सत्यमेव जयते

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

भारत सरकार
रेल मंत्रालय

TECHNICAL SPECIFICATION FOR STAND-ALONE WIND + SOLAR PHOTOVOLTAIC HYBRID POWER GENERATING SYSTEM FOR LEVEL CROSSING GATES

लेवल क्रासिंग गेटों के लिए स्टैन्ड–एलोन विन्ड +सोलर फोटोवोल्टेक
हायब्रिड पावर जनरेटिग प्रणाली हेतु तकनीकी विशिष्टि

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	Number	Date	Number	Date.	
1.	'1'	20.09.2010	-	-	Clause 6.2.14 deleted as duplicated Clause 9.0 (Guarantee/Warranty) and Annexure-3 (Eligibility Criteria for bidding) deleted as per Railway Board's letter No. 2006/Elect.(G)/150/9/Pt. dated 10.09.2010.
2.	-	-	'1'	14.02.2014	Rationalized the spec. and major editorial changes to improve its readability and clarity.

ISSUED BY
RESEARCH DESIGNS AND STANDARDS ORGANISATION
MANAKNAGAR, LUCKNOW – 226 011

जारीकर्ता
अनुसंधान अभिकल्प और मानक संगठन
मानक नगर, लखनऊ – 226 011

Approved by
द्वारा अनुमोदित

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Executive Director (EM)
कार्यकारी निदेशक (ऊर्जा प्रबन्धन)

Prepared by	Issued by
JE/EM	DIR (EM)

I N D E X

SPECIFICATION FOR STAND-ALONE WIND + SOLAR PHOTOVOLTAIC HYBRID POWER GENERATING SYSTEM FOR LEVEL CROSSING GATES

1.0 FOREWORD

The Wind and Sun are inexhaustible, reliable and non-polluting sources of power. Concerns over global climate change and resource scarcity make Wind + Solar photovoltaic (SPV) with battery backup an attractive power supply solution. The Wind Solar Hybrid (WSH) generating system is particularly suited for remote locations where grid electricity supply is either not available or is erratic. For manned Level Crossing Gates in non-RE sections, WSH system is an excellent solution. It will greatly help towards the safety of road-rail intersections.

2.0 SCOPE

This specification covers general and technical requirement of Stand-alone Wind Solar Hybrid generating system for power supply to manned Level Crossing Gates in non-RE sections. A pre-condition to technical feasibility of WSH is that the site should have at least 4.17 m/s annual average wind speed.

3.0 REFERENCE STANDARDS

IS: 12834:1989 (reaffirmed 2000)	Solar Photovoltaic Energy Systems – Terminology
IEC: 61215 (2005)	Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval
IEC: 60904-1(2006)	Photovoltaic Devices - Part-I: Measurement of Photovoltaic current-Voltage Characteristic
IEC: 61701	Salt mist corrosion testing of photovoltaic (PV) modules
IEC: 60068	Environmental testing
IS: 9000	Basic environmental testing procedure for Electronic and electrical items.
IEC -61400 -12-1	Power performance measurement of wind turbines.
IEC -61400 -2	Safety and function test and Duration test of wind turbines.
ASTM – B-117	Salt spray testing standard.

Note: Latest version of the standards shall be referred to

4.0 SYSTEM DESCRIPTION:

Wind Solar Hybrid generating system (WSH) shall consist of the following elements:

i) Wind Turbine (WT) to convert Wind energy to electricity.

ii) Hot dip galvanized MS tower with necessary accessories for mounting of WT.

iii) SPV Module to convert solar radiation directly into electricity.

iv) Module mounting structure of galvanized MS sections (SPV modules can be mounted on the WT tower, if feasible).

v) Battery bank to store the electric energy generated by WSH generating system.

vi) Following charge controllers/ chargers will be provided:

a) Solar charge controller (SCC) for receiving DC power from solar panels and delivering DC power supply to charge the battery.

b) Wind charge controller (WCC) for accepting multi-phase AC input from wind generator and delivering DC power supply to charge the battery.

c) A grid supplied charger that can accept 140-260 Volts, single phase, 50 Hz AC supply and deliver DC power supply to charge the battery (it will be an optional item i.e. not to be supplied unless specifically called for in the tender).

vii) LED based luminaires along with fixture and (in respect of outdoor luminaires) mounting pole

viii) Fan

ix) Interconnecting wires, cables and hardware.

In their offer, the firm should furnish a clause-by-clause confirmation of compliance to the spec. and also the specific information called for in Annex-4 of the spec.

5.0 GENERAL REQUIREMENTS

5.1 All wiring, enclosures and fixtures that are mounted outdoor must be resistant to high humidity conditions, corrosion, insect and dust intrusion.

5.2 Metal equipment cases and frames in the system shall be well grounded.

5.3 The main components shall be integrated in such a way as to allow replacement (in case of failure) with a similarly functioning component of a newer design or a different brand.

5.4 Suitable resettable isolating and overcurrent protection arrangements shall be incorporated. Toggle switches shall also be provided for switching 'on' and 'off' of individual equipments.

5.5 Proper sealing arrangements at the points of cables entering the enclosures (if any)/ buildings should be incorporated. Though not mandatory, contractors are however encouraged that the cables

entering into the enclosures should be sealed with modular EPDM based cable sealing and protection system based on multi-diameter technology.

5.6 Electronic components used in controller or elsewhere in the system shall generally meet the requirements mentioned as follows (documentary evidence in support of the same should be given):

i) All capacitors shall be rated for max. temperature of 105° C.

ii) Resistances shall preferably be made of metal film of adequate rating having a tolerance of not more than 5%.

iii) Switching devices such as transistors, IGBTs, MOSFETs, etc. shall have minimum junction temperature of 150°C.

iv) Devices shall have adequate thermal margin at ambient temp. of 55°C

v) Fibre glass epoxy of grade FR 4 or superior shall be used for PCB boards having a nominal board thickness 1.6mm and copper cladding thickness of 70 microns for power cards and 35 microns for control cards. Both track width and spacing between the tracks shall be 0.5 mm nominal and in no case shall be less than 0.3 mm. Assembled PCBs shall be given a conformal coating.

5.7 Wiring inside the Goomti should be routed through conduit pipes suitably clamped. Cables leading to outdoor lighting poles must not afford direct or easy access to non railway persons. Cable crossing underneath the tracks shall be at a minimum depth of one meter with respect to earth formation level of track.

6.0 TECHNICAL REQUIREMENT

Irrespective of the voltage level generated directly by WT or SPV, the nominal voltage at the output of charge controllers/ grid supplied battery charger, shall be 12V DC. Though not mandatory, firms are encouraged to provide a text type display (in Regional language/ English) so that the gateman can easily read/ infer the battery's state of charge.

6.1 System load

6.1.1 Load on the WSH shall comprise of the following:

i) 2 nos. 5W (nominal) LED based luminaires with fixtures, one inside Goomti and one outside Goomti under shed.

ii) 1 no. 20W (nominal) fan inside Goomti.

iii) 2 nos. 15W (nominal) LED based luminaires with fixtures, one on each side of the track. The 15W luminaires shall be mounted on individual poles.

6.1.2 The design of WSH is based on the following factors:

i) Battery autonomy: 2 days
ii) Operation period for indoor lighting: almost 20 hours.
iii) Operation period for outdoor lighting: almost 12 hours.
iv) Operation period for fan: almost 24 hours (in summer)
v) Solar Insolation: 5 peak sun hours/day
vi) Minimum annual average wind speed of 4.17 meters/sec.

6.2 Wind Turbine (WT)

6.2.1 The WT must have undergone IEC 61400-12-1 type testing for power performance measurement and IEC 61400-2 type testing for safety from an accredited test house such as Govt. of India's Centre for Wind Energy Technology (CWET), NREL, etc. Further, the offered WT should also have regular empanelment from CWET. The CWET certified power rating of WT, as per IEC 61400-12-1, should be minimum 600W.

6.2.2 All exposed/external parts of WT shall be suitably coated for prevention of corrosion in harsh marine environment. Although it is not mandatory for now, manufacturers however are encouraged to get the WT type tested for salt spray test as per ASTM B-117 for a minimum period of 1,000 hours, if they have not already done so. In case of bulk tenders, zonal railways can consider specifying that the contractor furnish this type test certificate (refer item 4(i) of Annexure-3).

6.2.3 The manufacturer will need to furnish evidence that the WT being supplied is same as the one type tested as per IEC 61400-12-1 and IEC 61400-2. Although it is not mandatory for now, manufacturers however are encouraged to create the necessary testing infrastructure for enabling the purchaser to verify the IEC 61400-12-1 certified power (watts) vs. rotational speed (RPM) in steps of 100 RPM, prior to dispatch. In case of bulk tenders, zonal railways can consider specifying that the contractor make available a test facility for carrying out such verification.

6.2.4 Suitable protection such as furling mechanism, pitch control of blades or electromagnetic braking shall be provided for protection of WT against high velocity wind, storms and over-speeding.

6.2.5 The WT shall be able to withstand wind speeds of 55 m/sec or 198 kmph.

6.2.6 Mounting Towers shall be of 15 meter height and made of hot dip galvanized mild steel. Galvanization thickness shall be of min. 85µm. If the systems are installed in coastal/ corrosive areas, the minimum galvanization thickness shall be 120µm. Unless the purchaser has

specifically asked for 120 µm thickness, normally 85 µm will be supplied. The turbine hub height shall be at least 5 meter above any obstruction within 200 meter radius. If at certain locations, tower height more than 15 m is required, then the same must be especially mentioned in the tender schedule (refer item 4 (iii) of Annexure-3). The tower has to be designed to withstand a minimum wind force of 55 m/s or 198 kmph (refer item 4(ii) of Annexure- 3).

6.2.7 WT shall be grounded properly. Towards this end, the contractor will supply and install an adequate number and size of IS: 3043-1987 compliant earthing kits.

6.3 SPV Modules

6.3.1 The solar module shall be an assembly of suitable inter-connected crystalline silicon solar cells. Imported SPV module or cell will not be accepted, unless MNRE's policy/ rules permit the same.

6.3.2 Minimum capacity of the solar panels installed shall be 160 Wp. Solar modules of minimum 80 Wp capacity shall be used.

6.3.3 Individual Solar PV Module should conform to IEC: 61215 Ed 2 or latest – Edition II, IEC : 61730 – I :2007, IEC : 61730 – II : 2007, manufactured in a plant certified under ISO 9001 : 2008 and also type tested by an accredited national/international testing laboratory. The Solar PV Module should be made from single/poly crystalline Silicon Solar Cell connected in series. PV modules to be used in a highly corrosive atmosphere (coastal areas, etc.) must qualify Salt Mist Corrosion Testing as per IEC 61701; this compliance and certification will not be required, unless the purchaser specifically asks for the same in the tender (refer item 2(i) in Annexure - 3).

6.3.4 The conversion efficiency of Solar PV Cells used in the module shall not be less than 15% and that of the module shall be not less than 13%.

6.3.5 Fill factor of the module shall not be less than 72%.

6.3.6 The solar module should have toughened, high transmissivity glass in front side of the module for improved visibility and protection against environmental hazards (rain, hail and storm) and weather proof TEDLAR/POLYSTER back sheet.

6.3.7 The transparency of toughened glass used shall be > 91%, when measured in actual sunlight by placing the glass plate perpendicular to the sun's rays through an air mass of 1.5. Certificate to this effect from a recognized test house or their own laboratory shall be submitted at the time of type approval.

6.3.8 The complete solar module shall be ensured for water-proof sealing in an anodized Aluminum frame.

6.3.9 The output terminals of the module shall be provided on the back of the solar PV module.

6.3.10 Terminal block shall be made of Noryl rubber or other suitable alternate materials with weatherproof design (minimum IP-65) and shall have a provision for opening for replacing the cables, if required.

6.3.11 The system shall be virtually maintenance free (except for cleaning the top glass of the solar panel depending on dust conditions at place of installation).

6.3.12 The solar cell shall have surface anti-reflective coating to help to absorb more light in all weather conditions.

6.3.13 A bird spike shall be provided to avoid bird sitting on the solar module at the highest point of the array/module structure.

6.3.14 SPV module shall be highly reliable, lightweight and shall have a service life of more than 25 years. SPV modules shall have a limited power loss of not more than 10% of nominal output at the end of 10 years and not more than 20% at the end of 25 years.

6.3.15 Wherever more than one module is required, identical models shall be used.

6.3.16 The output of any supplied module shall not be less than the rated output and shall not exceed the rated power by more than 5Wp. Each module therefore has to be tested and its rating displayed.

6.3.17 The solar module shall be able to withstand the following environmental conditions normally encountered at site:

i) Temperature extremes ranging from -10°C to +85°C.
ii) Wind load: 200 km/h.
iii) Maximum mean hourly rainfall of 40 mm.
iv) Humidity level upto 95%.

6.3.18 Each PV module must use a RF identification tag (RFID), which must contain the following information. The RFID can be inside or outside the module laminate, but must be able to withstand harsh environmental conditions.

i) Name of the manufacturer of PV Module
ii) Name of the Manufacturer of Solar cells

iii) Month and year of the manufacture (separately for solar cells and module)
iv) Country of origin (separately for solar cells and module)
v) I-V curve for the module
vi) Peak Wattage, I_m, V_m and FF for the module
vii) Unique Serial No and Model No of the module
viii) Date and year of obtaining IEC PV module qualification certificate
ix) Name of the test lab issuing IEC certificate
x) Other relevant information on traceability of solar cells and module as per ISO 9000 series.

6.3.19 Marking:

Each module shall carry the following clear and indelible markings:

- Name, monogram or symbol of manufacturer;
- Type or model number;
- Serial number;
- Polarity of terminals or leads (colour coding is permissible);
- Open – circuit voltage
- Operating voltage.
- Maximum system voltage for which the module is suitable;
- Operating current
- Short circuit current
- Date & place of manufacture.
- Weight of the module

6.3.20 The Array Junction Box should preferably have maximum 08 inputs and 01 output with MOV/SPD and Terminal block.

6.3.21 Suitable markings shall be provided on the bus bar for easy identification and cable ferrules shall be fitted at the cable termination points for identification. Cable entry points shall be fitted with MC-4 Connectors.

6.3.22 The SPV modules shall normally be mounted on a structure which is designed to withstand a wind speed of 200 kmph. For this compliance, contractor's certificate of conformity will be accepted.

6.3.23 The array structure shall be made of hot dip galvanized MS angles of size generally not less than 35mmX35mmX5mm. The galvanization thickness shall be at least 85 microns. For coastal/ corrosive environments, the galvanization thickness shall be at least 120 microns. If the purchaser does not specify anything to the contrary, then galvanization thickness of 85 microns shall be provided (refer Item 4(ii) of Annexure-3).

6.3.24 The foundation for module mounting structure shall be preferably 1:2:4 RCC construction or any other combination based on the local

site conditions for which design details shall be submitted. The installation of SPV modules should not impact the waterproofing of the existing terrace structure. The contractor shall be responsible for restoring the waterproofing to its original condition and for provision of additional waterproofing in the areas where RCC blocks are secured onto the terrace.

6.3.25 Alternatively (at the option of firm), the SPV modules with structure can be mounted on a tower of the WT. However, if the modules are installed on the rooftop, the clearance between the lowest part of the module structure and the developed ground level shall normally not be less than 200 mm. However, in exceptional cases, lower clearances may be allowed on case to case basis.

6.3.26 Generally, fasteners shall be of stainless steel SS304. To prevent pilferage, anti-theft fasteners shall, in consultation with railway site engineers, be provided at appropriate locations.

6.3.27 For grounding of array structure, the contractor will supply and install an adequate number and size of IS: 3043-1987 compliant earthing kits.

6.3.28 The module junction boxes (if any) shall be certified as per IEC 61215. Else, they should have the same properties as mentioned for array junction boxes. If array junction boxes are used, they shall have the following properties:

a) The module/array junction boxes shall be dust, vermin- and waterproof and made of Polycarbonate - Glass Fibre Substance (PC-GFS) thermoplastic. The enclosure should be double insulated with protection class II as per IEC 61439-1. Material and the protection class shall be marked on the enclosure.
b) The enclosure shall have a transparent front lid for enabling easy visibly.
c) The enclosures shall have IP 65/66 protection in accordance with IEC 60529. Third party conformance certificate is required to be given for IP 65/ IP 66 degree of protection.
d) Burning Behavior: Base part of Polycarbonate Enclosure shall be UL-94-V-0 compliant and Lid part of PC Enclosure shall be UL-94-V-2 compliant.
e) The enclosures shall have IK 08 degree of protection for mechanical load.
f) The material used shall be halogen, silicon free conforming to RoHS directive 2002/95/EC.
g) The enclosure shall have a usage temperature rating of -10°C to 55°C.
h) The enclosure should be chemically resistant to acid, lye, petrol, mineral oil and partially resistant to benzene.
i) The material of the enclosure shall be UV stabilized.

Unless otherwise stipulated, the properties mentioned above should be demonstrated through datasheet of the manufacturer.

6.3.29 The SPV Module shall be tested as per Annexure 1.

6.4 Charge Controllers, grid supplied charger, etc.

6.4.1 Solar charge controller

The Solar Charge Controller (SCC) will comply the following requirements:

(i) Suitable for charging T-Gel type VRLA as well as LMLA battery.
(ii) Suitable for receiving input from 160Wp solar PV system and battery charging.
(iii) The charge controller should generally comply IEC 62509. Set point accuracy of ±3% and self consumption of 0.2% shall be allowed.
(iv) The charge controller should have IP 31 protection. Manufacturers are however encouraged to provide higher IP protection.
(v) Capable of handling 120% of module's rated current.
(vi) To be at least PWM based; manufacturers are however encouraged to offer MPPT technology.
(vii) Efficiency at rated output voltage and full load should not be less than 90%. Even at less than full load, efficiency should not be less than 86% for up to 30% full load.
(viii) Temperature compensated charging.
(ix) Provision of blocking diode, preferably a Schottky diode, to prevent the battery from discharging itself through the SPV system/ charge controller. The current capacity of the blocking diode shall be 50% higher than the short circuit current at STC. The peak inverse voltage (PIV) of the diode shall be at least equal to the open circuit battery voltage. In case any alternative to Schottky diode is proposed, then technical literature and evidence in support of successful working of the same should be submitted for the consideration of RDSO/ purchaser.
(x) On its SPV power source side, the charge controller shall be protected against lightning and surges. The SPDs/MOVs used shall be rated for at least 10KA at 8/20 µSec. The voltage rating of the SPDs/MOVs shall be at least 10% higher than the specified value of the SPV array.
(xi) Protection shall also be provided against the following: battery overload, battery overcharge, short circuit and reverse polarity. Resettable reverse polarity protection should be provided. Although not mandatory, manufacturers are encouraged to provide auto resettable reverse polarity protection.
(xii) Cable of adequate size shall be provided between panel and battery.

(xiii) The charge controller shall incorporate the bulk and float charging methods. Though not mandatory, manufacturers are however encouraged to provide equalization charging facility also.

(xiv) The charge controller shall have insulation resistance of at least 50 MΩ. The test is to be performed between shorted DC output terminals and earth, shorted DC/AC input terminals and earth and shorted DC output terminals and shorted DC/AC terminals.

(xv) The charge controller shall withstand a test voltage of 2,000V applied between DC line terminals and earth for one minute without any puncture and arcing.

(xvi) In case the master controller is not provided, then the charge controller should have the feature of load disconnect to protect the battery from deep discharge.

(xvii) The charge controller should comply the following (optional) environmental tests with the charge controller working at full load for at least last half an hour as per IEC 60068/ IS 9000. Environmental test results for SCC of identical or any higher capacity of similar design will be acceptable. Environmental test compliance will only be required, if specifically asked for in the tender (refer item 3 (ii) of Annexure-3). In respect of bulk procurements, railways should ask for the same in their tenders.

a) Dry Heat Test: 50°C±2°C for 16 hours
b) Damp Heat Test (Steady state): 40°C, 93% RH for 4 days
c) Damp Heat Test (Cyclic): 40°C, 93% RH for 6 cycles (duration of one cycle shall be 24hrs)
d) Cold Test: 0°C for 16 hours
e) Change of temperature Test: -10°C to 50°C for 3 cycles (rate of change of temperature shall be 3°C per minute)

In respect of the requirements as specified in respect of set point accuracy, self consumption and efficiency, the basic intent is developmental. So, the firm must endeavor to achieve the same either by developing their design in-house or (if they cannot or do not succeed in developing the same) by sourcing it from any reputed/ proven manufacturer based in India. In the event that even reputed manufacturers based in India are unable to meet those requirements, appropriate relaxation will be permitted by RDSO at design approval stage.

6.4.2 Wind charge controller

The Wind Charge Controller (WCC) will comply the following requirements:

(i) Suitable for charging T-Gel type VRLA as well as LMLA battery.

(ii) Suitable for receiving multi-phase AC input from the WT and delivering DC power supply for battery charging and for supplying to the load.

(iii) To be at least PWM based; manufacturers are however encouraged to offer MPPT technology.

(iv) No minimum limit for efficiency is being mandated for now; but manufacturers are encouraged to provide the highest feasible efficiency.

(v) Temperature compensated charging.

(vi) Provision of blocking diode, preferably a Schottky diode, to prevent battery from discharging itself through the WT/ charge controller. The current capacity of the blocking diode shall be 50% higher than the short circuit current at STC. The peak inverse voltage (PIV) of the diode shall be at least equal to the open circuit battery voltage. In case any alternative to Schottky diode is proposed, then technical literature and evidence in support of successful working of the same should be submitted for the consideration of RDSO/ purchaser.

(vii) To save the WT from over-speeding (in event of generated energy not being consumed) and consequential damage, a resistive dump load of adequate rating will be provided. If any alternative to dump load is offered by the tenderer, then he should furnish literature endorsing such a design and/or evidence of successful working of the same for at least two years.

(viii) Protection against the following: battery overload, battery overcharge, short circuit and reverse polarity. Resettable reverse polarity protection shall be provided. Although not mandatory, manufacturers are encouraged to provide auto resettable reverse polarity protection.

(ix) Rating of offered WCC shall be appropriate for the WT's power rating.

(x) On the WT power source side, the charge controller shall be protected against lightning and surges. The SPDs/MOVs used shall be rated for at least 10KA at 8/20 μSec. The voltage rating of the SPDs/MOVs shall be at least 10% higher than the specified value of the WT.

(xi) Though not mandatory, manufacturers are however encouraged to incorporate all charging methods in the WCC i.e. auto, bulk, float as well as equalization.

(xii) The charge controller shall have insulation resistance of at least 50 MΩ. The test is to be performed between shorted DC output terminals and earth, shorted DC/AC input terminals and earth and shorted DC output terminals and shorted DC/AC terminals.

(xiii) The charge controller shall withstand a test voltage of 2,000V applied between DC line terminals and earth for one minute without any puncture and arcing.

(xiv) In case the master controller is not provided, then the charge controller should have the feature of load disconnect to protect the battery from deep discharge.

(xv) Though not mandatory, firms are encouraged to offer WCC complying with the following environmental tests with charge controller working at full load for at least last half an hour as per IEC 60068/ IS 9000.

a) Dry Heat Test: 50°C±2°C for 16 hours
b) Damp Heat Test (Steady state): 40°C, 93% RH for 4 days
c) Damp Heat Test (Cyclic): 40°C, 93% RH for 6 cycles (duration of one cycle shall be 24hrs)
d) Cold Test: 0°C for 16 hours
e) Change of temperature Test: -10°C to 50°C for 3 cycles (rate of change of temperature shall be 3°C per minute)

6.4.3 Grid supplied charger (optional item)

If grid electricity supply is available at a level crossing gate, then the purchaser can (optionally) order a battery charger which would be fed from grid electricity supply. The charger will work with 140 – 260V, 50 Hz AC input, will be based on PWM technology and shall be suitable for charging the battery. The input to the charger shall be protected against lightning and surge. Unless specifically asked for by the purchaser in the tender, the aforesaid grid fed battery charger will not be supplied (refer item no. 3(i) of Annexure-3).

6.4.4 Integrated functioning of charge controllers and charger

It will be necessary that the aforesaid charge controllers as also the grid fed charger (if provided) maintain the battery to the highest possible State of Charge (SOC) while protecting the battery from deep discharge or extended overcharge. Even where a grid fed charger is provided, in as far as possible, renewable energy will be utilized for battery charging. But if the battery's state of charge drops below a point, then the battery would be charged through the grid power supply; it should be possible for the purchaser to set the battery voltage at which the grid fed charger will cut in. The charge controllers and grid fed charger (if any) should function in an integrated manner and without necessitating manual operation. Wherever necessary, a master controller (or functionality thereof) shall be provided towards this end. The controller shall have dusk to dawn switching for outdoor lighting.

6.4.5 Indications and meters

Relevant meters should be provided for voltage, current and indication for Low Battery, Battery on charge and Battery fully charged. Detailed scheme shall be submitted at design/ drawing approval stage.

6.5 Battery Bank:

6.5.1 Unless otherwise specified by the purchaser, Battery Bank shall be Tubular Gel Valve Regulated Lead Acid Battery (VRLA) type complying IEC 60896 21 & 22. Gel tubular VRLA battery (when compared to the other type of VRLA battery) offers higher life in terms of cycles as well as years, there is far lower probability of PCL 3 effect, far lower risk of

thermal runaway/ dry out failures and its capacity as well as internal resistance is relatively stable during lifetime. Flooded battery is not recommended as it generates acid fumes that may be hazardous to the health of gateman and moreover, it requires topping up. The purchaser may at his option decide to specify any other type of VRLA battery, if considered necessary (refer item 1(i) of Annexure-3).

6.5.2 Unless otherwise specified by the purchaser, the storage battery bank rating shall be 2 nos. 12V 120 Ah (C10). The purchaser can at his option, depending on site requirements, specify a higher or lower Ah capacity of the battery (refer item 1(ii) of Annexure-3).

6.5.3 T-gel type VRLA Battery shall have a design life expectancy of more than 5 years at 50% DOD at 27°C.

6.5.4 The permissible self-discharge rate for T-gel VRLA batteries shall be less than 2% of the rated capacity per month at 27°C.

6.5.5 The charging instructions shall be provided along with the batteries.

6.5.6 The T-gel type VRLA batteries shall be discharged up to 80% DOD.

6.5.7 Suitable Battery Box made of Polycarbonate or M.S fabricated with acid proof paint shall be provided to house the battery.

6.5.8 Make of the battery shall be finalized at the system design stage.

6.6 Battery Testing

Tubular Gel VRLA batteries shall have third party certifications for life test as per IEC 61427 for minimum requirement of 13 units @150cycles / unit equaling to 5 years life. All routine tests as per applicable standards shall be conducted on the batteries. Performance characteristics curves of the offered battery, as indicated below, shall be submitted:

i) Charging-discharging characteristics at various temperature and cell voltage.
ii) Self discharge at various ambient temperatures.
iii) Cell voltage vs. State of charge.
iv) Capacity vs. Rate of discharge.
v) State of charge vs. Sp. Gravity of electrolyte.
vi) Depth of discharge vs. No. of cycles.

6.7 LED Lamp and fixtures

Instead of designing/ manufacturing a luminaire especially for this application, a commercially available LED luminaire (or an improved

version of it) of good repute/ performance record, if available, will be preferable. Unless otherwise specified in the following sub-clauses, LED/ luminaire manufacturer's data-sheet/ conformance certificate will be accepted in lieu of tests.

6.7.1 Rated Voltage and Power: Voltage: 12V DC; Power: 15W (nominal) for outdoor and 5W (nominal) for indoor (power ratings are inclusive of driver losses).

6.7.2 Minimum efficacy of luminaires shall be 80 lumen/ W i.e. minimum 400 (for 5W)/ 1200 (for 15W) system lumens. Third party certificates for compliance can be accepted. Else, this is required to be demonstrated through a test.

6.7.3 For outdoor luminaires, LM 79 report is required to be submitted. Else, the same can be demonstrated through a test.

6.7.4 LED type – White High Powered LEDs with CCT range of 5500-6500 K temperature. Colour Binning should comply existing ANSI standard C78.377A. White Point Stability of LED should be within 7 McAdam Step. LED should be of SMD type only.

6.7.5 Colour Rendering Index (CRI) shall not be less than 70 (nominal).

6.7.6 LED efficacy shall be minimum 100 lm @ 350mA drive current to meet the required LUX level. Nominal viewing angle of the LEDs used in the 15 W luminaire shall be 120^{o}.

6.7.7 L70 life of LED shall be more than 50,000 hours at soldering point temperature of 85 deg C and at luminaire operating current. The life time projection should be based on LM-80 test data and corresponding TM21 projection method for the corresponding driving currents at which the LEDs are driven.

6.7.8 Junction to soldering point thermal resistance should be less than 10 degC/W for outdoor luminaires.

6.7.9 LED used shall be of NICHIA / OSRAM / SEOUL SEMICONDUCTOR / PHILLIPS LUMILEDS / LEDNIUM/ CREE make.

6.7.10 LED fixing arrangement for outdoor luminaire of 15 W: Mounted on metal core PCB fixed to aluminum heat sink.

6.7.11 The 15W LED Luminaire for outdoor application shall be mounted on 5 m height from ground level on galvanized 6 m MS pole with necessary accessories i.e. one luminaire on each side of the two poles on either side of the track.

6.7.12 Avg. illuminance delivered by outdoor luminaire shall be 4 lux at ground level (5m from the luminaire) and shall be measured using 9 point method as defined in Annexure-2. The ratio of minimum to average illumination shall be at least 0.4 and the transverse uniformity ratio i.e. minimum to maximum illumination shall be at least 0.33. Third party certificates for compliance shall be acceptable. Else, the same is required to be demonstrated through a test.

6.7.13 Indoor LED Fixture: ABS plastic/Aluminum fixture with acrylic cover.

6.7.14 Outdoor LED Fixture: Pressure die-cast LM6 housing with IP65 protection, having toughened glass/ UV stabilized polycarbonate cover.

6.7.15 The LED luminaire shall comply IEC 60598/ IS 10322. Third party certificates for compliance shall be accepted. Else, this shall be demonstrated through a test.

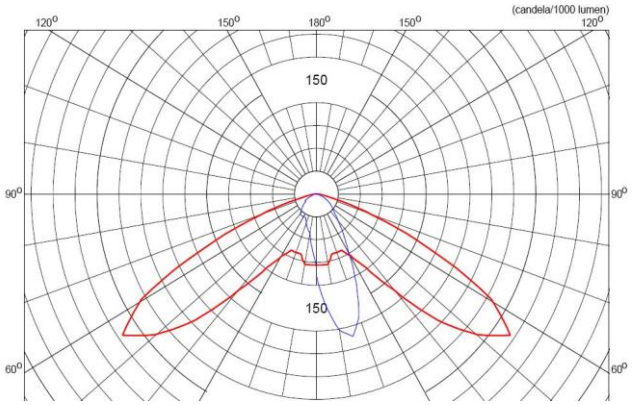
6.7.16 The temperature of the heat sink shall not be greater than 20°C above ambient temperature even after 6 hours of continuous operation. Further, soldering point temperature of the LEDs used in the luminaire shall also be demonstrated through a test.

6.7.17 The LED driver DC current regulation shall be better than 3%.

6.7.18 The LED controlgear shall comply to IS 15885 (Part 2 /Sec 13)/ IEC 61347-2-13 and IS 16104/ IEC 62384. Third party certificates for compliance shall be accepted. Else, this shall be demonstrated through a test.

6.7.19 Automatic dusk to dawn switching of the LED streetlights shall be integrated in the system. A separate switch and fuse arrangement for each LED light shall be provided inside the goomti for the purpose of safety and maintenance.

6.7.20 Typical light distribution for outdoor luminaire should be as per the following polar curve:



6.8 Fan

A DC wall mounted bracket fan shall be provided. A commercially available market product of good repute/ performance record will be preferable. Unless otherwise specified, fan manufacturer's data-sheet/ conformance certificate will be accepted in lieu of tests. Indicative technical parameters of the fan shall be as follows. But if it so happens that a commercially available market product of good repute/ performance record has somewhat different parameters, the same can also be accepted by the purchaser with the over-riding condition that the power consumption of fan will not exceed 25W in any case.

Voltage rating: 12V DC
Power: 20W (nominal)
Air flow: More than 0.25 m^3/sec.
Fan sweep: 300 mm
Motor insulation: F Class
Temp rise: less than 65° C above ambient.
Shroud shall be provided for protection.

6.9 Cables and Hardware

6.9.1 Cabling of the system shall be as short as possible to minimize the voltage drop in the wiring

6.9.2 Cable shall meet IS 1554 / 694 Part 1:1988 and shall be of 650 V/ 1.1 kV grade.

6.9.3 The module/ array wiring shall be water and UV resistant and suitable for Solar system application. The cables used shall be TUV 2Pfg 1169/08.2007 or VDE EPV 01:2008-02 or UL4703 certified.

6.9.4 All wiring must be sized to keep line voltage losses to less than 3% in each sub circuit and to allow the circuit to operate within the ampere rating of the wire.

6.9.5 Components and hardware shall be vandal and theft resistant. All parts shall be corrosion-resistant.

6.10 Protections

6.10.1 Adequate protection shall be incorporated under no-load conditions (i.e. when the system is ON and there is no load) from master controller output side.

6.10.2 If any other protection is necessary, the same will be deemed to be a part of the specification.

6.11 Marking:

Each WSH system shall carry the following clear and indelible markings on the controller:

- Name, monogram or symbol of system integrator;
- Type or model number;
- Serial number;
- Polarity of terminals or leads (colour coding is permissible);
- Output voltage.
- Max. power output
- Date of supply
- Battery type

  Total AH
  No./AH of batteries

7.0 INSTALLATION & COMMISSIONING:

The installation shall be done by the supplier/manufacturer who is responsible for system performance, direction of installation and structural stability. The supplier shall conduct a detailed site assessment. The installer shall obtain data specific to the site, rather than relying on general data.

8.0 DOCUMENTATION:

The supplier shall provide easy-to-use illustrated installation and operation manual in English and local language for easy installation and trouble-free usage. The manual shall contain complete system details such as array layout, schematic of the system, working principle, clear instruction on regular maintenance, troubleshooting of the system and emergency shutdown procedures.

9.0 LOG BOOKS

Railways shall maintain a logbook detailing inspection and operating activities. This logbook must be kept in a secure place and shall be

made available, whenever required for inspection. Testing of all protection devices shall be carried out at regular intervals (no longer than six months) by the customer and recorded in the logbook.

10.0 DESIGN APPROVAL

Design for complete system and sub-systems shall be approved by RDSO at design stage before manufacture of prototype conforming to this specification. The criteria for selection of sub-system / component shall be based on sound engineering practice conforming to the International/ Indian Standards wherever specific standard is not specified in this specification. The detailed calculation/simulated results shall be submitted in support of system/ sub-system rating. Adequate safety margin as stipulated in respective specification shall be used.

11.0 PROTOTYPE APPROVAL

The prototype system shall be offered to RDSO for testing and approval. For certain tests, the type testing authority i.e. RDSO may choose to rely upon previous type test reports/conformance certificates, as long as they pertain to similar design and comparable rating. However, the manufacturer cannot demand this as a matter of right.

Until the railways are able to issue their vendor list, they may in the interim period invite tender/ place order with the provision of accepting the material on the basis of firm's written clause-by-clause confirmation of the spec. and acceptance test alone, wherever this is considered necessary by CEE.

12.0 TESTS:

The manufacturer shall carry out routine tests at his works and shall maintain records for the same. Acceptance testing shall be carried out by the purchaser or his representative or by any agency deputed by the purchaser on his behalf.

12.1 Test on SPV Module:

S.N.	Name of Test	Type Test	Routine Test	Acceptance Test	Method
1.	Visual Examination	√	√	√	Refer Annexure 1
2.	Design Qualification	√	√	√*	IEC 61215 and Cl. 6.3.1 & 6.3.3

3.	Safety Test	√	√	√*	IEC 61730 and Cl. 6.3.3
4.	Photo Electrical Conversion Efficiency	√	√	√	By Sun simulator on each module and Cl. 6.3.4
5.	Fill Factor	√	√	√	By Sun simulator on each module and Cl. 6.3.5
6.	Transmitivity of Glass	√			As per Cl 6.3.7
7.	Rated output of module	√	√	√	By Sun simulator on each module and Cl. 6.3.2
8.	Module mismatch test	√		√	Refer Cl. 6.3.16
9.	Terminal block	√		√Ω	Refer Cl. 6.3.10
10.	Provision of Bird Spike	√		√	Refer Cl 6.3.13
11.	Provision of RFID tag with requisite details	√	√	√	Refer Cl 6.3.18
12.	Environmental tests	√		√**	Refer Clause 4.0 of Annexure 1
13.	Insulation Resistance	√		√	Refer Clause 5.6 of Annexure – 1
14.	Provision of Earthing	√		√	Refer Cl 6.3.27
15.	Warranty Certificate for the modules	√		√	Refer Cl 6.3.14
16.	Marking	√	√	√	Refer Cl 6.3.19

* Copy of the latest conformance certificates should be asked

Ω To be relied on datasheets and test reports

** If compliance has already been checked during type testing, the same will be relied upon, otherwise compliance will be ensured through physical tests

12.2 Tests on Module Mounting Structure:

S.N.	Name of Test	Type Test	Routine Test	Acceptance Test	Method
1.	Visual Examination	√	√	√	
2.	Dimension	√		√	As per manufacturer's data sheet and Cl. 6.3.23
3.	Conformance on module structure withstand capability	√		√	Refer Cl 6.3.22
4.	Clearance between module and ground			√	Refer Cl 6.3.25
5.	Galvanization thickness	√		√	Refer Cl 6.3.23
6.	Foundation			√	Refer Cl 6.3.24
7.	Fasteners			√	Refer Cl 6.3.26

12.3 Tests on module junction box, Array sub-main and main Junction Box:

S.N.	Name of Test	Type Test	Routine Test	Acceptance Test	Method
1.	Visual Examination	√	√	√	Refer Cl 6.3.20, 6.3.21
2.	Material	√		√£	Refer Cl 6.3.28
3.	IP Protection	√		√£	Refer Cl 6.3.28
4.	Cable entry and markings			√	Refer Cl 6.3.21

£ To be relied on datasheets and test reports

12.4 Test on Solar Charge Controller:

S.N.	Name of Test	Type Test	Routine Test	Acceptance Test	Method
1.	Visual Examination	√	√	√	
2.	Compliance to IEC: 62509	√		√a	Refer Cl. 6.4.1 (iii)
3.	Functionality and rating of the charge	√	√	√	Refer Cl. 6.4.1 (ii)

	controller				
4.	Auto, bulk, float and equalization charging of battery	√		√€	Refer Cl. 6.4.1 (xiii)
5.	PWM/ MPPT Technology	√		√ ɑ	Refer Cl. 6.4.1(vi)
6.	Capability for handling 120% of rated current	√		√ ɑ	Refer Cl. 6.4.1-(v)
7.	Insulation Resistance	√	√	√	Refer Cl. 6.4.1-(xiv)
8.	Efficiency	√		√€	Refer Cl. 6.4.1-(vii)
9.	Temp. Compensation	√		√ ɑ	Refer Cl. 6.4.1-(viii)
10.	Protection Tests	√		√€	Refer Cl. 6.4.1(xi)& (xvi)
11.	IP protection	√		√	Refer Cl. 6.4.1-(iv)
12.	Surge protection	√		√	Refer Cl. 6.4.1-(x)
13.	Self-Consumption Test	√		√€	Refer Cl. 6.4.1-(iii)
14.	Blocking Diode	√		√	Refer Cl. 6.4.1-(ix)
15.	Over Voltage Test	√		√***	Refer Cl. 6.4.1-(xv)
16.	Environmental Test	√		√ ɑ	Refer Cl. 6.4.1-(xvii)
17.	Suitability for both T-Gel VRLA as well as LMLA	√		√ ɑ	Refer Cl. 6.4.1-(i)
18.	Checking of electronic components	√		√π	Refer Cl 5.6
19.	Output to be cut-off on 80% DOD of battery	√		√	Refer Cl. 6.5.6
20.	Integrated functioning & charger functionality (if any)	√	√	√	Refer Cl. 6.4.3 & 6.4.4

ɑ If compliance has already been checked during type testing, the same will be relied upon, otherwise compliance will be ensured through physical tests

€ On random 5% of the samples or a minimum of 2 samples

*** On any one random sample

π To be relied on datasheets and test reports

12.5 Test on Wind Turbine

S.N.	Name of Test	Type Test	Routine Test	Acceptance Test	Method
1.	Visual Examination	√	√	√	
2.	Power Rating as per CWET/ accredited test house	√	√	√	As per Cl. 6.2.1
3.	Corrosion resistance	√		√¥	As per Cl. 6.2.2
4.	Power vs RPM curve	√			As per Cl. 6.2.3
5.	Protection against high velocity/ overspeeding	√	√	√	As per Cl. 6.2.4
6.	Mounting Structure and its galvanization thickness	√	√	√	As per Cl. 6.2.6
7.	Design calculation on tower wind withstand capability	√	√	√¥	As per Cl. 6.2.5
8.	Provision of earthing	√		√¥	As per Cl. 6.2.7

¥To verify test certificate

12.6 Tests on Battery:

S.N.	Name of Test	Type Test	Routine Test	Acceptance Test	Method
1.	Visual Examination	√	√	√	
2.	Battery Type	√		√	Refer Cl. 6.5.1
3.	Battery Voltage and AH	√£		√£	Refer Cl. 6.5.2
4.	Battery Life	√£		√£	Refer Cl. 6.5.3
5.	Enclosure material	√	√	√	Refer Cl. 6.5.7

6.	Self-Discharge Test	√£		√ £	Refer Cl. 6.5.4
7.	Battery Characteristics	√£		√ £	Refer Cl. 6.6

£ To be relied on datasheets and test reports

12.7 Test on Wind Charge Controller

S.N.	Name of Test	Type Test	Routine Test	Acceptance Test	Method
1.	Visual Examination	√	√	√	
2.	Rating of WCC	√	√	√	As per Cl 6.4.2(ix)
3.	Efficiency	√	√	√€	As per Cl 6.4.2(iv)
4.	Type of charger	√	√	√ ¤	As per Cl 6.4.2(iii)
5.	Temperature Compensation	√		√ ¤	As per Cl 6.4.2(v)
6.	Provision of blocking diode	√	√	√	As per Cl 6.4.2(vi)
7.	Protection against				
a	Battery overvoltage	√		√	As per Cl 6.4.2(viii)
b	Short Circuit	√		√	
c	Reverse Polarity	√	√	√	
d	Lightning & surge protection	√	√	√	As per Cl 6.4.2(x)
e	Overspeeding	√	√	√	As per Cl 6.4.2(vii)
8.	Output to be cut-off on 80% DOD of battery	√		√	Refer Cl. 6.5.6
9.	Dump load	√	√	√	As per Cl 6.4.2(vii)
10.	Auto, bulk, float and equalization charging of battery	√		√€	Refer Cl. 6.4.2 (xi)
11.	Over Voltage Test	√		√***	Refer Cl. 6.4.2-(xiii)
12.	Environmental Test	√		√ ¤	Refer Cl. 6.4.2-(xv)
13.	Suitability for both T-Gel VRLA as well as LMLA	√		√ ¤	Refer Cl. 6.4.2-(i)

S.N.	Name of Test	Type Test	Routine Test	Acceptance Test	Method
14.	Checking of electronic components	√		√ ¤	Refer Cl 5.6
15.	Integrated functioning & charger functionality (if any)	√	√	√	Refer Cl. 6.4.3 & 6.4.4

ª If compliance has already been checked during type testing, the same will be relied upon, otherwise compliance will be ensured through physical tests

€ On random 5% of the samples or a minimum of 2 samples

*** On any one random sample

¤ To be relied on datasheets and test reports

12.8 Tests on LED Lamp and Fixture:

S.N.	Name of Test	Type Test	Routine Test	Acceptance Test	Method
1.	Visual Examination	√	√	√	
2.	Rated Power of the luminaire	√	√	√	Refer Cl. 6.7.1
3.	Light Intensity	√		√¥*	Refer Cl. 6.7.2
4.	Lumen efficacy of the luminaire	√		√ µ	Refer Cl. 6.7.2
5.	LED Type	√&		√&	Refer Cl.6.7.4, 6.7.5, 6.7.6, 6.7.7, 6.7.8, 6.7.9, 6.7.10
6.	LM-80 and TM-21 reports for L70 Life of LEDs	√&		√&	Refer Cl. 6.7.7
7.	Lux Level	√		√ µ	Refer Cl. 6.7.12
8.	LED Luminaire and its fixture	√		√	Refer Cl. 6.7.10, 6.7.11, 6.7.13 and 6.7.14
9.	IP Protection	√		√¥*	Refer Cl. 6.7.14
10.	Heat Sink and soldering point temperature	√		√ µ	Refer Cl. 6.7.16
11.	LED Driver Regulation	√		√	Refer Cl. 6.7.17
12.	LED Control Gear Compliance	√		√¥*	Refer Cl. 6.7.18
13.	LED luminaire testing	√		√¥*	Refer Cl. 6.7.15

14.	Dusk to Dawn Switching	√		√ µ	Refer Cl. 6.7.19
15.	LM-79 Compliant and polar curve	√¥*		√¥*	Refer Cl. 6.7.3 & 6.7.20
16.	Checking of electronic components	√		√ &	Refer Cl 5.6

¥* Checking of test reports

& Checking of datasheets

µOn random 5% of the samples or a minimum of 2 samples

12.9 Tests on Cables and Hardware:

S.N.	Name of Test	Type Test	Routine Test	Acceptance Test	Method
1.	Visual Examination	√	√	√	
2.	Voltage rating	√		√	Refer Cl 6.9.2
3.	Voltage Drop			√	Refer Cl 6.9.4
4.	Module/ array wiring	√		√	Refer Cl 6.9.3
5.	Type and size of cable connecting the charge controller	√		√	Refer Cl 6.4.1(xii)

Annexure - 1

Quality Testing of PV-Module

Modules used in solar panels shall have IEC 61215 Ed 2 or latest compliance certificate. The qualification testing procedure is defined in IEC 61215 Ed 2 or latest to examine the impact of mechanical, thermal and electrical stress on power output. The bidder shall submit appropriate type approval certificate for the offered solar modules from accredited test laboratory.

Method of Testing

1.0 Visual Inspection:

Each module shall be carefully inspected under an illumination of not less than 1,000 lux for the following conditions:

1.1 Racked, bent, misaligned or torn external surfaces.

1.2 Broken / cracked cells

1.3 Faulty interconnections or joints

1.4 Cells touching one another or the frame

1.5 Failure of adhesive bonds; bubbles or delaminations forming a continuous path between a cell and edge of the module

1.6 Faulty terminations and exposed live electrical parts

1.7 Junction box should have common terminals with suitable blocking diode to prevent reverse current flow.

2.0 Performance at STC: (Clause 10.1 of IEC 61215 Ed 2 or latest)

The current-voltage characteristics of the module shall be determined in accordance with IEC 60904-1 at a specific set of irradiance and temperature conditions. Performance of PV-Module shall be generally evaluated at Standard-Test-Conditions (STC) as defined in IEC 60904 standards:

i) Cell temp. of 25° C,
ii) Incident solar irradiance of 1000W/m2,
iii) Spectral distribution of light spectrum with an air mass AM=1.5

3.0 All PV modules supplied shall be accompanied with I-V curves (tested in the manufacturing unit, clearly indicating the serial number, batch number, date and country of origin).

4.0 Environmental Testing:

Following environmental test shall be conducted on offered module or on module of similar design, for initial clearance of the offered system.

Test	**Test Details**	**Actual test to be carried out at Govt. Recognized Lab or manufacturer premises as per standard**
Cold Test	Temp. (-) 10^0C Duration: 16 hrs.	IEC-68-2-1
Dry Heat	Temp. (+) 70^0C Duration: 16 hrs	IEC-68-2-2
Salt spray*	Temp. (+) 35^0C, RH 95% Duration: 2 hrs spray and 22 hrs conditioning No. of Cycle : 01	IEC-68-2-11 Test Ka
Wind	Pressure equivalent to an air velocity of 200 km/hr.	
Rain	Test as required in the mentioned standards	JSS: 55555 (Test No. 12)
Dust	Temp : 40°C, RH < 50% Duration – 1 hr	JSS: 55555 (Test No. 14)
Others	Electrical Isolation test Routine test	Shall be done at manufacturers place for every modules offered

***** If compliance to IEC 61701 has been asked by the purchaser, then this test will not be required.

Note- Before and after the environmental testing the solar modules shall be subjected to performance test on sun simulator and insulation resistance test, and no degradation of maximum output power shall not exceed 5% of the value measured before the test.

5.0 Acceptance Criteria:

The module is deemed to have passed the tests if the sample meets the following criteria:

5.1 There is no evidence of a major visual defect such as a cracked or broken window, bubbles or de-lamination in the encapsulant etc.

5.2 There is no cell breakage and no water infiltration into terminal boxes.

5.3 No sample exhibits any open circuit or ground fault.

5.4 No visible evidence of major defects that may affect performance of the module.

5.6 Insulation Resistance not less than 50M-ohm at 500 V DC.

5.7 Degradation of performance may not exceed 5% after each single test or 8% after the whole sequence.

Annexure - 2

MEASUREMENT OF STREET LIGHTING LUX LEVELS

9 point method –

Basics:

- Divide the section between two poles into 4 quadrants of equal size
- Measure the Lux levels at four corners of each quadrant
- Take the average of each quadrants
- Find the average of the all the four quadrants
- Distance between two poles shall be at 15 m and the width of the road is to be taken as the height of the pole i.e. 5 m.

Position	Pole 1	Mid-Point	Pole 2
Edge of the road near light	P1	P2	P3
Mid road	P4	P5	P6
opposite edge of the road	P7	P8	P9

Average Lux levels = (P1+P3+P9+P7)/16 + (P2+P6+P8+P4)/8 + (P5)/16

Annexure - 3

TECHNICAL DETAILS TO BE FURNISHED BY THE PURCHASER IN HIS REQUISITION/ TENDER

1. Battery

i) Battery type (see Cl. 6.5.1)

ii) Battery Capacity required in AH (see 6.5.2)

2. SPV Module

i) Is Salt Mist Corrosion Testing required (see Cl. 6.3.3) (Yes/No)

3. Charge controllers and Grid supplied charger

i) Is grid supplied charger required (see Cl. 4.0-vi-c and 6.4.3) (Yes/No)

ii) Is compliance required for environmental testing of Solar Charge Controller (see cl. 6.4.1 (xvii)) (Yes/No)

4. Wind Turbine and Support Structure:

i) Is the firm required to submit type test certificate for salt spray test as per ASTM B-117 for a minimum period of 1,000 hours? (Refer Cl. 6.2.2) (Yes/No)

ii) Galvanization Thickness (Refer Cl. 6.2.6 & 6.3.23(iii))

iii) Will the height of all towers be 15m? (Yes/No)?
If no, then mention number of towers >15m along with their height. This will also need to be mentioned in tender work schedule. (Refer Cl. 6.2.6)

Annexure - 4

TECHNICAL DATA TO BE FURNISHED BY THE TENDERER IN HIS OFFER

1. Wind Generator

i) Make and model no.
ii) Rating of Wind Generator
iii) Regular empanelment from C-WET?
(Yes/ No)

2. SPV Module

i) Make and model no.
ii) Power rating

3. Charge Controllers

Please provide detail for wind, solar charge controllers and master controller (if any); if the purchaser has asked for a grid supplied charger, then also provide details thereof)

i) Make and model no.
ii) Ratings

4. Battery

i) Make and model no.
ii) Battery type
iii) VAH rating of battery (mention voltage as well as AH)
