

# TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)

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**TECHNICAL SPECIFICATIONS FOR  
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**1. WHITE LED (W-LED) BASED SOLAR LANTERN**

A Solar Lantern is a portable lighting device consisting of a PV module, battery, lamp, and electronics. Battery, lamp, and electronics are placed in a suitable housing, made of metal or plastic or fiber glass. The Solar lantern is suitable for either indoor or outdoor lighting, covering a full range of 360 degrees.

PV module converts sun light into electricity, charges the battery which powers the luminaire. Luminaire consists of White Light Emitting Diode (W-LED), a solid state device which emits light when an electric current passes through it.

**BROAD PERFORMANCE SPECIFICATIONS**

**There are three MODELS of WHITE LED (W-LED) Based Solar Lantern. The configuration of each model is as follows:**

	<b>Model-I</b>	<b>Model-IA</b>	<b>Model-II</b>
PV Module	4 Wp under STC	4 Wp under STC	8 Wp under STC
Battery	Sealed maintenance free lead acid battery with a capacity up to 7 AH, at voltage up to 12V @ C/20 rate of discharge or NiMH or Lithium-Ion of requisite capacity.	Lithium-Ferro Phosphate of 3x 3.2V, 1450 mAh (or requisite capacity)	Sealed maintenance free lead acid battery with a capacity up to 7 AH, at voltage up to 12V @ C/20 rate of discharge , or NiMH or Lithium-Ion or Lithium-Ferro Phosphate Of requisite capacity.
Autonomy	Minimum of 3 days or 12 operating hours per permissible discharge	Minimum of 6 operating hours per permissible discharge	Minimum of 3 days or 12 operating hours per permissible discharge

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Light Source	2.0 Watts (max.) W-LED luminaire, dispersed beam, soothing to eyes with the use of proper optics and diffuser	2.0 Watts (max.) W-LED luminaire, dispersed beam, soothing to eyes with the use of proper optics and diffuser	4.0 Watts (max.) W-LED luminaire, dispersed beam, soothing to eyes with the use of proper optics and diffuser
Light Output	<b>Multiple Light levels</b> The lamp should have two levels of light (operation at 100 % power and 60%power) to take care-of the different lighting needs, as per the User requirements		
Duty Cycle	4 hours a day (at full brightness level), under average daily insolation of 5.5 kWh/sq.m. on a horizontal surface		
Facility for Mobile Charging	USB port for Mobile Charging. However, in case of mobile charging, the duty cycle for light to be reduced /adjusted accordingly.		

Minimum level of illumination from W-LED lantern (at full brightness level) should be as follows:

S.No	Distance in feet	Illumination level when detector is in horizontal to center point of bottom of light source in Lux			Illumination level when detector is at an angle of 90 ° horizontal to the center point of the bottom of light source in Lux		
		Model I	Model IA	Model II	Model I	Model IA	Model II
1	1	50	50	250	160	160	300
2	2	10	10	45	50	50	125
3	3	4	4	17	22	22	55
4	4	2.5	2.5	4	15	15	28
5	5	1.5	1.5	2.5	8	8	16

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**TECHNICAL DETAILS**

**PV MODULE**

- (i) Indigenously manufactured PV modules should be used in the solar lantern.
- (ii) The PV module should have crystalline silicon solar cells, and should have humidity, freeze and damp heat tests certificate conforming to IEC 61215 Edition II / BIS 14286 from an NABL or IECQ accredited Laboratory.
- (iii) The PV module must have a minimum of 4 Wp / 8Wp at a load voltage\* of 8.6 V for 6 volt battery / 16.4 V for 12 volt battery or appropriate voltage for charging of battery used, under the standard test conditions (STC) of measurement.
- (iv) **The module efficiency should not be less than 10%.**
- (v) The terminal box on the module should have a provision of opening it for replacing the cable, if required.
- (vi) There should preferably be an arrangement (stand) for mounting the module at an optimum angle in the direction facing the sun.
- (vii) A foil/ strip containing the following details should be fixed inside the module so as to be clearly visible from the front side:-
  - a) Name of the Manufacturer and/ or distinctive Logo
  - b) Model and/ or Type No.
  - c) Serial No.
  - d) Year of manufacture
- (viii) **A distinctive serial number starting with NSM will be engraved on the frame of the module or screen printed on the tedlar sheet of the module.**

\*The load conditions of the PV module are not applicable for the system having MPPT.

**BATTERY**

**Model-I and Model-II**

- (i) Sealed maintenance free lead acid battery with a capacity of up to 10 AH, at voltages of up to 12 V @ C/20 rate of discharge  
OR

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NiMH / Lithium-Ion / Lithium-Ferro Phosphate of requisite capacity.

- (ii) Battery should conform to the latest BIS/ International standards.

**Model-IA**

- (i) **Lithium-Ferro Phosphate of 3X 3.2V, 1450mAh (or requisite capacity).**
- (ii) Battery should conform to the latest BIS/ International standards.

**LIGHT SOURCE**

- (i) The light source will be of White Light Emitting Diode (W-LED) type.
- (ii) The colour temperature of W-LED(s) used in the system should be in the range of 5500°K –6500°K.
- (iii) W-LED(s) should not emit ultraviolet light.
- (iv) The light output from the W - LED should be constant throughout the duty cycle.
- (v) The housing should be suitable for indoor as well as outdoor use.

**ELECTRONICS**

- (i) Efficiency of the electronic system should be at least 85%.
- (ii) Electronics should have temperature compensation for proper charging of the battery throughout the year.
- (iii) The idle current should be less than 1 mA
- (iv) The PCB containing the electronics should be capable of solder free installation and replacement.
- (v) Necessary lengths of wires/ cables, switches suitable for DC use and other protections should be provided.
- (vi) The system should have a USB port for mobile charging.

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## ELECTRONIC PROTECTIONS

- (i) Adequate protection is to be incorporated for “No Load” condition, e.g. when the lamp is removed and the lantern is switched ON.
- (ii) The system should have protection against battery overcharge and deep discharge conditions.
- (iii) The load reconnect should be provided at around 80% of the battery capacity status.
- (iv) Adequate protection should be provided against battery reverse polarity.
- (v) A fuse should be provided to protect against short circuit conditions.
- (vi) Protection for reverse flow of current through the PV module should be provided.
- (vii) During the charging, lamp cannot be switched “ON”.

## INDICATORS

- The system should have two indicators, green and red.
- The green indicator should indicate the charging under progress and should glow only when the charging is taking place. It should stop glowing when the battery is fully charged.
- Red indicator should indicate the battery “Load Cut Off” condition.

## QUALITY AND WARRANTY

- (i) The complete Solar Lantern with W-LED will be warranted for five years.
- (ii) The **Battery** must be warranted for a minimum period of Two years for Model– I & Model-II **and FIVE years for Model – IA**
- (iii) The Warrantee/ Guarantee Card to be supplied with the Solar Lantern must contain the details of the system supplied.

# **TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)**

## **OPERATION and MAINTENANCE MANUAL**

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

- Basic principles of Photovoltaics.
- A small write-up (with a block diagram) on Solar Lanterns - its components, PV module, battery, electronics and luminaire and expected performance.
- Significance of indicators.
- Type, Model number, Voltage, capacity of the battery, used in the system.
- The make, model number, country of origin and technical characteristics (including IESNA LM-80 report) of W-LEDs used in the lighting system.
- Clear instructions on mounting, operation, regular maintenance and trouble shooting of the Solar Lantern.
- Instructions on replacement of battery.
- DO's and DONT's.
- Name and address of the contact person for repair and maintenance during the warranty.



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**2. WHITE-LED (W-LED) BASED SOLAR HOME LIGHTING SYSTEMS**

A solar home lighting system (SHS) provides a comfortable level of illumination in one or more rooms of a house. The SHS consists of a PV module, control electronics, battery, and luminaire(s). There are several SHS models featuring one, two, or four luminaires based on White Light Emitting Diode (W-LED). The system could also be used to run a small DC fan or a 12-V DC television along with the W-LED Lamps.

PV module converts sunlight into electricity, which powers the luminaire(s). White Light Emitting Diode (W-LED) is a solid state device which emits light when electric current passes through it.

**BROAD PERFORMANCE SPECIFICATIONS**

The broad performance specifications of a W-LED light source based solar home lighting system are given below:

Module	6-40 Watt peak under STC
Battery	Lead acid sealed maintenance free, tubular flooded or Gel / VRLA or NiMH or Lithium-Ion, or Lithium-Ferro Phosphate
Light Source	2.5 Watts (max.) White Light Emitting Diode (W-LED)
Light Out put	Minimum 15 Lux when measured at the periphery of 2.5 meter diameter from a height of 2.5 meter. At any point within area of 2.5mtr diameter periphery the light level should not be more than three times of the periphery value. The illumination should be uniform without Dark Bands or abrupt variations and soothing to the eyes. Higher output would be preferred.
Multiple Light Levels	To take care of different lighting needs as per user's requirement. The lamp should have multiple levels of light (at least two levels) to take care of different lighting needs during the night.
Mounting of light	Wall or ceiling
Electronics	Min 85 % efficiency

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Average duty cycle	5 hours a day under average daily insolation of 5.5 kWh/ sq.m. on a horizontal surface.
Facility for Mobile Charging	USB port for Mobile Charging. However, in case of mobile charging, the duty cycle for light to be reduced /adjusted accordingly.
Autonomy	3 days or Minimum 15 operating hours per permissible discharge. OR Minimum 6 operating hours per permissible discharge at full light level (In case of NiMH or Lithium-Ferro Phosphate)

**There are six models of W-LED home lighting systems. The configuration of each model is as follows:**

**Model-I One White LED luminaire**

PV Module 6 Wp under STC  
Battery Lead acid Sealed maintenance free, 12V-7 AH @ C/20  
or NiMH or Lithium-Ion of requisite capacity

**Model-IA One White LED luminaire**

PV Module 6 Wp under STC  
Battery capacity Lithium-Ferro Phosphate of 3X 3.2V, 1800 mAh (or requisite e.g. 12.8 x 1400mAh)

**Model- II Two White LED luminaire**

PV Module 12 Wp under STC  
Battery Lead acid Tubular flooded or Gel / VRLA, 12V - 12AH @ C/20

**Model -III Two White LED luminaires and one DC fan of wattage up to 10 W**

PV Module 24 Wp under STC  
Battery Lead acid Tubular flooded or Gel / VRLA, 12V- 20AH @ C/20

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**Model -IV      Four White LED luminaires**

PV Module      24 Wp under STC

Battery          Lead acid Tubular flooded or Gel / VRLA, 12V- 20AH @ C/20

It should have a socket to provide power for a 12V DC TV set which can be purchased separately.

**Model -V          Two White LED luminaires and one DC fan of wattage up to 20 W**

PV Module      40 Wp under STC

Battery          Lead acid Tubular flooded or Gel / VRLA, 12V- 40AH @ C/10

It should have a socket to provide power for a 12V DC TV set which can be purchased separately.

**TECHNICAL DETAILS**

**PV MODULE (S)**

- (i) Indigenously manufactured PV modules should be used
- (ii) The PV modules up to 12 Wp capacity should have crystalline silicon solar cells, and should have humidity, freeze and damp heat tests certificate conforming to IEC 61215 Edition II / BIS 14286 from an NABL or IECQ accredited Laboratory.
- (iii) The PV modules more than 12 Wp capacity should be made up of crystalline silicon solar cells and must have a certificate of testing conforming to IEC 61215 Edition II / BIS 14286 from an NABL or IECQ accredited Laboratory.
- (iv) The power output of the module(s) under STC should be a minimum of 6 Wp or 12 Wp or 24 Wp or 40 Wp.
- (v) The Load voltage\* of 16.40 V for 12 V battery or appropriate voltage for charging of battery used, under the standard test conditions (STC) of measurement.

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- (vi) **The module efficiency for PV modules up to 12 Wp capacity should not be less than 10%. The module efficiency for PV modules 24 Wp / 40 Wp capacity should not be less than 12%.**
- (vii) The terminal box on the module should have a provision for opening, for replacing the cable, if required.
- (viii) There should be a Name Plate fixed inside the module which will give:
  - a. Name of the Manufacturer or Distinctive Logo.
  - b. Model Number
  - c. Serial Number
  - d. Year of manufacture
- (ix) A distinctive serial number starting with NSM will be engraved on the frame of the module or screen printed on the tedlar sheet of the module.

\*The Load voltage conditions of the PV modules are not applicable for the system having MPPT.

**BATTERY**

- (i) For Model-I, sealed maintenance free lead acid battery with a capacity of up to 7 AH, at voltages of up to 12V @ C/20 rate of discharge or NiMH or Lithium Ion battery of requisite capacity.
- (ii) For Model-I-A,  
Lithium-Ferro Phosphate of 3X 3.2V, 1800 mAh (or requisite) capacity
- (iii) For Models – II, III , IV & V, battery should have a minimum rating of 12V, 12 Ah or 12V, 20 Ah at C/20 rate of discharge or 12 V,40 Ah at C/10 rate of discharge, depending on the Model.
- (iv) 90 % of the rated capacity of the battery should be between fully charged & load cut off conditions in case of Model- 1A.  
For other Models, 75 % of the rated capacity of the battery should be between fully charged & load cut off conditions.
- (v) Battery should conform to the latest BIS/ International standards.

# TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)

## LIGHT SOURCE

- (i) The light source will be of white LED type.
- (ii) The colour temperature of W-LEDs used in the system should be in the range of 5500°K–6500°K.
- (iii) LEDs should not emit ultraviolet light.
- (iv) The light output from the W-LED light source should be constant throughout the duty cycle.
- (v) The lamps should be housed in an assembly suitable for indoor use.

## ELECTRONICS

- i. The total electronic efficiency should be at least 85 %.
- ii. Electronics should have temperature compensation for proper charging of the battery throughout the year. The idle current should be **less than 2mA**.
- iii. The voltage drop from module terminals to the battery terminals should not exceed *0.8 volts* including the drop across the diode and the cable when measured at maximum charging current.
- iv. The PCB containing the electronics should be capable of solder free installation and replacement.
- v. Necessary lengths of wires/cables, switches suitable for DC use and fuses should be provided.
- vi. The system should have a USB port for mobile charging

## ELECTRONIC PROTECTIONS

- (i) Adequate protection is to be incorporated under “No Load” condition, e.g. when the lamps are removed and the system is switched ON.
- (ii) The system should have protection against battery overcharge, deep discharge condition.
- (iii) Load reconnect should be provided at 80% of the battery capacity status.
- (iv) Adequate protection should be provided against battery reverse polarity.
- (v) Fuses should be provided to protect against short circuit conditions.
- (vi) Protection for reverse flow of current through the PV module(s) should be provided.

# TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)

## MECHANICAL COMPONENTS

- (i) Corrosion resistant metallic frame structure should be provided to hold the SPV module.
- (ii) The frame structure should have provision to adjust its angle of inclination to the horizontal, so that it can be installed at the specified tilt angle.
- (iii) Light source should be either for wall mounted or ceiling mounted or can be hung from the ceiling in a stable manner, as per site requirements.
- (iv) A vented plastic/ wooden/ metallic box with acid proof corrosion resistant paint for housing the storage battery indoors should be provided.

## INDICATORS

- The system should have two indicators, green and red.
- The green indicator should indicate the charging under progress and should glow only when the charging is taking place. It should stop glowing when the battery is fully charged.
- Red indicator should indicate the battery “Load Cut Off” condition

## QUALITY AND WARRANTY

- (i) **The Solar home lighting system will be warranted for a period of five years from the date of supply.**
- (ii) **The PV module(s) will be warranted for a minimum period of 25 years from the date of supply.** PV modules used in Solar Home Lighting System 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 battery **for Model-I** should be warranted for a period of **at least two years**. The battery **for Models– IA, II, III, IV and V** should be warranted for **a period of 5 years**.
- (iv) The Warranty Card to be supplied with the system must contain the details of the system. The manufacturers can also provide additional information about the system and conditions of warranty as necessary.

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**OPERATION and MAINTENANCE MANUAL**

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

- Basic principles of Photovoltaics.
- A small write-up (with a block diagram) on Solar Home Lighting System - its components, PV module, battery, electronics and luminaire and expected performance.
- Significance of indicators.
- Type, Model number, voltage & capacity of the battery, used in the system.
- The make, model number, country of origin and technical characteristics (including IESNA LM-80 report) of W-LEDs used in the lighting system must be indicated in the manual.
- Clear instructions about mounting of PV module(s).
- Clear instructions on regular maintenance and trouble shooting of the Solar Home Lighting System.
- DO's and DONT's.
- Name and address of the contact person for repair and maintenance.

# TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)

## 3. WHITE-LED (W-LED) BASED SOLAR STREET LIGHTING SYSTEM

A standalone solar photovoltaic street lighting system (SLS) is an outdoor lighting unit used for illuminating a street or an open area. The Solar Street Lighting System consists of solar photovoltaic (SPV) module, a luminaire, storage battery, control electronics, inter-connecting wires/cables, module mounting pole including hardware and battery box. The luminaire is based on White Light Emitting Diode (W-LED), a solid state device which emits light when electric current passes through it. The luminaire is mounted on the pole at a suitable angle to maximize illumination on the ground. The PV module is placed at the top of the pole at an angle facing south so that it receives solar radiation throughout the day, without any shadow falling on it. A battery is placed in a box attached to the pole.

Electricity generated by the PV module charges the battery during the day time which powers the luminaire from dusk to dawn. The system lights at dusk and switches off at dawn automatically.

**There are four models of White-LED (W-LED) Based Solar Street Lighting Systems:**

### Model- I:

- **With Lead Acid Battery.**
- The Street light operates from dusk to dawn at **full Brightness.**

### Model- II

- **With Lead Acid Battery.**
- The Street light operates from dusk to dawn.
  - **First Four hours at full Brightness**
  - **And then, rest of the time at lower light level, with motion sensor.**
    - In case any movement is there, it senses it and glows to full level.
    - Then it comes back to lower level after sometime, automatically.



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### Model- III

- **With Lithium Ferro phosphate Battery.**
- The Street light operates from dusk to dawn at **full Brightness.**

### Model- IV

- **With Lithium Ferro phosphate Battery.**
- The Street light operates from dusk to dawn.
  - **First Four hours at full Brightness**
  - **And then, rest of the time at lower light level, with motion sensor.**
    - In case any movement is there, it senses it and glows to full level.
    - Then it comes back to lower level after sometime, automatically.

**The configuration of each model with Specifications is described below:**

### MODEL- I:

- **With Lead Acid Battery.**
- **Operates from dusk to dawn at full Brightness.**

### BROAD PERFORMANCE SPECIFICATIONS

PV Module	40 Wp under STC
Battery	Lead acid Tubular Flooded or Tubular GEL / VRLA , 12V- 40 AH @ C/10
Light Source	White Light Emitting Diode (W-LED) 7 Watt (Max.), W-LED luminaire, dispersed beam, soothing to eyes with the use of proper optics and diffuser
Light Out put	Minimum 16 Lux when measured at the periphery of 4 meter diameter from a height of 4 meter. The illumination should be uniform without dark bands or abrupt variations, and soothing to the eye. Higher light output will be preferred.

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Mounting of light	Pole mounted, Minimum 4 meters above the ground level
Electronics Efficiency	Minimum 85% total
Duty Cycle	Dusk to dawn at full brightness
Autonomy	3 days or Minimum 42 operating hours per permissible discharge

**TECHNICAL DETAILS**

**PV MODULE**

- i. Indigenously manufactured PV module should be used.
- ii. The PV module should have crystalline silicon solar cells and must have a certificate of testing conforming to IEC 61215 Edition II / BIS 14286 from an NABL or IECQ accredited Laboratory.
- iii. The power output of the module(s) under STC should be a minimum of 40 Wp at a load voltage\* of  $16.4 \pm 0.2$  V.
- iv. The open circuit voltage\* of the PV modules under STC should be at least 21.0 Volts.
- v. **The module efficiency should not be less than 12 %.**
- vi. The terminal box on the module should have a provision for opening it for replacing the cable, if required.
- vii. There should be a Name Plate fixed inside the module which will give:
  - a. Name of the Manufacturer or Distinctive Logo.
  - b. Model Number
  - c. Serial Number
  - d. Year of manufacture
- viii. A distinctive serial number starting with NSM will be engraved on the frame of the module or screen printed on the tedlar sheet of the module.

\*The load voltage and Voc conditions of the PV modules are not applicable for the system having MPPT based charge controller

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**BATTERY**

- i. Lead Acid, tubular positive plate flooded electrolyte or Gel / VRLA Type.
- ii. The battery will have a minimum rating of 12V, 40 Ah at C/10 discharge rate.
- iii. 75 % of the rated capacity of the battery should be between fully charged and load cut off conditions.
- iv. Battery should conform to the latest BIS/ International standards.

**LIGHT SOURCE**

- i. The light source will be a white LED type.
- ii. The colour temperature of white LED used in the system should be in the range of 5500°K–6500°K.
- iii. W-LEDs should not emit ultraviolet light.
- iv. The light output from the white LED light source should be constant throughout the duty cycle.
- v. The lamps should be housed in an assembly suitable for outdoor use.
- vi. The temperature of heat sink should not increase more than 20°C above ambient temperature during the dusk to dawn operation.

**ELECTRONICS**

- i. The total electronic efficiency should be at least 85%.
- ii. Electronics should operate at 12 V and should have temperature compensation for proper charging of the battery throughout the year.
- iii. No Load current consumption should be less than 20 mA.
- iv. The PV module itself should be used to sense the ambient light level for switching ON and OFF the lamp.
- v. The PCB containing the electronics should be capable of solder free installation and replacement.
- vi. Necessary lengths of wires/cables, switches suitable for DC use and fuses should be provided.

**ELECTRONIC PROTECTIONS**

## **TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)**

- i. Adequate protection is to be incorporated under “No Load” conditions e.g. when the lamp is removed and the system is switched ON.
- ii. The system should have protection against battery overcharge and deep discharge conditions.
- iii. Fuse should be provided to protect against short circuit conditions.
- iv. Protection for reverse flow of current through the PV module(s) should be provided.
- v. Electronics should have temperature compensation for proper charging of the battery throughout the year.
- vi. Adequate protection should be provided against battery reverse polarity.
- vii. Load reconnect should be provided at 80% of the battery capacity status.

### **MECHANICAL COMPONENTS**

- i. A corrosion resistant metallic frame structure should be fixed on the pole to hold the SPV module.
- ii. The frame structure should have provision to adjust its angle of inclination to the horizontal, so that it can be installed at the specified tilt angle.
- iii. The pole should be made of Galvanised Iron (GI) pipe.
- iv. The height of the pole should be 4 metres above the ground level, after grouting and final installation.
- v. The pole should have the provision to hold the luminaire.
- vi. The lamp housing should be water proof and should be painted with a corrosion resistant paint.
- vii. A vented, acid proof and corrosion resistant metallic box **or plastic box [made of Polypropylene Copolymer (PP-CP)]** with a locking arrangement for outdoor use should be provided for housing the battery.

### **INDICATORS**

- The system should have two indicators, green and red.
- The green indicator should indicate the charging under progress and should glow only when the charging is taking place. It should stop glowing when the battery is fully charged.
- Red indicator should indicate the battery “Load Cut Off” condition.

# **TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)**

## **QUALITY AND 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 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 Warranty Card to be supplied with the system must contain the details of the system.

## **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:

- Basic principles of Photovoltaics.
- A small write-up (with a block diagram) on Solar Street Lighting System - its components, PV module, battery, electronics and luminaire and expected performance.
- Type, Model number, Voltage & capacity of the battery, used in the system.
- The make, model number, country of origin and technical characteristics (including IESNA LM-80 report) of W-LEDs used in the lighting system.
- About Charging and Significance of indicators.
- Clear instructions about erection of pole and mounting of PV module (s) and lamp housing assembly on the pole.
- Clear instructions on regular maintenance and trouble shooting of the Solar Street Lighting System.
- 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.

## **MODEL- II**

- **With Lead Acid Battery**
- **Operates dusk to dawn, First 4 Hours at full Brightness, rest of the time at lower light level, with motion sensor.**

**TECHNICAL SPECIFICATIONS FOR  
SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS  
(Off-grid Solar Applications Scheme 2016-17)**

**BROAD PERFORMANCE SPECIFICATIONS**

PV Module	30 Wp under STC
Battery	Lead acid Tubular Flooded or Tubular GEL / VRLA , 12V- 20 AH @ C/20
Light Source	White Light Emitting Diode (W-LED) 7 Watt (Max.), W-LED luminaire, dispersed beam, soothing to eyes with the use of proper optics and diffuser
Light Out put	Multiple Light levels: The lamp should have two levels of light to take care of different lighting needs during the night. <ul style="list-style-type: none"> <li>• <b>Minimum 16 Lux when measured at the periphery of 4 meter diameter from a height of 4 meter (at “High” illumination level). The illumination should be uniform without dark bands or abrupt variations.</b></li> <li>• <b>Minimum 8 lux at lower illumination level</b></li> </ul> <p>(Higher light output will be preferred)</p>
Mounting of light	Pole mounted, Minimum 4 meters above the ground level
Electronics Efficiency	Minimum 85% total
Duty Cycle	Dusk to Dawn 4 Hours full light, rest of the time at lower light level, with motion sensor. <ul style="list-style-type: none"> <li>• In case any movement is there, it senses it and glows to full level.</li> <li>• Then it comes back to lower level after sometime, automatically.</li> </ul>
Autonomy	3 days or Minimum 42 operating hours per permissible discharge

# TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)

## TECHNICAL DETAILS

### PV MODULE

- i. Indigenously manufactured PV module should be used.
- ii. The PV module should have crystalline silicon solar cells and must have a certificate of testing conforming to IEC 61215 Edition II / BIS 14286 from an NABL or IECQ accredited Laboratory.
- iii. The power output of the module(s) under STC should be a minimum of 40 Wp at a load voltage\* of  $16.4 \pm 0.2$  V.
- iv. The open circuit voltage\* of the PV modules under STC should be at least 21.0 Volts.
- v. **The module efficiency should not be less than 12 %.**
- vi. The terminal box on the module should have a provision for opening it for replacing the cable, if required.
- vii. There should be a Name Plate fixed inside the module which will give:
  - a. Name of the Manufacturer or Distinctive Logo.
  - b. Model Number
  - c. Serial Number
  - d. Year of manufacture
- viii. A distinctive serial number starting with NSM will be engraved on the frame of the module or screen printed on the tedlar sheet of the module.

\*The load voltage and Voc conditions of the PV modules are not applicable for the system having MPPT based charge controller

### BATTERY

- i. Lead Acid, tubular positive plate flooded electrolyte or Gel / VRLA Type.
- ii. The battery will have a minimum rating of 12V, 20 Ah at C/20 discharge rate.
- iii. 75 % of the rated capacity of the battery should be between fully charged and load cut off conditions.
- iv. Battery should conform to the latest BIS/ International standards.

**TECHNICAL SPECIFICATIONS FOR  
SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS  
(Off-grid Solar Applications Scheme 2016-17)**

**LIGHT SOURCE**

- i. The light source will be a white LED type.
- ii. The colour temperature of white LED used in the system should be in the range of 5500°K–6500°K.
- iii. W-LEDs should not emit ultraviolet light.
- iv. The light output from the white LED light source should be constant throughout the duty cycle.
- v. The lamps should be housed in an assembly suitable for outdoor use.
- vi. The temperature of heat sink should not increase more than 20°C above ambient temperature during the dusk to dawn operation.

**ELECTRONICS**

- i. The total electronic efficiency should be at least 85%.
- ii. Electronics should operate at 12 V and should have temperature compensation for proper charging of the battery throughout the year.
- iii. No Load current consumption should be less than 20 mA.
- iv. The PV module itself should be used to sense the ambient light level for switching ON and OFF the lamp.
- v. The PCB containing the electronics should be capable of solder free installation and replacement.
- vi. Necessary lengths of wires/cables, switches suitable for DC use and fuses should be provided.

**ELECTRONIC PROTECTIONS**

- i. Adequate protection is to be incorporated under “No Load” conditions e.g. when the lamp is removed and the system is switched ON.
- ii. The system should have protection against battery overcharge and deep discharge conditions.
- iii. Fuse should be provided to protect against short circuit conditions.
- iv. Protection for reverse flow of current through the PV module(s) should be provided.
- v. Electronics should have temperature compensation for proper charging of the battery throughout the year.
- vi. Adequate protection should be provided against battery reverse polarity.



**TECHNICAL SPECIFICATIONS FOR  
SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS  
(Off-grid Solar Applications Scheme 2016-17)**

- vii. Load reconnect should be provided at 80% of the battery capacity status.

**MECHANICAL COMPONENTS**

- i. A corrosion resistant metallic frame structure should be fixed on the pole to hold the SPV module.
- ii. The frame structure should have provision to adjust its angle of inclination to the horizontal, so that it can be installed at the specified tilt angle.
- iii. The pole should be made of Galvanised Iron (GI) pipe.
- iv. The height of the pole should be 4 metres above the ground level, after grouting and final installation.
- v. The pole should have the provision to hold the luminaire.
- vi. The lamp housing should be water proof and should be painted with a corrosion resistant paint.
- vii. A vented, acid proof and corrosion resistant metallic box **or plastic box [made of Polypropylene Copolymer (PP-CP)]** with a locking arrangement for outdoor use should be provided for housing the battery.

**INDICATORS**

- The system should have two indicators, green and red.
- The green indicator should indicate the charging under progress and should glow only when the charging is taking place. It should stop glowing when the battery is fully charged.
- Red indicator should indicate the battery “Load Cut Off” condition.

**QUALITY AND 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 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 Warranty Card to be supplied with the system must contain the details of the system.

## TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)

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:

- Basic principles of Photovoltaics.
- A small write-up (with a block diagram) on Solar Street Lighting System - its components, PV module, battery, electronics and luminaire and expected performance.
- Type, Model number, Voltage & capacity of the battery, used in the system.
- The make, model number, country of origin and technical characteristics (including IESNA LM-80 report) of W-LEDs used in the lighting system.
- About Charging and Significance of indicators.
- Clear instructions about erection of pole and mounting of PV module (s) and lamp housing assembly on the pole.
- Clear instructions on regular maintenance and trouble shooting of the Solar Street Lighting System.
- 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.

### MODEL- III

- **With Lithium Ferro phosphate Battery;**
- **Operates from dusk to dawn at full Brightness**

### BROAD PERFORMANCE SPECIFICATIONS

PV Module	40 Wp under STC
Battery	Minimum 160 Wh Lithium Ferro phosphate battery
Light Source	White Light Emitting Diode (W-LED) 7 Watt (Max.), W-LED luminaire, dispersed beam, soothing to eyes with the use of proper optics and diffuser

**TECHNICAL SPECIFICATIONS FOR  
SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS  
(Off-grid Solar Applications Scheme 2016-17)**

Light Out put	Minimum 16 Lux when measured at the periphery of 4 meter diameter from a height of 4 meter. 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	Pole mounted, Minimum 5 meters above the ground level
Electronics Efficiency	Minimum 85% total
Duty Cycle	Dusk to dawn

**TECHNICAL DETAILS**

**PV MODULE**

- i. Indigenously manufactured PV module should be used.
- ii. The PV module should have crystalline silicon solar cells and must have a certificate of testing conforming to IEC 61215 Edition II / BIS 14286 from an NABL or IECQ accredited Laboratory.
- iii. The power output of the module(s) under STC should be a minimum of 40 Wp at a load voltage\* of  $16.4 \pm 0.2$  V.
- iv. The open circuit voltage\* of the PV modules under STC should be at least 21.0 Volts.
- v. **The module efficiency should not be less than 12 %.**
- vi. The terminal box on the module should have a provision for opening it for replacing the cable, if required.
- vii. There should be a Name Plate fixed inside the module which will give:
  - a. Name of the Manufacturer or Distinctive Logo.
  - b. Model Number
  - c. Serial Number
  - d. Year of manufacture
- viii. A distinctive serial number starting with NSM will be engraved on the frame of the module or screen printed on the tedlar sheet of the module.

\*The load voltage and Voc conditions of the PV modules are not applicable for the system having MPPT based charge controller

# **TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)**

## **BATTERY**

- i. Minimum 160 Wh capacity Lithium Ferro Phosphate Battery.
- ii. Battery should conform to the latest BIS/ International standards.

## **LIGHT SOURCE**

- i. The light source will be a white LED type.
- ii. The colour temperature of white LED used in the system should be in the range of 5500°K–6500°K.
- iii. W-LEDs should not emit ultraviolet light.
- iv. The light output from the white LED light source should be constant throughout the duty cycle.
- v. The lamps should be housed in an assembly suitable for outdoor use.
- vi. The temperature of heat sink should not increase more than 20°C above ambient temperature during the dusk to dawn operation.

## **ELECTRONICS**

- i. The total electronic efficiency should be at least 85%.
- ii. Electronics should operate at 12 V and should have temperature compensation for proper charging of the battery throughout the year.
- iii. No Load current consumption should be less than 20 mA.
- iv. The PV module itself should be used to sense the ambient light level for switching ON and OFF the lamp.
- v. The PCB containing the electronics should be capable of solder free installation and replacement.
- vi. Necessary lengths of wires/cables, switches suitable for DC use and fuses should be provided.

## **ELECTRONIC PROTECTIONS**

- i. Adequate protection is to be incorporated under “No Load” conditions e.g. when the lamp is removed and the system is switched ON.
- ii. The system should have protection against battery overcharge and deep discharge conditions.
- iii. Fuse should be provided to protect against short circuit conditions.

## **TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)**

- iv. Protection for reverse flow of current through the PV module(s) should be provided.
- v. Electronics should have temperature compensation for proper charging of the battery throughout the year.
- vi. Adequate protection should be provided against battery reverse polarity.
- vii. Load reconnect should be provided at 80% of the battery capacity status.

### **MECHANICAL COMPONENTS**

- (i) A corrosion resistant metallic frame structure should be fixed on the pole to hold the SPV module.
- (ii) The frame structure should have provision so that the module can be oriented at the suitable tilt angle.
- (iii) The pole should be made of Galvanised Iron (GI) pipe.
- (iv) The height of the pole should be 5 metres above the ground level, after grouting and final installation.
- (v) The pole should have the provision to hold the luminaire.
- (vi) The Luminaire housing should be water proof (IP 65) and should be painted with a corrosion resistant paint and should be housing the battery. Alternatively, A vented, acid proof and corrosion resistant metallic box **or plastic box [made of Polypropylene-Copolymer (PP-CP)]** with a locking arrangement for outdoor use should be provided for housing the battery.

### **INDICATORS**

- The system should have two indicators, green and red.
- The green indicator should indicate the charging under progress and should glow only when the charging is taking place. It should stop glowing when the battery is fully charged.
- Red indicator should indicate the battery “Load Cut Off” condition.

### **QUALITY AND WARRANTY**

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

## **TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)**

- ii. **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 Warranty Card to be supplied with the system must contain the details of the system.

### **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:

- Basic principles of Photovoltaics.
- A small write-up (with a block diagram) on Solar Street Lighting System - its components, PV module, battery, electronics and luminaire and expected performance.
- Type, Model number, Voltage & capacity of the battery, used in the system.
- The make, model number, country of origin and technical characteristics (including IESNA LM-80 report) of W-LEDs used in the lighting system.
- About Charging and Significance of indicators.
- Clear instructions about erection of pole and mounting of PV module (s) and lamp housing assembly on the pole.
- Clear instructions on regular maintenance and trouble shooting of the Solar Street Lighting System.
- 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.

### **MODEL- IV**

- **With Lithium Ferro phosphate Battery**
- **Operates dusk to dawn, First 4 Hours at full Brightness, rest of the time at lower light level, with motion sensor.**

**TECHNICAL SPECIFICATIONS FOR  
SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS  
(Off-grid Solar Applications Scheme 2016-17)**

**BROAD PERFORMANCE SPECIFICATIONS**

PV Module	30 Wp under STC
Battery	Minimum 120 Wh Lithium Ferro phosphate battery
Light Source	White Light Emitting Diode (W-LED) 7 Watt (Max.), W-LED luminaire, dispersed beam, soothing to eyes with the use of proper optics and diffuser
Light Out put	Multiple Light levels: The lamp should have two levels of light to take care of different lighting needs during the night. <ul style="list-style-type: none"> <li>• <b>Minimum 16 Lux when measured at the periphery of 4 meter diameter from a height of 4 meter (at “High” illumination level). The illumination should be uniform without dark bands or abrupt variations.</b></li> <li>• <b>Minimum 8 lux at lower illumination level</b> (Higher light output will be preferred)</li> </ul>
Mounting of light	Pole mounted, Minimum 5 meters above the ground level
Electronics	Overall total Efficiency of the Electronics should be Minimum 90%
Duty Cycle	Dusk to Dawn  4 Hours full light, rest of the time at lower light level, <b>with motion sensor.</b> <ul style="list-style-type: none"> <li>• In case any movement is there, it senses it and glows to full level.</li> <li>• Then it comes back to lower level after sometime, automatically.</li> </ul>

# TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)

## TECHNICAL DETAILS

### PV MODULE

- i. Indigenously manufactured PV modules should be used.
- ii. The power output of the module under STC should be a minimum of 30 Wp.
- iii. The PV module should be made up of crystalline silicon solar cells and must have a certificate of testing conforming to IEC 61215 Edition II / BIS 14286 from an NABL or IECQ accredited Laboratory.
- iv. The Load voltage\* of 16.40 V for 12 V battery or appropriate voltage for charging of battery used, under the standard test conditions (STC) of measurement.
- v. **The module efficiency should not be less than 12 %.**
- vi. The terminal box on the module should have a provision for opening, for replacing the cable, if required.
- vii. There should be a Name Plate fixed inside the module which will give:
  - a. Name of the Manufacturer or Distinctive Logo.
  - b. Model Number
  - c. Serial Number
  - d. Year of manufacture
- viii. A distinctive serial number starting with NSM will be engraved on the frame of the module or screen printed on the tedlar sheet of the module.

\*The Load voltage conditions of the PV modules are not applicable for the system having MPPT.

### BATTERY

- i. Minimum 120 Wh Lithium Ferro Phosphate Battery.
- ii. Battery should conform to the latest BIS/ International standards.

### LIGHT SOURCE



**TECHNICAL SPECIFICATIONS FOR  
SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS  
(Off-grid Solar Applications Scheme 2016-17)**

- i. The light source will be of white LED type.
- ii. The colour temperature of W-LEDs used in the system should be in the range of 5500°K–6500°K.
- iii. LEDs should not emit ultraviolet light.
- iv. The light output from the W-LED light source should be constant throughout the duty cycle.
  
- v. The lamps should be housed in an assembly suitable for outdoor use.

**ELECTRONICS**

- i. The total electronic efficiency should be at least 85 %.
- ii. The idle current should be less than 10ma
- iii. The voltage drop from module terminals to the battery terminals should not exceed 0.8 volts including the drop across the diode and the cable when measured at maximum charging current.
- iv. The PCB containing the electronics should be capable of solder free installation and replacement.

**ELECTRONIC PROTECTIONS**

- i. The system should have protection against battery overcharge, deep discharge condition.
- ii. Adequate protection should be provided against battery reverse polarity.
- iii. Fuses should be provided to protect against short circuit conditions. Fuse is not mandatory, in case, over current protection is provided in the driver circuit.
- iv. Protection for reverse flow of current through the PV module(s) should be provided.

**MECHANICAL COMPONENTS**

- i. A corrosion resistant metallic frame structure should be fixed on the pole to hold the SPV module.

## **TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)**

- ii. The frame structure should have provision so that the module can be oriented at the suitable tilt angle.
- iii. The pole should be made of Galvanised Iron (GI) pipe.
- iv. The height of the pole should be 5 metres above the ground level, after grouting and final installation.
- v. The pole should have the provision to hold the luminaire.
- vi. The Luminaire housing should be water proof (IP 65) and should be painted with a corrosion resistant paint and should be housing the battery.

Alternatively:

A vented, acid proof and corrosion resistant metallic box or plastic box [made of Polypropylene-Copolymer (PP-CP)] with a locking arrangement for outdoor use should be provided for housing the battery.

### **INDICATORS**

- The system should have two indicators, green and red.
- The green indicator should indicate the charging under progress and should glow only when the charging is taking place. It should stop glowing when the battery is fully charged.
- Red indicator should indicate the battery “Load Cut Off” condition

### **QUALITY AND WARRANTY**

- i. **The complete Solar Street Lighting System (including battery) will be warranted for a period of Five years from the date of supply.**
- ii. **The PV module(s) will be warranted for a minimum period of 25 years from the date of supply.** PV modules used in Solar Home Lighting System 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 Warranty Card to be supplied with the system must contain the details of the system. The manufacturers can also provide additional information about the system and conditions of warranty as necessary.

# **TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)**

## **OPERATION and MAINTENANCE MANUAL**

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

- Basic principles of Photovoltaics.
- A small write-up (with a block diagram) on Solar Home Lighting System - its components, PV module, battery, electronics and luminaire and expected performance.
- Significance of indicators.
- Type, Model number, voltage & capacity of the battery, used in the system.
- The make, model number, country of origin and technical characteristics (including IESNA LM-80 report) of W-LEDs used in the lighting system must be indicated in the manual.
- Clear instructions about mounting of PV module(s).
- Clear instructions on regular maintenance and trouble shooting of the Solar Home Lighting System.
- DO's and DONT's.

# TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)

## 4. WHITE LED (W-LED) BASED 'SOLAR STUDY LAMP'

A '**Solar Study Lamp**' is a lighting device consisting of a PV module, battery, lamp, and electronics. Battery, lamp, and electronics are placed in a suitable housing. The Solar Study Lamp is especially suitable for study purposes. Lamp look is similar to table lamp, lamp base connected to LED with gooseneck type of arrangement

PV module converts sun light into electricity, charges the battery which powers the luminaire. Luminaire consists of White Light Emitting Diode (W-LED), a solid state device which emits light when an electric current passes through it.

**There are two Models of Solar Study Lamps:**

### Model I

The Solar lamp is designed to provide 4-5 hours of study light every day throughout the year.

### Model II

- The Solar lamp is designed to provide 4-5 hours of study light every day throughout the year.
- **There is an additional provision for Mobile Phone Charging in emergency** to charge Mobile phone battery up to 1000mAH capacity

**The configuration of each model with Specifications is described below:**

### Model I

**Broad Technical Specifications:**

PV Module                      2.5 Wp under STC

Battery                              **Lithium-Ferro Phosphate of 3.2V, 2000 mAh**

Light Source                      1 Watt W-LED luminaire, dispersed beam, soothing to eyes with the use of proper optics and diffuser

**TECHNICAL SPECIFICATIONS FOR  
SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS  
(Off-grid Solar Applications Scheme 2016-17)**

Light Output	Study lamp should deliver minimum of 150 Lux at over an area of 1.5 feet Diameter from a height of 1.0 foot.  [Minimum 150 Lux when measured at the periphery of 45 centimetres diameter from a height of 30 centimetres.]
Run Time	5 hours a day under average daily insolation of 5.5 kWh/ sq.m. on a horizontal surface.

**TECHNICAL DETAILS**

**PV MODULE**

- (i) Indigenously manufactured PV modules should be used in the Solar Study Lamp.
- (ii) The PV module should have crystalline silicon solar cells, and should have **humidity, freeze, thermal cycling and damp heat tests certificate conforming** to IEC 61215 Edition II / BIS 14286 from an NABL or IECQ accredited Laboratory.
- (iii) The PV module must have a minimum of 2.5 Wp at an appropriate voltage for charging of battery used, under the standard test conditions (STC) of measurement.
- (iv) There should preferably be an arrangement (stand) for mounting the module at an optimum angle in the direction facing the sun.
- (v) A foil/ strip containing the following details should be fixed inside on the module so as to be clearly visible from the front side:-
  - a) Name of the Manufacturer and/ or distinctive Logo
  - b) Model and/ or Type No.
  - c) Serial No.
  - d) Year of manufacture
- VI. A distinctive serial number starting with NSM will be engraved on the frame of the module or screen printed on the tedlar sheet of the module.

**BATTERY**

- i. **Rechargeable Lithium-Ferro Phosphate (LiFePO<sub>4</sub>)**

## **TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)**

- ii. Capacity: 3.2V, 2000 mAh
- iii. Number of charge-discharge cycles: >2000
- iv. Permissible Depth of Discharge (D o D): Up to 85%
- v. Battery should conform to the latest BIS/ International standards.

### **LIGHT SOURCE**

- I. The light source should be 1.0 Watts (max.) luminaire based on White Light Emitting Diode (W-LED).
- II. It should be dispersed beam, soothing to eyes with the use of proper optics and diffuser.
- III. Illuminance:
  - Minimum 150 Lux\* over an area of 1.5 feet diameter (when the height of Luminaire is kept 1 feet above the table)
  - (\* At the time of test, Luminaire would be horizontal and is kept 1 feet above the test bench such that there is no shadow of the lamp body)
- IV. Luminous performance of LED: Minimum 150 lumens per watt
- V. The colour temperature of W-LED(s) used in the system should be in the range of 5500°K –6500°K.
- VI. W-LED(s) should not emit ultraviolet light.
- VII. The light output from the W - LED should be constant throughout the duty cycle.

### **ELECTRONICS**

- I. Charging should be with 'MPPT' type micro controller based charger.
- II. Efficiency of the electronic system should be at least 85%.
- III. Electronics should have temperature compensation for proper charging of the battery throughout the year.
- IV. The idle current should be less than 1 mA
- V. The PCB containing the electronics should be capable of solder free installation and replacement.
- VI. Necessary lengths of wires/ cables, switches suitable for DC use and other protections should be provided.
- VII. The system should have a USB port for mobile charging

# TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)

## ELECTRONIC PROTECTIONS

- I. Adequate protection is to be incorporated for “No Load” condition, e.g. when the lamp is removed and the Solar Study Lamp is switched ON.
- II. The system should have protection against battery overcharge and deep discharge conditions.
- III. The load reconnect should be provided at around 80% of the battery capacity status.
- IV. Adequate protection should be provided against battery reverse polarity.
- V. A fuse should be provided to protect against short circuit conditions.
- VI. Protection for reverse flow of current through the PV module should be provided.
- VII. During the charging, lamp cannot be switched “ON”.

## INDICATORS

- The system should have two indicators, green and red.
- The green indicator should indicate the charging under progress and should glow only when the charging is taking place. It should stop glowing when the battery is fully charged.
- Red indicator should indicate the battery “Load Cut Off” condition.

## QUALITY AND WARRANTY

- I. The **complete Solar Study Lamp** will be warranted for five years.
- II. The battery should be warranted for **a period of 5 years**.
- III. The Warrantee/ Guarantee Card to be supplied with the Solar Study Lamp must contain the details of the system supplied.

# TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)

## OPERATION and MAINTENANCE MANUAL

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

- Basic principles of Photovoltaics.
- A small write-up (with a block diagram) on Solar Study Lamp - its components, PV module, battery, electronics and luminaire and expected performance.
- Significance of indicators.
- Type, Model number, Voltage, capacity of the battery, used in the system.
- The make, model number, country of origin and technical characteristics (including IESNA LM-80 report) of W-LEDs used in the lighting system.
- Clear instructions on mounting, operation, regular maintenance and trouble shooting of the Solar Study Lamp.
- Instructions on replacement of battery.
- DO's and DONT's.

## Model II

**There is a provision for Mobile Phone Charging in emergency** to charge Mobile phone battery up to 1000mAH capacity. The Mobile phone battery should be charged preferably during day time to save on the system battery. If the system's battery is discharged to 60 % state of Charge, the Mobile phone charging would be cut off (to save it for Lighting purpose).

### Broad Technical Specifications:

PV Module                      5 Wp under STC

Battery                              **Lithium-Ferro Phosphate of 3.2V, 2000 mAh**



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Light Source	1 Watt W-LED luminaire, dispersed beam, soothing to eyes with the use of proper optics and diffuser
Light Output	Study lamp should deliver minimum of 150 Lux at over an area of 1.5 feet Diameter from a height of 1.0 foot.  [Minimum 150 Lux when measured at the periphery of 45 centimetres diameter from a height of 30 centimetres.]
Run Time	5 hours a day under average daily insolation of 5.5 kWh/ sq.m. on a horizontal surface.
<b>USB Port</b>	<b>Provision for Mobile Phone Charging</b>  To charge up to 1000mAH capacity of Mobile phone battery, preferably during day time. At least 60 % state of charge of the battery to be reserved for lighting, (i.e. As soon as the system battery is discharged to 60 % state of Charge, Mobile phone charging to cut off).

**TECHNICAL DETAILS**

**PV MODULE**

- I. Indigenously manufactured PV modules should be used in the Solar Study Lamp.
- II. The PV module should have crystalline silicon solar cells, and should have **humidity; freeze, thermal cycling and damp heat tests certificate conforming** to IEC 61215 Edition II / BIS 14286 from an NABL or IECQ accredited Laboratory.
- III. The PV module must have a minimum of 5 Wp at an appropriate voltage for charging of battery used, under the standard test conditions (STC) of measurement.
- IV. There should preferably be an arrangement (stand) for mounting the module at an optimum angle in the direction facing the sun.
- V. A foil/ strip containing the following details should be fixed inside on the module so as to be clearly visible from the front side:-
  - a) Name of the Manufacturer and/ or distinctive Logo
  - b) Model and/ or Type No.

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c) Serial No.

d) Year of manufacture

VI. A distinctive serial number starting with NSM will be engraved on the frame of the module or screen printed on the tedlar sheet of the module.

**BATTERY**

- i. Rechargeable **Lithium-Ferro Phosphate** (LiFePO<sub>4</sub>)
- ii. **Capacity: 3.2V, 2000 mAh**
- iii. Number of charge-discharge cycles: >2000
- iv. Permissible Depth of Discharge (D o D): Up to 85%
- v. Battery should conform to the latest BIS/ International standards.

**LIGHT SOURCE**

- I. The light source should be 1.0 Watts (max.) luminaire based on White Light Emitting Diode (W-LED).
- II. It should be dispersed beam, soothing to eyes with the use of proper optics and diffuser.
- III. Illuminance:
  - Minimum 150 Lux\* over an area of 1.5 feet diameter (when the height of Luminaire is kept 1 feet above the table)
  - (\* At the time of test, Luminaire would be horizontal and is kept 1 feet above the test bench such that there is no shadow of the lamp body)
- IV. Luminous performance of LED: Minimum 150 lumens per watt
- V. The colour temperature of W-LED(s) used in the system should be in the range of 5500°K –6500°K.
- VI. W-LED(s) should not emit ultraviolet light.
- VII. The light output from the W - LED should be constant throughout the duty cycle.

**ELECTRONICS**

- I. Charging should be with 'MPPT' type micro controller based charger.

## **TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)**

- II. Facility for Mobile Phone Battery Charging:
  - USB port to charge Mobile phone battery up to 1000mAH capacity.
  - The Mobile phone battery to be charged preferably during day time so as to save on the system's battery.
  - As soon as the system battery is discharged to 60 % state of Charge, Mobile phone charging would be cut off (i.e. at least 60 % state of charge of the battery should always be reserved for lighting)
- III. Efficiency of the electronic system should be at least 85%.
- IV. Electronics should have temperature compensation for proper charging of the battery throughout the year.
- V. The idle current should be less than 1 mA
- VI. The PCB containing the electronics should be capable of solder free installation and replacement.
- VII. Necessary lengths of wires/ cables, switches suitable for DC use and other protections should be provided.

### **ELECTRONIC PROTECTIONS**

- I. Adequate protection is to be incorporated for "No Load" condition, e.g. when the lamp is removed and the Solar Study Lamp is switched ON.
- II. The system should have protection against battery overcharge and deep discharge conditions.
- III. The load reconnect should be provided at around 80% of the battery capacity status.
- IV. Adequate protection should be provided against battery reverse polarity.
- V. A fuse should be provided to protect against short circuit conditions.
- VI. Protection for reverse flow of current through the PV module should be provided.
- VII. During the charging, lamp cannot be switched "ON".

### **INDICATORS**

- The system should have two indicators, green and red.
- The green indicator should indicate the charging under progress and should glow only when the charging is taking place. It should stop glowing when the battery is fully charged.

## **TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)**

- Red indicator should indicate the battery “Load Cut Off” condition.

### **QUALITY AND WARRANTY**

- I. The **complete Solar Study Lamp** will be warranted for five years.
- II. The battery should be warranted for **a period of 5 years**.
- III. The Warrantee/ Guarantee Card to be supplied with the Solar Study Lamp must contain the details of the system supplied.

### **OPERATION and MAINTENANCE MANUAL**

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

- Basic principles of Photovoltaics.
- A small write-up (with a block diagram) on Solar Study Lamp - its components, PV module, battery, electronics and luminaire and expected performance.
- Significance of indicators.
- Type, Model number, Voltage, capacity of the battery, used in the system.
- The make, model number, country of origin and technical characteristics (including IESNA LM-80 report) of W-LEDs used in the lighting system.
- Clear instructions on mounting, operation, regular maintenance and trouble shooting of the Solar Study Lamp.
- Instructions on replacement of battery.
- DO's and DONT's.
- Name and address of the contact person for repair and maintenance during the warranty.

# TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)

## 5. PV INTEGRATED MICRO SOLAR DOME (PVi MSD)

PV integrated Micro Solar Dome (PViMSD) is based on the Principle of passive as well as active solar device and gives day and night lighting solution.

### **Description:**

Dome type day lighting device has a transparent semi-spherical upper dome made of acrylic material which captures the sunlight and the light passes through a sun-tube, having a thin layer of highly reflective coating on the inner wall of the passage. It also contains a lower dome made of acrylic. There is a shutter in the bottom of the lower dome which can be closed to give dimming effect of light in the daytime if required. The shutter is made of polycarbonate sheet pasted with film. The shutter keeps the room cool and also controls the illumination level as per requirement.

### **Functioning of PV integrated Micro Solar Dome**

#### **1. Day-time:**

The Sun light is captured by the upper dome from all corners and thereafter the light is passed through a sun tube lined with a highly reflective coating, The tube generally have a diameter of 152.4mm(6 inch). The length of the tube is also 152.4mm(6 inch). The concentrated light is then captured by lower dome through which it is spread out in the whole room. There is one shutter fitted in the lower part of the PV integrated Micro Solar Dome. The shutter can be closed manually to control the light entering in the room. Even the shutter could control the light partially. The dome operates for whole day with output equivalent to 30 to 1500 Lux when measured at the periphery of 2.5 meter diameter from a height of 2.5 meter.

#### **2. Night-time:**

PV integrated Micro Solar Dome (PViMSD) provides a comfortable level of illumination in the house during night time. The MSD consists of a PV module(s), Control electronics, Battery, and Luminaire. PV module converts sunlight into electricity and White Light Emitting Diode (W-LED) is a solid state device which emits light when electric current passes through it. The integrated PV module fitted in the dome charges a battery during day time which in turn provides light from the MSD for about 5 hrs (under 5.5kWh/sq.m Solar Insolation on a horizontal Surface ) through W-LED fitted in the lower dome.

## TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)

### Performance Specification of PV integrated Micro Solar Dome:

Hours of Operation	Daytime (hrs)	Night Time (hrs)	Total (hrs)
Summer	12	5	17
Winter	8	4	12

### Technical Specification of PV integrated Micro Solar Dome

#### PART-I: MICRO SOLAR DOME

<b>Material Table Upper Dome</b>	Acrylic
<b>Sun-tube</b>	All-weather-proof PVC pipe with water leak proof sealing materials
<b>Internal reflective coating</b>	High quality Acrylic mirror
<b>Lower Dome</b>	Any circular ceiling light fixture
<b>Shutter (Box type)</b>	Acrylic sheet 260 x 260 x 67mm Polycarbonate Sheet with heat resistance film.

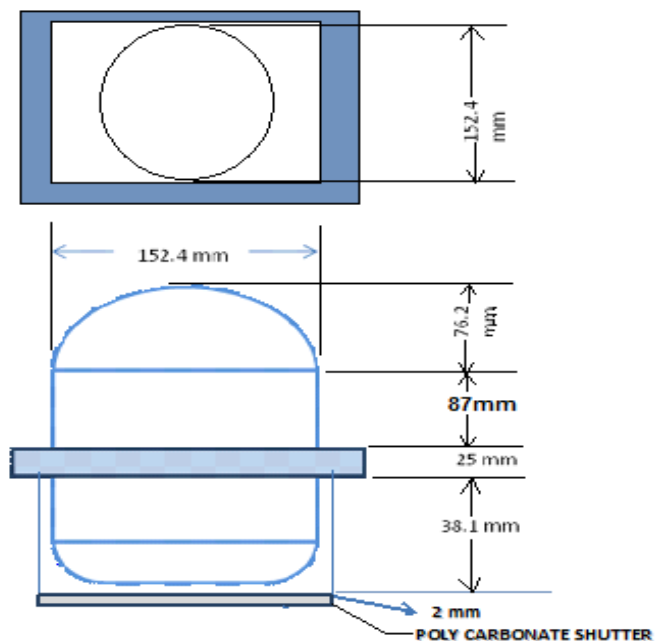


Fig.: Micro Solar Dome

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The above dimensions are indicative and may vary to ensure the proper compliance of performance specifications given here-in.

**FITTING & FIXING:**

- The PV integrated Micro Solar Dome can be mounted on any type of roof viz GCI sheet, Asbestos, clay tiles or patthar or concrete (dump construction).
- For GCI Sheet and asbestos, a high quality rubber sealant is used, applying layer by layer for uniformity.
- For clay tiles or patthar, the dome is first fixed by a uniform layer of any sort of structural epoxy adhesive. Later on the drying of the epoxy layer, a uniform thin layer of cement is applied.
- **Proper care is to be taken to ensure that it is 100% LEAK-PROOF.**

**PART-II : PV integrated Micro Solar Dome (PVi MSD)**

**BROAD PERFORMANCE SPECIFICATIONS**

The broad performance specifications of **(PViMSD)** are given below:

Module	6 Watt peak under STC
Battery	9.6 V, 1800 mAh [3X3.2 V, 1800 mAH Lithium-Ferro Phosphate type] or requisite capacity(e.g. 12.8 x 1400 mAh) OR 3.7 Volts , 7600 mAH [2 X 3800 mAh Lithium ion type]
Light Source	3 Watts (max.) White Light Emitting Diode (Package)
Light Out put	Minimum 15 Lux when measured at the periphery of 2.5 meter diameter from a height of 2.5 meter. At any point within area of 2.5mtr diameter periphery the light level should not be more than three times of the periphery value. The illumination should be uniform without Dark Bands or abrupt variations and soothing to the eyes. Higher output would be preferred.

**TECHNICAL SPECIFICATIONS FOR  
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Multiple Light Levels	To take care of different lighting needs as per user's requirement. The lamp should have multiple levels of light (at least two levels) to take care of different lighting needs during the night.
Mounting of light	Ceiling Mounting
Electronics	Min 85 % efficiency
Average duty cycle	4 hours a day under average daily insolation of 5.5 kWh/sq.m. on a horizontal surface.
Autonomy	Minimum 6 operating hours per permissible discharge at full light level

**TECHNICAL DETAILS**

**PV MODULE**

- i. Indigenously manufactured PV modules should be used.
- ii. The PV modules should have crystalline silicon solar cells, and should have humidity, freeze and damp heat tests certificate conforming to IEC 61215 Edition II / BIS 14286 from an NABL or IECQ accredited Laboratory.
- iii. The power output of the module(s) under STC should be a minimum of 6 Wp. The Load voltage\* of the PV Module should be appropriate voltage for charging of battery used, under the standard test conditions (STC) of measurement.
- iv. **The module efficiency for PV modules should not be less than 10%.**
- v. There should be a Name Plate fixed inside the module which will give:
  - a. Name of the Manufacturer or Distinctive Logo.
  - b. Model Number
  - c. Serial Number
  - d. Year of manufacture
- vi. A distinctive serial number starting with NSM will be engraved on the frame of the module or screen printed on the tedlar sheet of the module.



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**BATTERY**

- (i) 9.6 V, 1800 mAh; Lithium-Ferro Phosphate type (or requisite capacity)  
OR  
3.7 Volts , 7600 mAH , Lithium ion type (or requisite capacity)
- (ii) 90 % of the rated capacity of the battery should be between fully charged & load cut off.
- (iii) Battery should conform to the latest BIS/ International standards.

**LIGHT SOURCE**

- i. The light source will be of white LED type.
- ii. The colour temperature of W-LEDs used in the system should be in the range of 5500°K–6500°K.
- iii. LEDs should not emit ultraviolet light.
- iv. The light output from the W-LED light source should be constant throughout the duty cycle.
- v. The lamps should be housed in an assembly suitable for indoor use.

**ELECTRONICS**

- i. The total electronic efficiency should be at least 85 %.
- ii. Electronics should have temperature compensation for proper charging of the battery throughout the year. The idle current should be less than 2mA.
- iii. The voltage drop from module terminals to the battery terminals should not exceed *0.8 volts* including the drop across the diode and the cable when measured at maximum charging current.
- iv. The PCB containing the electronics should be capable of solder free installation and replacement.
- v. Necessary lengths of wires/cables, switches suitable for DC use and fuses should be provided.
- vi. The system should have a USB port for mobile charging

# **TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)**

## **ELECTRONIC PROTECTIONS**

- i. Adequate protection is to be incorporated under “No Load” condition, e.g. when the lamps are removed and the system is switched ON.
- ii. The system should have protection against battery overcharge, deep discharge condition.
- iii. Load reconnect should be provided at 80% of the battery capacity status.
- iv. Adequate protection should be provided against battery reverse polarity.
- v. Fuses should be provided to protect against short circuit conditions.
- vi. Protection for reverse flow of current through the PV module(s) should be provided.

## **MECHANICAL COMPONENTS**

- i. Corrosion resistant metallic frame or any other suitable structure should be provided to hold the SPV module.
- ii. The frame structure should have provision to adjust its angle of inclination to the horizontal, so that it can be installed at the specified tilt angle (optional).
- iii. Light source should be ceiling mounted or can be hung from the ceiling in a stable manner, as per site requirements.
- iv. A vented plastic/ wooden/ metallic box with acid proof corrosion resistant paint for housing the storage battery indoors should be provided.

## **INDICATORS**

- The system should have two indicators, green and red.
- The green indicator should indicate the charging under progress and should glow only when the charging is taking place. It should stop glowing when the battery is fully charged.
- Red indicator should indicate the battery “Load Cut Off” condition

## **WARRANTY AND WARRANTY**

- i. **The complete PV Integrated Micro Solar Dome (PVi MSD) including the battery should be warranted for a period of five years.**
- ii. **The PV module(s) will be warranted for a minimum period of twenty years.**

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- iii. The Warranty Card to be supplied with the system must contain the details of the system. The manufacturers can also provide additional information about the system and conditions of warranty as necessary.

**OPERATION and MAINTENANCE MANUAL**

An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the PV integrated Micro Solar Dome .The following minimum details must be provided in the Manual:

- Basic principles of Photovoltaics.
- A small write-up (with a block diagram) on PV integrated Micro Solar Dome (PViMSD) - its components, PV module, battery, electronics and luminaire and expected performance.
- Significance of indicators.
- Type, Model number, voltage & capacity of the battery, used in the system.
- The make, model number, country of origin and technical characteristics (including IESNA LM-80 report) of W-LEDs used in the lighting system must be indicated in the manual.
- Clear instructions about mounting of PV module(s).
- Clear instructions on regular maintenance and trouble shooting of the PV integrated Micro Solar Dome (PViMSD).
- DO's and DONT's.
- Name and address of the contact person for repair and maintenance.

**TECHNICAL SPECIFICATIONS FOR  
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**6. SOLAR HOME SYSTEMS (SOLAR POWER PACKS)**

A solar home system provides a comfortable level of illumination in one or more rooms of a house. The SHS consists of a PV module, control electronics, battery, and luminaire(s). There are several SHS models featuring 5 numbers of luminaires based on White Light Emitting Diode (W-LED). The “D.C. Models” could be used to run a small DC fan or a 12-V DC television along with the W-LED Lamps, while the “A.C. Models” could be used to run a fan and/or a television along with the W-LED Lamps.

**BROAD PERFORMANCE SPECIFICATIONS**

PV module	75Wp to 300Wp under STC  (with Module Mounting Structure)
Light source	<p>5 Nos. LED based luminaries :</p> <ul style="list-style-type: none"> <li>○ 3 Nos. of White Light Emitting Diode (W-LED) Luminaire (max. 3.0 Watts each) .The wattage of the LED used in the luminaire should be such that the total input power consumption by the luminaire is not more than 3 W (including the LED driver consumption).</li> <li>○ 2 Nos. of White Light Emitting Diode (W-LED) Luminaire (max. 6.0 Watts each). The wattage of the LED used in the luminaire should be such that the total input AC power consumption by the luminaire is not more than 6 W (including the LED driver consumption).</li> </ul>

**TECHNICAL SPECIFICATIONS FOR  
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Light Output	<p>3W, LED Luminaire:  Minimum 18 Lux when measured from a height of 2.5 meter in an area of 2.5 meter diameter.</p> <p>6W, LED Luminaire:  Minimum 32 Lux when measured from a height of 2.5 meter in an area of 2.5 meter diameter.</p> <p>[The light should be glaze free and should not have any shadow band. The variation in the minimum to maximum light in 4 Meter diameter area should not be more than 10 %.]</p>
Suggested indicative loads in addition to the Light	<p>One Fan for 3 -7 hrs. / day , to be purchased separately (Optional) and /or A TV set, for 3-7 hrs. / day to be purchased separately (Optional) or A PC, for 3 -6 hrs. / day to be purchased separately (Optional) or other equivalent loads Along with a provision for operating the radio and mobile charger etc.</p>
Battery	Lead Acid, Tubular positive plate flooded electrolyte or Gel or VRLA Type
Electronics	Minimum 85%. Efficiency
Working temperature	0 <sup>0</sup> - 45 <sup>0</sup> C

**TECHNICAL SPECIFICATIONS FOR  
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**6A. Solar Based Home Systems (SOLAR POWER PACKS): D.C. MODELS**

**i. SOLAR POWER PACK: 75 Wp**

- SPV Module (with Module Mounting Structure) :75 Wp
- Battery : 12V, 60Ah - C/10 Rated ; Lead Acid
- Solar Charge Controller : 12V,5 A
- Load :
  - 3 Nos. of White Light Emitting Diode (W-LED) Luminaire (max. 3.0 Watts each )  
for 5 Hrs. / day
  - 2 Nos. of White Light Emitting Diode (W-LED) Luminaire (max. 6.0 Watts each )  
for 4 Hrs. / day
  - 1 D.C. Fan(20Watts) for 4-5 Hrs. / day,  
OR  
Power for a 12V DC TV (max. 25 watts) set, for 3-4 hrs. / day  
- To be purchased separately (Optional)
  - Provision for operating the radio and USB port for Mobile Phone Charging

**iii. SOLAR POWER PACK : 100Wp**

- SPV Module (with Module Mounting Structure) :100 Wp
- Battery : 12V, 75Ah - C/10 Rated ; Lead Acid
- Solar Charge Controller : 12V,10 A

**TECHNICAL SPECIFICATIONS FOR  
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- Load :
  - 3 Nos. of White Light Emitting Diode (W-LED) Luminaire (max. 3.0 Watts each ) for 5 Hrs. / day
  - 2 Nos. of White Light Emitting Diode (W-LED) Luminaire (max. 6.0 Watts each ) for 5 Hrs. / day
  - 1 D.C. Fan(20Watts) for 3-4 Hrs. / day, and
  - Power for a 12V DC TV (max. 25 watts) set,
    - To be purchased separately (Optional) for 3-4 hrs. / day
  - Provision for operating the radio and USB port for Mobile Phone Charging

**iii. SOLAR POWER PACK : 150Wp**

- SPV Module (with Module Mounting Structure) :150 Wp
- Battery : 12V, 120 Ah - C/10 Rated ; Lead Acid
- Solar Charge Controller : 12V,15 A
- Load :
  - 3 Nos. of White Light Emitting Diode (W-LED) Luminaire (max. 3.0 Watts each ) for 6 Hrs. / day
  - 2 Nos. of White Light Emitting Diode (W-LED) Luminaire (max. 6.0 Watts each ) for 6 Hrs. / day
  - 1 D.C. Fan(20Watts) for 5-6 Hrs. / day
  - Power for a 12V DC TV (max. 25 watts) set,
    - To be purchased separately (Optional) 5-6 hrs. / day
  - Provision for operating the radio and USB port for mobile Phone Charging

**TECHNICAL SPECIFICATIONS FOR  
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**6B. SOLAR BASED HOME SYSTEMS (SOLAR POWER PACKS): A.C. MODELS**

**i. SOLAR POWER PACK: 200 Wp**

- SPV Module (with Module Mounting Structure) :200 Wp
- Battery : 24V, 75Ah OR 12V, **150 AH** - C/10 Rated ; Lead Acid
- Solar Charge Controller : 24V,10 A OR 12V, 20 A
- Solar Inverter: 24V/ 12 V , 300VA, Pure Sine wave (THD<5%)
- Load : 100 Watt A.C. load for 4-5 Hours/ day
- Suggested Indicative A.C. Loads\*:
  - 3 Nos. of White Light Emitting Diode (W-LED) Luminaire (max. 3.0 Watts each ) for 6 Hrs. / day
  - 2 Nos. of White Light Emitting Diode (W-LED) Luminaire (max. 6.0 Watts each ) for 6 Hrs. / day
  - Provision to Power
    - One Fan for 4-5 Hrs. / day , to be purchased separately (Optional)
    - OR
    - A TV set, for 4-5hrs. / Day to be purchased separately (Optional)
  - Provision for operating the radio and USB port for mobile Phone Charging

(\*OR Equivalent Load)



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**ii. SOLAR POWER PACK: 250 Wp**

- SPV Module (with Module Mounting Structure) : 250 Wp
- Battery : 24V/100Ah OR 12 V, 200 AH - C/10 Rated ; Lead Acid
- Solar Charge Controller : 24V,10 A OR 12 V, 20 A
- Solar Inverter: 24V /12 V , 300VA, Pure Sine wave (THD<5%)
- Load : 100 Watt load for 5-6 Hours/ day

Suggested Indicative Loads\*:

- 3 Nos. of White Light Emitting Diode (W-LED) Luminaire (max. 3.0 Watts each )  
for 6 Hrs. / day
- 2 Nos. of White Light Emitting Diode (W-LED) Luminaire (max. 6.0 Watts each )  
for 6 Hrs. / day
- Provision to Power
  - One Fan for 5-6 Hrs. / day , to be purchased separately (Optional)
  - OR
  - A TV set, for 5-6 hrs. / day, to be purchased separately (Optional)
- Provision for operating the radio and USB port for Mobile Phone Charging

(\*OR Equivalent Load)

**TECHNICAL SPECIFICATIONS FOR  
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**iii. SOLAR POWER PACK: 300 Wp**

- SPV Module (with Module Mounting Structure) : 300 Wp
- Battery: 24V/120Ah OR 12 V ,240 AH - C/10 Rated ; Lead Acid
- Solar Charge Controller : 24V, 15 A OR 12 V, 30 A
- Solar Inverter: 24V / 12 V, 300VA, Pure Sine wave (THD<5%)
  
- Load : 100 Watt load for 6-7 Hours/ day

Suggested Indicative Loads\*:

- 3 Nos. of White Light Emitting Diode (W-LED) Luminaire (max. 3.0 Watts each )  
for 6 Hrs. / day
- 2 Nos. of White Light Emitting Diode (W-LED) Luminaire (max. 6.0 Watts each )  
for 6 Hrs. / day
- Provision to Power
  - One Fan for 6-7 Hrs. / day , to be purchased separately (Optional)
  
  - OR
  - A TV set, for 6-7 hrs. / day, to be purchased separately (Optional)
- Provision for operating the radio and USB port for Mobile Phone Charging

(\*OR Equivalent Load)

**TECHNICAL SPECIFICATIONS FOR  
SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS  
(Off-grid Solar Applications Scheme 2016-17)**

**TECHNICAL DETAILS**

**PV MODULE (S)**

- I. Indigenously manufactured PV modules should be used
- II. The PV modules should be made up of crystalline silicon solar cells and must have a certificate of testing conforming to IEC 61215 Edition II / BIS 14286 from an NABL or IECQ accredited Laboratory.
- III. **The module efficiency should not be less than 14%.**
- IV. The terminal box on the module should have a provision for opening, for replacing the cable, if required.
- V. There should be a Name Plate fixed inside the module which will give:
  - a. Name of the Manufacturer or Distinctive Logo.
  - b. Model Number
  - c. Serial Number
  - d. Year of manufacture
- VI. A distinctive serial number starting with NSM will be engraved on the frame of the module or screen printed on the tedlar sheet of the module.

**BATTERY**

- I. The battery should be Lead Acid, Tubular positive plate flooded electrolyte or Gel or VRLA Type
- II. 75 % of the rated capacity of the battery should be between fully charged & load cut off conditions.
- III. Battery should conform to the latest BIS/ International standards.

**LIGHT SOURCE**

- I. The luminaries should use white LEDs. The colour temperature of white LEDs should be in the range of 5500° K – 6500°K. Use of LEDs which emit ultraviolet light will not permitted.
- II. The light output from the white LED light source should be constant throughout the operation of the lights.

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- III. The lamps should be housed in an assembly suitable for indoor use with an appropriate heat sink to dissipate the heat generated by LEDs during operation. The temperature of LED should not increase more than 10° above room temperature. This condition should be complied for 5 hours of operation of the lamp at a stretch while battery operating at any voltage between the loads disconnect and the charge regulation set point.
- IV. The luminaries must use the optics and diffuser in order to have uniform and glaze free light.
- V. The make, model number, country of origin and technical characteristics (including IESNA LM-80 report) of white LEDs used in the lighting system must be furnished along with the system.
- VI. All Luminaries should have a built in ON/OFF switch and fuse.

**ELECTRONICS**

- I. Electronics should operate at 12 / 24 V and should have adequate temperature compensation arrangement for proper charging of the battery throughout the year.
- II. Inverter should be with “THD” less than 5% and Efficiency more than 90 %.
- III. Necessary lengths of wires / cables, switches and fuses should be provided.
- IV. The system should have separate ports for connecting each load along with a charging port for mobile and laptop.
- V. The idle current i.e. when there is no load (& inverter is switched OFF, in case of A.C. Systems) and no display, it should be less than 150 mA.
- VI. The voltage drop from module terminals to the battery terminals should not exceed 1.0 volts including the dropage across the diode and the cable when measured at maximum charging current.
- VII. The PCB containing the electronics should be capable of solder free installation and replacement.
- VIII. Necessary lengths of wires/cables, switches suitable for DC use and fuses should be provided.
- IX. The inverter output AC voltage should not change with the decreased battery voltage in the operating voltage range of the battery

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## **ELECTRONIC PROTECTIONS**

- I. Adequate protection is to be incorporated under “No Load” condition, e.g. when the lamps and other loads are removed and the system is switched ON.
- II. The system should have protection against battery overcharge, deep discharge condition.
- III. Load reconnect should be provided at 90 % of the battery capacity status.
- IV. Adequate protection should be provided against battery reverse polarity.
- V. Fuses should be provided to protect against short circuit conditions.
- VI. Protection for reverse flow of current through the PV module(s) should be provided.

## **MECHANICAL COMPONENTS**

- (i) Corrosion resistant frame structure should be provided to hold the SPV module.
- (ii) The frame structure should have provision to adjust its angle of inclination to the horizontal, so that it can be installed at the specified tilt angle.
- (iii) Light source should be either for wall mounted or ceiling mounted or can be hung from the ceiling in a stable manner, as per site requirements.
- (iv) A vented plastic/ wooden/ metallic box with acid proof corrosion resistant paint for housing the storage battery indoors should be provided.

## **INDICATORS**

- The system should have two indicators, green and red.
- The green indicator should indicate the charging under progress and should glow only when the charging is taking place. It should stop glowing when the battery is fully charged.
- Red indicator should indicate the battery “Load Cut Off” condition

## **QUALITY AND WARRANTY**

- (i) **The Solar home system including Battery will be warranted for a period of five years from the date of supply.**

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- (ii) **The PV module(s) will be warranted for a minimum period of 25 years from the date of supply.** PV modules used in Solar Home Lighting System 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 Warranty Card to be supplied with the system must contain the details of the system. The manufacturers can also provide additional information about the system and conditions of warranty as necessary.

**OPERATION and MAINTENANCE MANUAL**

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

- Basic principles of Photovoltaics.
- A small write-up (with a block diagram) on Solar Home Lighting System - its components, PV module, battery, electronics and luminaire and expected performance.
- Significance of indicators.
- Type, Model number, voltage & capacity of the battery, used in the system.
- The make, model number, country of origin and technical characteristics (including IESNA LM-80 report) of W-LEDs used in the lighting system must be indicated in the manual.
- Clear instructions about mounting of PV module(s).
- Clear instructions on regular maintenance and trouble shooting of the Solar Home Lighting System.
- DO's and DONT's.
- Name and address of the contact person for repair and maintenance.

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**6C. WHITE-LED (W-LED) BASED SOLAR HOME LIGHTING SYSTEMS WITH  
BATTEN TYPE LUMINARY**

A solar home lighting system (SHS) provides a comfortable level of illumination in one or more rooms of a house. The SHS consists of a PV module, control electronics, battery, and luminaire(s). There are several SHS models featuring one, two, or four luminaires based on White Light Emitting Diode (W-LED). The system could also be used to run a small DC fan or a 12-V DC television along with the W-LED Lamps.

PV module converts sunlight into electricity, which powers the luminaire(s). White Light Emitting Diode (W-LED) is a solid state device which emits light when electric current passes through it.

**BROAD PERFORMANCE SPECIFICATIONS**

The broad performance specifications of a W-LED light source based solar home lighting system are given below:

Module	6-40 Watt peak under STC
Battery	Lead acid sealed maintenance free, tubular flooded or Gel / VRLA or NiMH or Lithium-Ion, or Lithium-Ferro Phosphate
Light Source	3 Watts for Batten type light source. White Light Emitting Diode (W-LED)
Light Out put	10 Lux when measured at the periphery of 2.5 meter diameter from a height of 2.5 meter. At any point within area of 2.5mtr diameter periphery the light level should not be more than three times of the periphery value. The illumination should be uniform without Dark Bands or abrupt variations and soothing to the eyes. Higher output would be preferred.
Multiple Light Levels	To take care of different lighting needs as per user's requirement. The lamp should have multiple levels of light (at least two levels) to take care of different lighting needs during the night.
Mounting of light	Wall or ceiling
Electronics	Min 85 % efficiency

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Average duty cycle	5 hours a day under average daily insolation of 5.5 kWh/ sq.m. on a horizontal surface.
Facility for Mobile Charging	USB port for Mobile Charging, However, the duty cycle for light to be adjusted accordingly.
Autonomy	3 days or Minimum 15 operating hours per permissible discharge. OR Minimum 6 operating hours per permissible discharge at full light level (In case of NiMH or Lithium-Ferro Phosphate)

**There are six models of W-LED home lighting systems. The configuration of each model is as follows:**

**Model-I      One White LED luminaire batten type**

PV Module      6 Wp under STC

Battery      Lead acid Sealed maintenance free, 12V-7 AH @ C/20  
or NiMH or Lithium-Ion of requisite capacity

**Model-IA      One White LED luminaire batten type**

PV Module      6 Wp under STC

Battery      Lithium-Ferro Phosphate of 3X 3.2V, 1800 mAh (or requisite capacity)

**Model- II      Two White batten type LED luminaire**

PV Module      12 Wp under STC

Battery      Lead acid Tubular flooded or Gel / VRLA, 12V - 12AH @ C/20

**Model -III      Two White batten type LED luminaires and one DC fan of wattage up to 10 W**

PV Module      24 Wp under STC

Battery      Lead acid Tubular flooded or Gel / VRLA, 12V- 20AH @ C/20

**Model -IV      Four White batten type LED luminaires**

PV Module      24 Wp under STC

Battery      Lead acid Tubular flooded or Gel / VRLA, 12V- 20AH @ C/20

It should have a socket to provide power for a 12V DC TV set which can be purchased separately.



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**Model -V** Two White batten type LED luminaires and one DC fan of wattage up to 20 W

PV Module 40 Wp under STC

Battery Lead acid Tubular flooded or Gel / VRLA, 12V- 40AH @ C/10

It should have a socket to provide power for a 12V DC TV set which can be purchased separately.

## TECHNICAL DETAILS

### PV MODULE (S)

- (i) Indigenously manufactured PV modules should be used
- (ii) The PV modules up to 12 Wp capacity should have crystalline silicon solar cells, and should have humidity, freeze and damp heat tests certificate conforming to IEC 61215 Edition II / BIS 14286 from an NABL or IECQ accredited Laboratory.
- (iii) The PV modules more than 12 Wp capacity should be made up of crystalline silicon solar cells and must have a certificate of testing conforming to IEC 61215 Edition II / BIS 14286 from an NABL or IECQ accredited Laboratory.
- (iv) The power output of the module(s) under STC should be a minimum of 6 Wp or 12 Wp or 24 Wp or 40 Wp.
- (v) The Load voltage\* of 16.40 V for 12 V battery or appropriate voltage for charging of battery used, under the standard test conditions (STC) of measurement.
- (vi) **The module efficiency for PV modules up to 12 Wp capacity should not be less than 10%. The module efficiency for PV modules 24 Wp / 40 Wp capacity should not be less than 12%.**
- (vii) The terminal box on the module should have a provision for opening, for replacing the cable, if required.
- (viii) There should be a Name Plate fixed inside the module which will give:
  - a. Name of the Manufacturer or Distinctive Logo.
  - b. Model Number
  - c. Serial Number
  - d. Year of manufacture
- (ix) **A distinctive serial number starting with NSM will be engraved on the frame of the module or screen printed on the tedlar sheet of the module.**

\*The Load voltage conditions of the PV modules are not applicable for the system having MPPT.

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**BATTERY**

- (i) For Model-I, sealed maintenance free lead acid battery with a capacity of up to 7 AH, at voltages of up to 12V @ C/20 rate of discharge or NiMH or Lithium Ion battery of requisite capacity.
- (ii) For Model-I-A,  
Lithium-Ferro Phosphate of 3X 3.2V, 1800 mAh (or requisite capacity)
- (iii) For Models – II, III, IV & V, battery should have a minimum rating of 12V, 12 Ah or 12V, 20 Ah at C/20 rate of discharge and 12 V, 40 Ah at C/10 rate of discharge, depending on the Model.
- (iv) 90 % of the rated capacity of the battery should be between fully charged & load cut off conditions in case of Model- 1A.  
For other Models, 75 % of the rated capacity of the battery should be between fully charged & load cut off conditions.
- (v) Battery should conform to the latest BIS/ International standards.

**LIGHT SOURCE**

- (i) The light source will be of white LED type.
- (ii) The colour temperature of W-LEDs used in the system should be in the range of 5500°K–6500°K.
- (iii) LEDs should not emit ultraviolet light.
- (iv) The light output from the W-LED light source should be constant throughout the duty cycle.
- (v) The lamps should be housed in an assembly suitable for indoor use.

**ELECTRONICS**

- i. The total electronic efficiency should be at least 85 %.
- ii. Electronics should have temperature compensation for proper charging of the battery throughout the year. The idle current should be less than 1 mA for **Models-I, I-A & II**, and for **Models-III, IV & V**, it should be less than 2mA.
- iii. The voltage drop from module terminals to the battery terminals should not exceed 0.6 volts including the drop across the diode and the cable when measured at maximum charging current.

## **TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)**

- iv. The PCB containing the electronics should be capable of solder free installation and replacement.
- v. Necessary lengths of wires/cables, switches suitable for DC use and fuses should be provided.
- vi. The system should have a USB port for mobile charging.

### **ELECTRONIC PROTECTIONS**

- (i) Adequate protection is to be incorporated under “No Load” condition, e.g. when the lamps are removed and the system is switched ON.
- (ii) The system should have protection against battery overcharge, deep discharge condition.
- (iii) Load reconnect should be provided at 80% of the battery capacity status.
- (iv) Adequate protection should be provided against battery reverse polarity.
- (v) Fuses should be provided to protect against short circuit conditions.
- (vi) Protection for reverse flow of current through the PV module(s) should be provided.

### **MECHANICAL COMPONENTS**

- (i) Corrosion resistant metallic frame structure should be provided to hold the SPV module.
- (ii) The frame structure should have provision to adjust its angle of inclination to the horizontal, so that it can be installed at the specified tilt angle.
- (iii) Light source should be either for wall mounted or ceiling mounted or can be hung from the ceiling in a stable manner, as per site requirements.
- (iv) A vented plastic/ wooden/ metallic box with acid proof corrosion resistant paint for housing the storage battery indoors should be provided.

### **INDICATORS**

- The system should have two indicators, green and red.
- The green indicator should indicate the charging under progress and should glow only when the charging is taking place. It should stop glowing when the battery is fully charged.
- Red indicator should indicate the battery “Load Cut Off” condition.

# **TECHNICAL SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS & POWER PACKS (Off-grid Solar Applications Scheme 2016-17)**

## **QUALITY AND WARRANTY**

- (i) **The Solar home lighting system will be warranted for a period of five years from the date of supply.**
- (ii) **The PV module(s) will be warranted for a minimum period of 25 years from the date of supply.** PV modules used in Solar Home Lighting System 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 battery **for Model-I** should be warranted for a period of **at least two years**. The battery **for Models– IA, II, III, IV and V** should be warranted for a **period of 5 years**.
- (iv) The Warranty Card to be supplied with the system must contain the details of the system. The manufacturers can also provide additional information about the system and conditions of warranty as necessary.

## **OPERATION and MAINTENANCE MANUAL**

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

- Basic principles of Photovoltaics.
- A small write-up (with a block diagram) on Solar Home Lighting System - its components, PV module, battery, electronics and luminaire and expected performance.
- Significance of indicators.
- Type, Model number, voltage & capacity of the battery, used in the system.
- The make, model number, country of origin and technical characteristics (including IESNA LM-80 report) of W-LEDs used in the lighting system must be indicated in the manual.
- Clear instructions about mounting of PV module(s).
- Clear instructions on regular maintenance and trouble shooting of the Solar Home Lighting System.
- DO's and DONT's.
- Name and address of the contact person for repair and maintenance.