SPECIFICATIONS FOR PUBLIC SOLAR-POWERED STREET LIGHTING PROJECTS

LAGOS STATE
ELECTRIFICATION
AGENCY

DISCLAIMER

The Solar Powered Light Emitting Diodes (LED) Specifications have been developed using information available from the field and other sources and is suitable for most public lighting situations encountered by the Lagos State Electrification Agency and the Ministry of Energy and Mineral Resources. Particular conditions affecting project sites or localities may require special notes or amendment to this Standard Document. It is the responsibility of all persons involved to ensure that a safe system of work is employed and that statutory (national and international) codes, standards and regulatory requirements applicable to the design and installation of public lighting on roads are met at all time.

Lagos State Electrification Agency and the Ministry of Energy & Mineral Resources will not accept any liability for defective work that may arise as a result of the use of this guideline as Street lighting Standards are subject to periodic review.

1.0 GENERAL

1.1 This Standard is subject to amendment, without notice to the public and the various public lighting practitioners, at any time. Any proposed deviation from this Standard must be submitted to the Lagos State Electrification Agency for approval considerations before implementation.

1.2 Solar Street lighting refers to the functional illumination of public and private highways and roads that permit the movement of vehicles and pedestrians within the State.

1.3 Proposals for public lighting installations must be accompanied with relevant design drawings and specifications in both hard and soft copies and must be submitted for approval consideration of the Lagos State Electrification Agency prior to the commencement of work. The proposals shall include, but not limited to, the positions of the lighting columns, type of columns, lanterns, structural stability design and calculations for the poles and plinths. Also, the proposal should contain the design data showing proposed illumination levels as appropriate.

1.4 The approved drawings will be used on any subsequent adoption inspections; therefore, any changes made to road or lighting layout should be resubmitted for approval.

1.5 The process and set of criteria and specifications for potentially becoming an approved product by a manufacturer or vendor is defined and set out in sections 4.0 – 8.0 within this document.

2.0 ADOPTION OF LIGHTING

2.1 The Contractor(s) shall be settled on a Pay-As-You-Go (PAYG) basis. The Contractor(s) shall give only daily charge in respect of payment of the lighting installation, and shall in addition, carry out planned maintenance of the installation consisting of servicing of LEDs, solar panels, charge controllers, storage systems, remote monitoring fixtures, columns and plinths. All repairs to any part of the lighting installation including damage repair will remain the responsibility of the Contractor(s) and worked into the daily charges.

2.2 The effectiveness of the LED light products has become more efficient and the efficacy of the diodes increasing, it has become more viable to use Solar Powered LED Street lights on various trunk and main roads. This is only viable where the source of solar is consistent and reliable.

3.0 RECOMMENDED LUMINAIRES PRODUCTS (LED)

The Solar Powered Light Emitting Diode (LED) quality, pricing and availability has completely revolutionised the lighting industry over the past ten years to such an extent that new light production is regularly dedicated solely to the use of LED elements.

The LED is now considered a mature technology and has been through rapid development phases continuously increasing the light output from the die, improving efficacy figures and at the same time allowing increased operational temperatures of the units. As the LED has evolved, so lens manufacturers have developed a myriad selection of optics to allow light patterns to be tailored and shaped to fit the desired profile to illuminate a given area.

4.0 KEY PRODUCT CRITERIA

The solar powered LED street product should achieve a standard to ensure that a consistent level of manufacturing, specification, performance and quality to ensure that the LASG is getting the best value for money. The overall performance of the product shall be guaranteed for a minimum period of Seven (7) years on all elements of the product.

Preference will be given to products that meet the LASG basic criteria. To be considered for supply of Solar Powered LED lighting systems, the supplier must demonstrate that its products meet the under listed attributes:

The product criteria should be broken down into 6 product categories:

1. LED Array
2. Solar Array
3. Energy Storage (Battery)
4. Control System
5. Overall Product
6. Pole & Plinth
7. Implementation of PoC

4.1 LED ARRAY

The LED array should be modular allowing for the following:

- Modular units which can be replaced simply if a failure was to occur.
- Various optical outputs can be used & easily changed.
- Modules can be tilted from -20 to +30 degrees customise roadway lighting.
- Optical outputs (Type I, II, III, IV & V)
- LED efficacy should be a minimum 210lm/w
- 5,000 - 5,500 Kelvins (+/- 3%)
- IP66
- IK08
- Temperature operation -40C to +55C
- Tested to minimum of 55,000 hours @ TM80.
- The LED must be hot binned at 85 degrees C or higher to ensure consistency of product.
- The LED case temperature should be able to exceed 120 degrees C without damage to the die.
- RAL 7001, 7004, 7040 or 7045 – 7047. Grey

4.2 SOLAR ARRAY

The solar array consists of the solar panel and the solar charge controller.

- Monocrystalline with a minimum efficiency of 21%
- Connection MC4 compatible
- Min 250W Solar Panel
- 2,400Pa Wind Loading
- Salt mist resistant
- 1,000V UL/1000V IEC Certified
- Up to 168 W/m2 power density
- MPPT Controller
- Controller remote programmable for setup
- Controller with inbuilt timer functions
- Wireless and Infrared connectivity for programming
- Inbuilt LED driver
- 12 or 24vdc selection
- LiFeP04, LiNiCoMn or NCM compatible
- Variable input voltage range
- IP68
- Operating Temperature – 40C to +60C

4.3 ENERGY STORAGE / BATTERY

The Energy Storage/Battery consists of battery cells and the battery management system.

- The battery should be a chemical consistency of LiFeP04, LiNiCoMn or NCM
- Minimum 6,000 cycles to 95% DOD
- A minimum of 1,000Wh of usable energy storage
- Over Charge Protection
- Load Open Protection
- Programmable Low Voltage Disconnect/Reconnect setting.
- Storage should be large enough to accommodate lighting cycle at power requirement needed and autonomy.

4.4 CONTROL SYSTEM

The control system consists of two elements, the individual on site control & the remote-control management system. These parameters should be the minimum requirement.

- The onsite programmer should allow for wireless & infrared control to reprogram the solar & light parameters.
- The lighting system needs to be fitted with a plug & play lighting control unit for remote operation.
- Remote operation via point to point, multicast or broadcast signalling protocols
- Gateway should have a capacity of up to 150 lighting unit capacity. (Terrain Dependent & Line of Sight)
- Gateway IoT system fitted with Network SIM card for mesh network operation.
- Remote control system to have a minimum of the following:
    - Remote Programming
    - Setup of light

- Geographical Map with light and gateway location
- Gateway Setup and Monitoring
- Light Monitoring (power, dimming, battery level, solar input/output, lifetime, brightness etc
- Inventory Management
- Fault Management
- Real-time Alarm System (Product tampering & Tracking)

4.5 OVERALL PRODUCT

There is a necessary criterion to be set to enable the flexibility with the whole product.

- The product / solar panel should be able to tilt from 0 – 35 degrees.
- The LED product is required to be tilted independent from the solar panel.
- The complete product should be an "all-in-one" unit.
- The various elements of the product can be swapped and changed simply without having to replace the complete product.
- LASG should visibly inscribed on the product casing.
- Product fitted with Anti-theft tilt system.
- Product fitted with 100% always active hardwired Geo-location anti-theft device for tracking product.
- Slip collar for pole up to 76mm.

Additional attributes that should be considered when looking at a supplier should consider the following:

- That the company has been in the business of manufacturing LED lighting for a minimum of 10 years.
- That the products have been installed in Nigeria and shown to have worked for a minimum period of 3 years.
- That the company itself has successfully deployed lights in Africa and preferably within Nigeria.
- That the company has a recognised delivery partner in country for supply and warranty purposes.
- The company is prepared to allow and will actively support the local manufacturing of named products within Nigeria.
- The company has its own in-house testing criteria such as Goniophotometer.

5.0 LIGHTING ROADWAY CRITERIA TO BE MET

A - Class Roads Minimum Criteria:

Road Width	10 - 16m	
Number of Lanes	3 - 4	
Pole Location	Single or Double (as applicable)	
Minimum Distance Between Poles	30m	
Pole Height	8m – 10m	
Maximum Lamp Tilt	10 Degrees	
Maximum Lamp Power	120 watts	
Emin	15 lux	
Emax	60 lux	
Eav	15 – 22.5 lux	
TI (%)	Max 20.00	

B - Class Roads Minimum Criteria:

Road Width	8 - 10m	
Number of Lanes	2	
Pole Location	Single or Double (as applicable	
Minimum Distance Between Poles	30m	
Pole Height	7m - 8m	
Maximum Lamp Tilt	10 Degrees	
Maximum Lamp Power	100 watts	
Emin	15 lux	
Emax	50 lux	
Eav	10 - 18 lux	
TI (%)	Max 25.00	

5.1 LSEA Definition of LED Quality Requirement

The key quality criteria (technical specification) which will be used for LED lighting and will also be the procurement criteria that will be used to compare different offers received from vendors:

- Electrical power (wattage).
- Luminous efficacy (light output).
- Light colour.
- Expected life cycle.
- Ability to switch – on/switch- off and control the system (including dimming)
- Test certificate (SONCAP etc)

5.2 Summary of LSEA LED Quality Metrics

Below is the summary of the LED quality metrics.

S/No	Issue	Criteria	Verification
1	Luminous Efficacy	≥ 210lumen/watt	Product datasheet
2	Lifetime	≥ 50,000 hours	Product datasheet
3	Colour Rendering Index (CRI)	CRI ≥ 70	Product datasheet
4	Colour Temperature	Between 4,850 – 5,500K	Product datasheet
5	Ingress Protecting Rating (IP)	≥ IP66	Product datasheet
6	Shock Resistance Class (IR)	≥ IR08	Product datasheet
7	Power Factors	$Cos^{\phi} \geq 0.95$	Product datasheet
8	Toxic Substances	Equipment must comply with directive 2002/95/CE of the European parliament and the council of 27 January 2003, regarding restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)	Supplier statement of compliance with this legislation.
9	Eco design	Equipment must be designed to facilitate dismantling and recovery for	Supplier statement of compliance with these

		reuse and recycling of its components and materials	criteria. Suppler register as product of EEE.
10	Luminaire	Quality and /or environmental labels and/or certification	Product labels and or certification (SONCAP)
11	Retrofit	Fixtures should enable retrofit or each key component within the product	Product datasheet
12	Head dissipation	Equipment must have an effective heat dissipation mechanism	
13	Smart Control	Multi light source, can be smart controlled	Product datasheet
14	Start	Low current start (0.6A); Start time: 0.06s, no warm-up is needed	Product datasheet
15	Manufactured	Overseas / Nigeria	Manufactured or assembled in Nigeria should always take precedence over any imported product

6.0 POLE & PLINTH

6.1 There is a necessary requirement for the company offering the full product proposal fully understands and has the ability to be able to engineer all of the necessary requirements such as wind loading calculations and engineering calculations for the concrete plinths and the poles.

6.2 As part of each proposal the company must be able to demonstrate the ability and knowledge by providing the calculations for the poles & concrete plinths.

- Calculations based upon 42m/s
- Maximum pole head weight of 50kg.
- Total surface area 2msq

6.3 The pole shall be hot dip Full Galvanized Steel with minimal thickness of **3mm** and the base plate should be square type of minimum **400mm x 400mm** with minimum plate thickness of **16mm** and slotted hole of anchor bolt.

6.4 The pole height shall either be eight meters (8m) or ten meters high (10m) except in exceptional cases where the need for lower pole of 7m or 12 meters are required.

6.5 The anti-climb paint covering over 4m from the pole fitting down the pole.

6.6 Pole shall be set on a minimal **600 x 800 x 800 mm or 600 x 800 x 1000 mm** plinth at the level necessary to obtain the required planting depth. The column foundation may be adjusted in accordance with the traffic level, the wind speed and environmental impact. Crash Barrier may be used in some case to protect the columns.

6.7 The plinth anchor bolts shall be threaded reinforce steel and minimum size **700mm x 24mm x 4units** and shall be provided with two nuts and two washers each. The nuts and washers shall be galvanized by the hot dip process.

6.8 The approved span between each pole shall be in the minimum of 30 meters. The columns shall be erected at the locations shown on the approved drawings.

6.9 The public lighting installations shall be located or erected behind the walkway.

6.10 The poles must be marine black paint colour and visually suitable to the existing contexts and environment. All painting shall be carried out in accordance with the paint manufacturer's instructions.

6.11 A visibility band of reflective paint shall be applied to public lighting columns in areas of high pedestrian traffic (1500mm above ground level). After erection, damages to the paints shall be made good.

6.12 Changes in configuration of pole and plinth will be permitted, providing the mounting height provides the required illuminance and stability are maintained.

6.13 Plinth / Pole dimensions and construction may vary and will depend on area. Calculations to be provided by installation company.

1	Shape	Polygonal or Stepped type
2	Material	High-Quality Steel
3	Surface Treatment	Hot-dip Galvanizing
4	Pole Height	8 – 10m
5	Arm Bracket	Single or Double
6	Top Diameter	70 - 76 mm
7	Bottom Diameter	Min 152.4 mm
8	Thickness	Min 3 mm
9	Pole Paint	Marine Black Paint
10	Anti-Theft Protection	Sharp Sparks at both Bottom-half and Top end
11	Base Plate	400 x 400 x 16 mm
12	Concrete Plinth Dimension	600 x 800 x 800 mm or 600 x 800 x 1000 mm
13	Anchor bolts	Galvanized Threaded Reinforced Steel
14	Anchor bolts dimension	700mmx24mmx4units

7.0 IMPLEMENTATION OF POC

The implementation of a pilot phase on a road of minimum 300m – 350m length (10 poles) at cost of vendor/manufacturer shall be done by the selected vendor for a period of 6-months.

An evaluation and the tracking of the result will be done at the end of 6-months to ascertain the following:

- Lumens
- Product performance
- Product reliability
- Product versatility
- System controls and reporting system
- OpEx savings
- Availability of the Lights
- Public perception of the new installation

8.0 PROOF OF CONCEPT PROCESS OVERVIEW

All solar light product to be considered for use on Lagos State roads must undergo a Proof of Concept (POC) process for a minimum of six (6) months.

This process shall be mandatory for all suppliers/manufacturers willing to get their product approved by LSEA for use by any MDA of Lagos State Government for solar street lighting project, irrespective of the project's size or complexity.

Historically, various solar products provided by suppliers have failed to meet expected performance levels, with some installations experiencing early failures or delivering underwhelming operational results. These shortcomings have resulted in avoidable service disruptions, increased maintenance burdens, and unnecessary financial costs to the Lagos State Government and in general to the taxpayer.

By enforcing a standardized Proof-of-Concept (POC) implementation process, the Government ensures:

- A consistent and measurable baseline for evaluating the quality and performance of all proposed solar lighting systems.
- A thorough validation of product performance, durability, versatility, control systems, reporting capabilities, and operational savings—including performance under adverse weather conditions when solar energy yield is at its lowest.
- That only products that have met the Lagos State minimum specification are approved for use within the State.
- A strengthened service level expectation from suppliers, ensuring that their technology, maintenance competence, and long-term support meets the Government's expectations.

8.1 Phase 1: Planning

8.1.1 Define Scope & Requirements:

- Clearly define the scope for the pilot (300m-350m road with 10 poles).
- The pilot is to run during the rainy and harmattan season.
- The minimum trial period shall be for a period of 6 months.
- The PoC process location will be defined by the LASG.
- Identify that the proposed product meets the minimum standards as detailed within this document.
- Establish the goals of the POC (lumens, performance, savings, etc.).

8.2 Phase 2: Pre-Installation

8.2.1 Site Preparation:

- Inspect and prepare the road where the installation will take place.
- Conduct an environmental impact assessment (if required).
- Confirm utility access and potential obstructions that could affect system installation.
- Provide a process of installation & impact statement prior to undertaking the PoC.

8.2.2 Installation:

- Install the solar lighting system as per the design.
- Ensure all components are tested upon installation to ensure correct function.
- Document the installation process and take baseline readings in accordance with this document. Confirmation of the validity of the readings will be confirmed by LASG own readings. (initial lumens, product specifications, and system status).

8.2.3 System Integration and Testing:

- Ensure integration of system controls (e.g., remote monitoring, security, real-time tracking).
- Conduct initial performance tests.
- Ensure system reporting is set up correctly in accordance with LASG requirements to meet the lighting levels displayed within this document. (e.g., real-time monitoring of battery charge, light levels, etc.).

8.3 Phase 3: Monitoring & Evaluation

8.3.1 Track Performance:

- Set up performance monitoring tools to track key metrics over time (lumens, product reliability, system availability, system performance & tracking).
- Ensure the system provides real-time data for evaluation.
- Schedule monthly regular checks on system performance and maintenance.

8.3.2 Specific Metrics to Track:

- **Lumens**: Measure light output monthly during the night and across winter/rainy season.
- **Product Performance**: Assess if the light intensity remains consistent or degrades over time.
- **Product Reliability**: Measure failure rates and identify any issues in the system.
- **Product Versatility**: Evaluate how well the system adapts to different environmental conditions (e.g., adjusting brightness based on weather).
- **System Controls & Reporting**: Track the functionality and reliability of the control system for monitoring the system's health, light levels, and battery charge.
- **OpEx Savings**: Estimate operational cost savings in terms of energy, maintenance, and other overhead costs.
- **Availability of the Lights**: Check how often the lights are operational and how frequently maintenance is required.
- **Public Perception**: Collect feedback from the local community (surveys, social media monitoring, etc.) about the new installation.

8.3.3 Rainy/Harmattan Season Monitoring:

- Ensure that a minimum of 6 months of the rainy/harmattan season are included in the evaluation.
- Track solar energy generation during lower solar gain periods (cloudy, rainy, etc.).
- Assess how the system compensates for less sunlight (e.g., battery storage, adaptive lighting).

8.4 Phase 4: Evaluation & Reporting (Month 6)

8.4.1 Data Collection:

- Collect data from the monitoring system, including all metrics established.
- Analyse data from the rainy/harmattan season.

8.4.2 Performance Review:

- Evaluate the system's overall performance against the initial goals and benchmarks.
- Identify any issues, limitations, or unexpected benefits that have occurred during the PoC.

8.4.3 Stakeholder Review & Evaluation:

- Hold a meeting with key stakeholders (vendor, MDA, community representatives, technical teams) to review findings.
- Discuss product performance, reliability, cost savings, and other evaluation criteria.

8.4.4 Public Perception Analysis:

- Review any public feedback collected during the pilot period.
- Identify common concerns, praises, or recommendations from the community.

8.4.5 Decision-Making:

- Based on the evaluation, decide whether to approve for use in Lagos State.
- Communicate the result of the evaluation of PoC to relevant stakeholders.

8.4.6 Final Report and Recommendations:

- Document the findings of the pilot project in a final report.
- Provide recommendations for further action, based on the evaluation criteria and data collected.
- Share the report with all relevant stakeholders.

Category	Score (1-10)	Notes						
LIGHT			MEASUREMENT CRITERIA					
Lumens Output		As per this measurement criteria	SPAN	0m				30m
Light Availability (%)		Average of all lights		0m	7.5m	15m	7.5m	0m
Failure Rate (%)		Average of all lights	0m					
Battery Storage Level (%)		Average of all lights	Middle of Road					
Average Battery Charge %		Average of all lights	Far Side of Road					
Solar Energy Generated (kWh)		Average daily value of all lights						
Product Performance			Maximum Lux Level					
Product Reliability		LASG overal thought on product	Minimum Lux Level					
Failure Events		Does the product meet 98% availability	Average Lux Level					
Control System/monitoring Status		Total amoun to failures incurred by all products	Cummulative Lux					
Monitoring Lighting		Does it meet all the criteria						
Programming		Is it responsive, does it meet the functions required						
Alarms		Is it responsive, does it meet the functions required						
Real-Time Product Tracking		Is it time responsive, does it meet the functions required						
Product Versatility		Is it time responsive, does it send out alarm & tracking accurate						
Public Perception		Measured against a validated system						
TOTAL SCORE	0							

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