

Request for Proposal

For

**DESIGN,SUPPLY,INSTALLATION,TESTING AND
COMMISSIONING OF NATIONAL FLAG INCLUDING
ILLUMINATION OF FLAG POST AT GANDHI
MANDAP,SARANIA HILLS ON DESIGN,BUILD AND
OPERATE BASIS WITH OPERATION AND MAINTENANCE
PERIOD OF ONE YEAR**

**Volume II B: SCOPE OF WORK & SPECIFICATIONS FOR ELECTRICAL
WORK**

Client:



GSCL, Guwahati, Assam

DOCUMENT NO: .10477A-CV-3000-3901

TABLE OF CONTENTS

1.0 SCOPE	3
2.0 DESIGN CONCEPT.....	5
3.0 PROJECT DETAILS	5
4.0 POWER DISTRIBUTION ARRANGEMENT	5
5.0 DESIGN CRITERIA	6
6.0 TECHNICAL SPECIFICATIONS -ELECTRICAL WORK	13
7.0 TECHNICAL SPECIFICATIONS -OTHER MISCELLANEOUS ITEMS.....	33
8.0 OPERATION & MAINTENANCE	36
9.0 MAKE LIST	36
10.0 ANNEXURES	39
11.0 LIST OF DRAWING	39

1.0 Scope

- 1.1 The scope of work covers the design, detailed engineering, preparation of construction drawing, manufacture, acceptance testing at manufacturer's works or at any accredited laboratory; supply, packing, forwarding and delivery from manufacturer's works/ place of storage to erection site including transit insurance; unloading, storage at site, moving from place of storage to place of installation, assembly, cleaning/ lubricating, touch up painting, erection, testing, commissioning & performance demonstration and handing over of the following systems/ equipment along with all necessary spares of original ratings & specifications in Design, Build and Operate (DBO) basis including the Defect Liability and Operation & Maintenance period for nos. of years as indicated in this document.
- 1.2 The brief scope of works includes the following;
- (a) Provision of power supply from the existing source (Distribution Transformer) for the following;
 - (i) Lighting of the Flag Mast
 - (ii) Aviation Obstruction Lights on top of the mast
 - (iii) Winch Motor of the Flag Mast
 - (b) Luminaires for the lighting of the Flag Mast
 - (c) Emergency power supply arrangement through Diesel Generator set with AMF panel
 - (d) Earthing and Lightning Protection of the Flag Mast and other electrical equipments like DG set, Panels etc.
 - (e) Auto Change Over cum Distribution Panel with Astronomical Timer
 - (f) Underground laid power cables
 - (g) Misc works like Fabrication of Steel supports for the above electrical equipments etc.

- 1.3 Preparation of design calculations based on parameters/ design criteria indicated in the specifications; carry out detailed engineering and preparation of Good for Construction (GFC) drawings for execution at site in accordance with technical data sheets, other relevant details provided in the specifications and submission to Client for approval before execution.
- 1.4 Submission of all “As Built” drawings, Data sheets, Calculations etc. after execution and commissioning of all the above equipment and systems.
- 1.5 All coordination for Liaison and obtaining required mandatory approvals/ NOCs from Local Power Supply Distributor (APDCL), Electrical Inspector, Aviation Department, Ministry of Defense, if required or any other Statutory Authority as applicable.
- 1.6 General Instruction to Bidders
- 1.6.1 During the construction at site, it shall be the BIDDER’S responsibility to take care of the safety and security of its personnel and material at site. The BIDDER shall be self reliant with all the requirements including tools and tackles for digging, filling, erecting, lifting, etc. and consumables required for construction like electricity and water at his own cost.
- 1.6.2 All SAFETY considerations in design and manufacturing for safe operation & maintenance by PURCHASER personnel and safe practices during installation at site shall be in the scope of the BIDDER. Cost towards accomplishing the same shall be included in the BID price and no extra claim shall be entertained later.
- 1.6.3 Equipments furnished shall be complete in every respect with all mountings, fittings, fixtures, and standard accessories normally provided with such equipment and / or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the Technical Specification unless included in the list of exclusions. Materials and component not specifically stated in the specification but which are necessary for commissioning and satisfactory operation unless specifically excluded shall be deemed to be included in the scope of specification and shall be supplied without any extra cost. All similar standard components/ parts of similar standard equipment provided shall be inter-changeable with one another.
- 1.6.4 The BIDDER shall be responsible for the selection and design of appropriate equipment to provide the best co-ordinated performance of the entire system. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.
- 1.6.5 The BIDDER shall take care not to damage any public/ private property by mistake or by intention during the course of work with its actions and shall be well insured to compensate the owner in case any such incidence happens.
- 1.6.6 All the cost towards liaison with statutory Bodies for seeking all necessary statutory approvals and other activities involving Govt. Agencies e.g., drawing approval, testing and commissioning etc, shall be borne by the BIDDER.
- 1.6.7 All the statutory fees for the above approvals shall be borne by PURCHASER. Such payments shall be reimbursed to the BIDDER upon submission of stamped receipts to the PURCHASER.

2.0 Design Concept

- 2.1 The design concept of electrical system as a whole is based on providing safe, reliable & stable power and efficient performance of electrical system.
- 2.2 The design standards described herein are generally in compliance with the Central Electricity Authority Regulations 2010, Latest Indian Standards, State Electricity Board Standards and Code of Practices already established in the country.
- 2.3 The design ambient temperature for all electrical equipment shall be 45°C.

3.0 Project Details

- (a) Site/ Environmental Conditions:
- (i) Ambient temperature : 45°C (site specific)
 - (ii) Relative Humidity : 5 - 95%
 - (iii) Area Classification : Non Hazardous
 - (iv) Seismic Data : As per IS 1893 (latest Issue)
- (b) Power/ Control Supply Distribution Voltage:
- (i) Incoming HV Supply -11kV, 3 Phase, 3 Wire, 50 Hz, provided by APDCL (Local Power Supply Company)
 - (ii) Outgoing LV Supply - 415V, 3 Phase, 4 Wire, 50 Hz, AC
 - (iii) General Lighting - 240V, 1 Ph, 2 Wire, 50Hz, AC
- (c) Voltage Variation: - As per CEA Guidelines
- (d) System Earthing:
- (i) 11 kV, 3 Ph AC system : Neutral Solidly Earthed
 - (ii) 415 V, 3 ph, AC system : Neutral Solidly Earthed
 - (iii) 240 V, 1 ph, AC system : Neutral Solidly Earthed
- (e) Fault Level – LV side Fault level shall be considered as 10 kA for 1 sec.
- (f) Battery Limit for BIDDER
- (i) From the outgoing of the APDCL LT Distribution Board.

4.0 Power Distribution Arrangement

- 4.1 The Grid power is available at Gandhi Mandap through a 100 kVA, 11/0.415 kV Distribution Transformer located at the back side of the Museum. As discussed with APDCL the transformer has spare capacity to cater to the need of the Lighting Load of the Flag Mast.
- 4.2 The BIDDER shall tap power supply for this project as mentioned above from the outgoing of the APDCL LT Distribution Board.
- 4.3 An alternate source of power shall be provided through Diesel Generator Set (DG Set) of appropriate capacity with Auto Mains Failure (AMF) Panel for auto operation during mains failure. The DG set shall be located near the existing transformer structure.
- 4.4 An outdoor and weatherproof, IP55, Power Distribution Board (PDB) shall be provided with two nos. of incomers from Grid & DG supply; and auto change over arrangement between the two supply sources for automatic changeover operation during power failure. The panel shall be located preferably close to the DG set within a distance of 5-10m.
- 4.5 Two Sub Distribution Boards (SDB) with 24 Hr Astronomical Time Switch and Contactor logic for automatic Dusk to Dawn operation of the Flag mast lighting are proposed to be located near the Mast. The entire mast lighting load shall be equally distributed amongst these two SDBs.
- 4.6 The power supply for the Mast equipments like Winch Motor, shall be directly tapped from the PDB.
- 4.7 Representative Single Line Diagram has been enclosed along with this document for reference.
- 4.8 All cabling shall be laid underground along the pathways with double compression gland termination in each panel/ equipment.
- 4.9 Dedicated Earth electrodes shall be provided for the Flag Mast, DG set, and PDB. All the pits shall be connected underground with a GI earth Strip grid to achieve an overall earthing resistance of 3 ohms.

5.0 Design Criteria

- 5.1 The design criteria, given below shall be followed by the CONTRACTOR for designing the power distribution system and sizing of electrical equipments for the required power supply for Flag Mast Lighting; however it is to be noted by the CONTRACTOR that, following this design criteria does not relieve the CONTRACTOR from adherence to the standards, regulatory requirements & best engineering practices.
- 5.2 The proposed Electrical Power Distribution System shall be designed to provide;
 - (a) Safety to Personnel and equipment during both operation and maintenance
 - (b) Reliability & Continuity of Service
 - (c) Minimal fire risk

- (d) Ease & flexibility of maintenance and operation
- (e) Protection of all electrical equipment through selective relaying system
- (f) Electrical supply to equipment and machinery within the design operating limits
- (g) Adequate provision for future extension
- (h) Maximum inter-changeability of equipment
- (i) Fail safe feature
- (j) Suitability for applicable environmental factors
- (k) Service Condition

5.3 All the components of the electrical system shall be sized to suit the maximum load under the most severe operating conditions. Accordingly, the maximum simultaneous consumption of power, required by continuously operating loads shall be considered and an additional margin shall be taken into account for intermittent service loads, if any. The amount of electrical power consumed by each area shall be calculated for its operation at the design capacity.

5.4 All equipment shall be designed to operate satisfactorily and meet the requirements specified in this specification under all site conditions where the equipment is proposed to be installed.

5.5 The equipment shall be designed and manufactured in accordance with the best engineering practices and shall be suitable for the intended purpose.

5.6 All the system and Equipment shall be designed with a reference ambient temperature of 45 Deg C

5.7 System Design Parameter:

5.7.1 415V System

a)	Nominal Voltage	415V
b)	Maximum System Voltage	1100V
c)	Rated Impulse Voltage withstand (peak)	-
d)	Rated one-minute power-frequency withstand voltage (rms)	3kV
e)	Rated short- time current (1 sec)	10kA

5.7.2 Lighting system

a)	Nominal Voltage	240V
b)	Phases	1
c)	Frequency	50Hz
d)	Connection	3 wires(Phase, Neutral & Earth)

5.8 Estimation Of Load/ Max Demand:

5.8.1 Following factor shall be considered for demand estimation;

- (a) Load factor
 - (i) Lighting Loads – 1.0
 - (ii) Misc Power Loads – 0.9
- (b) Utilization factor
 - (i) For all Loads except Misc Power loads – 1.0
 - (ii) For Misc Power loads – 0.3
- (c) Power factor of Motor – As per Manufacturer data sheet
- (d) Efficiency of Motors - As per the Manufacturer's Data sheets

5.9 Diesel Generator (DG) set Sizing :

5.9.1 Emergency power for the entire connected load shall be provided through a common DG set. The DG set shall be provided for stand-by operations.

5.9.2 The capacity of the DG shall be calculated based on the total simultaneous maximum demand of the loads specified in clauses above (calculated based on the load factors, PF, efficiency and diversity given above).

5.9.3 After consideration of 10% contingency over the above maximum demand (MD), sizing of the selected DG shall be calculated such that the maximum loading of the DG shall not exceed 80% at 0.8 PF.

5.9.4 The adequacy of DG sizing shall also be checked on the basis of Voltage dip observed at the motor terminal during the starting of the largest motor. The Voltage dip at motor terminal shall not exceed 15% i.e. with the use of appropriate starter & considering largest motor starting & base load (all other loads except the highest rating motor are running).

5.10 Cables:

The following main aspects shall be considered while deciding the final size of the cables/ wires -

5.10.1 Supply voltage and frequency

- (a) All cables shall be selected to carry the corresponding full load current under site conditions.
- (b) Route length and disposition of cables
- (c) Maximum allowable temperature rise under normal full load condition based on the material of cable insulation (XLPE/ PVC).
- (d) Maximum short circuit current duration (fault clearing time) and final temperature of cable during short circuit current flowing through the cable.
- (e) Fault clearing time of the upstream circuit breaker - For Cables emerging from MCCB outgoing of the PDB, fault clearing time shall be considered as 0.01 second
- (f) Appropriate de-rating factors as per cable manufacturer's catalogue and enlisted below shall be considered for sizing the cable:
 - (i) Ambient Air Temperature (minimum 45°C).
 - (ii) Ambient ground temperature (minimum 35°C to be considered) for directly laid cable in ground etc.
 - (iii) Depth of cable burial (minimum 750 mm for LT)
 - (iv) Thermal Resistivity of Soil (minimum 150°C Cm/ W to be considered)
 - (v) No. of cables in a group-touching each other or separated by a distance
 - (vi) No. of cable trays in tier if used
 - (vii) Any other de-ration factors as applicable & as per Manufacturer's catalog.

5.10.2 In running condition, cumulative voltage drop (Including HV and LV at 100% rated load) shall not exceed 6% (measured at load end) for the LV loads.

5.10.3 Cables up to and including size 4 sq mm are provided with PVC insulated copper conductor and cables beyond 4 sq mm are provided with XLPE insulated Aluminium conductor.

5.11 Illumination:

- 5.11.1 Latest version of related IS Standards, and National Lighting Code (NLC) shall be referred for designing Illumination for different areas.
- 5.11.2 Lighting design shall be performed using latest version of DiaLux Software/ Original Equipment Manufacturer (OEM) validated software. The Validation Report along with software and data files shall be acceptable to PURCHASER/ PURCHASER's representative.
- 5.11.3 The basis of design shall be based on the following lighting engineering criteria:
- (a) Lighting lux level.
 - (b) Luminance distribution.
 - (c) Glare restriction.
 - (d) Direction of incidence of light and shadow effect.
 - (e) Colour appearance and colour rendering of the light source.
- 5.11.4 Lighting Design
- (a) Narrow beam, Flicker Free, Adjustable (Beam Angle) Flood Light Luminaires shall be considered for the lighting of the Flag Mast and Flag.
 - (b) Concealed LED step Fittings or other Surface mounted LED up-lighter Luminaires shall be considered for illumination of the base of the Flag Mast.
 - (c) Following factors shall be considered while arriving at the utilization factor to determine the number of fixtures for each area/buildings.
 - (i) Maintenance Factor
 - a. Outdoor Area Lighting with LED Luminaire: : 0.8
 - (d) Uniformity factor shall be considered as per National Lighting code/NBC/IS code.
 - (e) The Lux level on flag (Horizontal plane) shall be min 15 Lux
 - (f) Uniformity factor on the Facade of the Flag shall be 0.4
 - (g) The lux level at Mast Base podium 10-15 Lux
- 5.12 Motor:
- 5.12.1 Shall be suitable for operation within supply conditions as specified above.

- 5.12.2 The motor shall be 3-phase squirrel cage induction type totally enclosed fan cooled (TEFC) suitable for required duty class. Motors shall have class F insulation with the temperature rise limited to class B.
- 5.12.3 The locked rotor current of the motor shall not exceed 600% of full load current (subject to tolerances as per the applicable standard) unless otherwise specified.
- 5.12.4 The Winch Motor shall be suitable for Forward / Reverse operation operated with DOL starter upto 5.5 kW. Beyond 5.5 kW Soft starter shall be provided for starting of Motor.
- 5.12.5 Proper Cut off Limit switches for extreme up and extreme down shall be provided to cut the supply to the motor starter at certain predefined levels during the travel. Redundant Limit switches shall be provided at both extremes.
- 5.12.6 Following Motor protection shall be provided for motors less than 15 kW
- (a) Thermal Overload relay
 - (b) Single phase preventer
- 5.13 LV Panels:
- 5.13.1 The design ambient temperature of air outside the switchgear enclosure shall be considered as 45 °C for the design of all equipment supplied against this specification.
- 5.13.2 The metal enclosed switchgear shall be designed to operate continuously to suit the system parameters and design considerations as specified
- 5.13.3 The equipment shall be designed and manufactured in accordance with the best engineering practice and shall be such that has been proved to be suitable for the intended purpose.
- 5.13.4 Electromechanical Interlocks shall be provided wherever two power sources are enclosed in one panel such that only one Source shall be in operation at a time and there are no accidental clashes of sources at any point in time during regular operations.
- 5.14 Earthing & Lightning Protection System:
- 5.14.1 The safety earthing and lightning protection system shall be based on the latest version of the following codes and standard.

Table 1: Standard and Guidelines for Earthing and Lightning Protection

a)	IS 3043- 1987, (Reaffirmed in 2006)	Code of practice for Safety Earthing
----	--	--------------------------------------

b)	IS/ IEC 62305- 2013	Code of Practice for the protection of buildings and allied structures against lightning.
c)	CEA guidelines 2010	Measures related to safety & electric supply.
d)	IEEE 80-2000-2013	IEEE Guide for Safety in AC Substation
e)	CPWD Specifications - 2013	General Specifications for Electrical Works Part I – Internal
f)	NBC 2016	Level of Lightning Protection for Building

5.14.2 Size of Earthing Conductors

- (a) The earthing conductor sizes shall be calculated as per IS: 3043. Following factors will be considered for sizing the earthing conductor

Table 2: Parameters for Sizing of Earth Conductor

a)	Design Ambient Temperature	45°C
b)	Allowable temperature rise	500°C
c)	Max fault Level	10 kA
d)	For steel welded joints Fault clearing time	1 second
e)	Overall earthing resistance of the grid	Less than 3 Ohms
f)	The soil resistivity of the project site as per actual geological survey carried out in Sep 2017.	280 Ohm meter

- (b) Conductor material shall be used as per mentioned in below table.

Sr. No.	Application	Material and Size
1.	Main Earth Grid below ground level	GI flat strip capable of withstanding fault level for 1 Sec

2.	Conductor connecting electrical equipment body to the Main Earth Grid or earth pit	GI flat strip capable of withstanding fault level for 1 Sec
3.	Conductor connecting electrical equipment neutral to earth pit	Cu flat strip capable of withstanding fault level for 1 Sec
4.	Conductor connecting Flag Mast to earth pit	Cu flat strip as per design

(c) The following Minimum Earth Electrodes shall be provided;

- (i) Mast – 2 Nos.
- (ii) DG Neutral – 2 Nos. – Copper Plate earthing as per IS 3043
- (iii) DG Body – 2 Nos.
- (iv) PDB – 2 Nos.
- (v) SDB and Luminaires – 2 Nos. near the Mast.

(d) For equipment earthing, two earthing leads will be used if rated voltage of the equipment is 250 Volts & above and one earthing lead will be provided for equipment rated below 250 Volts.

(e) The earthing conductors in outdoor areas shall be installed at a minimum depth of 600 mm below FGL.

6.0 Technical Specifications

6.1 OUTDOOR & WEATHERPROOF POWER DISTRIBUTION BOARD (PDB) AND SUB DBS (SDB):

6.1.1 The PDB shall be metal enclosed, Non Compartmentalised, Double Door Construction, free standing on raised structural supports, single front, fabricated with 2mm CRCA sheet steel for all doors, partitions and covers (and 2.5mm CRCA sheet steel for load bearing sections including all ACB feeders, if any).

6.1.2 The SDB shall be Similar in construction as PDB however shall be structural support/ Wall mounted.

6.1.3 The front Door shall be provided with Toughened Glass to see through the equipments mounted on the internal Door.

- 6.1.4 All outdoor panels shall be mounted on raised steel structures of minimum height 450 mm from FGL with proper foundation. The SITC of outdoor panels shall be inclusive of all design, engineering, supply (Steel and Civil building material), installation & commissioning of civil & structural works required for preparing such pedestal including excavation and backfilling. All mounting accessories like base channels, cross angles if required, nuts, bolts etc. shall be supplied by the vendor.
- 6.1.5 The panels shall be Weather proof conforming to IP55. The height of the panel shall not exceed 2000mm and the operating height shall not exceed 1800mm on top and 500mm at the bottom of the panel from FGL.
- 6.1.6 Adequate rain & sun protections shall be provided for the outdoor panels by way of raised hoods cum sheds above the panel extended such that the direct blasts of rain or sun rays are avoided. The rain hood cum shed shall be bolted and detachable to fix the Lifting lugs. Alternately a independent shed can be provided to safe guard the panel from sun and rain in all the seasons.
- 6.1.7 The gasket shall be suitable to withstand all weathers for long tenure of service. Suitable type test reports for the same shall be submitted for approval before procurement. All hardware shall be HD Galvanized.
- 6.1.8 All doors shall be hinged type with panel locks. All such doors shall open min 105 deg. All doors shall be with concealed type hinges and captive screws. Rear doors of panels, in case requiring rear access, shall be provided with removable hinged doors. Side covers of panels shall be with removable panels.
- 6.1.9 All doors shall be provided with durable and easy fitting locks with special keys to ensure opening by Authorised personnel. Suitable Rubber grommets shall be provided at the cable entry. All the panel boards shall have cable entry from bottom.
- 6.1.10 All the live bus bars shall be adequately shrouded against accidental contact by a shroud (and not by sleeve) to protect the workmen working on the switchgear. The protection shall be minimum IP20 inside the entire panel.
- 6.1.11 All fabrication work like cutting, drilling, punching, shearing & welding etc. related to switch board shall be complete before proceeding to 7 tank process. All interiors and exteriors of switchgear enclosure shall be finished and painted to prevent rusting and corrosion.
- 6.1.12 Sheet metal components shall be pre-treated using the seven tank phosphating process consisting of de-greasing, acid pickling, de-rusting, phosphating and passivation including repeated rinsing in between each process. On completion of passivation of the components they shall be preheated and then epoxy powder coated with Siemens grey RAL 7035 shade for exterior as well as interior and Glossy White shade for the gland plates (Inside the panel) and component mounting plate. Thickness of all painting shall be minimum 80 - 100 microns DFT.
- 6.1.13 Bus-bar rating of all panels shall be suitable for Continuous current rating at site conditions.

- 6.1.14 All bus-bars below 63A shall be tinned copper where as bus-bars for incomers greater than 63A shall be electrolytic grade Aluminium.
- 6.1.15 BIDDER shall ensure that incoming feeder shall be suitably designed for terminating the required no. of runs of 1.1kV grade XLPE insulated armoured cables with 20% spare capacity. BIDDER shall consider the necessary arrangement (dummy panel, adapter panel, rear extension etc.) if required, for terminating the cables within the limits specified above.
- 6.1.16 The bus-bars shall be designed considering the following criteria:
- (a) Maximum Current density of 1.5 A/ sq mm for copper and 1 A/ sq mm for Aluminium busbars.
 - (b) Sleeves made of insulating material on all bus bars.
 - (c) Bus bars carrying rated current continuously at Design Ambient Temperature shall be considered as 45°C and temperature rise shall be considered as per latest relevant standard.
 - (d) Configuration of bus bars and Proximity effect
 - (e) Bus bars shall withstand the short time rating of the panel.
- 6.1.17 Bus bar supports shall only be SMC irrespective of bus bar size. The size of Neutral bus-bars shall be 100% of Phase bus-bars.
- 6.1.18 All bus-bar shall be treated with anti-oxide paste wherever bi-metallic contact is required.
- 6.1.19 All the Terminals shall be Polyamide type. Sliding link type CT shorting terminals shall be provided for CT connections & screw / stud type terminals shall be provided for PT connections & other control circuit wiring.
- 6.1.20 20% extra terminals shall be provided for power as well as control for PURCHASER's use in each terminal strip/feeder.
- 6.1.21 All panels shall have Terminal block suitable for connecting minimum 6sq.mm. Conductor unless otherwise stated. There shall be no. joints or tapping between two terminals. More than two connections are not allowed from one terminal.
- 6.1.22 All power wiring for rating upto and including 63A shall be carried out with 1.1kV grade coloured FR PVC insulated, for phase identification, multi stranded copper wires duly crimped with ring type lugs.
- 6.1.23 Power connections for rating above 63A shall be done with bus bars (machine bend for proper profile) insulated with black heat shrinkable sleeves with phase identification coloured tapes duly supported on SMC insulators and placed with required minimum clearance of 25mm between phases and between phase to ground/ neutral. Such bus when brought out of the feeder for cable connections

shall be sufficient enough and profiled suitable for termination of the required number of cables.

- 6.1.24 All panel Control wiring shall be done by 1.1kV grade HFFR/FR PVC insulated multi-stranded copper wire. CT circuit wiring shall be done with minimum 2.5 Sq.mm size wire of above specification. Control and Potential circuits shall be wired with minimum 1.5 sq. mm size wires of above specifications. Wires shall be gray coloured with suitable crimp able copper lugs. CT's & PT's wiring shall be colour coded for multi-phase identifications (R-Y-B-N).
- 6.1.25 It shall be VENDOR's responsibility to maintain uniformity across various items/panels being procured.
- 6.1.26 Panel wiring & cabling shall be cross-ferruled. Ferrules shall be etched & painted type.
- 6.1.27 The panels shall be provided with engraved Aluminum name plate & caution Board with danger sign for the required voltage class to meet safety regulation as per CEA Guidelines.
- 6.1.28 Adequately rated anti-condensation space heaters shall be provided for each panel. Space heater shall be of the industrial strip continuous duty type, rated for operation on a 240 V, 1 phase, 50 Hz, AC system
- 6.1.29 Each space heater shall be provided with a Double pole MCB with overload and short circuit release, and a control thermostat to cut off the heaters at 35 °C.
- 6.1.30 Equipment Specifications

(a) Power Distribution Board (PDB)

- (i) All panel mounted equipments shall be mounted on the internal door. The equipment shall be removable and replaced from the front only.
- (ii) 415V, 3 Ph, Four(4) pole, MCCB (Ics=Icu=100%) shall be provided for both the Incomers of the PDB with thermal magnetic Overload, Short circuit and Earth fault release.
- (iii) Contactor based auto changeover scheme or Online Changeover switch based scheme shall be provided for change of power from Grid to DG and back. The reverse changeover from DG to Grid shall be carried out with certain time delay of 3 min to allow the supply voltage to stabilize and to avoid any surges.
- (iv) All outgoings shall be four (4) pole MCBs.
- (v) R,Y,B indications shall be provided at the incomer of both the MCCBs; ON, OFF and TRIP indications shall be provided for all the MCCBs. Indicating lamps shall be of the Multi chip LED type

with low watt consumption. Indicating lamp shall be of the double contact, bayonet cap type rated for operation at 240 V AC. Lamps shall be provided with translucent lamp covers. Bulbs and lenses shall be interchangeable and easily replaceable from the front.

- (vi) One no. digital Multi Function Meter (MFM) shall be provided on each incomer bus. The Meters shall display essential electrical parameters like (but not limited to) current, voltage, kW, kVA, KVAR, kWh, MD, PF, Hz, etc. and shall have provision for remote communication with SCADA. Preferred Make and Model – L&T Make Quasar meter or equivalent.
 - (vii) All instrument transformers shall be cast resin type and shall have insulation of class B or better.
 - (viii) It shall be entirely the responsibility of the BIDDER to ensure that characteristics of CTs, VTs and all other devices offered by him are such as to be suitable for the purpose for which they are intended.
 - (ix) The switchgear shall be complete with all equipment such as CT, VT, switches etc. duly wired up to terminal blocks. Terminal blocks shall be located at suitable place for easy access. CT shorting, isolating terminals, & earthing terminals shall be provided for CTs and isolating terminals shall be provided for VT connections. Twenty (20) percent spare terminals shall be provided in each cubicle. Ring type lugs suitable for termination of 2.5 sq mm copper wires shall be used.
- (b) Sub Distribution Board (SDB)
- (i) 415V, 50 Hz, 3 Ph, four (4) Pole RCBO shall be provided as incomer for the SDBs.
 - (ii) All Outgoings shall be four (4) Pole MCBs.
 - (iii) Astronomical Time Switch shall be provided in each SDB for Auto Operation. The time switch shall be suitable for the following;
 - a. Supply Volt – 110-240VAC, 50 Hz,
 - b. Programmable and Remote communicating
 - c. Precise time programming for Daily / Weekly / Pulse switching
 - d. 25 ON/OFF programs
 - e. Weekend exclusion (FRI SAT or SAT SUN) and Weekly OFF programming
 - f. LED indication of Relay status

- g. 12 / 24 hr. display formats
- h. 6 years battery reserve
- i. Simple Reset & Manual override
- j. Settable DST & Keypad Lock Feature
- k. Min Switching Time 1 Minute, Clock Accuracy – +/-2s/day
- l. No. of Operating Modes – 3 to 5
- m. Contact Rating – 16 A
- n. Mounting – DIN Rail

(c) CRCA JUNCTION BOX

- (i) CRCA Junction Boxes suitable for 4CX16 Sqm Al PVC Insulated Armoured cable as incomer and 3 nos. 4CX2.5 sqmm PVC Insulated Armoured cable as outgoings shall be provided mounted atleast 500mm above FGL on suitable steel supports for looping the power for the Flood Lights.
- (ii) The JB's shall be made of CRCA sheet steel, with rain canopy and hinged doors with locking arrangements, conforming to IP 66 protection, duly powder coated after due treatments and primer application.
- (iii) The terminal shall be suitable for termination of above cables comfortably. 20% spare terminals shall be provided in each JB.
- (iv) For ease of maintenance all the wiring shall be accessible from the front, cables will be neatly bunched in sides and adequate space should be there inside the box. For earthing two nos Bolted type earth terminals suitable to connect GI / Cu strip for earthing should be provided as per CEA regulations.
- (v) Junction boxes should be provided with aluminum name plate & caution Board with danger sign to meet safety requirements of CEA regulations.
- (vi) All cable entry shall be from bottom.

6.2 Documents to be submitted for approval after award of contract

- (a) General Arrangement and sections of the Panel with dimension
- (b) Control and Power wiring diagram

- (c) Mounting arrangement drawing of steel structure for the Panels
- (d) Type test certificate from Accredited laboratory for IP protection (IP55)
- (e) Foundation Details if any
- (f) Cable schedule

6.3 DG SET

6.3.1 The scope of works include supply, installation, testing and commissioning of DG-Set with weather proof acoustic enclosure, AMF panel for providing stand-by source of power supply.

6.3.2 Diesel engine

The DG set shall be for stand-by operations. The diesel engine shall be vertical cylinder, single acting, and mechanical injection type and furnished with all the required equipments as per standard practice. The engine should develop rated horse power to drive the rated kVA alternator. The required auxiliaries, guarantee of fuel consumption for rated output, provision for parallel operation, governor performance and torsional vibration shall be in accordance with BS: 649.

6.3.3 The engine shall be provided with an exhaust gas turbo charger and a charged air cooler, integral air intake filter and silencer. The engine should have throttle control, the engine water cooling should have radiator. For charged air cooler, the cooling water inlet flow shall be thermostatically controlled.

6.3.4 Fuel system

Fuel (Diesel) system to the engine shall be supplied from a fuel tank. The supplier should provide a fuel tank of adequate capacity, including 10% reserve capacity to be installed in a weather proof enclosure. The supplier should provide mechanical fuel level indicator with 'Low' and 'High' markings. Also fuel level indication should be provided in the AMF panel with alarm for Fuel level 'low'. The fuel tank shall be free standing, floor mounting type with mounting brackets, fuel inlet and outlet, air vent, drain plug, opening with cover for direct filling from the top of the tank.

6.3.5 Engine starting system

Starting of the diesel engine shall be of electric starting. The electric starting system should have starter motor, Lead acid starter Batteries, battery charger and necessary instrument and accessories to indicate the condition of the batteries.

6.3.6 Batteries

The batteries shall be sized taking in to account the starting load requirement of the DG set. Lead acid batteries, of suitable capacity to start the engine by 24V DC electrical starting Motor without struggling, and with suitable capacity of battery

cable. The batteries must be capable to try 3 unsuccessful starts continuously. The batteries have to be placed on a suitable well painted steel stand.

6.3.7 Air intake system:

Air intake system should have requisite air filters and complete interconnecting piping, supports etc.

6.3.8 Exhaust system

Engine exhaust system shall consist of exhaust gas driven turbo charger with lagged piping, interconnecting cylinder head outlets with the turbo charger inlet. Exhaust gas from the turbo charger shall be let out through exhaust gas silencer. The exhaust gas silencer, necessary pipes etc., shall be provided by the contractor. Exhaust piping shall be suitably cladded with aluminum sheets, mineral wool etc. The silencer should be of residential type. Flexible connection (expansion joints) shall be provided in the exhaust piping to avoid transmission of vibration from engine to the structure (acoustic and weather proof enclosure etc.). Also the exhaust line with suitable bends, collars, flanges, angle supports and other accessories should be provided. Provide necessary arrangements to avoid entry of rain water, falling dust etc. at the top of the exhaust pipe. The exhaust piping system should be designed and laid upto a height above the acoustic enclosure as permissible by local regulation or CPCB norms to suit the site and environmental condition.

Engine governing system: The engine governing system shall be of class 'A' hydraulic governor. An over speed trip mechanism shall be provided to automatically shut off the fuel supply in case of set speed reading above 110% of rated speed.

6.3.9 The Alternator

The Alternator shall be screen protected, drip proof, separately excited system (with PMG) of brush less, continuously rated to give an output at 0.8 pf at 415V, 50Hz, 1500rpm, 3 phase, 4wire. The alternator should be provided with automatic voltage regulator with voltage regulation of $\pm 0.5\%$ (MX321) and is designed, tested for confirming to IS 4772/1992 or IEC 34.

The insulating material of the alternator shall be non-hygroscopic and fully tropicalised. The Alternator shall be suitable for operation with its neutral solidly grounded. The neutral shall be formed at the terminal box.

Alternator windings shall be of Class H insulation with Class F temperature rise and tropicalised. The alternator shall have pre-packed grease lubricated ball or roller bearings and provided with facilities for re-greasing whilst in service.

The alternator shall be capable of maintaining a short circuit current of three times full load current for a period of 10 seconds. The alternator shall be fitted with an anti-condensation heater. No individual harmonic shall exceed 1% and the total

harmonic shall not exceed 3%. The alternator, its neutral and control panel shall be earthed as per relevant standards.

The alternator rotor assembly shall comprise exciter rotor, full wave silicon bridge rectifier surge protection device and salient pole rotating field system. The rotor shall be fitted with interconnected pole face damping windings. Voltage regulation shall be maintained to within $\pm 2.5\%$ for a power factor of 0.8 to unity, including hot to cold variations. The steady state frequency droop between no load and full load shall not exceed 5%. Transient voltage deviation following a step load of 60% of rated at a power factor of between 0.4 and zero shall not exceed 15% with a voltage recovery time to 97% rated voltage not exceeding 0.5 second. The set shall be capable of continuous operation with a phase current imbalance of 33% of rated current whilst maintaining the output voltage within $\pm 5\%$ of rated.

6.3.10 Mounting

Design, fabricate suitable base frame, which is a welded construction using channel iron etc. to mount D-G set. The whole set and base frame should be mounted on 12 Nos. (min) of heavy duty type Anti vibration mounts of DUNLOP' (b – SERIES) or its equivalent make.

6.3.11 AMF control panel

The automatic mains failure (AMF) panel should be made out of well painted 16SWG sheet steel enclosure with necessary components like MCCB for local isolation, control relays, timers, busbars, protective relays, metering, battery charger, indication, annunciation system etc should be provided.

The panel shall be inbuilt in the DG acoustic enclosure, mounted on the surface such that it can be operated and monitored from outside/ without entering the enclosure.

The AMF should be operating in Test/ manual / auto mode and 3 attempt starting facility with necessary control relays.

6.3.12 Earthing

The Generator Neutral should be earthed with 2Nos. of Copper plate electrode and GI pipe electrode for Body earthing as per IS 3043

6.3.13 Tests

Supplier shall perform all standard tests (Shop tests) on Engine and alternator and the test reports pertaining to the engine and alternator should be submitted.

6.3.14 Commissioning

Supplier shall perform the following tests at site to the satisfaction of GSCL

(a) Testing the set in Auto / Manual / Test modes.

- (b) Testing for all Interlocks
- (c) Full load test on the set for Eight hours

6.3.15 Acoustic and Weather proof Enclosure

The DG Set shall be provided with acoustic enclosure, fully integrated, weather proof with superior finish for long and durable life. The enclosure should be well fabricated structure on all sides. Provide sufficient working clearance around the D-G set inside the enclosure.

- (a) Special acoustic panels of optimum sound attenuation using special aluminum sheets (perforated) and acoustic grade high density wool sandwiched with gypsum.
- (b) Self insulated ventilation louvers for proper air aspiration and temperature control with suitable incorporation of special blower / axial fans of heavy duty depending on the on-site fresh air needs.
- (c) Corrugated steel frames and sturdy supporting material for housing the panels, effective sealing with the right gasket/ neoprene materials.
- (d) Well fabricated / nylon wheeled smooth sliding doors to be provided for easy access to the set. Suitable locking arrangement has to be provided on the doors.
- (e) Aesthetic finish (with intensive painting care) for perfect integration with the surroundings.
- (f) Noise level should be less than $65 \pm 3\text{dB}$ at 3 meter distance from the enclosure.
- (g) Acoustic and weather proof enclosure system should be complete in all respect as per prevailing standards.
- (h) Adequate and suitable lighting arrangement inside the acoustic enclosure shall be made.

6.3.16 Documents to be submitted after award of Order

- (a) DG sizing Calculations
- (b) General Arrangement and Sectional Drawing of the DG Set with and Without Acoustic Enclosure, Fuel tank and Foundation
- (c) Data sheets of Engine, Alternator, Battery, AVR, AMF panel
- (d) General Arrangement of Foundation
- (e) Civil Construction drawing of Foundation

- (f) Piping layout – Diesel, Exhaust
- (g) Earthing Layout
- (h) Fence details if provided
- (i) Engine Drawings and Test Certificates
- (j) Alternator Drawings and Test Certificates
- (k) AMF Panel
 - (i) GA Drawing
 - (ii) Power and control Wiring Diagram
 - (iii) Type test certificate for IP protection
- (l) Bill of Quantities along with Make and Model of each item.
- (m) Type test certificates of DG set including Heat Run test and IP protection with Acoustic enclosure

6.4 LUMINAIRES

6.4.1 The scope of works include Design, Supply, Installation, testing and Commissioning of efficient LED based Illumination system for the Flag Mast with Flag and the base of the Mast.

6.4.2 **BIDDER shall offer Lighting Arrangement without any High Lighting mast due to space constraint at the site. Ground mounted or pole mounted solutions (Poles less than 2 M height) with steel mounting supports will be preferred.**

6.4.3 The base of the Mast shall be Illuminated with suitable decorative LED Luminaires like LED Step Light or Uplighters.

6.4.4 Luminaires shall offer lighting with very high light output, optical efficiency, ease of installation, reliability and flexibility. The Luminaires shall offer Low Glare, High efficiency and reduced light spillage.

6.4.5 For LED Lighting

- (a) Environmental Conditions

The average atmospheric condition during the year is mentioned below. The equipment shall be designed to work in such environmental conditions:

- (i) Maximum ambient air temperature: 45° C
- (ii) Minimum ambient air temperature: 5° C
- (iii) Max. Relative humidity: 90%
- (iv) Atmosphere: Dusty and Humid

- (v) Rainfall data:1600 mm
- (vi) The equipment shall be suitable to sustain and work in the humid and dusty atmosphere of Guwahati.
- (b) List of Standards

Table 3.- List Of Standards

<u>S. No.</u>	<u>Brief Title</u>	<u>IS/IEC Code</u>
1.	Testing procedure of photometric testing for LED Luminaires	LM 79
2.	Testing procedure on the lifespan of LED Luminaires	LM 80
3.	National Lighting Code	SP72
4.	Method of Measurement of Lumen Maintenance of Solid State Light (LED) Sources	IS:16105 – based on IES-LM-80-2008
5.	Method of Electrical and Photometric Measurements of Solid-State Lighting (LED) Products	IS:16106 – based on IES-LM-79-2008
6.	Limits of Harmonic Current Emissions	IS 14700-3-2
7.	DC or AC supplied electronic control gear for LED modules - Performance requirements	IEC 62384
8.	Lamp control gear: Particular requirements for DC or AC supplied electronic control gear for LED modules	IEC 61347-2-13
9.	Environmental Testing: Tests – Test Db: Damp heat, Cyclic (12h+12h cycle)	IEC 60068-2-38
10.	Electro Magnetic compatibility (EMC)- Limits for Harmonic current emission— (equipment input current ≤ 16 A per phase)	IEC 61000-3-2
11.	Equipment for general lighting purposes - EMC	IEC 61547

	Immunity requirements	
12.	LED Modules for General Lighting-Safety Specifications	IEC 62031
13.	Degrees of Protection provided by enclosures (IP Code)	IEC 60529
14.	Particular Requirements - Fixed general purpose Luminaires/ Specification for Luminaires	IEC 60598-2-1/ IS10322
15.	General Lighting - LEDs and LED modules – Terms and Definitions/ General lighting – Light emitting diode (LED) products and related equipment –Terms and definitions	IS:16101 / IEC TS 62504
16.	LED Modules for General Lighting - Safety Requirements	IS:16103(Part1)
17.	LED Modules for General Lighting - Performance Requirements	IS:16103(Part2)
18.	Safety of Lamp Control Gear - Particular Requirements of D.C. or A.C. Supplied Electronic Control gear for Led Modules	IS:15885(Part2/ Sec13)
19.	Luminaire Performance – Particular Requirements – LED Luminaire	IS 16107-2-1

- (c) The Luminaires shall work on single phase three wire system (phase, neutral & earth).
- (d) The luminaire light output (lumen) shall be constant, flicker free and shall be able to withstand allowable supply source voltage variations/ fluctuations, spikes and harmonics.
- (e) The Luminaries shall have a sturdy and corrosion resistant high pressure Die cast Aluminium alloy housing with weatherproof gasket. The housing shall be Epoxy coated, without any cracks or thorough holes, made in a single piece of die-cast LM6 Aluminium alloy. The luminaries shall be totally enclosed, dust tight and water proof.

- (f) Heat sink used should be aluminium extrusion having high conductivity. The dimensions of luminaries shall be optimum and adequate to permit sufficient heat dissipation, through the body itself, so as to prevent abnormal temperature rise inside the lantern and consequential damage to the cover and gasket materials, LEDs, lenses and electronic drivers. Heat sink must be thermally connected to PCB/ LED light source.
- (g) The Luminaries Housing shall be suitable for termination of 3C X 2.5 sqmm copper conductor PVC insulated flexible Cable with Double Compression Cable Glands
- (h) The optical system shall consists of individual Poly Carbonate lenses on high power LEDs designed & tested to achieve optimum optical performance.
- (i) The LED Luminaire offered for illumination of the Flag Mast and the Flag shall display the following;
 - (i) Excellent Colour Consistency. The LEDS shall be optimally binned such that the colour consistency is within 2 SDCM.
 - (ii) The Luminaire shall be designed for narrow beam with specific beam angles such that the Central Beam shall provide lux levels of 1 fc or 10 Lux at a distance of 300m.
 - (iii) The Luminaire shall be adjustable 360 deg around the central / vertical axis.
- (j) Suitable number of LED lamps shall be used in the luminaries. The manufacturer shall submit the proof of procurement of LEDs from OEMs at the time of testing along with the test reports.
- (k) The Luminaries shall be provided with distortion free, clear, high tensile, heat resistant, toughened glass of minimum 0.8mm thickness with corrosion free/ stainless Steel screws.
- (l) An extruded silicon loop gasket shall be provided in the lantern body to ensure a weather proof seal between the cover and the metal housing to exclude the entry of dust, water, insects, etc. Luminaries should conform to degree of protection of IP 66 or above. Felt gasket will not be accepted. **The test report from NABL accredited laboratory** shall be submitted for approval before execution.
- (m) Luminaire shall be enclosed in an aesthetically designed housing with corrosion resistant polyester powder Coating after phosphor-chromate treatment.
- (n) All Luminaires shall conform to RoHS/CE/ERTL/ERDI requirements.

- (o) Name of the ULB, Year of Manufacture, Batch No., Serial Number or Identification No. Luminaries Manufacturer's Name / Logo, Wattage and Frequency should be embossed on the housing.
- (p) LED luminaries, should conform to the various National / International standards for safety & performance. **Manufacturer should provide test reports as per LM 79 & LM80.** The test report from NABL accredited laboratory shall be submitted along with the technical proposal/ Bid for LED as well as Luminaires.
- (q) Luminaries should conform to the National / International standards for Safety & Performance and test certificates as per IS 16103/ IS 16107 should be provided by the manufacturer. In case of luminaries are imported, the BIDDER shall conform to test parameters as per UL or equivalent standards.
- (r) The electrical component of the LED and LED driver must be suitably enclosed in separate sealed unit to function in environment conditions mentioned above.
- (s) All the connecting wires inside the Luminaries shall be Low Smoke Halogen Free, fire retardant cable.
- (t) Adequate protection against Overloading, Short Circuit, Over Voltage, Over temperature, Under Voltage, String Open, Surge Protection shall be provided within the Luminaries.
- (u) Design of the thermal management shall be done in such a way that it shall not affect the properties of the diffuser.
- (v) All the material used in the luminaries shall not contain any toxic material, shall be halogen free and fire retardant confirming to relevant standards.
- (w) The Manufacturer shall have all the relevant testing facilities certified by an accredited laboratory and shall be offered for inspection to the PURCHASER for verification of the required parameters and tests. BIDDER shall confirm the same in the BID.
- (x) The control gear shall comply with the provisions of IEC 61347-2-13, IEC 62031 and IEC 62384 as appropriate.
- (y) In Guwahati the switching surges are expected in the power supply system. Appropriate surge protection shall be provided by the CONTRACTOR for all the Luminaires offered by it. In case the Luminaires do not have such protections Inbuilt, external arrangements shall be provided for the existing fittings. No claim for failure of Luminaires, on account of voltage surges will be considered.
- (z) If required, additionally, as per ANSI C 136.2-2014/ UL-1449, External Surge protection device (SPD) with Thermal Protection (TMOVs) of

minimum 20 kV/ 10 kA to be separately installed with each fixture. The same shall be certified from independent lab and follow IEC 62305 & IEC 61643-11-2011.

- (aa) Five (5) year warrantee shall be provided for all the LED Luminaires.

6.4.6 Aviation Obstruction Light (AOL)

- (a) Two (2) nos. redundant Low power consumption Red coloured Flashing LED AOL shall be provided on the top of the Mast.
- (b) A medium intensity light suitable for 100m mast with minimum directional (radial) light Intensity of 1600 cd, in each direction, shall be provided.
- (c) The life of the lamps shall be minimum 100,000 hrs and BIDDER shall confirm the same **along with the Bid** and submit the Test reports for the same during execution. The BIDDER shall also guarantee no replacement of the Lamp during the entire O&M period or minimum of 5 years whichever is higher and confirm the same **along with the Bid**. Any replacement of the Luminaire shall be carried out by the CONTRACTOR as its own cost including the cost of lifting arrangement, safety etc.
- (d) The LED Luminaires shall be Shock & Vibration resistant, shall be able to sustain Voltage fluctuations and supply surges. Separate Surge protection device shall be provided for the Luminaires.
- (e) The light shall be Binay make Model no. 4000CD or equivalent.

6.4.7 Documents to be submitted for Lighting System after award of Contract

- (a) Dialux Design files as per design criteria of the mast and the mast foundation
- (b) Technical Data Sheet of the Luminaires offered
- (c) Type Test certificates for Lamps and Luminaires as asked for in the specifications
- (d) Luminaire Layout Drawing
- (e) Point wiring drawing
- (f) Bill of Quantity with make and Models

6.5 CABLING SYSTEM

- 6.5.1 The scope shall be inclusive of supply, installation, testing & commissioning of power & control cables, cable terminations, cable accessories, stripping of cable insulation, supplying and fixing of Aluminium lugs for aluminium cables & tinned plated copper lugs for copper cables and crimping the same to the conductor,

supply and fixing of double compression cable glands including all labour supply and consumable material required for jointing/ termination. The rate shall also include the laying of cable in ground/ in cable trays / cleating to structure etc.

6.5.2 Applicable Standards: The cables shall confirm to the latest applicable standards.

6.5.3 Constructional Features:

- (a) The LV Power cables shall be 1.1kV grade, 4/ 3 Core, multi-stranded, Al/ Cu conductor, XLPE insulated, extruded inner & outer PVC sheath compound type ST2 and galvanized wire (up to 6 sq mm) / steel strip(>6 sq mm) armoured cables. All single phase, Lighting cables, UPS cables shall have 100% Neutral.
- (b) All the control cables shall be 1.1kV grade, no. of cores multi-stranded, Copper conductor, PVC insulated, extruded inner PVC & outer PVC FRLS sheath compound type ST2 and galvanized steel round wire armoured.
- (c) All control cables shall be with following specific requirements:
 - (i) Copper conductor stranded class 2.
 - (ii) PVC Insulated
 - (iii) Provided with inner extruded PVC and outer PVC FRLS sheath of extruded black PVC compound.
 - (iv) Galvanized steel armouring in the form of GI round wire.
 - (v) Core identification shall be by printed numerals.
 - (vi) The insulation over the individual conductor core will be colour coded.
 - (vii) Minimum 2 spare cores for above 7C.
- (d) All control wiring shall be PVC FRLS insulated.
- (e) Earthing Cable shall be Single core multi-stranded Cu, 1.1 kV grade, XLPE insulated, un-armoured green coloured outer sheath with yellow strips/ band cable to be laid underground.
- (f) Four (4) Core Stranded Copper conductor, ERP insulated Flexible cable shall be laid from the Winch Base Compartment till the Aviation Obstruction Light (AOL) on top of the Mast duly dressed along the entire length of the mast.

6.5.4 Cable Terminations:

- (a) Cable Lugs

- (i) Cable lugs shall be of tinned copper, solder less crimping type for Cu cables & AL lugs for the AL cables.
 - (ii) The current rating of the lugs shall be same as that of the respective cable conductors.
 - (iii) Bi-metal strip/ Bi-metallic lug shall be used whenever two different metals are to be connected together.
 - (iv) Double holes extended neck (long barrel neck) type lugs shall be used in case of cables above 185 sq. mm.
 - (v) Anticorrosion/ anti-oxidation compounds shall be used for crimping lugs. This shall especially be ensured for Al cable terminations & bimetallic terminations shall be used wherever required.
 - (vi) If termination is done with crimping tool employing crimping die then forming dies shall be used to make the sector shaped conductor into a round conductor before crimping the lugs on the conductor. The lug must not be crimped directly on the sector conductor. Before crimping the lug, the conductor shall be thoroughly cleaned and special jelly applied over it to prevent further oxidation.
- (b) Cable Glands
- (i) Glands shall generally be of the double compression hexagonal type brass glands. Earth continuity of brass glands shall be assured.
 - (ii) Cable glands shall be brass casting, machine finished and Nickel-plated to avoid corrosion and oxidation. Rubber components used in cable gland shall be of neoprene. Cable glands shall be with metric threads.
 - (iii) Where holes for cable entries are not provided it shall be the responsibility of the Contractor to mark out and drill such holes. Burrs and swarfs shall be removed, care being taken to ensure that swarfs and filings, etc do not enter the equipment.
 - (iv) For non-hazardous areas cable glands in situations where moisture may be present shall be double seal weatherproof type, gland shrouds shall be used and entry shall be sealed.

6.5.5 Cable Installation

- (a) Cable installation shall be in accordance with IS 1255: 2001- latest edition.

- (b) All cables shall be laid buried underground from the Main PDB to the SDBs and SDBs to the respective Junction Boxes and Luminaires. The depth of laying is minimum 750mm measured from FGL to the top of the highest cable with proper 100mm sieved sand bed below and above the cable; and a layer of brick/ tile for protection of the cable against any kind of digging.
- (c) Cables shall be installed in such a way that the minimum bending radii are not reduced when installed or during installation.
- (d) Minimum Clearance of 300mm shall be kept between any other utility & power cables.
- (e) Cables are to be installed without tees or through joints unless otherwise approved by the Purchaser's Representative.
- (f) Concealed stranded copper conductor FR PVC insulated Wires/ Flexible Cables shall be laid in UPVC pipes for wiring up the base of the Mast with concealed Luminaires.
- (g) CONTRACTOR shall provide PVC Conduit in the RCC before casting as per approved method of construction along with all the required material including hardware, binding wire, accessories like 16 SWG MS junction box, PVC couplers & bends etc.

6.6 EARTHING AND LIGHTNING PROTECTION SYSTEM

6.6.1 Codes And Standards:

The general design shall be on the basis of following codes and standards (their latest amendments) in line with design criteria & specification requirements.

- (a) IS 3043-1987 – Re-affirmed in 2006: Code of practice for Safety Earthing
- (b) IS / IEC 62305: Protection against lightning.
- (c) IEEE 80 – 2000: IEEE Guide for Safety in Sub-station Earthing.
- (d) Central Electricity Authority (CEA) Regulations – 2010
- (e) IEEE 1100- Electronic earthing.

6.6.2 All materials and fittings used in the earthing installation shall conform to the relevant National and International Standards & shall be approved by the CEIG.

6.6.3 Galvanized Iron flat / wire shall be used as earthing conductor. Copper flat / wire shall be used for DG neutral.

6.6.4 The underground joints in the system shall be properly welded or brazed and the bolted type connection shall be made with structures/ equipments. Welded and

- Bolted joints shall be covered with bituminous compound/ tapes as suitable. Welding shall be done as per IS 816.
- 6.6.5 Earthing conductor shall be protected against mechanical damages considering the installation conditions.
- 6.6.6 The earthing system shall comprise of earth electrodes, earthing grid or a combination of these in order to obtain the required earth electrode resistance of less than 3 Ohm.
- 6.6.7 In case conventional electrodes are provided then GI Pipe electrodes shall be provided for all the equipment and system earthing where as Copper plate earthing shall be provided for grounding the DG Neutral. All electrodes shall be as per IS 3043 or as specified by CEIG. The depth of the electrode shall be based on the calculation requirements.
- 6.6.8 However, Maintenance Free Earth pit can be considered in lieu of the above because the Soil resistivity is very high and requires large nos. of electrodes for achieving the required value.
- 6.6.9 Maintenance free earth electrode shall be CPRI/ PWD, CPCB & CEIG approved corrosion free, copper Single pipe technology chemical earthing system with 50 mm dia. and of suitable length complete with Grounding Minerals and Earth Pit with cover.
- 6.6.10 The minimum spacing between two adjacent earthing pits shall not be less than 3000mm and shall be kept 1500 mm away from footings of the foundation of the structure.
- 6.6.11 Earth pit chamber shall be of RCC/ brick chamber of 600 mm x 600 mm dimension, with hinged chequered cast Iron cover plate. The covers shall have handle for handling which can be camouflaged with the cover when not used. Earthing pits (chambers) shall be painted Green and the earth-pit number shall be marked on it.
- 6.6.12 All materials used for the earth electrode installation shall be purpose made for the application and site conditions and shall be approved by CEIG.
- 6.6.13 All civil works, such as excavation, boring, provision of charcoal & salt in adequate quantity, backfilling for the installation of the earth electrodes and the earth pit/ inspection pit shall be in the scope of CONTRACTOR. The CONTRACTOR shall dispose the excess excavated earth as per the direction of GSCL.
- 6.6.14 After the earthing installation has been completed the CONTRACTOR shall demonstrate to GSCL/ it's Representative that the resistance of the electrodes to earth and the continuity of the earth network are within the limits specified. Any additional earth electrodes required to achieve the required value shall be provided by the CONTRACTOR.
- 6.6.15 All test instruments required for the tests shall be provided by the CONTRACTOR.

6.6.16 Lightning Protection: The lightning protection system for the Flag Mast shall be established by calculating the risk factor value as per procedure given in IS/IEC 62305-2010 and if found necessary, the same shall be provided by the BIDDER. The Calculations shall be submitted for approval.

6.6.17 Drawings to be submitted

- (a) Earth Grid sizing calculations
- (b) Earthing strip and electrode layout as proposed

6.7 MISCELLANEOUS

6.7.1 2 Nos. 5 kg CO2 Type Fire Extinguisher and Sand Bucket set with mounting stand and rain shed shall be provided for DG set and PDB.

6.7.2 Laminated SLD and panel wiring diagram shall be provided within the DG enclosure and the PDB for Maintenance requirements.

6.7.3 Contractor shall make provision for measurement of Lux level as specified to demonstrate the performance of the offered Lighting system.

7.0 TECHNICAL SPECIFICATIONS -OTHER MISCELLANEOUS ITEMS

RAISING AND LOWERING MECHANISM

7.1 For lowering and raising the flag assembly, a winch arrangement shall be provided at the bottom of the Mast. This shall have the provision of operating both Manually as well as Electrically.

7.2 For the convenience of use during maintenance work on the Mast, the speed of operation of the winch, when operated by power drive, shall be consistent with safety and with the practical operating speed of the winch and other parts.

7.3 The winch shall be suitable to handle the required weight of the assembly including all the accessories, with a factor of safety not less than two, unless otherwise specified.

7.4 Minimum two nos. of winch drums shall be provided for the winch assembly. The winch shall be self sustainable type with positive locking arrangement without the need of the brake shoe, springs or clutches.

7.5 The winch shall be self lubricating type.

7.6 The capacity, operating speed, safe working load, recommended lubrication and serial number of the winch shall be clearly marked on each winch.

- 7.7 The winch drum shall be grooved to ensure perfect seat for stable and tidy rope lay, with no chances for any rope slippage.
- 7.8 The rope termination in the winch shall be such that distortion and twisting is eliminated and at least 5 to 6 turns of rope remains on the drum even when the carriage assembly is fully lowered and rested on the rest pads.
- 7.9 The mast shall be fitted with flexible stranded high tensile strength stainless steel wire ropes, which shall have a factor of safety not less than five times the safe working load of the winch.
- 7.10 Particular care shall be exercised in all aspects of design, manufacture, testing and installation arrangements of the system to ensure safety under all operation conditions.
- 7.11 The protection against uncontrolled or dangerous runaway speed occurring in the event of the total failure of these devices shall not be dependent on the brake shoe, springs or clutches.
- 7.12 The winch shall be designed to be suitable for operation under the conditions of dampness and dirt occurring inside a Mast.
- 7.13 A suitable, high powered, electrically driven, internally mounted power tool with manual over ride shall be supplied for the raising and lowering of the assembly during maintenance purposes. The power tool shall be provided with a motor of the required rating and shall be supplied complete with suitable control.
- 7.14 The rating and capacity of the electric motor used in the power tool shall be compatible to lift the designed load with design margin of minimum 20%. Manual over ride shall also be provided for manual operation of winches.
- 7.15 Power tool mounting shall be so designed that it will be not only self supporting but also align the power tool perfectly with respect to the winch spindle during the operations.
- 7.16 There shall be separate torque limiting device to protect the wire from over stretching. It shall be mechanical with suitable load adjusting device. The torque limiter shall trip the load when it exceeds the adjusted speed. There shall be suitable provision for warning the operator once the load is tripped off. The torque limiter is a requirement as per relevant standards in view of the overall safety of the system.
- 7.17 Mast shall be provided with one power supply feeder pillar distribution box, which shall be located within the mast.
- 7.18 Motor starters shall be complete with MCCB/ MPCB, contactor, and bimetal relay with single phasing prevention feature (for 3 phase motors).
- 7.19 Limit switches as mentioned above shall be provided and interlocked for safety cut off of the drive.

- 7.20 Adequate indication lamps for indicating the incoming power supply healthy shall be provided.
- 7.21 On number heavy duty HD galvanized lightning finial shall be provided for Mast. The lightning finial shall be provided as per the relevant standards at the centre of the head frame. It shall be bolted solidly to the head frame to get a direct conducting path to the earth through the Mast.
- 7.22 The suspension system shall consist of only non-corrodible stainless steel of AISI 316 or better grade.
- 7.23 The SS ropes shall be of suitable size, the central core being of the same material. Two continuous lengths of the stainless steel wire ropes shall be used in the system. Intermediate joints/ terminations either bolted or else are not acceptable in view of the required safety on the wire ropes between winch and carriage.
- 7.24 The power and control cables including flexible trailing cables shall be provided. The connection from the feeder pillar at the base of the Mast to the JB on the Carriage shall be made through special multi core trailing cable of minimum size 4 sqmm copper conductor, EPR insulated metal braided and sheathed in heavy duty poly-chloroprene.
- 7.25 Minimum five cores shall be provided unless otherwise specified. Separate cable shall be used for the aviation luminaires. One dedicated core shall be kept for earthing. Suitable treatment shall be provided for the outer sheath to protect it from rodent/ termite or any other possible type of damages.
- 7.26 All cables shall be 1.1 kV grade. All connections at the bottom of the Mast shall be through metal cased plug and socket arrangement to enable easy disconnection.
- 7.27 Drawings of the Total WINCH and power tool assembly shall be provided for approval with details of each component including drum, rope, etc.
- 7.28 PU Painting - Flag mast shall be finished with Polyurethane (PU) paint over the galvanized surface after application of Primer coat.

8.0 OPERATION AND MAINTENANCE

- 8.1 The Contractor shall create preventive & predictive maintenance schedule and formats for the electrical and mechanical equipments and components included in the scope of this work and maintain the same during the contract period. The maintenance shall include but not limited to checking of insulation resistance of equipments, earth resistance of earth pits and grid, operation of winch assembly, checking of tension on the ropes, cable continuity tests. Safety interlocks, speed of winch etc.

9.0 MAKE LIST**Table 4: Make List**

Sr. No.	Material/ Equipment	Vendor
A.	Outdoor Panels (PDB & SDBs) + JBs	Manufacturer with Type Tested Design at CPRI or equivalent labs for minimum IP protection tests.
1.	Switchgear	Siemens, ABB, Schneider Electric, L&T
2.	Potential & control Transformer (PT)	Kappa, Pragati ,AE
3.	Current Transformer (Cast Resin Epoxy Coated)	Kappa, Pragati ,AE
4.	Electronic Multi-functional Meter (A/V/PF/HZ/KWH) with LCD/LED Display.	Schneider, Siemens, L&T, Secure
5.	Change over switch (automatic/ manual)	HPL, Socomec, L&T
6.	Indicating Lamps	Siemens, Schneider ,ABB ,L&T BCH, Tecknic
7.	Selector Switches	Kaycee, ABB, Siemens, Salzer

8.	Alarm Annunciators (solid state type with LED illumination) / Facia Annunciator	Minilec ,Yashmun
9.	Push Buttons	ABB, L&T, Schneider ,Siemens, BCH, Tecknic
10.	Space heater	Girish or equivalent
11.	Terminal Blocks /connectors	Jainson , Elmex, Connect well Wago
12.	Astronomical Timer	ABB, Siemens, GIC, L&T
B	Flag Mast	
1.	DOL/ Soft Starter for Winch Motor	L&T, Schneider, ABB, Siemens
2.	Motor	Crompton Greaves, Bharat Bijlee, Siemens, ABB, or Equivalent makes
3.	Switchgear	Same as Above (PDB)
C	DG	Cummins, Kirloskar Oil Engines, Caterpillar, Greaves
1	Lead Acid Tubular Batteries	Amar Raja, Exide, Hitachi, HBL
2	Switchgear for AMF Panel	Same as above
D	Lighting system	

1.	Luminaires	Philips, OSRAM, or Equivalent
2.	Aviation Obstruction Lights (AOL)	Binay or Equivalent
3.	UPVC Conduit/JB/flexible conduit / tees/ Bevels, elbow & accessories	Precision , Polycab
4.	Copper Conductor PVC Insulated Wires/ Stranded Flexible Wires (FRLS) (including panel wiring)	Finolex, RR Kabel, KEI, Havel
E	Cables	
1.	LT armoured Cable	Finolex, RPG , Polycab ,CCI, Universal
2.	LT Flexible Cable	Finolex, RPG, Polycab, Universal
3.	Cable Gland	Comet, Dowells, Braco
4.	Cable Lugs	Comet, Braco, Dowells
5.	Cable termination Kit	Raychem, 3M
6.	Cable Jointing Kit	Raychem, 3M
F	Earthing Strip, and accessories	Shruti, Profab, Sadhana, Sterlite
G	Misc.	
1.	Fire Sealant & Fire Retardant Paint	3 M India Ltd., HILTI, Promat, OBO

2.	Water barriers/sealing system	Roxtec, Rayflate
3.	Insulating mat	Electromat / National or equivalent with Type test certificates

10.0 ANNEXURES

ANNEXURE 1

TABLE NO. 5 - LUMINAIRE DATA SHEET OF LED FLOOD LIGHT LUMIANIRE

Sr. No.	Parameters	Requirements / Value
1.	Type	LED Luminaries complete with all accessories including integrated driver, internal wiring with fire retardant wires, etc., for Flood Lighting
2.	LED chip make	Nichia, Philip Lumiled, Osram, CREE
3.	Rated Voltage	230V
4.	Operating Voltage Range	Single phase 140-280 volt AC. But luminaries shall be tested for 100V to 300 V AC
5.	Frequency	50 Hz +/- 3%
6.	Power Factor	> 0.95
7.	LED wattage	1-3 Watt
8.	LED chip Efficacy	>135 Lm/Watt

9.	LED Drive current	$\geq 350 \text{ mA} < 750 \text{ mA}$
10.	LED Beam Angle	Bidder to decide
11.	Colour Temperature	$\geq 5000\text{K}$. (+/- 300K)
12.	Rated Minimum LED Life (L70)	100,000 Burning Hours L70 at 50 deg C (With only 30% Lumen Degradation or 70% Lumen maintenance)
13.	System efficacy	$\geq 58 \text{ Lm/Watt}$
14.	Total Lumen Output	Bidder to offer
15.	Colour Rendering Index of Luminaires	> 70
16.	System Power Efficiency	$\geq 90\%$
17.	Driver Type	Constant Current based Electronic Driver
18.	Driver Efficiency	$> 85\%$
19.	Driver Life	$> 20000 \text{ hrs.}$
20.	Maximum temperature rise for Driver	$< 30 \text{ Deg C}$ at 45 Deg C ambient
21.	Operating Temperature Range	-20 Deg C to $+ 50 \text{ Deg C}$
22.	Luminaries body temperature after 12 hours of continuous operation	$\leq 30 \text{ Deg C}$ from ambient

23.	Junction temperature	< 85 Deg C - self certified by Manufacturer
24.	Heat Sink Temperature	≤ 15 C from ambient
25.	Solder point temperature	< 70 Deg C
26.	Operating Humidity	10% to 95% RH
27.	Control Wiring/ Protection	Prewired with low smoke halogen free, fire retardant e beam cable up to terminal block. Fuse protection shall be provided inside.
28.	Operating Hours	Dusk to Dawn (max 12 Hrs.)
29.	Total Harmonics Distortion (THD)	<10%
30.	Construction	High power SMD and LED must be mounted on Copper MCPCB for high thermal conductivity and fastest heat transfer from the LED junction
31.	IP Protection	IP66 or more; no water stagnation anywhere
32.	Luminary Housing	Pressure Die Cast Aluminum (grade 5000 or similar) housing with corrosion resistant polyester powder coating & safety as per IEC 60598 / IS 10322. Mounting bracket with aiming & locking facilities. Large surface area with fins to dissipate the heat to ambient air
33.	Heat Sink	Well-designed thermal management system with defined heat sink - Aluminium extrusion

34.	Clip / Fastners	Corrosion free/ Stainless steel.
35.	Wire	The connecting wires used inside the luminaries, shall be Low Smoke Halogen Free, fire retardant e-beam cable and fuse protection shall be provided in input side.
36.	Materials	Halogen free and fire retardant confirming to UL94.
37.	Optics	Secondary lens array should be provided for optimized roadway photometric distribution. Lens material should be optical high grade PMMA with more than 90% light transmittance.
38.	IK protection for Optic Cover	>IK07
39.	Photometric measurements	LM-79/IS16105.
40.	Minimum Surge Protection	>4 kV
41.	Protection Required in Driver Module	
a.	Short Circuit	Yes; Constant current limit mode.
b.	Over Voltage	Yes; Auto Isolation
c.	Over Temperature	Yes; Auto Shut Off.
d.	Under Voltage	Yes;
e.	String Open Protection	Yes;

11.0 LIST OF DRAWING

- Single Line Diagram