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ENERGY EFFICIENCY IN STREET/PUBLIC AREA LIGHTING

VOLUME 2: SPECIFICATIONS ELEMENTS FOR STREET/ PUBLIC AREA LIGHTING

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Section 1: Specifications template for new street lighting installations – New works (Street lighting along new roads)

1. GENERAL

1.1. SCOPE OF WORKS

The contractor/ supplier shall be responsible to design, install, test and commission the whole lighting system in accordance with these specifications and the conditions of operations and maintenance encountered at the site.

1.2. PERFORMANCE CRITERIA

The lighting levels for different types of roads are as follows:

Table 1: Lighting levels for different types of roads

Road Type	Luminance cd/m ² minimum maintained value	E _{ave} in lux, minimum maintained value	E _{min} in lux, maintained value
Motorway	1.5	-	-
Main Road Type A	1.0	-	-
Main Road Type B	0.75	-	-
Busy urban road	-	10	3
Normal urban road	-	7.5	1.5
Small or quiet urban road	-	5	1.0
Rural and residential roads	-	3	0.6

1.3. QUALITY ASSURANCE

The relevant Authority may request a standard production model luminaire sample, identical (including LED Package) to the proposed product, to be installed for inspection. The Client may also request independent testing of sample luminaires to verify luminaire performance and compliance with the specifications. Testing shall be conducted as per the applicable IESNA, ANSI or approved International equivalent approved methods of products using Solid Stage Lighting (SSL) sources. All testing certificates shall be from a Laboratory certified/approved by UKAS or UL or has ISO 17025 or equivalent certification.

1.4. DESIGN CALCULATIONS

All structural design and calculations shall be undertaken by a Registered Civil /Structural Engineer Registered in Mauritius and who shall be approved by the RDA.

1.5. LIAISON WITH RELEVANT AUTHORITIES

The contractor / supplier shall liaise with all relevant authorities in connection with street lighting installation and seek their approval before proceeding with any ordering or installation. The client will advise on the list of authorities to be contacted. The works shall be done under the supervision and approval of the Central Electricity Board, the Ministry of Local Government and the Energy Services Division as applicable. The contractor shall liaise with the CEB and Energy Services division to witness all tests and commissioning procedures.

The contractor shall seek and obtain the permission of the Road Development Authority (RDA), the Traffic Management and Road Safety Unit and the Police Traffic Branch before undertaking any works that will disrupt the traffic. The contractor shall allow for all costs to provide policemen for traffic control during this type of works.

2. APPLICABLE STANDARDS

The following standards and guidance documents shall be applicable for the project:

BS 5489-1 2013- Code of Practice for design of road lighting

BS EN 13201- Parts 1-5- Road Lighting

CIE 115 -2010 - Lighting of Roads for Motor and Pedestrian Traffic.

CIE 129 - Guide for Lighting Exterior Work Areas.

IEC 60529 or EN 60 529 (IP) and EN 50 102 (IK).

BS EN 62471:2008 or ANSI/IESNA RP-27.3-07 Photo biological Safety of Lamps and Lamp Systems.

EN 60598-parts 1, 2-1 & 2-3 –Electrical safety -General and for Road Lighting Luminaires.

BS EN 61547, BS EN 61000-3-2, BS EN 61000-3-3 & BS EN 55015 -Electromagnetic Compatibility.

CIE 126-1997 Guidelines for Minimizing Sky Glow and IESNA TM-10 Addressing Obtrusive (Urban Sky Glow and Light Trespass) in conjunction with Urban Lighting.

Commission Internationale de L'Eclairage (CIE).

IEC 60068-2-68 ed1.0 - Environmental testing - Part 2: Tests - Test L: Dust and Sand.

IESNA LM-79-08 Test method for LED luminaires

IESNA LM-80-08 Test method for lumen maintenance of LED light sources.

IESNA TM-21-11 Projecting long term lumen maintenance of LED light sources.

3. POWER SUPPLY

3.1. POWER SUPPLY CHARACTERISTICS

The power supplies and distribution equipment shall be sized to cater for a 400/230 Volts, 50 Hz AC supply with a variation of $\pm 10\%$ in voltage and $\pm 1\%$ in frequency. Equipment shall be selected to operate with the above supply unless otherwise specified. Main low voltage switchgear shall incorporate spaces to enable the addition of future circuit breakers if required to serve dedicated equipment loads.

3.2. LIAISON WITH THE CEB

The contractor / supplier shall liaise with the CEB to ascertain the site supply characteristics and incorporate the CEB's requirements in his design and installations.

3.3. METERING

Electricity meters shall be installed on new installations which are fed by a separate supply and /or as appropriate, after consultation with the Client. The metering system shall meet the requirements of the CEB.

4. LV PANELS, SWITCHGEARS AND ACCESSORIES

4.1. LOW VOLTAGE SWITCHBOARD PANELS AND DISTRIBUTION BOARDS

Low Voltage switchboards shall be to BS EN 60439 and shall be adequate for the voltage, load current, prospective fault levels, and type of supply.

Enclosures shall be metal construction, with all electrical conductors, contacts etc., totally enclosed. They shall be unit or cubicle type construction from the same manufacturer as the switchgear. They shall be protected to not less than IP31 for indoor use and shall be weatherproofed IP65 for exterior use.

Enclosures shall be provided with facilities for padlocking or locking to prevent unauthorised interference. The locks to be operable by a key common to all enclosures, switchgear and distribution gear locks.

Enclosures shall be provided with adequate local means of isolation, earthing and insulation to ensure safety of operatives during maintenance works. Such isolation to be lockable in the OPEN position.

Enclosures shall be adequately ventilated or cooled.

Floor mounted panels shall be mounted on a plinth in wet plant areas. Wall mounted panels shall be fixed to the structural wall with bolts.

Enclosures shall be finished in manufacturers' standard stoved enamel finish. Plain steelwork to be painted to BS 6150 with red lead primer and two coats of enamel to match the switchgear, Beige colour.

Enclosures shall be arranged with operating handles, control knobs, push buttons etc., within the range of 450mm and 1800mm above floor level.

Enclosures shall be provided with cable entry locations (top, bottom etc.) to suit the detail of the scheme and be of adequate size to accommodate all incoming cables.

Enclosures shall be so designed and constructed as to protect all live parts to IP2X including live parts behind locked doors, removable panels, and particularly on the back of opening doors.

Enclosures shall be so designed and constructed that all user adjustments are accessible without opening doors or removing panels; i.e. from the outside.

The contractor will liaise with the CEB, whenever required, to ensure that the cubicle to house the distribution board is large enough to allow working space at the top and bottom of the board. At least 300 mm will be allowed as working space at the top and bottom of the cubicle. The construction drawings will be issued for approval to the Engineer before construction.

4.2. FUSE SWITCHES AND SWITCH FUSES

All fuses and switch fuses shall be to BS EN 60947-3. They shall be fitted with HBC fuses to all line conductors for a.c. and to all poles of d.c. systems. They shall be fitted as required with a neutral terminal. For units exceeding 100 A, this terminal shall have a removable bolted link.

4.3. AIR CIRCUIT BREAKERS (ACB'S) AND MOULDED CASE CIRCUIT BREAKERS (MCCB'S)

ACB's and MCCB's shall be of the four-pole type and shall be to BS EN 60947-2. They shall be provided with positive means for preventing any one pole of a multi-pole MCCB being operated or tripped, independently of the other poles.

4.4. MINIATURE CIRCUIT BREAKERS (MCB'S)

MCB's shall be to BS 3871 and shall be of the two pole or four pole type. The Neutral connection shall be open in event of tripping of the circuit breaker.

MCB shall be provided with single phase or three phase instantaneous magnetic and overload tripping. They shall be of Type C.

MCB shall be provided with positive means for preventing any one pole of a multi-pole MCB being operated or tripped independently of the other poles. Tripping of the circuit breaker shall cause opening of the neutral pole as well.

4.5. RESIDUAL CURRENT DEVICES (RCD'S) AND RCBO

RCD's and RCBO shall be provided to BS EN 61008 and shall be rated maximum 300 mA, adjustable trip type. Unless otherwise specified, RCD/RCBO shall be of the two pole for single phase and four pole type for three phase. The Neutral shall open in event of tripping of the device.

4.6. FUSES

Fuses shall be to BS 88 HBC cartridge type for general power applications, fitted inside fuse spurs. They shall be fitted to all-insulated carriers incorporating means of identifying failed fuses.

4.7. BUSBARS AND CONNECTIONS

Busbars shall be of constant cross section copper throughout. The copper conductors shall be tinned. Busbars shall be air insulated except where solid insulation is a design feature. They shall be connected to outgoing switches with solid copper connections. The connections to be as short and direct as possible.

Busbars shall be rigidly clamped and secured to prevent undue movement under fault conditions or displacement as a result of the installation of cabling and provided, where necessary, with insulated phase or circuit barriers. All clamping and supporting bolts, nuts and screws to be plated brass or steel.

Busbars shall be separate for individual supply systems. Two systems shall not occupy the same busbar chamber unless they are segregated and separated by earthed metal and warning notices fixed.

4.8. CURRENT TRANSFORMERS

Comply with BS EN 60044-1. Provide separate current transformers for each protection device and instrumentation. Ensure current transformers provide appropriate accuracy and are compatible with over current factors, characteristics, performance and VA rating required for satisfactory operation of protection devices, instruments and meters indicated.

Ensure that current transformers are capable of withstanding maximum short time withstand current of value and duration indicated for assembly.

Provide test links in secondary connections of all current transformers to facilitate testing of instruments, meters and protection devices.

4.9. INSTRUMENTS AND METERS

4.9.1. Standards

Comply with BS 89 and BS EN 60051-1 for voltmeters, ammeters, watt meters, frequency indicators and power factor indicators.

Comply with BS 7856, BS EN 62053-11, BS EN 62053-22 or BS EN 62053-21 for kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters, and BS EN 62053-23 for KVAhr meters.

Protect wiring to voltmeters by separate fuses.

Protect potential coils of watt meters, frequency indicators, power factor indicators and kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters by separate fuses.

Supply instruments and meters suitable for flush mounting and type, size and accuracy as indicated.

Ensure that indicating scales for all instruments comply with BS 3693.

Completely segregate all instruments in instrument compartments. Panel mount meters on front of instrument compartment.

4.9.2. Indicator Lights

Supply lamps of same type throughout. Provide indicator lamps with lamp test facility.

Lamps

- Supply interchangeable indicators for respective units.

Protect wiring to indicator lamp units by separate cartridge fuses. Lens Colour in accordance with BS EN 60073.

4.10. DISTRIBUTION BOARDS

Comply with BS EN 60439-3 as appropriate. Make internal separation Form 1 unless otherwise indicated. Make fuse boards fully shrouded. Fit each distribution board with an isolating switch.

Install busbars in same position relative to their fuse carriers or miniature circuit-breakers (MCBs) for each pole. In TPN distribution boards supply neutral busbars with one outgoing terminal for each outgoing circuit.

Provide a multi-terminal earthing bar for circuit protective conductors for both insulated and metal-cased boards, with one terminal for each outgoing circuit. Connect directly to earthing terminal without dependence on exposed conductive parts of enclosure.

Identify each fuseway and MCB way by numbering. Identify each terminal on neutral busbar and earthing bar with its respective fuseway or MCB way.

Where specific ratings are indicated incorporate fuses or MCBs, otherwise leave ways blank for future additions.

4.11. CABLE TERMINATIONS:

Ensure that switchgear and distribution boards are provided with facilities to terminate size, number and type of cable indicated. Where necessary use fabricated steel extension boxes for glanding large and multiple cables.

Provide non-ferrous metal glanding plates for single core cable terminations.

5. CONDUIT

5.1. STANDARDS

Provide conduit and cable trunking in accordance with the relevant British Standards and in particular the requirements of BS 7671 Requirements for Electrical Installations (The IET Wiring Regulations).

5.2. CONDUIT SYSTEMS - NON-METALLIC FLEXIBLE

Provide conduit systems to BS EN 61386. Use conduit of each type from one manufacturer.

Material - Insulating, PVC.

Method of connection - Threadable or non-threadable.

Suitability for bending - Flexible, BS EN 61386-23.

5.3. CONDENSATION PREVENTION

Install conduit and trunking systems to ensure internal condensation does not affect operation of associated circuits. Provide drainage points in accordance with BS 7671.

Where conduit passes through external wall between two areas of different ambient temperatures or in other locations likely to cause condensation, install a conduit or adaptable box. After wiring fill box with inert, permanently plastic compound with high insulation value.

5.4. EQUIPMENT CONNECTIONS:

Where surface mounted equipment is installed in conjunction with concealed conduit work, terminate concealed conduit at flush mounted conduit or adaptable box. Drill back of equipment, bush for back entry and mount equipment to conceal back box.

Connect to fixed equipment via conduit box located adjacent to termination point, using either solid or flexible conduit as indicated for final connection to equipment terminations.

Use conduit box as cable change point to facilitate changed wiring locally to adjacent equipment.

Connect trunking to equipment by specially fabricated connectors or by couplers and externally screwed brass bushes.

5.5. CLEANING BEFORE WIRING:

Clean inside of conduits and trunking with swabs immediately before wiring.

Inspect all components and remove any foreign matter, fit temporary plugs to open ends of conduit and trunking to prevent ingress of water and solid material.

5.6. WIRING

Comply with BS 7671 when wiring installations.

Segregate circuits as indicated.

Ensure draw wires are left within empty conduits for use of specialist installers. Use draw wires comprising nylon tapes with fitted eyelets.

For concealed conduit ensure system is installed to enable re-wiring to be carried out from boxes for fittings or accessories only. Draw-in boxes will only be permitted with prior permission in writing.

Do not use tallow or any other substances to facilitate drawing-in of cables.

5.7. INSTALLATION OF CAST IN OR BURIED CONDUIT

Ensure cast-in conduits are firmly secured to reinforcing steelwork and that accessory and/or conduit boxes are secured so they do not move during subsequent building operations.

Ensure there is no blockage immediately shuttering is removed.

Check there is no mechanical damage to conduit in floor screed prior to screeding. Fix securely before screed is poured. Provide temporary protection to conduits until screeds are laid.

Ensure minimum amount of cross-overs occur dependent upon screed depth. Do not install draw boxes in floors.

Do not install conduits in screeds in areas indicated within site blinding in main structural slabs unless prior permission in writing is obtained.

5.8. UNDERGROUND INSTALLATION

Where buried below ground, use Class 4 conduit. Do not use any buried conduit boxes unless prior permission in writing has been obtained. Wrap conduit with PVC self-adhesive tape, half lapped. Extend taping 150 mm beyond point where conduit leaves ground. Install circular through conduit boxes at the end of the tape. Fill conduit boxes after cable installation with inert, permanently plastic compound with high insulation value, and wrap in PVC self-adhesive tape.

6. CABLES AND WIRING

6.1. CABLE MANUFACTURER

Use new cables, delivered to site with seals intact, manufactured not more than one year prior to delivery, labelled with manufacturer's name, size, description, BS number, classification, length, grade and date of manufacture.

6.2. STANDARD ORDINARY FLEXIBLE CORDS - MULTI COPPER CORES

Standard - BS 6500, Tables 12 and 13, and 16; BS 7919 Tables 10 and 14.

6.3. STANDARD POWER SUPPLY CABLES, COPPER CONDUCTORS, THERMOSETTING INSULATION, SHEATHED

Standard - BS 5467, Tables 4, 6, 8, and 10.

Mechanical protection - Unarmoured.

6.4. STANDARD POWER SUPPLY CABLES, COPPER CONDUCTORS, THERMOSETTING INSULATION, SHEATHED AND ARMoured:

Standard - BS 5467, Tables 4, 6, 8, and 12.

Mechanical protection - Armour.

6.5. STANDARD POWER SUPPLY CABLES, COPPER CONDUCTORS, PVC INSULATION, SHEATHED:

Standard - BS 6004, Tables 7 and 8.

Mechanical protection - Unarmoured.

6.6. CABLES GLANDS - UNARMoured CABLES, INDOORS:

Cable type:

- Flexible; wiring and power; control and auxiliary; and communications.
- Standard - BS EN 50262 non-metallic, cable retention, IP54; Type A1 as BS 6121-5 Annex A.
- Environment - Indoor.

6.7. CABLES GLANDS - UNARMoured CABLES, OUTDOORS:

Cable type:

- Flexible; wiring and power; control and auxiliary; and communications.
- Standard - BS EN 50262 non-metallic, cable retention, IP54; Type A2 as BS 6121-5 Annex A.
- Environment - Outdoor.

6.8. CABLES GLANDS - ARMOURED CABLES, DRY INDOORS:

Cable type:

- Wiring and power; and control and auxiliary.
- Standard - BS EN 50262 metallic, cable retention Class A, protective connection to earth, IP54. Type B as BS 6121-5 Annex A.
- Environment - Dry indoors.

6.9. CABLE GLANDS - ARMOURED CABLES, INDOORS:

Cable type:

- Wiring and power; and control and auxiliary.
- Standard - BS EN 50262 metallic, cable retention Class A, protective connection to earth, IP54. Type B as BS 6121-5 Annex A.
- Environment - Indoor.

6.10. CABLE GLANDS - ARMOURED CABLES, OUTDOORS:

Cable type:

- Wiring and power; and control and auxiliary.
- Standard - BS EN 50262 metallic, cable retention Class A, protective connection to earth, IP54 with shroud. Type C as BS 6121-5 Annex A.
- Environment - Outdoor.

6.11. CABLE INSTALLATION - GENERAL:

Use and install cables only as directed in the appropriate standard or as directed by the manufacturer in writing. Lay cables in one length unless otherwise indicated. Obtain permission from supervising officer for all through joints, and where overall length requirement exceeds practical drum size.

Handle, install and dispose of cables on wooden drums in accordance with BS 8512.

Install cables when ambient temperature is 5°C or greater, using cables stored at or above this temperature for not less than 24 hours.

Use drum stands, drum axles, fair leads, rollers, cable stockings and other equipment as recommended by the cable manufacturer and as appropriate to the method of installation.

6.12. CABLE INSTALLATION IN TRENCHES:

Lay cables on newly prepared bedding. Ensure multiple layers of cable are separated vertically by a 50mm layer of hard rammed bedding material.

When using a power winch ensure tension on the cable is taken by element of the cable designed for that purpose, that is armour or conductor cores as appropriate and not plastic sheath, metal sheath or core insulation.

When hand pulling cable ensure no kinks are formed and that flaking, when used, is done in the correct direction.

Do not allow cable to twist during installation. Use swivels to connect pulling bond to cable stocking or equivalent fitting.

Check drum is suitable for jacking before commencing installation. If drum or reel is unsuitable for jacking, flake cable in correct direction in maximum size turns from drum or reel before commencing installation. Use skilled labour to supervise all unreeling, flaking or running of cable from a drum.

Lay cables in the formation shown, ensure spacing is not reduced below that indicated. Bind trefoil groups at 1m intervals. Bind any associated earth or protective conductor to its cable or trefoil group at 1m intervals.

Space multiple cables in trenches in accordance with BS 7671.

Ensure installation radii and permanent bending radii are not less than those recommended by the manufacturer.

Do not lay cables to BS 6007, BS 6500, BS 7211 or BS 7919 direct in the ground.

6.13. CABLE INSTALLATION - FLEXIBLE CORDS:

Grip cords securely at connections. Where they do not form an integral part of the connected accessory or equipment, provide separate proprietary cord grips.

7. SOLAR POWERED EQUIPMENT

7.1. PV MODULE

The Photovoltaic (PV) module should have crystalline silicon solar cells and should have a certificate of test conforming to IEC 61215 Edition II from an IECQ accredited Laboratory.

The power output of the module(s) under standard testing conditions (STC) should be determined by the supplier at a load voltage of $16.4 \pm 0.2V$. The open circuit voltage of the PV modules under STC should be at least 21 Volts. The module efficiency should not be less than 12%.

The power tolerance level should be 0/+3% and the operating PV temperature ranges between $-10^{\circ}C$ to $+85^{\circ}C$.

The module temperature sensitivity of peak power should not exceed $0.45\%/^{\circ}C$. The module weight should not exceed 25 kg.

The PV module frame should be made from anodized aluminium alloy. Solar module's glass shall have a high transmittance tempered glass.

Electrical connection shall be on a robust terminal bloc in an IP65 junction box or higher. The terminal box on the module should have a provision for opening, for replacing the cable, if required.

The PV Module design & type should comply with qualification standard IEC/EN 61215 in the case of Crystalline types. The PV Module safety qualification standard is IEC/EN 61730. Modules should also carry a CE mark.

All d.c. component ratings (cables, isolators/disconnectors, switches, connectors, etc) of the system must be derived from the maximum voltage and current of the PV array. This must take into account system voltage/currents of the series/parallel connected modules making up the array. It must also take into account the maximum output of the individual modules.

Specific calculations of worst case open-circuit voltage V_{oc} and the short circuit current I_{sc} , calculated from manufacturer's data for a temperature range of -15°C to 80°C and irradiance up to 1250 W/m^2 in line with British Energy Networks Association (ENA) engineering recommendations G83/1.

Each PV module must have a RF identification tag (RFID) which must contain the following information:

- a) Name of the Manufacturer of PV module
- b) Model or type number
- c) Unique serial number
- d) Year of manufacture
- e) Peak wattage of the module

A distinctive serial number starting with NSM must be engraved on the frame of the module.

The module should be guaranteed for 10 years at 90% of rated power output and 25 years at 80% of rated output power. The annual output power depreciation should be less than 0.8 %.

7.2. BATTERY

Maintenance free battery of Gel or VRLA type to be provided.

The battery bank size per solar power lighting system is 960 Ah for a 160W LED light.

75% of the rated capacity of the battery should be fully charged and load cut off conditions.

Battery should confirm to BS EN 50272-1:2010.

The charge controller must carry a CE Mark. A means of manual isolation must be provided between the charge controller and the battery, either combined with the over current device or as a separate unit. The isolator must be double pole, d.c. rated and

load break, and the length of the cable between it and the battery must be as short as practicable.

Battery gases are corrosive, so cables and other items inside a battery enclosure need to be corrosion resistant. Sensitive electronic devices should not be mounted in, or above, a battery box.

Battery banks, if applicable, must be housed in such a way that (BS 6133) access can be restricted to authorised personnel, adequate containment is assured and appropriate temperature control can be maintained. Adequate ventilation to be provided.

The batteries shall be house in a battery box which is IP66, UV resistant and suitable for the environment in Mauritius.

7.3. INVERTER

The inverter should be of quasi sine wave/ sine wave type, with frequency in the range of 20 - 30 KHz. Half-wave operation is not acceptable.

The total electronic efficiency should be not less than 85 %.

The idle current consumption should not be more than 10 mA.

The PV module itself should be used to sense the ambient light level for switching ON and OFF the lamp.

The Inverter shall be provided with integrated fuses and AC & DC switches. The Inverter shall have the following protections: reverse current, input over voltage & over current via fuses.

The AC power of the inverter must synchronize automatically with the AC voltage and frequency of the grid (Single phase depending on each PV system requirements) within the tolerance range specified according to the British Energy Networks Association (ENA) engineering recommendations (G59/2 or G83/1) depending on inverter's maximum rated current (less or greater than 16A per phase). The Inverter should be designed to operate the PV array near its Maximum Power Point (MPP).

The inverter must be treated as standard electrical apparatus and earthed as per BS 7671 if Class 1.

The temperature operating range should be -20 °C to 60 °C.

Inverters dissipate heat and should be provided with sufficient ventilation. Clearance distances as specified by the manufacturer (e.g to a heatsink) should also be observed.

Harmonic distortion to be less than 3%.

Protection degree is IP65 or higher (outdoor). Inverter to be CE compliant.

Warranty after installation should be at least 5 years.

Inverters must carry a Type Test certificate to the requirements of Engineering Recommendation G83/1 or comply with all other parts of ER G83/1 unless specifically agreed by the engineer.

8. LUMINAIRES AND LAMPS

8.1. SODIUM VAPOUR LUMINAIRE AND LAMPS

8.1.1. Sodium high pressure lanterns:

The luminaires shall be constructed from marine grade die cast aluminium, totally enclosed, with a polyester powder coating and shall conform to BS EN 60598 and have a minimum degree of protection rating of IP 65 to BS EN 60529. Where a separate gear compartment exists, this shall have a degree of protection of at least IP 43. The powder coat finish shall withstand the standard cut tests as defined in BS EN 2409 and BS3900.

All lamps shall comply with the appropriate British or European Standard i.e. BS or BS EN and shall be manufactured within the E.U. by a manufacturer approved by the client.

The luminaires shall incorporate an efficient optical system to direct the light onto the road surface. The efficiency of the whole luminaire shall be specified.

Luminaires shall have an integral flexible mounting system and be capable of being mounted 42mm to 60mm diameter side entry and 60 to 76 post top mounted without the need for separate spigot adaptors. Side entry lanterns shall have a positive locking device so as to prevent the lantern turning on its axis.

The luminaire shall be installed in accordance with the manufacturer's instructions with no gap between the lantern and the shoulder of any bracket arm. The lantern shall also be installed at the correct design tilt and horizontal alignment and to ensure that the design 'IP' rating is maintained. All fixing bolts shall be mechanically tightened. Where a torque setting is recommended for the fixing screws/bolts, a torque wrench shall be used to ensure that the requirements are met.

Luminaires shall be environmentally friendly and all component parts shall be at least 90% recyclable at the end of life.

Bowls/protectors shall be vandal resistant and stabilised to minimise loss of transparency due to weathering and exposure to ultra violet light. All luminaires shall be fitted with bowls of sound and robust construction capable of being easily removed for maintenance or repair purposes and easily closed to maintain its IP rating and integrity. The lamps, reflectors, refractors and bowl shall be clean and free from dirt and stains after installation and the lamp shall be correctly positioned within the lantern. The bowl or other component giving access to the interior of the lantern shall, when in the open position, be attached in such a way that it will not accidentally fall off the luminaire. All hinges, toggle catches, captive screws and nuts shall be made of non-corrosive material.

The optical equipment controlling light distribution should be in high purity aluminium reflectors and/or prismatic refractors and these shall have a smooth exterior surface or

be protected by hermetically sealed cover plates to prevent an accumulation of dirt and to facilitate cleaning.

The luminaire shall be fitted with integral electronic control gear and complete with fuse holder and an appropriately rated cartridge fuse or miniature circuit breaker, located adjacent to the terminal block which shall be capable of accepting a conductor of 2.5mm². The fuse or circuit breaker shall be easily accessible for replacement or resetting.

Luminaires shall provide a light output ratio in excess of 75% with an upward light output ratio of no more than 0.5%. The I_{max} above 95° shall be zero.

Luminaires shall have integral high frequency control gear and have a heat barrier between the lamp enclosure and gear compartment.

All luminaires shall be fitted with a porcelain terminal block, earth terminal, cable clamp and lamp holder ready wired to connector block with heat resisting type cable.

Luminaires shall be securely fitted to bracket arms or columns and the lamp and all parts affecting the photometric performance shall be in a clean condition and correctly orientated.

Ballasts shall comply with EN61000-3-2:2000, EN61347-2-12-2005, EN61000-3-3:2001, BS EN 61347-1, BS EN 61347-2-1, BS EN 61347-2-8, BS EN 61347-2-9 and BS EN 60921 or BS EN 60923 as appropriate and be tap selected to the specified operating voltage of the network.

8.1.2. Sodium high pressure lamps

The high pressure sodium lamps shall comply with IEC 60662 and shall be suitable for operation on high or low power factor circuits with a ballast conforming with IEC 60923 and fitted with Edison screw type caps conforming to IEC 60061. The lamps shall be of the twin arc type. Lamps covered by this specification shall comply with the technical and performance requirements as detailed in Table 2 below:

Table 2: Sodium high pressure lamps.

LAMP WATTAGE	LUMEN OUTPUT 100 HRS (MINIMUM)	LUMEN OUTPUT 15,000 HRS
150	14500	13500
250	26000	25000
400	47000	44000

Lamps shall be guaranteed for at least 5 years or 15,000 hours of operation. They shall be compatible with the lantern used and must not be fitted in the lantern until the lantern has been correctly fixed to the column/bracket.

The lamps shall be legibly and indelibly marked on the exterior surface with the following information:

- Trade name, trademark, or identification mark of the manufacturer;
- Catalogue reference number
- Batch code, serial number;
- Lamp type & rated wattage.

8.1.3. Sodium high pressure luminaire warranty

The Supplier/Contractor shall provide a Warranty from the manufacturer as follows:

- A written warranty for a minimum five-year on-site replacement material, fixture, finishes and workmanship. On-site replacement shall include transport, removal of defective and installation of the new product. Body and finish warranty shall include warranty against failure or substantial deteriorations such as corrosion, blistering, cracking, peeling, chalking or fading, at no cost to the client.
- A written warranty for a minimum five years' replacement for non-starting SHP lamps (where the lamp can be demonstrated to be functional) at no cost to the Client.
- A written warranty for a minimum five years' replacement material warranty on all ballasts, power supply units and in-built control components at no cost to the client.
- A written warranty for a minimum five years' replacement for maintained luminance and illuminance levels as needed at no cost to the Client, provided that the luminaire system has been maintained as per specifications. The supplier must provide data showing the expected light loss from the SHP lamp at the time of failure.

A written warranty for a minimum 10 years against the deterioration of the housing, all external components; such as lenses, gaskets & fastenings, and the fixture finishes including, but not limited to, corrosion, yellowing, blistering, chalking, cracking, peeling or fading at no cost to the Client.

8.2. LED LUMINAIRES AND LAMPS:

8.2.1. General

The luminaires and lamps supplied under this contract shall be the latest series / model available from the manufacturer and shall have passed all the tests specified in this document. The luminaires shall be designed to operate continuously at 35°C and in a marine environment with occasional very high wind speed. The manufacturers shall guarantee adherence to this Specification and the performance of their luminaire under all the required design conditions. Independent test reports should be provided to show the luminaires will operate under these conditions.

Streetlighting luminaires should be IP66 or better. Luminaires should be supplied with a 2m flexible flying lead when mounted on a CEB pole or 8 m lead when fixed on columns. Luminaires will be Class 1 and 230V unless otherwise specified.

The luminaire housing shall be slim with low profile and shall be of either extruded aluminium or die cast aluminium and high corrosive resistance. Luminaire components to be tested in accordance with the requirements of BSEN 60598 or similar International

equivalent standard. The finish coating for housing shall be with an anti-corrosive anodized/painting process or equivalent, providing excellent UV and environmental exposure resistance to fading, peeling cracking or corrosion. The driver(s) shall be integral to the fixture head, encapsulated/potted and protected in a waterproof (IP) environment, enabling access to the driver(s) for easy maintenance requirements. The driver compartment should be separate from the optical compartment housing the LEDs. The fixtures shall be CE or UL certified, or comply with equivalent international standards with all certification made available.

8.2.2. Construction

Within the Luminaire:

The light source shall be high brightness white. Light emitting Diodes (LEDs) with individual minimum efficacy of at least **100 lm/W** arranged modularly to provide the required lighting output.

The LEDs shall be from a reputed manufacturer of LEDs with proven past experience in the manufacture of LED for at least 10 past years. The CRI shall be greater than 70. The LEDs shall be removable/replaceable on site by modular means without any possible risk to affect the luminaire photometry and without the need to demount the fixtures.

Whole Luminaire Efficacy (Systems efficiency):

The optimum efficiency of the luminaire shall be confirmed as follows: Minimum luminaire efficacy shall be 90 lm/W (@min 35 °C, min95%RH)

This is given as total luminaire design lumen output (lm) over total luminaire circuit Watts (W) at minimum 35-degrees Centigrade outside ambient temperature and minimum 95% relative humidity.

8.2.3. Optical Control

The luminaire shall be fitted with optical refractors, diffusers and/or reflectors. Different optics shall be proposed to exactly suit the specific applications. Independent laboratory photometric test reports shall be submitted for the luminaire photometric files used in the lighting calculations. The testing should conform to IESNA LM-79-08 standards. Dialux photometric digital data files shall be considered acceptable and shall not need any independent laboratory test.

8.2.4. Thermal Management

The LED modules shall be mounted on heavy duty heat sinks to ensure proper heat dissipation and to ensure that luminaires to work efficiently in Mauritian climatic conditions. The luminaire shall be provided with a ventilation arrangement allowing heat to be dissipated to the atmosphere.

The design shall be such that the luminaire shall be self-cleaning in normal operation. The luminaire shall be provided with a heavy-duty rugged cast aluminium adjustable slip fitter mountable to suit the proposed pole. The Contractor shall coordinate with the LED fitting manufacturer and pole manufacturer to make sure complete compatibility of

the products. The fixing should ensure that the luminaire/outreach arm is suitable for the high wind speeds expected and will not move from its designed position or become disconnected.

8.2.5. Bowls

Bowls/protectors shall be vandal resistant and stabilised to minimise loss of transparency due to weathering and exposure to ultra violet light. All luminaires shall be fitted with bowls of sound and robust construction capable of being easily removed for maintenance or repair purposes and easily closed to maintain its IP 66 rating and integrity. The lamps, reflectors, refractors and bowl shall be clean and free from dirt and stains after installation and the lamp shall be correctly positioned within the lantern. The bowl or other component giving access to the interior of the lantern shall, when in the open position, be attached in such a way that it will not accidentally fall off the luminaire. All hinges, toggle catches, captive screws and nuts shall be made of non-corrosive material.

8.2.6. Fixture Technical Data –

The following information will be provided for each of the type of LED luminaire being proposed:

- Physical description of lighting fixture with dimensions.
- Details of the driver(s) including, manufacturer, driver efficiency, catalogue code, certifications and input watts.
- Luminaire photometric reports per IESNA LM-79-08, or similar International approved equivalent; including, laboratory name, report number, date, luminaire catalogue number, luminaire, and light source specifications.
- Photometry table of zonal lumen output in 10o vertical increments showing both the lumen value and the percentage of total out per 100 increments. Provide photometric files in IES or EULUMDAT format, for example IES, LDT or ULD files.
- Confirm a minimum of 6,000 hours of continuous operation of the LEDs at three different temperatures per LM-80-08, or similar International approved equivalent.
- Documentation of the expected useful life including the testing and calculation of useful life and verification of site lighting performance at that life. If the site defined performance methods are used, the interpolation between the three sets of LM-80 data, and all calculations applied in deriving the proposed LLD and useful life shall be provided.

8.2.7. LED modules

Within the fixture the LED modules shall meet the following requirements:

- Operating temperature rating shall be between 0°C and minimum +50°C at a minimum 95% Relative Humidity (RH).
- Storage (i.e. non-operating/daytime) temperature: all LED components to be designed to tolerate between - 40°C and minimum +80°C at a minimum 95% Relative Humidity (RH).

- Correlated colour temperature (CCT): 3000K- 5000K
- Colour rendering index (CRI): > 70
- Comply with IES LM 80, IES TM 28 and IES TM 21 or equivalent standards.
- Luminaire manufacturer shall submit reliability reports indicating that the manufacturer of the LED (chip, diode, or package) has performed Joint Electron Devices Engineering Council (JEDEC), or similar International approved equivalent; reliability tests on the LEDs. Factory pre-release test reports shall be provided from the LED manufacturer duly complying with JEDEC JESD22-A108C, or equivalent, for operating life tests at 85° C Ambient temperatures and also for humidity and salt atmosphere corrosion tests. Standards and tests used must be stated.

8.2.8. LED Drivers Technical Requirements

Within the fixture the LED driver(s) shall meet the following requirements:

- Drivers shall be dimmable unless specified otherwise and have a minimum efficiency of 85%. When dimmed, Power Factor should be > 0.7 over complete range.
- Case (Tc°C) temperature rating -40°C to minimum +80°C and at a minimum 95% Relative Humidity (RH). Driver/Fixture to have some means of built-in overheat thermal protection in the form of automatic dimming or stepping/holding down of the driver where temperature exceeds operational limits. Thermal cut-out devices which turn the fixture LEDs completely off are not acceptable.
- The driver and driver output current must be shown to be fully tested and compatible with the exact LED chips of the luminaire. All information provided and the cost analysis/payback calculations, if needed, should be calculated with the exact drive current including the calculation for the life cycle, life and resultant increase or decrease of the energy consumption if applicable.
- Input voltage; capable of 230V ±10% volt, single phase or as required by the site. Power supplies can be UL Class 1 or II output or similar European CE or International equivalent.
- Surge protection: Must be tested in accordance to the requirements of IEEE/ASNI C62.41.2-2002, Scenario I Location Category C or International equivalent. Drivers shall have a Power Factor (PF) of more than 0.90.
- Drivers shall have a total individual luminaire Harmonic Distortion (THD) of: < 20% in accordance with ANSI C82.77 (2002)
- Driver shall have an in-built protection against overload and surges up to 6kV. Drivers shall have a lifetime of at least 50,000 h.

8.2.9. Luminaire Requirements

The dedicated luminaire expected useful life (light output) and depreciation requirements shall be as follows:

8.2.9.1. Useful Life:

The useful life of the luminaire in terms of lumen output must be as per LM-79-08 or approved International equivalent.

8.2.10. Project Performance Requirement

Lamp Maintenance Factor (MF)

$MF = LLMF \times LSF \times LMF$ (Lamp Lumen Maintenance Factor x Lamp Survival Factor x Luminaire Maintenance Factor)

- Assume LLMF is 0.70 for LED luminaires except where recommended otherwise by the luminaire manufacturer.
- The LSF should be obtained from the manufacturer and shall not be less than 0.9
- Refer to Table B.1 of BS 5489 for LMF

8.2.11. Photobiological Safety

Ensure luminaire complies with Photobiological Safety of lamps and lamp systems in accordance with the requirements of BS EN 62471:2008 or ANSI/IESNA RP-27.3-0. Provide proof of testing and compliance with the standards with certification provided to prove the fixture is classed as “Exempt”

8.2.12. Lighting Calculations

The following performance reports of the lighting installation shall be submitted for approval along with the material submittal:

- Computer generated photometric analysis report which will include:
 - Point by point light levels over a matrix between two poles. Spacing between calculations points shall be as per IESNA, EN 13201 and BS EN 5489 standards or equivalent European or International Standards.
 - Maximum, minimum and average illuminance on the road surface.

These reports shall be submitted for two scenarios:

- The initial light level, that is at start of the project.
- The end of life stage- This calculation will show the minimum Maintained illuminance/luminance values. At this point, the lamps or LEDs should be replaced and the luminaires cleaned/replaced.

The contractor / Supplier / Manufacturer shall use an accredited and recognised software for such calculations. In case of any dispute over the type of software to be used, Dialux shall be considered as an acceptable and final software for such calculations. Where proprietary software is used, (software from manufacturer) the results shall be checked and validated by an independent third party software calculations like Dialux.

8.2.13. Quality Assurance

The client may request a standard production model luminaire sample, identical (including LED Package) to the proposed product, to be installed for inspection. The Client may also request independent testing of sample luminaires to verify luminaire performance and compliance with the specifications. Testing shall be conducted as per the applicable IESNA, ANSI or approved International equivalent approved methods of products using Solid Stage Lighting (SSL) sources. The Client shall be sole judge regarding acceptability of optical system performance. All testing certificates shall be from a Laboratory certified/approved by UKAS or UL or the Government of Mauritius, or has ISO 17025 or equivalent certification.

8.2.14. LED Luminaire Warranty

The Supplier/Contractor shall provide a Warranty from the Luminaire Supplier / manufacturer as follows:

- A written warranty for a minimum five-year on-site replacement material, fixture, finishes and workmanship. On-site replacement shall include transport, removal of defective and installation of the new product. Body and finish warranty shall include warranty against failure or substantial deteriorations such as corrosion, blistering, cracking, peeling, chalking or fading, at no cost to the client.
- A written warranty for a minimum five years' replacement material warranty for defective or non-starting LED source assemblies at no cost to the Client.
- A written warranty for a minimum five years' replacement material warranty on all supplied drivers, power supply units and in-built control components at no cost to the client.
- A written warranty for a minimum five years' replacement material warranty for maintained luminance and illuminance levels on all light sources (LED package, LED array, or LED module) including, but not limited to the LED die, encapsulate, and phosphor. The manufacturer/ supplier/ contractor shall replace the light source(s) or luminaire as needed at no cost to the Client if the expected useful life of the luminaire system is not maintained as per specifications. The supplier must provide data showing the expected light loss from the LEDs to the time at which the LEDs should be replaced.
- A written warranty for a minimum ten years against the deterioration of the housing, all external components; such as lenses, gaskets & fastenings, and the fixture finishes including, but not limited to, corrosion, yellowing, blistering, chalking, cracking, peeling or fading at no cost to the Client.
- A written warranty for a minimum five years' replacement for non-starting SHP lamps (where the lamp can be demonstrated to be functional) at no cost to the Client.
- A written warranty for a minimum five years' replacement material warranty on all ballasts, power supply units and in-built control components at no cost to the client.
- A written warranty for a minimum five years' replacement for maintained luminance and illuminance levels as needed at no cost to the Client, provided that the luminaire system has been maintained as per specifications. The supplier must

provide data showing the expected light loss from the SHP lamp at the time of failure.

- A written warranty for a minimum 10 years against the deterioration of the housing, all external components; such as lenses, gaskets & fastenings, and the fixture finishes including, but not limited to, corrosion, yellowing, blistering, chalking, cracking, peeling or fading at no cost to the Client.

9. POLES:

9.1. GENERAL

Pole shall be of a type and shape that can accommodate the luminaires proposed and at the height being installed. The final shape of the pole shall be discussed with and approved by the client before ordering.

Poles and foundations should be designed for the expected wind speed of 300 km/h bearing in mind the wind area of the luminaire. i.e. they should be designed as a complete system.

9.2. MATERIALS

9.2.1. Foundations.

Structural analysis / calculations shall be submitted to show that the foundation design meets the load of the given pole type with the proposed luminaire. The pole and foundation design shall be undertaken by a Registered Civil / Structural Engineer in Mauritius and who shall be approved by the Road Development Authority.

9.2.2. Access door-

Each pole shall have one service hatch approximately 2m from ground level where the connection of cables can be made between the outside network and the pole accessories. The cover shall be fixed by two star screws. The access door cover shall be fixed with hinges made of corrosion resistant materials such as stainless steel grade 316(A4), brass, hot-dip galvanized steel, etc. as applicable based on the pole and cover plate material and shall not be easily openable with normal screwdrivers or tools. The access doors should be earthed with a separate cable and not simply earthed via the fixing screw.

9.2.3. Electric conduits.

Electric conduits shall be installed through foundation and shall enter the poles from base plate.

9.2.4. Steel work.

Poles' steel work shall be manufactured out of BS grade S355 steel for 10-14m poles or as appropriate to a pole of lower height. All components of the pole are required to be hot dip galvanised to BS 729 with minimum thickness coating of 100 µm. Where steelwork is in contact with aluminium work, the manufacturer shall ensure that bi-metallic corrosion is prevented by means approved method.

The pole will be fixed in a concrete base to be designed by a registered professional civil/ structural engineer in Mauritius and who shall be approved by the RDA. The sizing of the concrete bases and stub columns fixed in position must withstand wind speed of 300km/h.

Anchor bolts, nuts, pole structure will be done accordingly to requirements of BS 729.

Aluminium work. (used in public areas like gardens and parks)

Poles in aluminium shall be made up of extruded aluminium alloy which shall have an anodized protective coating finish to 25 microns. The colour of the anodized finish shall be as approved by the Client. The transition rim shall be of cast aluminium alloy of grade LM6 having a minimum 100 microns of polyester powder coating, matching the approved colour of the anodized extruded aluminium.

Bracketry.

Pole brackets shall be manufactured out of BS grade S275 Steel. This shall have high strength, be easily machinable able to handle an array of finishes. All steel components shall be hot-dip galvanized to a minimum thickness of 100 microns.

Fasteners.

All fasteners supplied shall be made of corrosion resistant materials such as stainless steel; - Grade 316, brass, hot-dip galvanized steel etc., based on the materials with which it will be in contact. Bi-metallic contact shall be properly designed to avoid any galvanic or bimetallic corrosion.

Earthing and bonding

M12 x40 mm long threaded stud carrying two nuts and two washers shall be provided as an earth bonding point. It shall be located in the electric compartment.

Pole Identification Tag.

The name of the lighting column manufacturer and the date of manufacture shall be clearly marked using an aluminium name tag affixed to the column in an appropriate location and manner to suit the column design and access. The pole shall also carry a unique identification tag which will provide information on its location, height, jurisdiction (which municipality or district council), date installed, a phone number for fault reporting etc. The full list of information to be provided in this tagging will be supplied by the client. This tagging could be in a form of bar code. The tag will be riveted or welded to the pole and shall be highly resistant to weather conditions. It shall be fixed at 2m above the ground.

9.3. ASSEMBLY

The pole shall be complete with all accessories and all necessary component. The final assembly of pole and components shall be ready for installation at site without any works required other than using suitable fixing tools.

9.3.1. Mast arm for the Luminaires.

The mast arm for the luminaire (if used) shall be fitted on site to the pole. The attachment of the mast arms shall be made of standard fasteners through the

structural casting. The mast arm shall be self-supporting against all forces including uplift.

Note that the use of mast arms is to be minimised. The preferred solution is to mount the luminaire directly to the column.

9.3.2. Additional Assembly

Provisions shall be made on the pole for enabling the fixing of other accessories such as street signs, CCTV cameras or traffic signal lights by others after the installation of poles. These provisions shall allow for future additional accessories to be added without having to remove the existing installed accessories, luminaire brackets or the like. The provisions shall be such as to ensure the clean, aesthetic look is maintained and shall allow for complete dismantling, when not in use, without leaving behind any clamps, lugs, etc...

9.4. DESIGN SUBMISSION AND PRODUCTION

All design shall be undertaken by a Registered Civil / Structural Engineer registered in Mauritius and who shall be approved by the RDA.

a) Strength.

The poles shall be capable of withstanding a basic wind speed of 83.3 m/s or 300 km/hr when equipped with the actual number of lanterns and the associated fittings or accessories as confirmed by the Client. Design calculations shall be submitted to the Client for approval, showing the following: -

- Wind load derivation on luminaires and mounted accessories
- Wind loading derivation on the pole
- Sectional area of the pole at regular intervals of height along the pole, especially at areas of cross-section change and hand hole opening
- Stress at the intervals specified in (iii) above
- Strength of the pole at the intervals specified in (iii) above
- Combined Stress Ratios at the intervals specified in (iii) above

b) Deflection.

Actual deflection against the deflection limit of the poles shall be clearly stated in the design calculations and shall conform to AASTHO. The actual deflection calculated shall be based on the basic wind speed of 45m/s and shall be measured at the lantern position. The calculated deflection shall be the sum of deflection on the vertical pole section as well as the outreach bracket arm section. Deflection of both the vertical pole and the arm shall be shown in the design submission.

Design calculations shall show the pole deflection and shall be checked against the allowable deflection and special deflection limits required for high definition cameras or traffic signal poles, where applicable.

9.4.1. Quality Assurance

The client may request standard production model samples, identical to the proposed, product to be installed. The client may request independent testing of the sample poles to verify the performance and compliance with the specifications. The client shall be the sole judge regarding the acceptability of the performance of the light poles. According to the requirements of the Project's Contract documents, if required the client reserves the right to attend, or appoint a third party to attend, a factory inspection. During a factory inspection, the manufacturer shall perform a full deflection test, as agreed jointly with an accredited independent test house and the client, on a randomly selected pole from the manufactured lot, for each type of ordered pole, to establish the design compliance and structural integrity of the manufactured pole under simulated conditions of full loading, strictly in accordance with the approved design calculations and drawings. Different options of the base or lower cladding unit are shown on the drawings. The client will choose one option during the material review process and the sample shall be submitted accordingly.

9.4.2. Warranty

The Supplier /Contractor shall provide a Warranty to the satisfaction of either the relevant Client, on the materials and performance, as follows:

- Provide a written ten-year on-site replacement material, galvanising and workmanship. On-site replacement included transportation, removal and installation of new pole.
- Provide a written ten (10) year replacement warranty for defective poles at no cost to the Client.

9.5. CONNECTIONS TO LUMINAIRES

9.5.1. Cable Protection

Use appropriate size of grommet where cables enter through hole in luminaire body. Generally, luminaires will be supplied with a 2m flying lead.

9.5.2. Earthing

Ensure that the earthing terminal of Class 1 luminaires is connected to the conduit protective conductor of the supply circuit.

Loose Wiring- Clip or tie back with suitable proprietary devices loose wiring within luminaire, at 300mm intervals.

10. EARTHING AND BONDING

10.1. MATERIALS GENERALLY:

Use materials and installations methods in accordance with BS EN 62305, BS 7671, BS 7430, Electricity Safety, Quality and Continuity Regulations and Local Electricity Supply Authority Requirements as appropriate.

10.2. CONDUCTORS TO EARTHING SYSTEMS TO BS 7430:

Use - Earthing conductor.

Minimum dimension - BS 7430, current density 50A/mm².

Form - Strip.

Material - Copper, annealed.

Coverings - None.

Accessories - Conductor clips, metallic.

10.3. ROD EARTH ELECTRODES FOR SYSTEM EARTHING:

Standard - BS 7430.

Form - rod with female thread each end.

Dimensions:

- Rod Diameter - 15 mm - nominal.
- Rod Length - 2.4m (2 x 1.2) minimum.

Earth electrode couplings:

- Use high strength driving cap in contact with driven rod and couplings of compatible material fully enclosing the rod threads.

Earth electrodes in drawpits:

- Provide concrete cover, permanently labelled, for electrodes installed through cable drawpit bases.

Main earth conductor connection:

- Connect main earth conductor to first electrode using heavy duty purpose made silicon aluminium bronze body conductor clamp and high tensile phosphor bronze bolt.
- Material, minimum size as BS 7430 Table 4 - Copper.

10.4. EARTH ELECTRODE INSPECTION FACILITIES:

Provide enclosure for each connection between earth conductor and associated earth electrode system. Install so that top is flush with finished ground or floor level. Ensure enclosure provides adequate access for testing purposes. Provide pit details for builder's work.

10.5. MAIN EQUIPOTENTIAL BONDS:

Provide main equipotential bonds in accordance with BS 7671 in all columns.

- Material - Insulated cable, single core to BS 6004.
- Use no joints in main equipotential bonds.

10.6. SUPPLEMENTARY EQUIPOTENTIAL BONDS:

Provide supplementary equipotential bonds to BS 7430, BS 7671 and BS EN 50310.

Do not use joints in supplementing bonds.

- Material - Insulated cable, single core to BS 6004.

10.7. CIRCUIT PROTECTIVE CONDUCTORS:

Material:

- Insulated cable, single core to BS 6004 of minimum cross section area 6mm² where cable size exceeds 6 mm²
- Same size as live conductor when supply cable is less than 6 mm²

10.8. EARTHING CLAMPS:

Use clamps complying with BS 951, for bonding pipes and earthing of conductors.

10.9. EARTH BUSBARS:

Material:

- Manufacture earth busbars from hard drawn, tinned, high conductivity copper bar.

Substation Earth busbar:

- 75 x 13mm cross section 600mm minimum length.

Main Earth Terminal busbar:

- 25 x 6 mm minimum for incoming live conductor not exceeding 50mm and 50 x 6 mm minimum for incoming live conductor over 50mm².

10.10. TEST LINKS:

Provide two test links, in connections between main earth conductors and earth busbar. Fabricate each from two additional sections of earth busbar. Mount one section on stand-off insulators matching earth busbar; use remaining section as removable test link. Secure 12mm high tensile brass studs to fixed sections of busbar and drill corresponding clearance holes in test links and provide brass washers, nuts and locking devices to secure frame/neutral earthing and test links.

10.11. PROTECTIVE CONDUCTOR WARNING NOTICES/LABELS:

Provide a permanent label durably marked in letters 4.75mm minimum height "SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE", in visible position, at each bonding conductor connection to extraneous conductive parts.

10.12. MAIN EARTH CONDUCTOR - WARNING TAPES:

Provide green/yellow PVC tapes labelled "EARTHING CONDUCTOR" over complete external lengths of main earth conductors at 300mm depth below finished ground.

10.13. EARTH BAR LABEL:

Label earth bar "SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE" with wall mounted laminated plastic tablet engraved in 10mm high red letters on white ground.

10.14. DISSIMILAR METALS:

Ensure, where dissimilar metals are used for system, that purpose made jointing materials are used such that corrosion and deterioration of the electrical connection are not caused. Ensure bonding connections to other metal parts of building are electrolytically compatible with those metal parts. Use the guidance given in BS 7430 Table 8 when bonding dissimilar materials.

10.15. COPPER TAPE JOINTS:

Provide waterproof protection at joints subject to moisture.

Joint copper tapes by brazing, using zinc-free brazing metal with melting point at least 600°C or thermic welding.

10.16. INSTALLATION OF EARTHING SYSTEM:

Carry out installation of earthing system in accordance with BS 7671 (IET Wiring Regulations 17th Edition) and BS 7430. Secure bare copper tape to structure with fixing devices which avoid piercing tape and ensure 3mm (minimum) clearance of tape from structure, at 450mm maximum centres.

Locate electrodes not less than 2m distant from structure and away from all cables and metallic fences. Drive rods vertically and locate electrode heads just below ground level. Install interconnecting tape 750mm below finished ground level, rising vertically at each electrode.

Ensure where electrodes are installed in a group, minimum distance between electrodes is twice depth of rods.

Provide earth bar at incoming electrical service position. Mount on insulated supports. Drill holes, one for each cable plus 30% spare holes (two minimum) at 50 mm minimum centres through bar for connection of cable lugs. Ensure holes are minimum size to maintain adequate contact.

Connect main earth conductors and main equipotential bonding conductors to earth bar.

Terminate protective conductors on switchboard earthing bar. Extend protective conductor from incoming main cable gland direct to earth bar.

Extend separate protective conductor from earth bar to switchpanel served by incoming main cable.

Extend when main cable is provided by CEB, separate protective conductor from main cable armouring to earth bar.

11. TESTING AND COMMISSIONING OF ELECTRICAL SERVICES

11.1. INCORPORATED EQUIPMENT CHARACTERISTICS:

Obtain and use information from manufacturers of equipment provided.

Use information provided, for equipment supplied by others and incorporated into installation.

11.2. PROSPECTIVE SHORT CIRCUIT CURRENT:

Determine values of I_p by measurement, unless other means are indicated. Determine I_p at all necessary points within installation to confirm correct equipment selections.

Obtain from supply undertaker written confirmation of maximum and minimum values of I_p at origin of installation. Adjust subsequent measured values of I_p accordingly.

11.3. INITIAL VERIFICATION:

Carry out detailed inspection to verify the requirements of BS 767.

11.4. TEST EQUIPMENT AND CONSUMABLES:

Provide test equipment and consumables to complete tests satisfactorily and to retest any failed installations following corrective measures.

Test equipment quality assurance requirements to BS EN ISO 10012.

11.5. TESTING

Carry out in the same order as published the tests required by BS 7671, Section 612 for New Installation or Altered or Added Installation as appropriate.

11.6. EARTH FAULT LOOP IMPEDANCE:

Use 25 A test current. Measure and record source impedance (Z_E).

If alternative LV supply arrangements are available, measure Z_S when using supply with highest impedance.

Measure Z_S with main equipotential bonding conductors connected. Do not summate values of several parts of each loop.

11.7. SETTINGS AND ADJUSTMENTS:

Confirm characteristics and settings of protective devices are within maximum and minimum specified tripping times. Check correct operation of devices. Confirm interlocks and sequences operate safely and as indicated.

11.8. CERTIFICATION AND REPORTING:

Complete and hand over to the Client a Completion and Inspection Certificate to BS 7671 Appendix 6 for New Installation or Altered or Added Installation as appropriate.

11.9. INSTALLATION CERTIFICATES:

Provide installation certificates for electrical installations in accordance with BS 7671 (IET Regulations).

Record details of departures from BS 7671 (IET Wiring Regulations) on certificate.

Provide copies of calculations justifying departure from BS 7671 (IET Wiring Regulations) and attach to certificates.

11.10. RECORDS:

Record all results and instrument readings on approved Record Sheets and hand over to the client two copies for each inspection and test

11.11. CONDUCTIVE PARTS:

Test conductive parts simultaneously accessible with exposed conductive parts of extraneous conductive parts. Establish that they are either not an extraneous conductive part, or that they are reliably connected by metal to main equipotential bonding.

Confirm conductive parts which are not extraneous conductive parts are separated from earth by an impedance greater than 50,000 ohms. Confirm other conductive parts are bonded to equipotential zone earthbar by an impedance not exceeding 0.1 ohms.

11.12. LABELS AND NOTICES:

Apply identification labels and notices in accordance with BS 7671 (IET Wiring Regulations), section 514 to all electrical cables plant and equipment including components of mechanical systems.

Identification of protective devices.

- Diagrams, charts or tables to comply with Clauses 514.9 and 560.7.9.
- Warning notices, voltages in excess of 250 volts.
- Periodic inspection and test notices.

- Residual current device notices.
- Earth electrode safety electrical connection label.
- Bonding conductor connector point to extraneous conductive parts label.
- Earth free local equipotential bonding areas warning notice.
- Electrical separation areas warning notice.
- Outdoor equipment socket outlet notice.

11.13. MATERIALS:

Use materials for labels and notices with a predicted life equal to or greater than the design life of the electrical cables, plant, equipment or installation to which it refers.

External:

- Signwritten, or stencil in paint compatible with surface.
- Colour - Background, plant standard finish. Lettering, white.

Internal:

- Engraved thermosetting plastic laminate.
- Colour - Background, white or red. Lettering, red or white.

11.14. FIXING - INTERNAL:

Fix labels and notices using materials compatible with label or notice and surface to which it is fixed by screws into tapped hole or bolted complete with washer nut and locking device.

11.15. SAFETY SIGNS:

Label all electrical plant and equipment using safety sign 8.A.0044 of BS 5499-5 where voltages above ELV exist.

Provide supplementary or text signs complying with BS 5499-5 with each safety sign 8.A.0044 as indicated.

Label all electrical plant and equipment with the labels specified in the appropriate British Standards for that plant or equipment.

Identify each substation and main switchroom with safety sign 8.A.0044 to BS 5499-5 for any fire extinguishing system and notice giving details of:

- Name of the Substation or switchroom
- The presence of Medium and Low Voltages.
- Administrative instructions for access.
- Location and method of contacting controlling authority.
- Actions to be taken in an emergency.

11.16. MAINTENANCE NOTICES:

Fix notices giving warning of, and instructions on, any special maintenance procedures to plant and equipment.

11.17. SWITCHGEAR:

Fit labels on switchgear as required by BS EN 60439 to indicate duty of unit, its voltage, phase and current rating, protective device rating size of conductor involved, and all other necessary details.

Use an agreed serial coding system, provide at the switch a key to the coding system.

11.18. DISTRIBUTION BOARDS:

On each distribution board identify every outgoing way with a renewable circuit chart in a transparent plastic envelope permanently fitted inside distribution board cover. Clearly indicate in typed script, circuit identification number, cable size, fuse or circuit breaker rating and a description of item supplied and area supplied by circuit.

11.19. SCHEMATIC DIAGRAMS:

Provide a purpose made schematic diagram permanently fixed showing the connections of the equipment and plant.

Locations and materials as indicated in contract preliminaries.

11.20. CABLE IDENTIFICATION:

Provide all cables, other than final sub-circuit wiring enclosed in conduits or trunking, with labels fixed at each end of cable either side of wall and floor penetrations at approximately 12m intervals at convenient inspection points by means of non-releasable plastic straps, minimum width 4mm.

Ensure labels show the reference number of cable.

11.21. UNDERGROUND CABLE IDENTIFICATION:

Identify external underground cable routes by means of approved markers along their length at distances not exceeding 50m and where a change of direction occurs on such routes. Provide cables markers with a brass plate or impress concrete to clearly indicate the reference of group of cables or reference number of cable and operating voltage of cable. Provide key to any reference system used at switchgear. Mark and protect direct buried cables with plastic tape yellow printed black "DANGER ELECTRIC CABLES" elsewhere.

11.22. CABLE JOINTING AND TERMINATION:

Connect all cables in the installation so that the correct sequence of phase rotation is maintained throughout. Where straight through joints are approved joint medium voltage conductors as they lie, ensuring their complete length is phased out on completion. Ensure connections at terminations of MV cables are made in the correct phase rotation

and ensure cable conductor termination marking if any, complies with this phase sequence. Where straight through joints are approved on low voltage cables, whether power cables or control or auxiliary cables, joint conductors strictly in accordance with their colour or numeric coding. Where such joints are approved on mineral insulated or other non-coded conductor cables, identify each core at the joint and make the joint core to core.

12. PAINTING AND ANTI-CORROSION TREATMENTS

Corrosion treatment shall be mainly by hot dip galvanising. However, when this is not possible or practical, paint shall be used for corrosion prevention. This treatment against corrosion shall be first approved by the client.

12.1. PAINT MATERIALS:

Use the following materials as appropriate:

- Solvent borne priming paint to BS 7956 for bare woodwork.
- Red Oxide priming paint for bare iron and steelwork.
- Zinc Chromate priming paint for bare ferrous and non-ferrous metals.
- Calcium Plumbate priming paint to BS 3698 for galvanized steel or composite wood/metal components.
- Undercoating paint for previously primed or painted surfaces before the application of finishing coats.
- Gloss finishing paint for previously primed or painted/undercoated surfaces.
- Epoxy resin paint for specialist coatings requiring resistance to acids, alkalis, oils, solvents, abrasion or high humidity.
- Aluminium paint to BS 388 for structural steelwork, storage vessels, heated metallic surfaces and similar applications where moisture and heat resistant properties are required.
- Cold galvanizing paint for making good damage to previously galvanized surfaces and protection to galvanized materials modified during installation.
- Zinc-rich metallic to BS 4652 for bare iron and steelwork where electrical conductivity has to be assured.
- Black tar-based paint to BS 1070 for moisture resistant protection to metal surfaces where decorating appearance is not important.
- Bitumen based coatings for cold application to BS 3416 protection to iron and steel, particularly pipelines and fittings for use in contact with potable water.
- Bitumen based coatings for cold application to BS 6949 not to be used in contact with potable water.

12.2. PAINT QUALITY:

Ensure paints used are of quality and type to suit application and that: -

- primers have good adhesion, covering power, rust-inhibiting and grain filling properties.
- gloss finishing paints are of machine finish grade having high adhesion and high resistance to solvents, mineral oils, cutting oils, detergents, chipping and impact damage.

13. TESTING AND COMMISSIONING

13.1. HANDOVER

The contractor shall make arrangements to enable the Engineer or his representative to witness tests, or test and inspect at site or at the manufacturer's premises.

The Contractor shall appoint a registered Electrical Engineer, from the contractor's own staff or an independent company, (known as the Commissioning Engineer) who is fully conversant with the operation of the road lighting installations and competent to supervise the whole of these testing and commissioning procedures.

The Engineer and his representatives shall witness the proceedings, confirm the recorded results and determine whether the specified requirements have been met. The Engineer shall only witness final tests and commissioning procedures. Pre-tests and pre-commissioning procedures shall be undertaken by the Contractor under the supervision and control of his Electrical Engineer.

The Engineer shall be given adequate written notice of the date and place of each (or series of) test, inspection, commissioning or demonstration procedure.

All Testing instruments, meters and recorders shall be calibrated by an approved agency or the manufacturer before testing commence for this project. Any certificate issued 30 days prior to the date of commissioning shall not be considered and new certificates will have to be produced.

The Contractor shall provide within his price for all labour, materials including fuel and energy and apparatus required for carrying out the testing, commissioning.

All testing and commissioning shall be undertaken prior to handing over.

13.2. TESTING

The Contractor shall include the provision of a separate set of drawings and/or report sheets to be used to accurately record the following test and inspection information: -

- Plant, section and installation under test.
- Manufacturers reference number where applicable.
- Date, time, duration of test (and weather conditions if appropriate).

- Test results with itemised readings including records of all other checks and tests.
- The Contractor shall allow for the testing of all equipment, material and installations and if the first inspection or test fails, repetition of the procedure within a reasonable time, adhering to the time cycles and other requirements as specified for the first test.
- All tests shall be completed before any services are concealed.

The Engineer will: -

- Give forty-eight four hours written notice of his intention to be represented at the test.
- If he decides after inspection or testing, that such plant or any part thereof is defective, or not conforming with the specification, reject such defective parts by written notice within a reasonable time, indicating the area of dispute.
- If he considers the tests are being unduly delayed, arrange for instructions to carry out the tests within 10 days.

13.3. COMMISSIONING

Commissioning shall be following satisfactory completion of the foregoing tests and when the installation is in a safe and satisfactory condition, include for setting it to work and regulation and adjustment as necessary to the design requirements.

Commissioning shall in general terms include the following procedures:

- Shall be setting to work all systems as specified and ensuring that the performance requirements have been achieved.
- Shall be balancing and regulating all systems to meet specified performance requirements.
- Shall be making final adjustments and before practical completion, demonstrating by commissioning procedures detailed elsewhere in this specification, that the provisions of the contract have been met in total by completing the previous testing and setting to work procedures and by showing that the completely integrated installation will function in accordance with the specified performance requirements.
- Shall include records of all test results on the sheets provided, completing all commissioning documents and at all stages ensuring that the Engineer has certified the documents and/or arranged for instructions for any remedial work.

13.4. COMMISSIONING PROCEDURES

The Contractor shall ensure that the following requirements are observed when, commissioning the engineering works: -

- Progressive static testing will be witnessed by the Engineer(s) when the work is presented as ready for testing. This will include Insulation Resistance Tests, Earth Continuity Tests, light level tests etc.
- The Contractor shall complete all pre-commissioning examination and testing to ensure that each system or item of equipment is complete, in a safe condition and all notices displayed before the Engineer (s) are convened for the final testing and commissioning. Completion for operational purposes implies the bulk of the snagging of work has been offered to the Site Engineer(s) and remedial work completed.
- Instructions to the user's staff to be completed by handover.

13.5. HANDOVER PROCEDURES

The contractor shall prepare the following mechanical or electrical documents to be available not less than one month before Practical Completion of any part of the Contract. It shall include for incorporating the following documents into one or more volumes of durable finish service manuals, with format and contents agreed with the Engineer. Three sets to be provided on completion.

- Index of contents
- Description of design assumptions
- Commissioning Documents and Reports
- Manufacturers operation/Service & maintenance manuals
- Manufacturers spares list & ordering procedure
- Operational & Maintenance routines, procedures for fault finding
- Line diagrams of plant control systems & descriptions of control operation incorporating all set points.
- Emergency call-out service - personnel & telephone contacts
- List of tools, keys & special requirements for handing over
- Guarantees, Test Certificates & Reports
- List of Record Drawings (drawings separately available)

The documents shall be provided in 3 hard copies and 3 sets of CD.

13.6. RECORD DRAWINGS

The Contractor shall modify the installation drawings as necessary to record the "as installed" changes which may have occurred and thus form the basis of the final "As Fitted" drawings.

The record drawings which shall be available not less than one month before practical completion of any part of the contract.

The record drawings shall indicate to a suitable scale agreed by the Engineer (which shall be in any case not less than the tender or installation drawings or 1:50) the layout, identity, size and position of all services installed together with valves, control items, plant, conduit routes, lighting fittings, switches, distribution boards etc. The drawings shall show the results of all commissioning tests. The size, type and length of each ELV, LV and HV cable (to the nearest metre) shall also be given together with the measured earth fault loop impedance where applicable. All fuse or breaker current rating shall be shown as well as all trip settings.

Inter connections between items of equipment, including those provided by others and terminal numbering and cable core identification of all alarm and control circuits shall be given. The drawings shall be amplified with schedules and/or diagrammatic presentation. Particular attention shall be paid to the location and depth of buried cables.

Section 2: Specifications template for supply of Sodium High Pressure (SHP) lamps

1. GENERAL

1.1. SCOPE OF WORKS (OR PROJECT DESCRIPTION)

The contractor / supplier/ manufacturer shall ensure that the product specifications are fully in compliance, without any deviation from this Specification before submitting for approval. Any deviation should be brought to the notice of the client. The contractor/ supplier shall be responsible supply, install, test and commission the whole lighting system in accordance with these specifications and the conditions of operations and maintenance encountered at the site.

1.2. QUALITY ASSURANCE

The client may request a standard production model luminaire sample, identical (including LED Package) to the proposed product, to be installed for inspection. The Client may also request independent testing of sample luminaires to verify luminaire performance and compliance with the specifications. Testing shall be conducted as per the applicable IESNA, ANSI or approved International equivalent approved methods of products using Solid Stage Lighting (SSL) sources. All testing certificates shall be from a Laboratory certified/approved by UKAS or UL or has ISO 17025 or equivalent certification.

1.3. DESIGN CALCULATIONS

All structural design and calculations shall be undertaken by a Registered Civil /Structural Engineer Registered in Mauritius and who shall be approved by the RDA.

1.4. LIAISON WITH RELEVANT AUTHORITIES

The contractor / supplier shall liaise with all relevant authorities in connection with street lighting installation and seek their approval before proceeding with any ordering or installation. The client will advise on the list of authorities to be contacted. The works shall be done under the supervision and approval of the Central Electricity Board, the Ministry of Local Government and the Energy Services Division as applicable. The contractor shall liaise with the CEB and Energy Services division to witness all tests and commissioning procedures.

The contractor shall seek and obtain the permission of the Road Development Authority (RDA), the Traffic Management and Road Safety Unit and the Police Traffic Branch before undertaking any works that will disrupt the traffic. The contractor shall allow for all costs to provide policemen for traffic control during this type of works.

2. APPLICABLE STANDARDS

The following standards and guidance documents shall be applicable for the project:

BS 5489-1 2013- Code of Practice for design of road lighting

BS EN 13201- Parts 1-5- Road Lighting

CIE 115 -2010 - Lighting of Roads for Motor and Pedestrian Traffic.

CIE 129 - Guide for Lighting Exterior Work Areas.

IEC 60529 or EN 60 529 (IP) and EN 50 102 (IK).

BS EN 62471:2008 or ANSI/IESNA RP-27.3-07 Photo biological Safety of Lamps and Lamp Systems.

EN 60598-parts 1, 2-1 & 2-3 –Electrical safety -General and for Road Lighting Luminaires.

BS EN 61547, BS EN 61000-3-2, BS EN 61000-3-3 & BS EN 55015 -Electromagnetic Compatibility.

CIE 126-1997 Guidelines for Minimizing Sky Glow and IESNA TM-10 Addressing Obtrusive (Urban Sky Glow and Light Trespass) in conjunction with Urban Lighting.

Commission Internationale de L'Eclairage (CIE).

IEC 60068-2-68 ed1.0 - Environmental testing - Part 2: Tests - Test L: Dust and Sand.

IESNA LM-79-08 Test method for LED luminaires

IESNA LM-80-08 Test method for lumen maintenance of LED light sources.

IESNA TM-21-11 Projecting long term lumen maintenance of LED light sources.

3. POWER SUPPLY

3.1. POWER SUPPLY CHARACTERISTICS

The power supply characteristics are as follows:

Voltage: 400/230 V

Frequency 50 Hz

The luminaire shall be selected to operate with the above supply voltage with a variation of $\pm 10\%$.

4. SODIUM VAPOUR LUMINAIRE AND LAMPS

4.1. SHP LANTERNS

The luminaires shall be constructed from marine grade die cast aluminium, totally enclosed, with a polyester powder coating and shall conform to BS EN 60598 and have a minimum degree of protection rating of IP 65 to BS EN 60529. Where a separate gear compartment exists, this shall have a degree of protection of at least IP 43. The powder coat finish shall withstand the standard cut tests as defined in BS EN 2409 and BS3900.

All lamps shall comply with the appropriate British or European Standard i.e. BS or BS EN and shall be manufactured within the E.U. by a manufacturer approved by the client.

The luminaires shall incorporate an efficient optical system to direct the light onto the road surface. The efficiency of the whole luminaire shall be specified.

Luminaires shall have an integral flexible mounting system and be capable of being mounted 42mm to 60mm diameter side entry and 60 to 76 post top mounted without the need for separate spigot adaptors. Side entry lanterns shall have a positive locking device so as to prevent the lantern turning on its axis.

Luminaires shall be environmentally friendly and all component parts shall be at least 90% recyclable at the end of life.

Bowls/protectors shall be vandal resistant and stabilised to minimise loss of transparency due to weathering and exposure to ultra violet light. All luminaires shall be fitted with bowls of sound and robust construction capable of being easily removed for maintenance or repair purposes and easily closed to maintain its IP rating and integrity. The lamps, reflectors, refractors and bowl shall be clean and free from dirt and stains after installation and the lamp shall be correctly positioned within the lantern. The bowl or other component giving access to the interior of the lantern shall, when in the open position, be attached in such a way that it will not accidentally fall off the luminaire. All hinges, toggle catches, captive screws and nuts shall be made of non-corrosive material.

The optical equipment controlling light distribution should be in high purity aluminium reflectors and/or prismatic refractors and these shall have a smooth exterior surface or be protected by hermetically sealed cover plates to prevent an accumulation of dirt and to facilitate cleaning.

The luminaire shall be fitted with integral electronic control gear and complete with fuse holder and an appropriately rated cartridge fuse or a two pole miniature circuit breaker complying with BS 3871, located adjacent to the terminal block which shall be capable of accepting a conductor of 2.5mm². The fuse or circuit breaker shall be easily accessible for replacement or resetting.

Luminaires shall provide a light output ratio in excess of 75% with an upward light output ratio of no more than 0.5%. The I_{max} above 95° shall be zero.

Luminaires shall have integral high frequency control gear and have a heat barrier between the lamp enclosure and gear compartment.

All luminaires shall be fitted with a porcelain terminal block, earth terminal, cable clamp and lamp holder ready wired to connector block with heat resisting type cable.

4.2. SODIUM HIGH PRESSURE LAMPS

The high pressure sodium lamps shall comply with IEC 60662 and shall be suitable for operation on high or low power factor circuits with a ballast conforming with IEC 60923 and fitted with Edison screw type caps conforming to IEC 60061. The lamps shall be of the twin arc type. Lamps covered by this specification shall comply with the technical and performance requirements as detailed in Table 3 below:

Table 3: Sodium high pressure lamps.

LAMP WATTAGE	LUMEN OUTPUT 100 HOURS (MINIMUM)	LUMEN OUTPUT
150	14500	13500
250	26000	25000
400	47000	44000

Lamps shall be guaranteed for at least 5 years or 15,000 hours of operation. They shall be compatible with the lantern used and must not be fitted in the lantern until the lantern has been correctly fixed to the column/bracket.

The lamps shall be legibly and indelibly marked on the exterior surface with the following information:

- Trade name, trademark, or identification mark of the manufacturer;
- Catalogue reference number
- Batch code, serial number;
- Lamp type & rated wattage.

4.3. INSTALLATION

The luminaire shall be installed in accordance with the manufacturer's instructions with no gap between the lantern and the shoulder of any bracket arm. The lantern shall also be installed at the correct design tilt and horizontal alignment and to ensure that the design 'IP' rating is maintained. All fixing bolts shall be mechanically tightened. Where a torque setting is recommended for the fixing screws/bolts, a torque wrench shall be used to ensure that the requirements are met.

Luminaires shall be securely fitted to bracket arms or columns and the lamp and all parts affecting the photometric performance shall be in a clean condition and correctly orientated.

Ballasts shall comply with EN61000-3-2:2000, EN61347-2-12-2005, EN61000-3-3:2001, BS EN 61347-1, BS EN 61347-2-1, BS EN 61347-2-8, BS EN 61347-2-9 and

BS EN 60921 or BS EN 60923 as appropriate and be tap selected to the specified operating voltage of the network.

4.4. SODIUM HIGH PRESSURE LUMINAIRE WARRANTY

The Supplier/Contractor shall provide a Warranty from the manufacturer as follows:

A written warranty for a minimum five-year on-site replacement material, fixture, finishes and workmanship. On-site replacement shall include transport, removal of defective and installation of the new product. Body and finish warranty shall include warranty against failure or substantial deteriorations such as corrosion, blistering, cracking, peeling, chalking or fading, at no cost to the client.

A written warranty for a minimum five years' replacement for non-starting SHP lamps (where the lamp can be demonstrated to be functional) at no cost to the Client.

A written warranty for a minimum five years' replacement material warranty on all ballasts, power supply units and in-built control components at no cost to the client.

A written warranty for a minimum five years' replacement for maintained luminance and illuminance levels as needed at no cost to the Client, provided that the luminaire system has been maintained as per specifications. The supplier must provide data showing the expected light loss from the SHP lamp at the time of failure.

A written warranty for a minimum 10 years against the deterioration of the housing, all external components; such as lenses, gaskets & fastenings, and the fixture finishes including, but not limited to, corrosion, yellowing, blistering, chalking, cracking, peeling or fading at no cost to the Client.

5. POLES:

5.1. GENERAL

Pole shall be of a type and shape that can accommodate the luminaires proposed and at the height being installed. The final shape of the pole shall be discussed with and approved by the client before ordering.

Poles and foundations should be designed for the expected wind speed of 300 km/h bearing in mind the wind area of the luminaire. i.e. they should be designed as a complete system.

All structural design and calculations shall be undertaken by a Registered Civil /Structural Engineer Registered in Mauritius and who shall be approved by the RDA.

5.2. MATERIALS

5.2.1. Foundations

Structural analysis / calculations shall be submitted to show that the foundation design meets the load of the given pole type with the proposed luminaire. All structural design and calculations shall be undertaken by a Registered Civil /Structural Engineer Registered in Mauritius and who shall be approved by the RDA.

5.2.2. Access door

Each pole shall have two one service hatches approximately, 2m from ground level where the connection of cables can be made between the outside network and the pole accessories. The cover shall be fixed by two star screws. The access door cover shall fixed with hinges made of corrosion resistant materials such as stainless steel grade 316(A4), brass, hot-dip galvanized steel, etc. as applicable based on the pole and cover plate material and shall not be easily openable with normal screwdrivers or tools. The access doors should be earthed with a separate cable and not simply earthed via the fixing screw.

5.2.3. Electric conduits

Electric conduits shall be installed through foundation and shall enter the poles from base plate.

5.2.4. Steel work.

Poles' steel work shall be manufactured out of BS grade S355 steel for 10-14m poles or as appropriate to a pole of lower height. All components of the pole are required to be hot dip galvanised to BS 729 with minimum thickness coating of 100 µm. Where steelwork is in contact with aluminium work, the manufacturer shall ensure that bi-metallic corrosion is prevented by means approved method.

The pole will be fixed in a concrete base to be designed by a registered professional civil/ structural engineer in Mauritius. The sizing of the concrete bases and stub columns fixed in position must withstand wind speed of 300km/h.

Anchor bolts, nuts, pole structure will be done accordingly to requirements of BS 729.

Aluminium work. (used in public areas like gardens and parks)

Poles in aluminium shall be made up of extruded aluminium alloy which shall have an anodized protective coating finish to 25 microns. The colour of the anodized finish shall be as approved by the Client. The transition rim shall be of cast aluminium alloy of grade LM6 having a minimum 100 microns of polyester powder coating, matching the approved colour of the anodized extruded aluminium.

Bracketry.

Pole brackets shall be manufactured out of BS grade S275 Steel. This shall have high strength, be easily machinable able to handle an array of finishes. All steel components shall be hot-dip galvanized to a minimum thickness of 100 microns.

Fasteners.

All fasteners supplied shall be made of corrosion resistant materials such as stainless steel; - Grade 316, brass, hot-dip galvanized steel etc., based on the materials with which it will be in contact. Bi-metallic contact shall be properly designed to avoid any galvanic or bimetallic corrosion.

Earthing and bonding

M12 x40 mm long threaded stud carrying two nuts and two washers shall be provided as an earth bonding point. It shall be located in the electric compartment.

Pole Identification Tag.

The name of the lighting column manufacturer and the date of manufacture shall be clearly marked using an aluminium name tag affixed to the column in an appropriate location and manner to suit the column design and access. The pole shall also carry a unique identification tag which will provide information on its location, height, jurisdiction (which municipality or district council), date installed, a phone number for fault reporting etc. The full list of information to be provided in this tagging will be supplied by the client. This tagging could be in a form of bar code. The tag will be riveted or welded to the pole and shall be highly resistant to weather conditions. It shall be fixed at 2m above the ground.

5.3. ASSEMBLY

The pole shall be complete with all accessories and all necessary component. The final assembly of pole and components shall be ready for installation at site without any works required other than using suitable fixing tools.

5.3.1. Mast arm for the Luminaires.

The mast arm for the luminaire (if used) shall be fitted on site to the pole. The attachment of the mast arms shall be made of standard fasteners through the structural casting. The mast arm shall be self-supporting against all forces including uplift.

Note that the use of mast arms is to be minimised. The preferred solution is to mount the luminaire directly to the column.

5.3.2. Additional Assembly

Provisions shall be made on the pole for enabling the fixing of other accessories such as street signs, CCTV cameras or traffic signal lights by others after the installation of poles. These provisions shall allow for future additional accessories to be added without having to remove the existing installed accessories, luminaire brackets or the like. The provisions shall be such as to ensure the clean, aesthetic look is maintained and shall allow for complete dismantling, when not in use, without leaving behind any clamps, lugs, etc...

5.4. DESIGN SUBMISSION AND PRODUCTION

All structural design and calculations shall be undertaken by a Registered Civil /Structural Engineer Registered in Mauritius and who shall be approved by the RDA.

a) Strength.

The poles shall be capable of withstanding a basic wind speed of 83.3 m/s or 300 km/hr when equipped with the actual number of lanterns and the associated fittings or accessories as confirmed by the Client. Design calculations shall be submitted to the Client for approval, showing the following: -

Wind load derivation on luminaires and mounted accessories

Wind loading derivation on the pole

Sectional area of the pole at regular intervals of height along the pole, especially at areas of cross-section change and hand hole opening

Stress at the intervals specified in (iii) above

Strength of the pole at the intervals specified in (iii) above

Combined Stress Ratios at the intervals specified in (iii) above

b) Deflection.

Actual deflection against the deflection limit of the poles shall be clearly stated in the design calculations and shall conform to AASTHO. The actual deflection calculated shall be based on the basic wind speed of 45m/s and shall be measured at the lantern position. The calculated deflection shall be the sum of deflection on the vertical pole section as well as the outreach bracket arm section. Deflection of both the vertical pole and the arm shall be shown in the design submission.

Design calculations shall show the pole deflection and shall be checked against the allowable deflection and special deflection limits required for high definition cameras or traffic signal poles, where applicable.

5.5. QUALITY ASSURANCE

The client may request standard production model samples, identical to the proposed, product to be installed. The client may request independent testing of the sample poles to verify the performance and compliance with the specifications. The client shall be the sole judge regarding the acceptability of the performance of the light poles. According to the requirements of the Project's Contract documents, if required the client reserves the right to attend, or appoint a third party to attend, a factory inspection. During a factory inspection, the manufacturer shall perform a full deflection test, as agreed jointly with an accredited independent test house and the client, on a randomly selected pole from the manufactured lot, for each type of ordered pole, to establish the design compliance and structural integrity of the manufactured pole under simulated conditions of full loading, strictly in accordance with the approved design calculations and drawings. Different options of the base or lower cladding unit are shown on the drawings. The client will choose one option during the material review process and the sample shall be submitted accordingly.

5.6. WARRANTY

The Supplier /Contractor shall provide a Warranty to the satisfaction of either the relevant Client, on the materials and performance, as follows:

Provide a written ten-year on-site replacement material, galvanising and workmanship. On-site replacement included transportation, removal and installation of new pole.

Provide a written ten (10) year replacement warranty for defective poles at no cost to the Client.

5.7. CONNECTIONS TO LUMINAIRES

5.7.1. Cable Protection

Use appropriate size of grommet where cables enter through hole in luminaire body. Generally, luminaires will be supplied with a 2m flying lead.

5.7.2. Earthing

Ensure that the earthing terminal of Class 1 luminaires is connected to the conduit protective conductor of the supply circuit.

Loose Wiring- Clip or tie back with suitable proprietary devices loose wiring within luminaire, at 300mm intervals.

Section 3: Specifications template for supply of LED luminaires

1. GENERAL

1.1. SCOPE OF WORKS

This contract is for the replacement of the existing street lighting system along three stretches of road by high efficiency LED street lights (retrofit). This is being undertaken as a pilot study to assess the suitability and performance of LED street lights in Mauritius.

The road stretches under this pilot study are:

Main Road Type A- from Vandermeersch round about to Ebene Cybercity round about.

Main Road Type B- from Quartier Militaire round about to Providence

Residential Road- Capucines Avenue, Sodnac Quatre Bornes

The supplier shall supply and install the new LED lights on existing columns and brackets along these stretches of roads, and connect to the existing power supply cable.

The contractor / supplier/ manufacturer shall ensure that the product specifications are fully in compliance from this Specification, before submitting for approval. Any deviation should be brought to the notice of the client. The contractor/ supplier shall be responsible to supply, install, test and commission the whole lighting system in accordance with these specifications and the conditions of operations and maintenance encountered at the site.

1.2. QUALITY ASSURANCE

The client may request a standard production model luminaire sample, identical (including LED Package) to the proposed product, to be installed for inspection. The Client may also request independent testing of sample luminaires to verify luminaire performance and compliance with the specifications. Testing shall be conducted as per the applicable IESNA, ANSI or approved International equivalent approved methods of products using Solid Stage Lighting (SSL) sources. All testing certificates shall be from a Laboratory certified/approved by UKAS or UL or has ISO 17025 or equivalent certification.

1.3. PERFORMANCE CRITERIA

The lighting performance along these roads shall be as close as possible to the values specified in the “Standards for street and exterior public areas lighting in Mauritius” for the various road types. The contractor shall undertake a site survey to ascertain himself of the exact pole intervals and height along the roads under this contract and take into consideration in the lighting design simulations. The simulation results based on the pole intervals and height along these roads shall be submitted along with the tender. The simulation results shall be signed by a Registered Electrical Engineer in Mauritius or a Chartered Electrical Engineer.

All deviation to the above performance criteria shall be highlighted in the offer.

1.4. LIAISON WITH RELEVANT AUTHORITIES

The contractor / supplier shall liaise with all relevant authorities in connection with street lighting installation and seek their approval before proceeding with any ordering or installation. The client will advise on the list of authorities to be contacted. The works shall be done under the supervision and approval of the Central Electricity Board, the Ministry of Local Government and the Energy Services Division as applicable. The contractor shall liaise with the CEB and Energy Services Division, if instructed by the Engineer, to witness all tests and commissioning procedures.

The contractor shall seek and obtain the permission of the Road Development Authority (RDA), the Traffic Management and Road Safety Unit (TRMSU) and the Police Traffic Branch before undertaking any work that will disrupt the traffic. The contractor shall allow for all costs to provide policemen for traffic control during the works.

2. APPLICABLE STANDARDS

The following standards and guidance documents shall be applicable for the project:

BS 5489-1 2013- Code of Practice for design of road lighting

BS EN 13201- Parts 1-5- Road Lighting

CIE 115 -2010 - Lighting of Roads for Motor and Pedestrian Traffic.

CIE 129 - Guide for Lighting Exterior Work Areas.

IEC 60529 or EN 60 529 (IP) and EN 50 102 (IK).

BS EN 62471:2008 or ANSI/IESNA RP-27.3-07 Photo biological Safety of Lamps and Lamp Systems.

EN 60598-parts 1, 2-1 & 2-3 –Electrical safety -General and for Road Lighting Luminaires.

BS EN 61547, BS EN 61000-3-2, BS EN 61000-3-3 & BS EN 55015 -Electromagnetic Compatibility.

CIE 126-1997 Guidelines for Minimizing Sky Glow and IESNA TM-10 Addressing Obtrusive (Urban Sky Glow and Light Trespass) in conjunction with Urban Lighting.

Commission Internationale de L'Eclairage (CIE):

IEC 60068-2-68 ed1.0 - Environmental testing - Part 2: Tests - Test L: Dust and Sand.

IESNA LM-79-08 Test method for LED luminaires

IESNA LM-80-08 Test method for lumen maintenance of LED light sources.

IESNA TM-21-11 Projecting long term lumen maintenance of LED light sources.

3. POWER SUPPLY

3.1. POWER SUPPLY CHARACTERISTICS

The power supply characteristics are as follows:

Voltage: 400/230 V

Frequency 50 Hz

The luminaire shall be selected to operate with the above supply voltage with a variation of $\pm 10\%$.

4. LUMINAIRES AND LAMPS

4.1. GENERAL

The luminaires and lamps supplied under this contract shall be the latest series / model available from the manufacturer and shall have passed all the tests specified in this document. The luminaires shall be designed to operate continuously at 35°C and in a marine environment with occasional very high wind speed. The manufacturers shall guarantee adherence to this Specification and the performance of their luminaire under all the required design conditions. Independent test reports should be provided to show the luminaires will operate under these conditions.

Street lighting luminaires should be IP66. Luminaires should be supplied with a 2m flexible flying lead when mounted on a CEB pole or 10 m lead when fixed on columns. Luminaires will be Class 1 and 230V unless otherwise specified.

The luminaire housing shall be slim with low profile and shall be of either extruded aluminium or die cast aluminium and high corrosive resistance. Luminaire components to be tested in accordance with the requirements of BSEN 60598 or similar International equivalent standard. The finish coating for housing shall be with an anti-corrosive anodized/painting process or equivalent, providing excellent UV and environmental exposure resistance to fading, peeling cracking or corrosion. The driver(s) shall be integral to the fixture head, encapsulated/potted and protected in a waterproof (IP) environment, enabling access to the driver(s) for easy maintenance requirements. The driver compartment should be separate from the optical compartment housing the LEDs. The fixtures shall be CE or UL certified, or comply with equivalent international standards with all certification made available.

4.2. CONSTRUCTION

Within the Luminaire:

The light source shall be high brightness warm white Light emitting Diodes (LEDs) with individual minimum efficacy of at least 100 lm/W arranged modularly to provide the required lighting output.

The LEDs shall be from a reputed manufacturer with proven experience in the manufacture of LED for at least 10 past years. The CRI shall be greater than 70. The LEDs shall be removable/replaceable on site by modular means without any possible risk to affect the luminaire photometry and without the need to demount the fixtures.

Whole Luminaire Efficacy (Systems efficiency):

The optimum efficiency of the luminaire shall be confirmed as follows:

Minimum luminaire efficacy shall be 90 lm/W (@min 35 oC, min95%RH)

This is given as total luminaire design lumen output (lm) over total luminaire circuit Watts (W) at minimum 35-degrees Centigrade outside ambient temperature and minimum 95% relative humidity.

4.3. OPTICAL CONTROL

The luminaire shall be fitted with optical refractors, diffusers and/or reflectors. The luminaire with the right optics will be proposed so that the performance criteria set in Section 1.4 are achieved as close as possible. Independent laboratory photometric test reports shall be submitted for the luminaire photometric files used in the lighting calculations. The testing should conform to IESNA LM-79-08 standards. Dialux photometric digital data files shall be considered acceptable and shall not need any independent laboratory test.

4.4. THERMAL MANAGEMENT

The LED modules shall be mounted on heavy duty heat sinks to ensure proper heat dissipation and to ensure that luminaires to work efficiently in Mauritian climatic conditions. The luminaire shall be provided with a ventilation arrangement allowing heat to be dissipated to the atmosphere.

The design shall be such that the luminaire shall be self-cleaning in normal operation. The luminaire shall be provided with a heavy-duty rugged cast aluminium adjustable slip fitter mountable to suit the proposed pole.

4.5. BOWLS

Bowls/protectors shall be vandal resistant and stabilised to minimise loss of transparency due to weathering and exposure to ultra violet light. All luminaires shall be fitted with bowls of sound and robust construction capable of being easily removed for maintenance or repair purposes and easily closed to maintain its IP 66 rating and integrity. The lamps, reflectors, refractors and bowl shall be clean and free from dirt and stains after installation and the lamp shall be correctly positioned within the lantern. The bowl or other component giving access to the interior of the lantern shall, when in the open position, be attached in such a way that it will not accidentally fall off the luminaire. All hinges, toggle catches, captive screws and nuts shall be made of non-corrosive material.

4.6. FIXTURE TECHNICAL DATA –

The following information will be provided for each of the type of LED luminaire being proposed:

Physical description of lighting fixture with dimensions.

Details of the driver(s) including, manufacturer, driver efficiency, catalogue code, certifications and input watts.

Luminaire photometric reports per IESNA LM-79-08, or similar International approved equivalent; including, laboratory name, report number, date, luminaire catalogue number, luminaire, and light source specifications.

Photometry table of zonal lumen output in 10o vertical increments showing both the lumen value and the percentage of total out per 100 increments. Provide photometric files in IES or EULUMDAT format, for example IES, LDT or ULD files.

Confirm a minimum of 6,000 hours of continuous operation of the LEDs at three different temperatures per LM-80-08, or similar International approved equivalent.

Documentation of the expected useful life including the testing and calculation of useful life and verification of site lighting performance at that life. If the site defined performance methods are used, the interpolation between the three sets of LM-80 data, and all calculations applied in deriving the proposed LLD and useful life shall be provided.

4.7. LED MODULES

Within the fixture the LED modules shall meet the following requirements:

Operating temperature rating shall be between 0°C and minimum +50°C at a minimum 95% Relative Humidity (RH).

Storage (i.e. non-operating/daytime) temperature: all LED components to be designed to tolerate between - 40°C and minimum +80°C at a minimum 95% Relative Humidity (RH).

Correlated colour temperature (CCT): 3000K- 5000K

Colour rendering index (CRI): > 70

Comply with IES LM 80, IES TM 28 and IES TM 21 or equivalent standards.

Luminaire manufacturer shall submit reliability reports indicating that the manufacturer of the LED (chip, diode, or package) has performed Joint Electron Devices Engineering Council (JEDEC), or similar International approved equivalent; reliability tests on the LEDs. Factory pre-release test reports shall be provided from the LED manufacturer duly complying with JEDEC JESD22-A108C, or equivalent, for operating life tests at 85° C Ambient temperatures and for humidity and salt atmosphere corrosion tests. Standards and tests used must be stated.

4.8. LED DRIVERS

Within the fixture the LED driver(s) shall meet the following requirements:

Drivers shall be dimmable unless specified otherwise and have a minimum efficiency of 85%. When dimmed, Power Factor should be > 0.7 over complete range.

Case (Tc°C) temperature rating -10°C to minimum +60°C and at a minimum 95% Relative Humidity (RH). Driver/Fixture to have some means of built-in overheat thermal protection in the form of automatic dimming or stepping/holding down of the driver where temperature exceeds operational limits. Thermal cut-out devices which turn the fixture LEDs completely off are not acceptable.

The driver and driver output current must be shown to be fully tested and compatible with the exact LED chips of the luminaire. All information provided and the cost analysis/payback calculations, if needed, should be calculated with the exact drive current including the calculation for the life cycle, life and resultant increase or decrease of the energy consumption if applicable.

Input voltage; capable of 230V \pm 10% volt, single phase or as required by the site.

Power supplies can be UL Class 1 or II output or similar European CE or International equivalent.

Surge protection: Must be tested in accordance to the requirements of IEEE/ASNI C62.41.2-2002, Scenario I Location Category C or International equivalent.

Drivers shall have a Power Factor (PF) of more than 0.90.

Drivers shall have a total individual luminaire Harmonic Distortion (THD) of: < 20% in accordance with ANSI C82.77 (2002)

Driver shall have an in-built protection against overload and surges up to 6kV.

Drivers shall have a lifetime of at least 50,000 h.

4.9. USEFUL LIFE:

The useful life of the luminaire in terms of lumen output must be as per LM-79-08 or approved International equivalent.

4.10. PHOTOBIOLOGICAL SAFETY

Ensure luminaire complies with Photobiological Safety of lamps and lamp systems in accordance with the requirements of BS EN 62471:2008 or ANSI/IESNA RP-27.3-0. Provide proof of testing and compliance with the standards with certification provided to prove the fixture is classed as "Exempt"

4.11. QUALITY ASSURANCE

The client may request a standard production model luminaire sample, identical (including LED Package) to the proposed product, to be installed for inspection. The Client may also request independent testing of sample luminaires to verify luminaire performance and compliance with the specifications. Testing shall be conducted as per the applicable IESNA, ANSI or approved International equivalent approved methods of products using Solid Stage Lighting (SSL) sources. The Client shall be sole judge regarding acceptability of optical system performance. All testing certificates shall be from a Laboratory certified/approved by UKAS or UL or the Government of Mauritius, or has ISO 17025 or equivalent certification.

4.12. INSTALLATION

The luminaire shall be installed in accordance with the manufacturer's instructions with no gap between the lantern and the shoulder of any bracket arm. The lantern shall also be installed at the correct design tilt and horizontal alignment and to ensure that the design 'IP' rating is maintained. All fixing bolts shall be mechanically tightened. Where a torque setting is recommended for the fixing screws/bolts, a torque wrench shall be used to ensure that the requirements are met.

Luminaires shall be securely fitted to bracket arms or columns and the lamp and all parts affecting the photometric performance shall be in a clean condition and correctly orientated.

The Contractor shall coordinate with the LED fitting manufacturer and pole manufacturer to make sure complete compatibility of the products. The fixing should ensure that the luminaire/outreach arm is suitable for the high wind speeds expected and will not move from its designed position or become disconnected

4.13. LED LUMINAIRE WARRANTY

The Supplier/Contractor shall provide a Warranty from the Luminaire Supplier / manufacturer or himself, as follows:

- A written warranty for a minimum five-year on-site replacement material, fixture, finishes and workmanship. On-site replacement shall include transport, removal of defective and installation of the new product. Body and finish warranty shall include warranty against failure or substantial deteriorations such as corrosion, blistering, cracking, peeling, chalking or fading, at no cost to the client.
- A written warranty for a minimum five years' replacement material warranty for defective or non-starting LED source assemblies at no cost to the Client.
- A written warranty for a minimum five years' replacement material warranty on all supplied drivers, power supply units and in-built control components at no cost to the client.
- A written warranty for a minimum five years' replacement material warranty for maintained luminance and illuminance levels on all light sources (LED package, LED array, or LED module) including, but not limited to the LED die, encapsulate, and phosphor. The manufacturer/ supplier/ contractor shall replace the light source(s) or luminaire as needed at no cost to the Client if the expected useful life of the luminaire system is not maintained as per specifications. The supplier must provide data showing the expected light loss from the LEDs to the time at which the LEDs should be replaced.
- A written warranty for a minimum ten years against the deterioration of the housing, all external components; such as lenses, gaskets & fastenings, and the fixture finishes including, but not limited to, corrosion, yellowing, blistering, chalking, cracking, peeling or fading at no cost to the Client.

5. POLES:

5.1. GENERAL

Pole shall be of a type and shape that can accommodate the luminaires proposed and at the height being installed. The final shape of the pole shall be discussed with and approved by the client before ordering.

Poles and foundations should be designed for the expected wind speed of 300 km/h bearing in mind the wind area of the luminaire. i.e. they should be designed as a complete system.

All structural design and calculations shall be undertaken by a Registered Civil /Structural Engineer Registered in Mauritius and who shall be approved by the RDA.

5.2. MATERIALS

5.2.1. Foundations.

Structural analysis / calculations shall be submitted to show that the foundation design meets the load of the given pole type with the proposed luminaire. All structural design and calculations shall be undertaken by a Registered Civil /Structural Engineer Registered in Mauritius and who shall be approved by the RDA.

5.2.2. Access door-

Each pole shall have one service hatch approximately, 2m from ground level where the connection of cables can be made between the outside network and the pole accessories. The cover shall be fixed by two star screws. The access door cover shall be fixed with hinges made of corrosion resistant materials such as stainless steel grade 316(A4), brass, hot-dip galvanized steel, etc. as applicable based on the pole and cover plate material and shall not be easily openable with normal screwdrivers or tools. The access doors should be earthed with a separate cable and not simply earthed via the fixing screw.

5.2.3. Electric conduits.

Electric conduits shall be installed through foundation and shall enter the poles from base plate.

5.2.4. Steel work.

Poles' steel work shall be manufactured out of BS grade S355 steel for 10-14m poles or as appropriate to a pole of lower height. All components of the pole are required to be hot dip galvanised to BS 729 with minimum thickness coating of 100 µm. Where steelwork is in contact with aluminium work, the manufacturer shall ensure that bi-metallic corrosion is prevented by means approved method.

The pole will be fixed in a concrete base to be designed by a registered professional civil/ structural engineer in Mauritius. The sizing of the concrete bases and stub columns fixed in position must withstand wind speed of 300km/h.

Anchor bolts, nuts, pole structure will be done accordingly to requirements of BS 729.

Aluminium work. (used in public areas like gardens and parks)

Poles in aluminium shall be made up of extruded aluminium alloy which shall have an anodized protective coating finish to 25 microns. The colour of the anodized finish shall be as approved by the Client. The transition rim shall be of cast aluminium alloy of grade LM6 having a minimum 100 microns of polyester powder coating, matching the approved colour of the anodized extruded aluminium.

Bracket

Pole brackets shall be manufactured out of BS grade S275 Steel. This shall have high strength, be easily machinable able to handle an array of finishes. All steel components shall be hot-dip galvanized to a minimum thickness of 100 microns.

Fasteners

All fasteners supplied shall be made of corrosion resistant materials such as stainless steel; - Grade 316, brass, hot-dip galvanized steel etc., based on the materials with which it will be in contact. Bi-metallic contact shall be properly designed to avoid any galvanic or bimetallic corrosion.

Earthing and bonding

M12 x40 mm long threaded stud carrying two nuts and two washers shall be provided as an earth bonding point. It shall be in the electric compartment.

Pole Identification Tag

The name of the lighting column manufacturer and the date of manufacture shall be clearly marked using an aluminium name tag affixed to the column in an appropriate location and manner to suit the column design and access. The pole shall also carry a unique identification tag which will provide information on its location, height, jurisdiction (which municipality or district council), date installed, a phone number for fault reporting etc. The full list of information to be provided in this tagging will be supplied by the client. This tagging could be in a form of bar code. The tag will be riveted or welded to the pole and shall be highly resistant to weather conditions. It shall be fixed at 2m above the ground.

5.3. ASSEMBLY

The pole shall be complete with all accessories and all necessary component. The final assembly of pole and components shall be ready for installation at site without any works required other than using suitable fixing tools.

5.3.1. Mast arm for the Luminaires.

The mast arm for the luminaire (if used) shall be fitted on site to the pole. The attachment of the mast arms shall be made of standard fasteners through the structural casting. The mast arm shall be self-supporting against all forces including uplift.

Note that the use of mast arms is to be minimised. The preferred solution is to mount the luminaire directly to the column.

5.3.2. Additional Assembly

Provisions shall be made on the pole for enabling the fixing of other accessories such as street signs, CCTV cameras or traffic signal lights by others after the installation of poles. These provisions shall allow for future additional accessories to be added without having to remove the existing installed accessories, luminaire brackets or the like. The provisions shall be such as to ensure the clean, aesthetic look is maintained and shall allow for complete dismantling, when not in use, without leaving behind any clamps, lugs, etc.

5.4. DESIGN SUBMISSION AND PRODUCTION

All structural design and calculations shall be undertaken by a Registered Civil /Structural Engineer Registered in Mauritius and who shall be approved by the RDA.

a) Strength.

The poles shall withstand a basic wind speed of 83.3 m/s or 300 km/hr when equipped with the actual number of lanterns and the associated fittings or accessories as confirmed by the Client. Design calculations shall be submitted to the Client for approval, showing the following: -

- Wind load derivation on luminaires and mounted accessories
- Wind loading derivation on the pole
- Sectional area of the pole at regular intervals of height along the pole, especially at areas of cross-section change and hand hole opening
- Stress at the intervals specified in (iii) above
- Strength of the pole at the intervals specified in (iii) above
- Combined Stress Ratios at the intervals specified in (iii) above

b) Deflection.

Actual deflection against the deflection limit of the poles shall be clearly stated in the design calculations and shall conform to AASTHO. The actual deflection calculated shall be based on the basic wind speed of 45m/s and shall be measured at the lantern position. The calculated deflection shall be the sum of deflection on the vertical pole section as well as the outreach bracket arm section. Deflection of both the vertical pole and the arm shall be shown in the design submission.

Design calculations shall show the pole deflection and shall be checked against the allowable deflection and special deflection limits required for high definition cameras or traffic signal poles, where applicable.

5.5. QUALITY ASSURANCE

The client may request standard production model samples, identical to the proposed, product to be installed. The client may request independent testing of the sample poles to verify the performance and compliance with the specifications. The client shall be the sole judge regarding the acceptability of the performance of the light poles. According to the requirements of the Project's Contract documents, if required the client reserves the right to attend, or appoint a third party to attend, a factory inspection. During a factory inspection, the manufacturer shall perform a full deflection test, as agreed jointly with an accredited independent test house and the client, on a randomly selected pole from the manufactured lot, for each type of ordered pole, to establish the design compliance and structural integrity of the manufactured pole under simulated conditions of full loading, strictly in accordance with the approved design calculations and drawings. Different options of the base or lower cladding unit are shown on the drawings. The client will choose one option during the material review process and the sample shall be submitted accordingly.

5.6. WARRANTY

The Supplier /Contractor shall provide a Warranty to the satisfaction of either the relevant Client, on the materials and performance, as follows:

Provide a written ten-year on-site replacement material, galvanising and workmanship. On-site replacement included transportation, removal and installation of new pole.

Provide a written ten (10) year replacement warranty for defective poles at no cost to the Client.

5.7. CONNECTIONS TO LUMINAIRES

5.7.1. Cable Protection

Use appropriate size of grommet where cables enter through hole in luminaire body. Generally, luminaires will be supplied with a 2m flying lead.

5.7.2. Earthing

Ensure that the earthing terminal of Class 1 luminaires is connected to the conduit protective conductor of the supply circuit.

Loose Wiring- Clip or tie back with suitable proprietary devices loose wiring within luminaire, at 300mm intervals.

5.7.3. Miniature Circuit breakers

If used, miniature circuit breakers shall be of two pole type, complying to BS 3871.

Section 4: Specifications for stand-alone solar PV street lighting

1. GENERAL

1.1. SCOPE OF WORKS

The report describes the specifications of a solar PV street and public area lighting system which includes the specifications of the pole, specifications of the light fittings, batteries, PV panels and inverters, LV panels, switchgears and accessories.

The solar PV lighting system basically consists of:

- a) Solar photovoltaic (PV) module to convert sunlight into DC current
- b) Luminaire/LED Street light
- c) Maintenance free battery to store and restore energy
- d) A charge controller to manage the energy flow
- e) Pole and solar panel bracket
- f) Interconnecting cables

The solar photovoltaic (PV) panel is fixed firmly on top of the pole with suitable tilt and inclination so as to receive maximum sunlight throughout the day. The solar photovoltaic module thus produces suitable voltage and current which is used to charge the battery via a charge controller. The energy stored in the battery is used to light up the LED which is housed inside the luminaire during night time.

Energy efficient LED street lamps, an inverter and charge controller card which is used to convert the stored DC energy in the battery to suitable AC voltage to ignite the LED. The charge controller protects the battery from over charge and deep discharge. The solar photovoltaic module, LED street lamp and the battery box are fitted on to the Pole and are interconnected through the cables. The solar street light operates in the stand-alone mode.

The solar battery is housed inside a battery box, which is underground or fixed on the pole at a suitable height from the ground for easy maintenance and replacement. The battery provided shall be a maintenance free battery to avoid periodic maintenance of the battery using distilled water.

The contractor/ supplier shall be responsible to design, install, test and commission the whole lighting system in accordance with these specifications and the conditions of operations and maintenance encountered at the site.

1.2. PERFORMANCE CRITERIA

The lighting levels for different types of roads are as follows:

Table 4: Lighting levels for different types of roads

Road Type	Luminance cd/m ² minimum maintained value	E _{ave} in lux, minimum maintained value	E _{min} in lux, maintained value
Motorway	1.5	-	-
Main Road Type A	1.0	-	-
Main Road Type B	0.75	-	-
Busy urban road	-	10	3
Normal urban road	-	7.5	1.5
Small or quiet urban road	-	5	1.0
Rural and residential roads	-	3	0.6

1.3. QUALITY ASSURANCE

The relevant Authority may request a standard production model luminaire sample, identical (including LED Package) to the proposed product, to be installed for inspection. The Client may also request independent testing of sample luminaires to verify luminaire performance and compliance with the specifications. Testing shall be conducted as per the applicable IESNA, ANSI or approved International equivalent approved methods of products using Solid Stage Lighting (SSL) sources. All testing certificates shall be from a Laboratory certified/approved by UKAS or UL or has ISO 17025 or equivalent certification.

1.4. DESIGN CALCULATIONS

All structural design and calculations shall be undertaken by a Registered Civil /Structural Engineer Registered in Mauritius and who shall be approved by the RDA.

1.5. LIAISON WITH RELEVANT AUTHORITIES

The contractor / supplier shall liaise with all relevant authorities in connection with street lighting installation and seek their approval before proceeding with any ordering or installation. The client will advise on the list of authorities to be contacted. The works shall be done under the supervision and approval of the Central Electricity Board, the Ministry of Local Government and the Energy Services Division as applicable. The contractor shall liaise with the CEB and Energy Services division to witness all tests and commissioning procedures.

The contractor shall seek and obtain the permission of the Road Development Authority (RDA), the Traffic Management and Road Safety Unit and the Police Traffic Branch

before undertaking any works that will disrupt the traffic. The contractor shall allow for all costs to provide policemen for traffic control during this type of works.

2. APPLICABLE STANDARDS

The following standards and guidance documents shall be applicable for the project:

BS 5489-1 2013- Code of Practice for design of road lighting

BS EN 13201- Parts 1-5- Road Lighting

CIE 115 -2010 - Lighting of Roads for Motor and Pedestrian Traffic.

CIE 129 - Guide for Lighting Exterior Work Areas.

IEC 60529 or EN 60 529 (IP) and EN 50 102 (IK).

BS EN 62471:2008 or ANSI/IESNA RP-27.3-07 Photo biological Safety of Lamps and Lamp Systems.

EN 60598-parts 1, 2-1 & 2-3 –Electrical safety -General and for Road Lighting Luminaires.

BS EN 61547, BS EN 61000-3-2, BS EN 61000-3-3 & BS EN 55015 -Electromagnetic Compatibility.

CIE 126-1997 Guidelines for Minimizing Sky Glow and IESNA TM-10 Addressing Obtrusive (Urban Sky Glow and Light Trespass) in conjunction with Urban Lighting.

Commission Internationale de L'Eclairage (CIE).

IEC 60068-2-68 ed1.0 - Environmental testing - Part 2: Tests - Test L: Dust and Sand.

IESNA LM-79-08 Test method for LED luminaires

IESNA LM-80-08 Test method for lumen maintenance of LED light sources.

IESNA TM-21-11 Projecting long term lumen maintenance of LED light sources.

3. POWER SUPPLY

3.1. POWER SUPPLY CHARACTERISTICS

The power supply will be applicable for solar powered luminaire in case there is a backup or secondary power supply which does not depend on primary distribution from solar powered equipment.

The power supplies and distribution equipment shall be sized to cater for a 400/230 Volts, 50 Hz AC supply with a variation of $\pm 10\%$ in voltage and $\pm 1\%$ in frequency. Equipment shall be selected to operate with the above supply unless otherwise specified. Main low voltage switchgear shall incorporate spaces to enable the addition of future circuit breakers if required to serve dedicated equipment loads.

3.2. LIAISON WITH THE CEB

The contractor / supplier shall liaise with the CEB to ascertain the site supply characteristics and incorporate the CEB's requirements in his design and installations.

3.3. METERING

Electricity meters shall be installed on new installations which are fed by a separate supply and /or as appropriate, after consultation with the Client. The metering system shall meet the requirements of the CEB.

4. LV PANELS, SWITCHGEARS AND ACCESSORIES

4.1. LOW VOLTAGE SWITCHBOARD PANELS AND DISTRIBUTION BOARDS

Low Voltage switchboards shall be to BS EN 60439 and shall be adequate for the voltage, load current, prospective fault levels, and type of supply.

Enclosures shall be metal construction, with all electrical conductors, contacts etc., totally enclosed. They shall be unit or cubicle type construction from the same manufacturer as the switchgear. They shall be protected to not less than IP31 for indoor use and shall be weatherproofed IP65 for exterior use.

Enclosures shall be provided with facilities for padlocking or locking to prevent unauthorised interference. The locks to be operable by a key common to all enclosures, switchgear and distribution gear locks.

Enclosures shall be provided with adequate local means of isolation, earthing and insulation to ensure safety of operatives during maintenance works. Such isolation to be lockable in the OPEN position.

Enclosures shall be adequately ventilated or cooled.

Floor mounted panels shall be mounted on a plinth in wet plant areas. Wall mounted panels shall be fixed to the structural wall with bolts.

Enclosures shall be finished in manufacturers' standard stoved enamel finish. Plain steelwork to be painted to BS 6150 with red lead primer and two coats of enamel to match the switchgear, Beige colour.

Enclosures shall be arranged with operating handles, control knobs, push buttons etc., within the range of 450mm and 1800mm above floor level.

Enclosures shall be provided with cable entry locations (top, bottom etc.) to suit the detail of the scheme and be of adequate size to accommodate all incoming cables.

Enclosures shall be so designed and constructed as to protect all live parts to IP2X including live parts behind locked doors, removable panels, and particularly on the back of opening doors.

Enclosures shall be so designed and constructed that all user adjustments are accessible without opening doors or removing panels; i.e. from the outside.

The contractor will liaise with the CEB, whenever required, to ensure that the cubicle to house the distribution board is large enough to allow working space at the top and bottom of the board. At least 300 mm will be allowed as working space at the top and bottom of the cubicle. The construction drawings will be issued for approval to the Engineer before construction.

4.2. FUSE SWITCHES AND SWITCH FUSES

All fuses and switch fuses shall be to BS EN 60947-3. They shall be fitted with HBC fuses to all line conductors for a.c. and to all poles of d.c. systems. They shall be fitted as required with a neutral terminal. For units exceeding 100 A, this terminal shall have a removable bolted link.

4.3. AIR CIRCUIT BREAKERS (ACB'S) AND MOULDED CASE CIRCUIT BREAKERS (MCCB'S)

ACB's and MCCB's shall be of the four pole type and shall be to BS EN 60947-2. They shall be provided with positive means for preventing any one pole of a multi-pole MCCB being operated or tripped, independently of the other poles.

4.4. MINIATURE CIRCUIT BREAKERS (MCB'S)

MCB's shall be to BS 3871 and shall be of the two pole or four pole type. The Neutral connection shall be open in event of tripping of the circuit breaker.

MCB shall be provided with single phase or three phase instantaneous magnetic and overload tripping. They shall be of Type C.

MCB shall be provided with positive means for preventing any one pole of a multi-pole MCB being operated or tripped independently of the other poles. Tripping of the circuit breaker shall cause opening of the neutral pole as well.

4.5. RESIDUAL CURRENT DEVICES (RCD'S) AND RCBO

RCD's and RCBO shall be provided to BS EN 61008 and shall be rated maximum 300 mA, adjustable trip type. Unless otherwise specified, RCD/RCBO shall be of the two pole for single phase and four pole type for three phase. The Neutral shall open in event of tripping of the device.

4.6. FUSES

Fuses shall be to BS 88 HBC cartridge type for general power applications, fitted inside fuse spurs. They shall be fitted to all-insulated carriers incorporating means of identifying failed fuses.

4.7. BUSBARS AND CONNECTIONS

Busbars shall be of constant cross section copper throughout. The copper conductors shall be tinned. Busbars shall be air insulated except where solid insulation is a design feature. They shall be connected to outgoing switches with solid copper connections. The connections to be as short and direct as possible.

Busbars shall be rigidly clamped and secured to prevent undue movement under fault conditions or displacement as a result of the installation of cabling and provided, where necessary, with insulated phase or circuit barriers. All clamping and supporting bolts, nuts and screws to be plated brass or steel.

Busbars shall be separate for individual supply systems. Two systems shall not occupy the same busbar chamber unless they are segregated and separated by earthed metal and warning notices fixed.

4.8. CURRENT TRANSFORMERS

Comply with BS EN 60044-1. Provide separate current transformers for each protection device and instrumentation. Ensure current transformers provide appropriate accuracy and are compatible with over current factors, characteristics, performance and VA rating required for satisfactory operation of protection devices, instruments and meters indicated.

Ensure that current transformers are capable of withstanding maximum short time withstand current of value and duration indicated for assembly.

Provide test links in secondary connections of all current transformers to facilitate testing of instruments, meters and protection devices.

4.9. INSTRUMENTS AND METERS

4.9.1. Standards

Comply with BS 89 and BS EN 60051-1 for voltmeters, ammeters, watt meters, frequency indicators and power factor indicators.

Comply with BS 7856, BS EN 62053-11, BS EN 62053-22 or BS EN 62053-21 for kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters, and BS EN 62053-23 for KVAhr meters.

Protect wiring to voltmeters by separate fuses.

Protect potential coils of watt meters, frequency indicators, power factor indicators and kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters by separate fuses.

Supply instruments and meters suitable for flush mounting and type, size and accuracy as indicated.

Ensure that indicating scales for all instruments comply with BS 3693.

Completely segregate all instruments in instrument compartments. Panel mount meters on front of instrument compartment.

4.9.2. Indicator Lights

Supply lamps of same type throughout. Provide indicator lamps with lamp test facility.

Lamps

- Supply interchangeable indicators for respective units.

Protect wiring to indicator lamp units by separate cartridge fuses. Lens Colour in accordance with BS EN 60073.

4.10. DISTRIBUTION BOARDS

Comply with BS EN 60439-3 as appropriate. Make internal separation Form 1 unless otherwise indicated. Make fuse boards fully shrouded. Fit each distribution board with an isolating switch.

Install busbars in same position relative to their fuse carriers or miniature circuit-breakers (MCBs) for each pole. In TPN distribution boards supply neutral busbars with one outgoing terminal for each outgoing circuit.

Provide a multi-terminal earthing bar for circuit protective conductors for both insulated and metal-cased boards, with one terminal for each outgoing circuit. Connect directly to earthing terminal without dependence on exposed conductive parts of enclosure.

Identify each fuseway and MCB way by numbering. Identify each terminal on neutral busbar and earthing bar with its respective fuseway or MCB way.

Where specific ratings are indicated incorporate fuses or MCBs, otherwise leave ways blank for future additions.

4.11. CABLE TERMINATIONS:

Ensure that switchgear and distribution boards are provided with facilities to terminate size, number and type of cable indicated. Where necessary use fabricated steel extension boxes for glanding large and multiple cables.

Provide non-ferrous metal glanding plates for single core cable terminations.

5. CONDUIT

5.1. STANDARDS

Provide conduit and cable trunking in accordance with the relevant British Standards and in particular the requirements of BS 7671 Requirements for Electrical Installations (The IET Wiring Regulations).

5.2. CONDUIT SYSTEMS - NON-METALLIC FLEXIBLE

Provide conduit systems to BS EN 61386. Use conduit of each type from one manufacturer.

Material - Insulating, PVC.

Method of connection - Threadable or non-threadable.

Suitability for bending - Flexible, BS EN 61386-23.

5.3. CONDENSATION PREVENTION

Install conduit and trunking systems to ensure internal condensation does not affect operation of associated circuits. Provide drainage points in accordance with BS 7671.

Where conduit passes through external wall between two areas of different ambient temperatures or in other locations likely to cause condensation, install a conduit or adaptable box. After wiring fill box with inert, permanently plastic compound with high insulation value.

5.4. EQUIPMENT CONNECTIONS:

Where surface mounted equipment is installed in conjunction with concealed conduit work, terminate concealed conduit at flush mounted conduit or adaptable box. Drill back of equipment, bush for back entry and mount equipment to conceal back box.

Connect to fixed equipment via conduit box located adjacent to termination point, using either solid or flexible conduit as indicated for final connection to equipment terminations.

Use conduit box as cable change point to facilitate changed wiring locally to adjacent equipment.

Connect trunking to equipment by specially fabricated connectors or by couplers and externally screwed brass bushes.

5.5. CLEANING BEFORE WIRING:

Clean inside of conduits and trunking with swabs immediately before wiring.

Inspect all components and remove any foreign matter, fit temporary plugs to open ends of conduit and trunking to prevent ingress of water and solid material.

5.6. WIRING

Comply with BS 7671 when wiring installations.

Segregate circuits as indicated.

Ensure draw wires are left within empty conduits for use of specialist installers. Use draw wires comprising nylon tapes with fitted eyelets.

For concealed conduit ensure system is installed to enable re-wiring to be carried out from boxes for fittings or accessories only. Draw-in boxes will only be permitted with prior permission in writing.

Do not use tallow or any other substances to facilitate drawing-in of cables.

5.7. INSTALLATION OF CAST IN OR BURIED CONDUIT

Ensure cast-in conduits are firmly secured to reinforcing steelwork and that accessory and/or conduit boxes are secured so they do not move during subsequent building operations.

Ensure there is no blockage immediately shuttering is removed.

Check there is no mechanical damage to conduit in floor screed prior to screeding. Fix securely before screed is poured. Provide temporary protection to conduits until screeds are laid.

Ensure minimum amount of cross-overs occur dependent upon screed depth. Do not install draw boxes in floors.

Do not install conduits in screeds in areas indicated within site blinding in main structural slabs unless prior permission in writing is obtained.

5.8. UNDERGROUND INSTALLATION

Where buried below ground, use Class 4 conduit. Do not use any buried conduit boxes unless prior permission in writing has been obtained. Wrap conduit with PVC self-adhesive tape, half lapped. Extend taping 150 mm beyond point where conduit leaves ground. Install circular through conduit boxes at the end of the tape. Fill conduit boxes after cable installation with inert, permanently plastic compound with high insulation value, and wrap in PVC self-adhesive tape.

6. CABLES AND WIRING

6.1. CABLE MANUFACTURER

Use new cables, delivered to site with seals intact, manufactured not more than one year prior to delivery, labelled with manufacturer's name, size, description, BS number, classification, length, grade and date of manufacture.

6.2. STANDARD ORDINARY FLEXIBLE CORDS - MULTI COPPER CORES

Standard - BS 6500, Tables 12 and 13, and 16; BS 7919 Tables 10 and 14.

6.3. STANDARD POWER SUPPLY CABLES, COPPER CONDUCTORS, THERMOSETTING INSULATION, SHEATHED

Standard - BS 5467, Tables 4, 6, 8, and 10.

Mechanical protection - Unarmoured.

6.4. STANDARD POWER SUPPLY CABLES, COPPER CONDUCTORS, THERMOSETTING INSULATION, SHEATHED AND ARMoured:

Standard - BS 5467, Tables 4, 6, 8, and 12.

Mechanical protection - Armour.

6.5. STANDARD POWER SUPPLY CABLES, COPPER CONDUCTORS, PVC INSULATION, SHEATHED:

Standard - BS 6004, Tables 7 and 8.

Mechanical protection - Unarmoured.

6.6. CABLES GLANDS - UNARMoured CABLES, INDOORS:

Cable type:

- Flexible; wiring and power; control and auxiliary; and communications.
- Standard - BS EN 50262 non-metallic, cable retention, IP54; Type A1 as BS 6121-5 Annex A.
- Environment - Indoor.

6.7. CABLES GLANDS - UNARMoured CABLES, OUTDOORS:

Cable type:

- Flexible; wiring and power; control and auxiliary; and communications.
- Standard - BS EN 50262 non-metallic, cable retention, IP54; Type A2 as BS 6121-5 Annex A.
- Environment - Outdoor.

6.8. CABLES GLANDS - ARMoured CABLES, DRY INDOORS:

Cable type:

- Wiring and power; and control and auxiliary.
- Standard - BS EN 50262 metallic, cable retention Class A, protective connection to earth, IP54. Type B as BS 6121-5 Annex A.
- Environment - Dry indoors.

6.9. CABLE GLANDS - ARMoured CABLES, INDOORS:

Cable type:

- Wiring and power; and control and auxiliary.
- Standard - BS EN 50262 metallic, cable retention Class A, protective connection to earth, IP54. Type B as BS 6121-5 Annex A.
- Environment - Indoor.

6.10. CABLE GLANDS - ARMoured CABLES, OUTDOORS:

Cable type:

- Wiring and power; and control and auxiliary.
- Standard - BS EN 50262 metallic, cable retention Class A, protective connection to earth, IP54 with shroud. Type C as BS 6121-5 Annex A.
- Environment - Outdoor.

6.11. CABLE INSTALLATION - GENERAL:

Use and install cables only as directed in the appropriate standard or as directed by the manufacturer in writing. Lay cables in one length unless otherwise indicated. Obtain permission from supervising officer for all through joints, and where overall length requirement exceeds practical drum size.

Handle, install and dispose of cables on wooden drums in accordance with BS 8512.

Install cables when ambient temperature is 5°C or greater, using cables stored at or above this temperature for not less than 24 hours.

Use drum stands, drum axles, fair leads, rollers, cable stockings and other equipment as recommended by the cable manufacturer and as appropriate to the method of installation.

6.12. CABLE INSTALLATION IN TRENCHES:

Lay cables on newly prepared bedding. Ensure multiple layers of cable are separated vertically by a 50mm layer of hard rammed bedding material.

When using a power winch ensure tension on the cable is taken by element of the cable designed for that purpose, that is armour or conductor cores as appropriate and not plastic sheath, metal sheath or core insulation.

When hand pulling cable ensure no kinks are formed and that flaking, when used, is done in the correct direction.

Do not allow cable to twist during installation. Use swivels to connect pulling bond to cable stocking or equivalent fitting.

Check drum is suitable for jacking before commencing installation. If drum or reel is unsuitable for jacking, flake cable in correct direction in maximum size turns from drum or reel before commencing installation. Use skilled labour to supervise all unreeling, flaking or running of cable from a drum.

Lay cables in the formation shown, ensure spacing is not reduced below that indicated. Bind trefoil groups at 1m intervals. Bind any associated earth or protective conductor to its cable or trefoil group at 1m intervals.

Space multiple cables in trenches in accordance with BS 7671.

Ensure installation radii and permanent bending radii are not less than those recommended by the manufacturer.

Do not lay cables to BS 6007, BS 6500, BS 7211 or BS 7919 direct in the ground.

6.13. CABLE INSTALLATION - FLEXIBLE CORDS:

Grip cords securely at connections. Where they do not form an integral part of the connected accessory or equipment, provide separate proprietary cord grips.

7. SOLAR PV EQUIPMENT

7.1. PV MODULE

The Photovoltaic (PV) module should have crystalline silicon solar cells and should have a certificate of test conforming to IEC 61215 Edition II from an IECQ accredited Laboratory.

The power output of the module(s) under standard testing conditions (STC) should be determined by the supplier at a load voltage of $16.4 \pm 0.2V$. The open circuit voltage of the PV modules under STC should be at least 21 Volts. The module efficiency should not be less than 12%.

The power tolerance level should be $0/+3\%$ and the operating PV temperature ranges between $-10^{\circ}C$ to $+85^{\circ}C$.

The module temperature sensitivity of peak power should not exceed $0.45\%/^{\circ}C$. The module weight should not exceed 25 kg.

The PV module frame should be made from anodized aluminium alloy. Solar module's glass shall have a high transmittance tempered glass.

Electrical connection shall be on a robust terminal bloc in an IP65 junction box or higher. The terminal box on the module should have a provision for opening, for replacing the cable, if required.

The PV Module design & type should comply with qualification standard IEC/EN 61215 in the case of Crystalline types. The PV Module safety qualification standard is IEC/EN 61730. Modules should also carry a CE mark.

All d.c. component ratings (cables, isolators/disconnectors, switches, connectors, etc) of the system must be derived from the maximum voltage and current of the PV array. This must take into account system voltage/currents of the series/parallel connected modules making up the array. It must also take into account the maximum output of the individual modules.

Specific calculations of worst case open-circuit voltage V_{oc} and the short circuit current I_{sc} , calculated from manufacturer's data for a temperature range of $-15^{\circ}C$ to $80^{\circ}C$ and irradiance up to $1250 W/m^2$ in line with British Energy Networks Association (ENA) engineering recommendations G83/1.

Each PV module must have a RF identification tag (RFID) which must contain the following information:

- a) Name of the Manufacturer of PV module
- b) Model or type number
- c) Unique serial number
- d) Year of manufacture
- e) Peak wattage of the module

A distinctive serial number starting with NSM must be engraved on the frame of the module.

The module should be guaranteed for 10 years at 90% of rated power output and 25 years at 80% of rated output power. The annual output power depreciation should be less than 0.8 %.

7.2. BATTERY

Maintenance free battery of Gel or VRLA type to be provided.

The battery bank size per solar power lighting system is 960 Ah for a 160W LED light.

75% of the rated capacity of the battery should be fully charged and load cut off conditions.

Battery should confirm to BS EN 50272-1:2010. The battery should be fixed above ground level mounted on the lighting pole.

The charge controller must carry a CE Mark. A means of manual isolation must be provided between the charge controller and the battery, either combined with the over current device or as a separate unit. The isolator must be double pole, d.c. rated and load break, and the length of the cable between it and the battery must be as short as practicable.

Battery gases are corrosive, so cables and other items inside a battery enclosure need to be corrosion resistant. Sensitive electronic devices should not be mounted in, or above, a battery box.

Battery banks, if applicable, must be housed in such a way that (BS 6133) access can be restricted to authorised personnel, adequate containment is assured and appropriate temperature control can be maintained. Adequate ventilation to be provided.

The batteries shall be housed in a battery box which is IP66, UV resistant and suitable for the environment in Mauritius.

7.3. INVERTER

The inverter should be of quasi sine wave/ sine wave type, with frequency in the range of 20 - 30 KHz. Half-wave operation is not acceptable.

The total electronic efficiency should be not less than 85 %.

The idle current consumption should not be more than 10 mA.

The PV module itself should be used to sense the ambient light level for switching ON and OFF the lamp.

The Inverter shall be provided with integrated fuses and AC & DC switches. The Inverter shall have the following protections: reverse current, input over voltage & over current via fuses.

The AC power of the inverter must synchronize automatically with the AC voltage and frequency of the grid (Single phase depending on each PV system requirements) within

the tolerance range specified according to the British Energy Networks Association (ENA) engineering recommendations (G59/2 or G83/1) depending on inverter's maximum rated current (less or greater than 16A per phase). The Inverter should be designed to operate the PV array near its Maximum Power Point (MPP).

The inverter must be treated as standard electrical apparatus and earthed as per BS 7671 if Class 1.

The temperature operating range should be -20 °C to 60 °C.

Inverters dissipate heat and should be provided with sufficient ventilation. Clearance distances as specified by the manufacturer (e.g to a heatsink) should also be observed.

Harmonic distortion to be less than 3%.

Protection degree is IP65 or higher (outdoor). Inverter to be CE compliant.

Warranty after installation should be at least 5 years.

Inverters must carry a Type Test certificate to the requirements of Engineering Recommendation G83/1 or comply with all other parts of ER G83/1 unless specifically agreed by the engineer.

8. LED LUMINAIRES AND LAMPS

8.1. GENERAL

The luminaires and lamps supplied under this contract shall be the latest series / model available from the manufacturer and shall have passed all the tests specified in this document. The luminaires shall be designed to operate continuously at 35°C and in a marine environment with occasional very high wind speed. The manufacturers shall guarantee adherence to this Specification and the performance of their luminaire under all the required design conditions. Independent test reports should be provided to show the luminaires will operate under these conditions.

Streetlighting luminaires should be IP66 or better. Luminaires should be supplied with a 2m flexible flying lead when mounted on a CEB pole or 8 m lead when fixed on columns. Luminaires will be Class 1 and 230V unless otherwise specified.

The luminaire housing shall be slim with low profile and shall be of either extruded aluminium or die cast aluminium and high corrosive resistance. Luminaire components to be tested in accordance with the requirements of BSEN 60598 or similar International equivalent standard. The finish coating for housing shall be with an anti-corrosive anodized/painting process or equivalent, providing excellent UV and environmental exposure resistance to fading, peeling cracking or corrosion. The driver(s) shall be integral to the fixture head, encapsulated/potted and protected in a waterproof (IP) environment, enabling access to the driver(s) for easy maintenance requirements. The driver compartment should be separate from the optical compartment housing the LEDs. The fixtures shall be CE or UL certified, or comply with equivalent international standards with all certification made available.

The luminaire bracket will have an adjustable tilt so that the luminaire itself can be tilted to compensate for the arm tilt angle to achieve a better light uniformity. This will apply for retrofit projects.

8.2. CONSTRUCTION

Within the Luminaire:

The light source shall be high brightness white Light emitting Diodes (LEDs) with individual minimum efficacy of at least **100 lm/W** arranged modularly to provide the required lighting output.

The LEDs shall be from a reputed manufacturer of LEDs with proven past experience in the manufacture of LED for at least 10 past years. The CRI shall be greater than 70. The LEDs shall be removable/replaceable on site by modular means without any possible risk to affect the luminaire photometry and without the need to demount the fixtures.

Whole Luminaire Efficacy (Systems efficiency)

The optimum efficiency of the luminaire shall be confirmed as follows: Minimum luminaire efficacy shall be 90 lm/W (@min 35 °C, min95%RH)

This is given as total luminaire design lumen output (lm) over total luminaire circuit Watts (W) at minimum 35-degrees Centigrade outside ambient temperature and minimum 95% relative humidity.

8.3. OPTICAL CONTROL

The luminaire shall be fitted with optical refractors, diffusers and/or reflectors. Different optics shall be proposed to exactly suit the specific applications. Independent laboratory photometric test reports shall be submitted for the luminaire photometric files used in the lighting calculations. The testing should conform to IESNA LM-79-08 standards. Dialux photometric digital data files shall be considered acceptable and shall not need any independent laboratory test.

8.4. THERMAL MANAGEMENT

The LED modules shall be mounted on heavy duty heat sinks to ensure proper heat dissipation and to ensure that luminaires to work efficiently in Mauritian climatic conditions. The luminaire shall be provided with a ventilation arrangement allowing heat to be dissipated to the atmosphere.

The design shall be such that the luminaire shall be self-cleaning in normal operation. The luminaire shall be provided with a heavy-duty rugged cast aluminium adjustable slip fitter mountable to suit the proposed pole. The Contractor shall coordinate with the LED fitting manufacturer and pole manufacturer to make sure complete compatibility of the products. The fixing should ensure that the luminaire/outreach arm is suitable for the high wind speeds expected and will not move from its designed position or become disconnected.

8.5. BOWLS

Bowls/protectors shall be vandal resistant and stabilised to minimise loss of transparency due to weathering and exposure to ultra violet light. All luminaires shall be fitted with bowls of sound and robust construction capable of being easily removed for maintenance or repair purposes and easily closed to maintain its IP 66 rating and integrity. The lamps, reflectors, refractors and bowl shall be clean and free from dirt and stains after installation and the lamp shall be correctly positioned within the lantern. The bowl or other component giving access to the interior of the lantern shall, when in the open position, be attached in such a way that it will not accidentally fall off the luminaire. All hinges, toggle catches, captive screws and nuts shall be made of non-corrosive material.

8.5.1. Fixture Technical Data –

The following information will be provided for each of the type of LED luminaire being proposed:

- Physical description of lighting fixture with dimensions.
- Details of the driver(s) including, manufacturer, driver efficiency, catalogue code, certifications and input watts.
- Luminaire photometric reports per IESNA LM-79-08, or similar International approved equivalent; including, laboratory name, report number, date, luminaire catalogue number, luminaire, and light source specifications.
- Photometry table of zonal lumen output in 10o vertical increments showing both the lumen value and the percentage of total out per 100 increments. Provide photometric files in IES or EULUMDAT format, for example IES, LDT or ULD files.
- Confirm a minimum of 6,000 hours of continuous operation of the LEDs at three different temperatures per LM-80-08, or similar International approved equivalent.
- Documentation of the expected useful life including the testing and calculation of useful life and verification of site lighting performance at that life. If the site defined performance methods are used, the interpolation between the three sets of LM-80 data, and all calculations applied in deriving the proposed LLD and useful life shall be provided.

8.5.2. LED modules

Within the fixture the LED modules shall meet the following requirements:

- Operating temperature rating shall be between 0°C and minimum +50°C at a minimum 95% Relative Humidity (RH).
- Storage (i.e. non-operating/daytime) temperature: all LED components to be designed to tolerate between - 40°C and minimum +80°C at a minimum 95% Relative Humidity (RH).
- Correlated colour temperature (CCT): 3000K- 5000K

- Colour rendering index (CRI): > 70
- Comply with IES LM 80, IES TM 28 and IES TM 21 or equivalent standards.
- Luminaire manufacturer shall submit reliability reports indicating that the manufacturer of the LED (chip, diode, or package) has performed Joint Electron Devices Engineering Council (JEDEC), or similar International approved equivalent; reliability tests on the LEDs. Factory pre-release test reports shall be provided from the LED manufacturer duly complying with JEDEC JESD22-A108C, or equivalent, for operating life tests at 85° C Ambient temperatures and also for humidity and salt atmosphere corrosion tests. Standards and tests used must be stated.

8.5.3. LED Drivers Technical Requirements

Within the fixture the LED driver(s) shall meet the following requirements:

Drivers shall be dimmable unless specified otherwise and have a minimum efficiency of 85%. When dimmed, Power Factor should be > 0.7 over complete range.

Case (Tc°C) temperature rating -40°C to minimum +80°C and at a minimum 95% Relative Humidity (RH). Driver/Fixture to have some means of built-in overheat thermal protection in the form of automatic dimming or stepping/holding down of the driver where temperature exceeds operational limits. Thermal cut-out devices which turn the fixture LEDs completely off are not acceptable.

The driver and driver output current must be shown to be fully tested and compatible with the exact LED chips of the luminaire. All information provided and the cost analysis/payback calculations, if needed, should be calculated with the exact drive current including the calculation for the life cycle, life and resultant increase or decrease of the energy consumption if applicable.

Input voltage; capable of 230V ±10% volt, single phase or as required by the site. Power supplies can be UL Class 1 or II output or similar European CE or International equivalent.

Surge protection: Must be tested in accordance to the requirements of IEEE/ANSI C62.41.2-2002, Scenario I Location Category C or International equivalent.

Drivers shall have a Power Factor (PF) of more than 0.90.

Drivers shall have a total individual luminaire Harmonic Distortion (THD) of: < 20% in accordance with ANSI C82.77 (2002)

Driver shall have an in-built protection against overload and surges up to 6kV.

Drivers shall have a lifetime of at least 50,000 h.

8.5.4. Luminaire Requirements

The dedicated luminaire expected useful life (light output) and depreciation requirements shall be as follows:

8.5.4.1. Useful Life:

The useful life of the luminaire in terms of lumen output must be as per LM-79-08 or approved International equivalent.

8.5.5. Project Performance Requirement

Lamp Maintenance Factor (MF)

$MF = LLMF \times LSF \times LMF$ (Lamp Lumen Maintenance Factor x Lamp Survival Factor x Luminaire Maintenance Factor)

- Assume LLMF is 0.70 for LED luminaires except where recommended otherwise by the luminaire manufacturer.
- The LSF should be obtained from the manufacturer and shall not be less than 0.9
- Refer to Table B.1 of BS 5489 for LMF

8.5.6. Photobiological Safety

Ensure luminaire complies with Photobiological Safety of lamps and lamp systems in accordance with the requirements of BS EN 62471:2008 or ANSI/IESNA RP-27.3-0. Provide proof of testing and compliance with the standards with certification provided to prove the fixture is classed as "Exempt"

8.5.7. Lighting Calculations

The following performance reports of the lighting installation shall be submitted for approval along with the material submittal:

- Computer generated photometric analysis report which will include:
 - Point by point light levels over a matrix between two poles. Spacing between calculations points shall be as per IESNA, EN 13201 and BS EN 5489 standards or equivalent European or International Standards.
 - Maximum, minimum and average illuminance on the road surface.

These reports shall be submitted for two scenarios:

- The initial light level, that is at start of the project.
- The end of life stage- This calculation will show the minimum Maintained illuminance/luminance values. At this point, the lamps or LEDs should be replaced and the luminaires cleaned/replaced.

The contractor / Supplier / Manufacturer shall use an accredited and recognised software for such calculations. In case of any dispute over the type of software to be used, Dialux shall be considered as an acceptable and final software for such calculations. Where proprietary software is used, (software from manufacturer) the results shall be checked and validated by an independent third party software calculations like Dialux.

8.5.8. Quality Assurance

The client may request a standard production model luminaire sample, identical (including LED Package) to the proposed product, to be installed for inspection. The Client may also request independent testing of sample luminaires to verify luminaire performance and compliance with the specifications. Testing shall be conducted as per the applicable IESNA, ANSI or approved International equivalent approved methods of products using Solid Stage Lighting (SSL) sources. The Client shall be sole judge regarding acceptability of optical system performance. All testing certificates shall be from a Laboratory certified/approved by UKAS or UL or the Government of Mauritius, or has ISO 17025 or equivalent certification.

8.5.9. LED Luminaire Warranty

The Supplier/Contractor shall provide a Warranty from the Luminaire Supplier / manufacturer as follows:

- A written warranty for a minimum five-year on-site replacement material, fixture, finishes and workmanship. On-site replacement shall include transport, removal of defective and installation of the new product. Body and finish warranty shall include warranty against failure or substantial deteriorations such as corrosion, blistering, cracking, peeling, chalking or fading, at no cost to the client.
- A written warranty for a minimum five years' replacement material warranty for defective or non-starting LED source assemblies at no cost to the Client.
- A written warranty for a minimum five years' replacement material warranty on all supplied drivers, power supply units and in-built control components at no cost to the client.
- A written warranty for a minimum five years' replacement material warranty for maintained luminance and illuminance levels on all light sources (LED package, LED array, or LED module) including, but not limited to the LED die, encapsulate, and phosphor. The manufacturer/ supplier/ contractor shall replace the light source(s) or luminaire as needed at no cost to the Client if the expected useful life of the luminaire system is not maintained as per specifications. The supplier must provide data showing the expected light loss from the LEDs to the time at which the LEDs should be replaced.
- A written warranty for a minimum ten years against the deterioration of the housing, all external components; such as lenses, gaskets & fastenings, and the fixture finishes including, but not limited to, corrosion, yellowing, blistering, chalking, cracking, peeling or fading at no cost to the Client.
- A written warranty for a minimum five years' replacement for non-starting SHP lamps (where the lamp can be demonstrated to be functional) at no cost to the Client.
- A written warranty for a minimum five years' replacement material warranty on all ballasts, power supply units and in-built control components at no cost to the client.
- A written warranty for a minimum five years' replacement for maintained luminance and illuminance levels as needed at no cost to the Client, provided that the luminaire system has been maintained as per specifications. The supplier must

provide data showing the expected light loss from the SHP lamp at the time of failure.

- A written warranty for a minimum 10 years against the deterioration of the housing, all external components; such as lenses, gaskets & fastenings, and the fixture finishes including, but not limited to, corrosion, yellowing, blistering, chalking, cracking, peeling or fading at no cost to the Client.

9. POLES

9.1. GENERAL

Pole shall be of a type and shape that can accommodate the luminaires proposed and at the height being installed. The final shape of the pole shall be discussed with and approved by the client before ordering.

Poles and foundations should be designed for the expected wind speed of 300 km/h bearing in mind the wind area of the luminaire, weight and wind area of PV panels and weight and wind area of batteries at top of the pole. i.e. they should be designed as a complete system.

9.2. MATERIALS

9.2.1. Foundations.

Structural analysis / calculations shall be submitted to show that the foundation design meets the load of the given pole type with the proposed luminaire. The pole and foundation design shall be undertaken by a Registered Civil / Structural Engineer in Mauritius and who shall be approved by the Road Development Authority.

9.2.2. Access door

Each pole shall have two one service hatches approximately, 2m from ground level where the connection of cables can be made between the outside network and the pole accessories. The cover shall be fixed by two star screws. The access door cover shall fixed with hinges made of corrosion resistant materials such as stainless steel grade 316(A4), brass, hot-dip galvanized steel, etc. as applicable based on the pole and cover plate material and shall not be easily openable with normal screwdrivers or tools. The access doors should be earthed with a separate cable and not simply earthed via the fixing screw.

9.2.3. Electric conduits.

Electric conduits shall be installed through foundation and shall enter the poles from base plate.

9.2.4. Steel work.

Poles' steel work shall be manufactured out of BS grade S355 steel for 10-14m poles or as appropriate to a pole of lower height. All components of the pole are required to be hot dip galvanised to BS 729 with minimum thickness coating of 100 µm. Where steelwork is in contact with aluminium work, the manufacturer shall ensure that bi-metallic corrosion is prevented by means approved method.

The pole will be fixed in a concrete base to be designed by a registered professional civil/ structural engineer in Mauritius and who shall be approved by the RDA. The sizing of the concrete bases and stub columns fixed in position must withstand wind speed of 300km/h.

Anchor bolts, nuts, pole structure will be done accordingly to requirements of BS 729.

Aluminium work. (used in public areas like gardens and parks)

Poles in aluminium shall be made up of extruded aluminium alloy which shall have an anodized protective coating finish to 25 microns. The colour of the anodized finish shall be as approved by the Client. The transition rim shall be of cast aluminium alloy of grade LM6 having a minimum 100 microns of polyester powder coating, matching the approved colour of the anodized extruded aluminium.

Bracketry.

Pole brackets shall be manufactured out of BS grade S275 Steel. This shall have high strength, be easily machinable able to handle an array of finishes. All steel components shall be hot-dip galvanized to a minimum thickness of 100 microns.

Fasteners.

All fasteners supplied shall be made of corrosion resistant materials such as stainless steel; - Grade 316, brass, hot-dip galvanized steel etc., based on the materials with which it will be in contact. Bi-metallic contact shall be properly designed to avoid any galvanic or bimetallic corrosion.

Earthing and bonding

M12 x40 mm long threaded stud carrying two nuts and two washers shall be provided as an earth bonding point. It shall be located in the electric compartment.

Pole Identification Tag.

The name of the lighting column manufacturer and the date of manufacture shall be clearly marked using an aluminium name tag affixed to the column in an appropriate location and manner to suit the column design and access. The pole shall also carry a unique identification tag which will provide information on its location, height, jurisdiction (which municipality or district council), date installed, a phone number for fault reporting etc. The full list of information to be provided in this tagging will be supplied by the client. This tagging could be in a form of bar code. The tag will be riveted or welded to the pole and shall be highly resistant to weather conditions. It shall be fixed at 2m above the ground.

9.2.5. Assembly

The pole shall be complete with all accessories and all necessary component. The final assembly of pole and components shall be ready for installation at site without any works required other than using suitable fixing tools.

9.2.6. Mast arm for the Luminaires.

The mast arm for the luminaire (if used) shall be fitted on site to the pole. The attachment of the mast arms shall be made of standard fasteners through the

structural casting. The mast arm shall be self-supporting against all forces including uplift.

Note that the use of mast arms is to be minimised. The preferred solution is to mount the luminaire directly to the column.

9.2.7. Additional Assembly

Provisions shall be made on the pole for enabling the fixing of other accessories such as street signs, CCTV cameras or traffic signal lights by others after the installation of poles. These provisions shall allow for future additional accessories to be added without having to remove the existing installed accessories, luminaire brackets or the like. The provisions shall be such as to ensure the clean, aesthetic look is maintained and shall allow for complete dismantling, when not in use, without leaving behind any clamps, lugs, etc...

9.3. DESIGN SUBMISSION AND PRODUCTION

All design shall be undertaken by a Registered Civil / Structural Engineer registered in Mauritius and who shall be approved by the RDA.

a) Strength.

The poles shall be capable of withstanding a basic wind speed of 83.3 m/s or 300 km/hr when equipped with the actual number of lanterns and the associated fittings or accessories as confirmed by the Client. Design calculations shall be submitted to the Client for approval, showing the following: -

Wind load derivation on luminaires and mounted accessories

Wind loading derivation on the pole

Sectional area of the pole at regular intervals of height along the pole, especially at areas of cross-section change and hand hole opening

Stress at the intervals specified in (iii) above

Strength of the pole at the intervals specified in (iii) above

Combined Stress Ratios at the intervals specified in (iii) above

b) Deflection.

Actual deflection against the deflection limit of the poles shall be clearly stated in the design calculations and shall conform to AASTHO. The actual deflection calculated shall be based on the basic wind speed of 45m/s and shall be measured at the lantern position. The calculated deflection shall be the sum of deflection on the vertical pole section as well as the outreach bracket arm section. Deflection of both the vertical pole and the arm shall be shown in the design submission.

Design calculations shall show the pole deflection and shall be checked against the allowable deflection and special deflection limits required for high definition cameras or traffic signal poles, where applicable.

9.4. QUALITY ASSURANCE

The client may request standard production model samples, identical to the proposed, product to be installed. The client may request independent testing of the sample poles to verify the performance and compliance with the specifications. The client shall be the sole judge regarding the acceptability of the performance of the light poles. According to the requirements of the Project's Contract documents, if required the client reserves the right to attend, or appoint a third party to attend, a factory inspection. During a factory inspection, the manufacturer shall perform a full deflection test, as agreed jointly with an accredited independent test house and the client, on a randomly selected pole from the manufactured lot, for each type of ordered pole, to establish the design compliance and structural integrity of the manufactured pole under simulated conditions of full loading, strictly in accordance with the approved design calculations and drawings. Different options of the base or lower cladding unit are shown on the drawings. The client will choose one option during the material review process and the sample shall be submitted accordingly.

9.5. WARRANTY

The Supplier /Contractor shall provide a Warranty to the satisfaction of either the relevant Client, on the materials and performance, as follows:

- Provide a written ten-year on-site replacement material, galvanising and workmanship. On-site replacement included transportation, removal and installation of new pole.
- Provide a written ten (10) year replacement warranty for defective poles at no cost to the Client.

10. CONNECTIONS TO LUMINAIRES

10.1. CABLE PROTECTION

Use appropriate size of grommet where cables enter through hole in luminaire body. Generally, luminaires will be supplied with a 2m flying lead.

10.2. EARTHING

Ensure that the earthing terminal of Class 1 luminaires is connected to the conduit protective conductor of the supply circuit.

Loose Wiring- Clip or tie back with suitable proprietary devices loose wiring within luminaire, at 300mm intervals.

11. EARTHING AND BONDING

11.1. MATERIALS GENERALLY:

Use materials and installations methods in accordance with BS EN 62305, BS 7671, BS 7430, Electricity Safety, Quality and Continuity Regulations and Local Electricity Supply Authority Requirements as appropriate.

11.2. CONDUCTORS TO EARTHING SYSTEMS TO BS 7430:

Use - Earthing conductor.

Minimum dimension - BS 7430, current density 50A/mm².

Form - Strip.

Material - Copper, annealed.

Coverings - None.

Accessories - Conductor clips, metallic.

11.3. ROD EARTH ELECTRODES FOR SYSTEM EARTHING:

Standard - BS 7430.

Form - rod with female thread each end.

Dimensions:

- Rod Diameter - 15 mm - nominal.
- Rod Length - 2.4m (2 x 1.2) minimum.

Earth electrode couplings:

- Use high strength driving cap in contact with driven rod and couplings of compatible material fully enclosing the rod threads.

Earth electrodes in drawpits:

- Provide concrete cover, permanently labelled, for electrodes installed through cable drawpit bases.

Main earth conductor connection:

- Connect main earth conductor to first electrode using heavy duty purpose made silicon aluminium bronze body conductor clamp and high tensile phosphor bronze bolt.
- Material, minimum size as BS 7430 Table 4 - Copper.

11.4. EARTH ELECTRODE INSPECTION FACILITIES:

Provide enclosure for each connection between earth conductor and associated earth electrode system. Install so that top is flush with finished ground or floor level. Ensure enclosure provides adequate access for testing purposes. Provide pit details for builder's work.

11.5. MAIN EQUIPOTENTIAL BONDS:

Provide main equipotential bonds in accordance with BS 7671 in all columns.

- Material - Insulated cable, single core to BS 6004.
- Use no joints in main equipotential bonds.

11.6. SUPPLEMENTARY EQUIPOTENTIAL BONDS:

Provide supplementary equipotential bonds to BS 7430, BS 7671 and BS EN 50310.

Do not use joints in supplementing bonds.

- Material - Insulated cable, single core to BS 6004.

11.7. CIRCUIT PROTECTIVE CONDUCTORS:

Material:

- Insulated cable, single core to BS 6004 of minimum cross section area 6mm² where cable size exceeds 6 mm²
- Same size as live conductor when supply cable is less than 6 mm².

11.8. EARTHING CLAMPS:

Use clamps complying with BS 951, for bonding pipes and earthing of conductors.

11.9. EARTH BUSBARS:

Material:

- Manufacture earth busbars from hard drawn, tinned, high conductivity copper bar.

Substation Earth busbar:

- 75 x 13mm cross section 600mm minimum length.

Main Earth Terminal busbar:

- 25 x 6 mm minimum for incoming live conductor not exceeding 50mm and 50 x 6 mm minimum for incoming live conductor over 50mm².

11.10. TEST LINKS:

Provide two test links, in connections between main earth conductors and earth busbar. Fabricate each from two additional sections of earth busbar. Mount one section on stand-off insulators matching earth busbar; use remaining section as removable test link. Secure 12mm high tensile brass studs to fixed sections of busbar and drill corresponding clearance holes in test links and provide brass washers, nuts and locking devices to secure frame/neutral earthing and test links.

11.11. PROTECTIVE CONDUCTOR WARNING NOTICES/LABELS:

Provide a permanent label durably marked in letters 4.75mm minimum height "SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE", in visible position, at each bonding conductor connection to extraneous conductive parts.

11.12. MAIN EARTH CONDUCTOR - WARNING TAPES:

Provide green/yellow PVC tapes labelled "EARTHING CONDUCTOR" over complete external lengths of main earth conductors at 300mm depth below finished ground.

11.13. EARTH BAR LABEL:

Label earth bar "SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE" with wall mounted laminated plastic tablet engraved in 10mm high red letters on white ground.

11.14. DISSIMILAR METALS:

Ensure, where dissimilar metals are used for system, that purpose made jointing materials are used such that corrosion and deterioration of the electrical connection are not caused. Ensure bonding connections to other metal parts of building are electrolytically compatible with those metal parts. Use the guidance given in BS 7430 Table 8 when bonding dissimilar materials.

11.15. COPPER TAPE JOINTS:

Provide waterproof protection at joints subject to moisture.

Joint copper tapes by brazing, using zinc-free brazing metal with melting point at least 600oC or thermic welding.

11.16. INSTALLATION OF EARTHING SYSTEM:

Carry out installation of earthing system in accordance with BS 7671 (IET Wiring Regulations 17th Edition) and BS 7430. Secure bare copper tape to structure with fixing devices which avoid piercing tape and ensure 3mm (minimum) clearance of tape from structure, at 450mm maximum centres.

Locate electrodes not less than 2m distant from structure and away from all cables and metallic fences. Drive rods vertically and locate electrode heads just below ground level. Install interconnecting tape 750mm below finished ground level, rising vertically at each electrode.

Ensure where electrodes are installed in a group, minimum distance between electrodes is twice depth of rods.

Provide earth bar at incoming electrical service position. Mount on insulated supports. Drill holes, one for each cable plus 30% spare holes (two minimum) at 50 mm minimum centres through bar for connection of cable lugs. Ensure holes are minimum size to maintain adequate contact.

Connect main earth conductors and main equipotential bonding conductors to earth bar.

Terminate protective conductors on switchboard earthing bar. Extend protective conductor from incoming main cable gland direct to earth bar.

Extend separate protective conductor from earth bar to switchpanel served by incoming main cable.

Extend when main cable is provided by CEB, separate protective conductor from main cable armouring to earth bar.

12. TESTING AND COMMISSIONING OF ELECTRICAL SERVICES

12.1. INCORPORATED EQUIPMENT CHARACTERISTICS:

Obtain and use information from manufacturers of equipment provided.

Use information provided, for equipment supplied by others and incorporated into installation.

12.2. PROSPECTIVE SHORT CIRCUIT CURRENT:

Determine values of IP by measurement, unless other means are indicated. Determine IP at all necessary points within installation to confirm correct equipment selections.

Obtain from supply undertaker written confirmation of maximum and minimum values of IP at origin of installation. Adjust subsequent measured values of IP accordingly.

12.3. INITIAL VERIFICATION:

Carry out detailed inspection to verify the requirements of BS 767.

12.4. TEST EQUIPMENT AND CONSUMABLES:

Provide test equipment and consumables to complete tests satisfactorily and to retest any failed installations following corrective measures.

Test equipment quality assurance requirements to BS EN ISO 10012.

12.5. TESTING

Carry out in the same order as published the tests required by BS 7671, Section 612 for New Installation or Altered or Added Installation as appropriate.

12.6. EARTH FAULT LOOP IMPEDANCE:

Use 25 A test current. Measure and record source impedance (Z_E).

If alternative LV supply arrangements are available, measure Z_S when using supply with highest impedance.

Measure Z_S with main equipotential bonding conductors connected. Do not summate values of several parts of each loop.

12.7. SETTINGS AND ADJUSTMENTS:

Confirm characteristics and settings of protective devices are within maximum and minimum specified tripping times. Check correct operation of devices. Confirm interlocks and sequences operate safely and as indicated.

12.8. CERTIFICATION AND REPORTING:

Complete and hand over to the Client a Completion and Inspection Certificate to BS 7671 Appendix 6 for New Installation or Altered or Added Installation as appropriate.

12.9. INSTALLATION CERTIFICATES:

Provide installation certificates for electrical installations in accordance with BS 7671 (IET Regulations).

Record details of departures from BS 7671 (IET Wiring Regulations) on certificate.

Provide copies of calculations justifying departure from BS 7671 (IET Wiring Regulations) and attach to certificates.

12.10. RECORDS:

Record all results and instrument readings on approved Record Sheets and hand over to the client two copies for each inspection and test

12.11. CONDUCTIVE PARTS:

Test conductive parts simultaneously accessible with exposed conductive parts of extraneous conductive parts. Establish that they are either not an extraneous conductive part, or that they are reliably connected by metal to main equipotential bonding.

Confirm conductive parts which are not extraneous conductive parts are separated from earth by an impedance greater than 50,000 ohms. Confirm other conductive parts are bonded to equipotential zone earthbar by an impedance not exceeding 0.1 ohms.

12.12. LABELS AND NOTICES:

Apply identification labels and notices in accordance with BS 7671 (IET Wiring Regulations), section 514 to all electrical cables plant and equipment including components of mechanical systems.

Identification of protective devices.

- Diagrams, charts or tables to comply with Clauses 514.9 and 560.7.9.
- Warning notices, voltages in excess of 250 volts.
- Periodic inspection and test notices.
- Residual current device notices.
- Earth electrode safety electrical connection label.

- Bonding conductor connector point to extraneous conductive parts label.
- Earth free local equipotential bonding areas warning notice.
- Electrical separation areas warning notice.
- Outdoor equipment socket outlet notice.

12.13. MATERIALS:

Use materials for labels and notices with a predicted life equal to or greater than the design life of the electrical cables, plant, equipment or installation to which it refers.

External:

- Signwritten, or stencil in paint compatible with surface.
- Colour - Background, plant standard finish. Lettering, white.

Internal:

- Engraved thermosetting plastic laminate.
- Colour - Background, white or red. Lettering, red or white.

12.14. FIXING - INTERNAL:

Fix labels and notices using materials compatible with label or notice and surface to which it is fixed by screws into tapped hole or bolted complete with washer nut and locking device.

12.15. SAFETY SIGNS:

Label all electrical plant and equipment using safety sign 8.A.0044 of BS 5499-5 where voltages above ELV exist.

Provide supplementary or text signs complying with BS 5499-5 with each safety sign 8.A.0044 as indicated.

Label all electrical plant and equipment with the labels specified in the appropriate British Standards for that plant or equipment.

Identify each substation and main switchroom with safety sign 8.A.0044 to BS 5499-5 for any fire extinguishing system and notice giving details of:

- Name of the Substation or switchroom
- The presence of Medium and Low Voltages.
- Administrative instructions for access.
- Location and method of contacting controlling authority.
- Actions to be taken in an emergency.

12.16. MAINTENANCE NOTICES:

Fix notices giving warning of, and instructions on, any special maintenance procedures to plant and equipment.

12.17. SWITCHGEAR:

Fit labels on switchgear as required by BS EN 60439 to indicate duty of unit, its voltage, phase and current rating, protective device rating size of conductor involved, and all other necessary details.

Use an agreed serial coding system, provide at the switch a key to the coding system.

12.18. DISTRIBUTION BOARDS:

On each distribution board identify every outgoing way with a renewable circuit chart in a transparent plastic envelope permanently fitted inside distribution board cover. Clearly indicate in typed script, circuit identification number, cable size, fuse or circuit breaker rating and a description of item supplied and area supplied by circuit.

12.19. SCHEMATIC DIAGRAMS:

Provide a purpose made schematic diagram permanently fixed showing the connections of the equipment and plant.

Locations and materials as indicated in contract preliminaries.

12.20. CABLE IDENTIFICATION:

Provide all cables, other than final sub-circuit wiring enclosed in conduits or trunking, with labels fixed at each end of cable either side of wall and floor penetrations at approximately 12m intervals at convenient inspection points by means of non-releasable plastic straps, minimum width 4mm.

Ensure labels show the reference number of cable.

12.21. UNDERGROUND CABLE IDENTIFICATION:

Identify external underground cable routes by means of approved markers along their length at distances not exceeding 50m and where a change of direction occurs on such routes. Provide cables markers with a brass plate or impress concrete to clearly indicate the reference of group of cables or reference number of cable and operating voltage of cable. Provide key to any reference system used at switchgear. Mark and protect direct buried cables with plastic tape yellow printed black "DANGER ELECTRIC CABLES" elsewhere.

12.22. CABLE JOINTING AND TERMINATION:

Connect all cables in the installation so that the correct sequence of phase rotation is maintained throughout. Where straight through joints are approved joint medium voltage conductors as they lie, ensuring their complete length is phased out on completion.

Ensure connections at terminations of MV cables are made in the correct phase rotation and ensure cable conductor termination marking if any, complies with this phase sequence. Where straight through joints are approved on low voltage cables, whether power cables or control or auxiliary cables, joint conductors strictly in accordance with their colour or numeric coding. Where such joints are approved on mineral insulated or other non-coded conductor cables, identify each core at the joint and make the joint core to core.

13. PAINTING AND ANTI-CORROSION TREATMENTS

Corrosion treatment shall be mainly by hot dip galvanising. However, when this is not possible or practical, paint shall be used for corrosion prevention. This treatment against corrosion shall be first approved by the client.

13.1. PAINT MATERIALS:

Use the following materials as appropriate:

- Solvent borne priming paint to BS 7956 for bare woodwork.
- Red Oxide priming paint for bare iron and steelwork.
- Zinc Chromate priming paint for bare ferrous and non-ferrous metals.
- Calcium Plumbate priming paint to BS 3698 for galvanized steel or composite wood/metal components.
- Undercoating paint for previously primed or painted surfaces before the application of finishing coats.
- Gloss finishing paint for previously primed or painted/undercoated surfaces.
- Epoxy resin paint for specialist coatings requiring resistance to acids, alkalis, oils, solvents, abrasion or high humidity.
- Aluminium paint to BS 388 for structural steelwork, storage vessels, heated metallic surfaces and similar applications where moisture and heat resistant properties are required.
- Cold galvanizing paint for making good damage to previously galvanized surfaces and protection to galvanized materials modified during installation.
- Zinc-rich metallic to BS 4652 for bare iron and steelwork where electrical conductivity has to be assured.
- Black tar-based paint to BS 1070 for moisture resistant protection to metal surfaces where decorating appearance is not important.
- Bitumen based coatings for cold application to BS 3416 protection to iron and steel, particularly pipelines and fittings for use in contact with potable water.
- Bitumen based coatings for cold application to BS 6949 not to be used in contact with potable water.

13.2. PAINT QUALITY:

Ensure paints used are of quality and type to suit application and that: -

- primers have good adhesion, covering power, rust-inhibiting and grain filling properties.
- gloss finishing paints are of machine finish grade having high adhesion and high resistance to solvents, mineral oils, cutting oils, detergents, chipping and impact damage.

14. TESTING AND COMMISSIONING

14.1. HANDOVER

The contractor shall make arrangements to enable the Engineer or his representative to witness tests, or test and inspect at site or at the manufacturer's premises.

The Contractor shall appoint a registered Electrical Engineer, from the contractor's own staff or an independent company, (known as the Commissioning Engineer) who is fully conversant with the operation of the road lighting installations and competent to supervise the whole of these testing and commissioning procedures.

The Engineer and his representatives shall witness the proceedings, confirm the recorded results and determine whether the specified requirements have been met. The Engineer shall only witness final tests and commissioning procedures. Pre-tests and pre-commissioning procedures shall be undertaken by the Contractor under the supervision and control of his Electrical Engineer.

The Engineer shall be given adequate written notice of the date and place of each (or series of) test, inspection, commissioning or demonstration procedure.

All Testing instruments, meters and recorders shall be calibrated by an approved agency or the manufacturer before testing commence for this project. Any certificate issued 30 days prior to the date of commissioning shall not be considered and new certificates will have to be produced.

The Contractor shall provide within his price for all labour, materials including fuel and energy and apparatus required for carrying out the testing, commissioning.

All testing and commissioning shall be undertaken prior to handing over.

14.2. TESTING

The Contractor shall include the provision of a separate set of drawings and/or report sheets to be used to accurately record the following test and inspection information: -

- Plant, section and installation under test.
- Manufacturers reference number where applicable.
- Date, time, duration of test (and weather conditions if appropriate).
- Test results with itemised readings including records of all other checks and tests.

- The Contractor shall allow for the testing of all equipment, material and installations and if the first inspection or test fails, repetition of the procedure within a reasonable time, adhering to the time cycles and other requirements as specified for the first test.
- All tests shall be completed before any services are concealed.

The Engineer will: -

- Give forty-eight hours written notice of his intention to be represented at the test.
- If he decides after inspection or testing, that such plant or any part thereof is defective, or not conforming with the specification, reject such defective parts by written notice within a reasonable time, indicating the area of dispute.
- If he considers the tests are being unduly delayed, arrange for instructions to carry out the tests within 10 days.

14.3. COMMISSIONING

Commissioning shall be following satisfactory completion of the foregoing tests and when the installation is in a safe and satisfactory condition, include for setting it to work and regulation and adjustment as necessary to the design requirements.

Commissioning shall in general terms include the following procedures:

- Shall be setting to work all systems as specified and ensuring that the performance requirements have been achieved.
- Shall be balancing and regulating all systems to meet specified performance requirements.
- Shall be making final adjustments and before practical completion, demonstrating by commissioning procedures detailed elsewhere in this specification, that the provisions of the contract have been met in total by completing the previous testing and setting to work procedures and by showing that the completely integrated installation will function in accordance with the specified performance requirements.
- Shall include records of all test results on the sheets provided, completing all commissioning documents and at all stages ensuring that the Engineer has certified the documents and/or arranged for instructions for any remedial work.

14.4. COMMISSIONING PROCEDURES

The Contractor shall ensure that the following requirements are observed when, commissioning the engineering works: -

- Progressive static testing will be witnessed by the Engineer(s) when the work is presented as ready for testing. This will include Insulation Resistance Tests, Earth Continuity Tests, light level tests etc.

- The Contractor shall complete all pre-commissioning examination and testing to ensure that each system or item of equipment is complete, in a safe condition and all notices displayed before the Engineer (s) are convened for the final testing and commissioning. Completion for operational purposes implies the bulk of the snagging of work has been offered to the Site Engineer(s) and remedial work completed.
- Instructions to the user's staff to be completed by handover.

14.5. HANDOVER PROCEDURES

The contractor shall prepare the following mechanical or electrical documents to be available not less than one month before Practical Completion of any part of the Contract. It shall include for incorporating the following documents into one or more volumes of durable finish service manuals, with format and contents agreed with the Engineer. Three sets to be provided on completion.

- Index of contents
- Description of design assumptions
- Commissioning Documents and Reports
- Manufacturers operation/Service & maintenance manuals
- Manufacturers spares list & ordering procedure
- Operational & Maintenance routines, procedures for fault finding
- Line diagrams of plant control systems & descriptions of control operation incorporating all set points.
- Emergency call-out service - personnel & telephone contacts
- List of tools, keys & special requirements for handing over
- Guarantees, Test Certificates & Reports
- List of Record Drawings (drawings separately available)

The documents shall be provided in 3 hard copies and 3 sets of CD.

14.6. RECORD DRAWINGS

The Contractor shall modify the installation drawings as necessary to record the "as installed" changes which may have occurred and thus form the basis of the final "As Fitted" drawings.

The record drawings which shall be available not less than one month before practical completion of any part of the contract.

The record drawings shall indicate to a suitable scale agreed by the Engineer (which shall be in any case not less than the tender or installation drawings or 1:50) the layout, identity, size and position of all services installed together with valves, control items, plant, conduit routes, lighting fittings, switches, distribution boards etc. The drawings shall show the results of all commissioning tests. The size, type and length of each ELV,

LV and HV cable (to the nearest metre) shall also be given together with the measured earth fault loop impedance where applicable. All fuse or breaker current rating shall be shown as well as all trip settings.

Inter connections between items of equipment, including those provided by others and terminal numbering and cable core identification of all alarm and control circuits shall be given. The drawings shall be amplified with schedules and/or diagrammatic presentation.

Particular attention shall be paid to the location and depth of buried cables.

APPENDICES

APPENDIX A: Guidance on the use of the specifications elements for street and public area lighting

1. INTRODUCTION

This annexure provides guidance on the use of the specifications elements for street and public area lighting in Mauritius. This Appendix should not form part of the specifications issued in a tender document; it shall be only used to amend the specification's to suit the type of works being procured.

2. SCOPE OF THIS DOCUMENT

This specification document has been prepared to procure new street and public area lighting installation using three types of lamp technology:

- LED lighting
- Sodium High Pressure lamps
- Solar PV lighting

This document is meant for works on new roads or for new street lighting installations along existing roads. It is not to be used for the supply only of poles and luminaires; this is covered in separate documents.

3. ARRANGEMENT OF SECTIONS

3.1 NON-EDITABLE SECTIONS

The following sections have very limited scope for modifications and if strictly needed, should be edited by a competent person, namely an Electrical Engineer.

- Section 2
- Section 3
- Section 4
- Section 5
- Section 6
- Section 9
- Section 10
- Section 11
- Section 12
- Section 13.

These sections cover the general aspects of the installation which is not directly linked with the type of lamps being installed.

3.2 EDITABLE SECTIONS

The following section should be edited by the client, to suit the type of projects being procured:

- **Section 1-** This section can be modified to provide more description on the scope of works. The following further information can be provided under this section:
 - Name and description of the contract and the works
 - The works location
 - The extent of the works (length of road being constructed and the quantity of lighting to be installed)
 - The name of the client
 - Any other information of general nature

These modifications / editing would be applicable for example when a municipality (client) is procuring a new road lighting works along an existing road or independently from a new road construction, where the street lighting works is the main contract.

In the case of a new road construction project, it is expected that the above information would have already been provided in the Preliminaries and General works description bill of quantities and there may be no need to modify this section. The user should check with the RDA or the person preparing the contract document in such a case.

- **Section 7-** This section is to be kept if the client intends to procure a solar street lighting installation.
- **Section 8.1-** This section should be kept if the client intends to procure a street lighting system using sodium high pressure lamps.
- **Section 8.2-** This section should be kept if the client intends to procure a street lighting installation using LED lamps.

The client shall retain the relevant sections in case the contract comprises of street lighting installation using a combination of lamp types.

APPENDIX B: Guidance on the use of the specifications elements for the supply of Sodium High Pressure (SHP) lamps and luminaires

1. INTRODUCTION

This annexure provides guidance on the use of the specifications elements for Sodium High Pressure (SHP) lamps and luminaires. This Appendix should not form part of the specifications issued in a tender document; it shall be only used to amend the specification's to suit the type of works being procured.

2. SCOPE OF THIS DOCUMENT

This specification document has been prepared to procure the supply and installation of SHP lanterns and poles to be used for replacing existing installations.

This document should not be used for new street lighting installations with new wiring and along new roads or existing roads without any previous street lighting installations, which is covered in the "Specifications elements for street and public area lighting."

This document can be used by the client to procure the supply only of street lanterns and poles and which will be installed by the client himself by slightly amending this document as described below.

3. ARRANGEMENT OF SECTIONS

3.1 NON-EDITABLE SECTIONS

The following sections have very limited scope for modifications and if strictly needed, should be edited by a competent person, namely an Electrical Engineer.

- Section 2
- Section 3

These sections cover the general aspects of the installation which is not directly linked with the type of lamps being installed.

3.2 EDITABLE SECTIONS

The following section should be edited by the client, to suit the type of projects being procured:

- **Section 4.3, Section 4.4 (first bullet point) and section 5.7** - These sections should be removed if the contract is for the supply of luminaires and poles only, excluding installation.
- **Section 5-** should be removed if the contract does not include poles and its installations.

APPENDIX C: Guidance on the use of the specifications elements for supply of LED luminaires and lamps

1. INTRODUCTION

This annexure provides guidance on the use of the specifications elements for supply of LED luminaires and lamps. This Appendix should not form part of the specifications issued in a tender document; it shall be only used to amend the specification's to suit the type of works being procured.

2. SCOPE OF THIS DOCUMENT

This specification document has been prepared to procure the supply and installation of LED lanterns, lamps and poles to be used for retrofitting LED street lights on existing poles.

This document should not be used for new street lighting installations with new wiring and along new roads or existing roads without any previous street lighting installations, which is covered in the "Specifications elements for street and public area lighting."

This document can be used by the client to procure the supply only of street lanterns and poles and which will be installed by the client himself by slightly amending this document as described below.

3. ARRANGEMENT OF SECTIONS

3.1 NON-EDITABLE SECTIONS

The following sections have very limited scope for modifications and if strictly needed, should be edited by a competent person, namely an Electrical Engineer.

- Section 2
- Section 3

These sections cover the general aspects of the installation which is not directly linked with the type of lamps being installed.

3.2 EDITABLE SECTIONS

The following section should be edited by the client, to suit the type of projects being procured:

- **Section 4.12, Section 4.13 (first bullet point) and section 5.7-** These sections should be removed if the contract is for the supply of luminaires and poles only, excluding installation.
- **Section 5-** should be removed if the contract does not include poles and its installations.