luminaires shall be so designed, brand new and constructed to be capable of providing the required lighting performance level. The following must be observed:

- i. Solar panels shall be sized such that they can provide sufficient energy to the system for the intended service life of 25 years.
- ii. System losses shall be considered including dust and dirt, wiring losses, electronics losses and charging losses.
- iii. Batteries shall be sized for 80% capacity (exclusive of low voltage cut-off) to ensure a reasonable battery service life.
- iv. The average luminous flux of luminaire shall not depreciate more than 30% from initial value.
- v. Lighting level (i.e luminance or illuminance) shall be at rated levels for determining battery size for two (2) days of autonomy.
- vi. The solar lighting system shall be based on a 12VDC (nominal) or 24VDC (nominal) system voltage only.

2. SOLAR ROAD LIGHTING LUMINAIRE

2.1. The luminaire shall be designed by using solid state lighting i.e Light Emitting Diode (LED) as a light source.

2.2. The LED luminaire and its associated electrical components and technical specifications shall be designed and comply to the L-S20: Specification for Road Lighting Installation (Addendum No.1: Road Lighting Luminaires – LED).

3. CONSTRUCTION AND COMPONENTS**3.1. Solar Module**

3.1.1. The solar module consists of PV module shall be monocrystalline type.

INTEGRATED SOLAR LED ROAD LIGHTING SYSTEM

3.1.2. The solar module shall be designed to meet the following criteria:

i. The rated power (Wp) of the solar PV module shall be determined by the following parameters:

- a) Number of hours of operation of luminaire per day.
- b) Total wattage of the luminaire.
- c) Sufficient autonomy to cater for up to two overcast or rainy days Two days autonomy of the luminaire.

a) The PV module shall have a certificate of testing conforming to MS IEC 61215 or MS IEC 61646 respectively.

ii. The module efficiency shall not be less than 14%.

iii. PV module shall contain the following information:

- a) Name of the manufacturer of PV Module.
- b) Model Number and Type
- c) Serial Number
- d) Month and year of manufactured
- e) I-V curve of module
- f) Peak Wattage of module
- g) Voltage open circuit (Voc), short circuit current (Isc), maximum current (Imp), maximum voltage (Vm) and maximum power (Pmax)
- h) Serial Number and Model Number of the module

iv. The solar module shall be designed with the following features:

- a) Covering material: Highly transparent, reflective, tempered solar glass;
- b) Encapsulation: Solar cell matrix embedded in EVA film
- c) Junction box: Junction box with integrated 3 bypass diodes, IP 65, welded contacts, fully encapsulated
- d) Plugs: Touch-proof plug connectors with polarity reversal protection, MC4
- e) Maximum system voltage: PC II 1000V / 600V according to UL 1703
- f) Dynamic load (wind load): 2.4 kN/m² (2,400 Pa)
- g) Permitted operating temperature: -20. to +70.
- h) Warranties:
 - . 10 years product warranty
 - . Linear 25 years performance warranty
 - . The actual power shall be minimum of 97% of the nominal power in the first year
 - . The actual power shall not fall by more than 0.7% annually beginning in the second year
 - . The actual power of at least 80% guaranteed after 25 years

4. Batteries

INTEGRATED SOLAR LED ROAD LIGHTING SYSTEM

4.1. Batteries are used to store the electricity generated by the solar panel. Solar power applications typically use deep-cycle batteries because they can persist repeated and deep discharges.

4.2. The battery shall be of the following type:

- a) Lithium-Ion, Lithium-Polymer or Lithium-iron Phosphate battery
- b) Or any other new and latest battery technology

4.3. The batteries shall be deep cycle batteries with the following features:

- b) Nominal voltage: 12VDC or 24 VDC
- c) Provide certified battery discharge cycles at 25°C and 40°C.
- d) A minimum life cycle of 2,000 cycles at 80% depth of discharge (DOD)
- e) Operating temperature range of -5°C to +60°C.
- f) Threaded post terminals with brass inserts.
- g) Sufficient autonomy to cater up to two overcast or rainy days.
- h) Manufacturer certified to ISO 9001 and ISO 14001.
- i) Warranty: 5 years

5. Solar Charge Controller

5.1. Charge controllers shall be used to control the charging of the batteries. Since the output from solar panels are variable and needs adjustments, charge controllers fetch the variable voltage/current from solar panels, condition it to suit the safety of the batteries. The main functions of charge controllers are to prevent over-charging of batteries from solar panels, over-discharging of batteries to the load and to control the functionalities of the load.

5.2. Solar Charge Controller shall be used for protecting the battery from over charging and deep discharging. Charge controllers are basically DC-DC converters, where PWM or MPPT technique is used to regulate the switches of the controller.

5.3. The solar charge controller shall have the required temperature sensor for preventing the battery from overheating.

5.4. The solar charge controller shall be designed with the following features:

- a) Efficiency: minimum 90% at full load
- b) Humidity: 95% non-condensing
- c) Construction: Open Frame
- d) Terminations: Connectors
- e) Operating Temperature: 0 to 50°C
- f) Storage Temperature: 0 to 70°C
- g) Protections: Reverse current protection from battery to PV
- h) Warranty: 5 years
- i) Corrosion-proof epoxy-encapsulated PCB (\geq IP 67)
- j) No moving parts, switches or buttons.
- k) Infrared remote-control programming accessory
- l) Intelligent timer functions available for lighting control

INTEGRATED SOLAR LED ROAD LIGHTING SYSTEM

- m) Four-stage battery charging (main, float, boost, equalization), temperature compensated
- n) Automatic system voltage recognition (12VDC or 24VDC)
- o) Over-voltages from PV Array
- p) Polarity reversal from PV array and batteries,
- q) Protection against lighting surges (voltages and current)
- r) Protection against reverse current from batteries.
- s) Overheating and Overload protection
- t) Open circuit protection without battery

6. Battery Box (For Remote Type)

6.1. Battery box shall be used to house the battery securely. Metallic powder coated and vented boxes shall be used. Battery box shall be designed with the following features:

- a) Outdoor weatherproof metal housing with high resistance to corrosion with a durable finish with smooth reflective colour paint and shall be provided with mesh louvre or ventilation vent with filter which located at top of the pole under the Solar PV.
- b) Theft proof locking system.

7. Recommendation of JKR’s Specification on Pre-set Dimming – First 4 hours 100%, next 2 hours 60% and last 6 hours 40%

Pre-set dimming – 4hrs (100%), 2hrs (60%) & 6hrs (40%)					
Product	Luminaire Power	LED Lumen (Lm)	Luminaire Efficacy $\geq 150\text{Lm/W}$ CCT 3000K, Ra 70	LifePO4 Battery 12.8V	Solar PV(Mono) 18V
1	40W	6,000 lm	96 pcs of LEDs	487Wh (38Ah)	80W
2	60W	9,000 lm	96 pcs of LEDs	730Wh (57Ah)	120W
3	80W	12,000 lm	144 pcs of LEDs	974Wh (76Ah)	160W
4	100W	15,000 lm	288 pcs of LEDs	1216Wh (95Ah)	200W
5	120W	18,000 lm	288 pcs of LEDs	1460Wh (114Ah)	240W

8. IoT Ready for Solar Street Light

Solar Street Light product must READY with IoT smart lighting system by remote controlling which presents a reliable way to:

- a) Energy Saving
- b) Sustainable – Remotely Control on Lighting Adjustment
- c) Cloud Monitoring
- d) Data & Asset Management
- e) Ease for Maintenance eg: Failure Detection with Alarm

INTEGRATED SOLAR LED ROAD LIGHTING SYSTEM

- f) Open API & Integration Ready with other systems.
- g) Better Report Presentation with Statistics Ready
- h) Flexible, Reliable and Smart City Solution to the industries.

9. Lighting Column

Lighting column shall comply to section 8.0 of L-S 20 Specification for Road Lighting Installation. It shall be designed and fabricated to withstand loading comprising of all solar road lighting components.

10. Installation

10.1 The configuration of solar road lighting system shall be designed to be robust and shall withstand the harsh environmental condition as the system will be continuously exposed to sun, rain, fog, pollution etc. The solar road lighting system installed shall not damage the aesthetic of the city or road; rather it shall beautify the existing roadway.

11. Collection of Product - End of Life

11.1 Local factory and manufacturer should offer innovative product, recycling and end-of-life programs to help reduce disposal impacts via safe, responsible and valuable alternative re-uses. A well demonstrate program in partnership with a waste management company to address these unique disposal issues. Through this program, customers/user may return their end of life products for proper disposal and environmentally safe.