

47

 BHARAT HEAVY ELECTRICALS LIMITED TRANSMISSION PROJECTS ENGINEERING MANAGEMENT													
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CONTENTS													
Section		Description										No. of Sheets	
Section 1		Scope, Specific Technical Requirements & Bill of quantities										08	
		Enclosed Drawings										04	
		Annexure BOQ										05	
		Encl: Customer Specification (Section :LS,Rev.06)										31	
Section 2		GENERAL TECHNICAL REQUIREMENT										7	
Section 3		Project Details and General Specification										28	
		Doc No. TB-384-316-S03, Rev-1											
Section 4		Guaranteed Technical Particulars										06	
Section 5		CHECK LIST										05	
		ANNEXURE-A (Schedule of Technical deviations)										02	
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Substation Package – SS02 for Construction of 765/400/220kV Banaskantha S/S and Extension of 400kV Sankhari (GETCO) S/S including 400kV Transformer and Reactor associated with Green Energy Corridors: Inter-State Transmission Scheme (ISTS) – Part B

Bharat Heavy Electricals Ltd.

Illumination System

Doc. No. TB-384-316-140 Section- 1

SECTION-1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 The illumination System is required for the following project.

Name of Customer : Power Grid Corporation of India Ltd.

Name of the Project : Substation Package – SS02 for Construction of 765/400/220kV Banaskantha S/S and Extension of 400kV Sankhari (GETCO) S/S including 400kV Transformer and Reactor associated with Green Energy Corridors: Inter-State Transmission Scheme (ISTS) – Part B

The specification comprise of following sections:

Section-1: Scope, Specific Technical Requirements & Bill of Quantities

Section-2: Detailed Technical Requirement - Equipment Specification

Section-3: Project Details & General Technical Requirements

Section-4: Guaranteed Technical Particulars (to be reviewed and approved during contract stage)

Section-5: Checklist

In case of any conflict between various sections, order of precedence shall be in the same order as listed above.

1.1 SCOPE

This specification covers the specific technical requirements of Illumination system Comprising

- a) Design, engineering, manufacture, Supply, testing at works, packing and dispatch of equipment & material to site.
- b) Unloading, storage, Erection, testing, commissioning & handing over.
- c) Storage space shall be provided by BHEL.

The Illumination System shall be provided for the following areas:

- ☐ Switchyard Area
- ☐ DG Set area lighting
- ☐ LT Transformer Yard area
- ☐ Illumination around CRB
- ☐ Street lighting

46

Substation Package – SS02 for Construction of 765/400/220kV Banaskantha S/S and Extension of 400kV Sankhari (GETCO) S/S including 400kV Transformer and Reactor associated with Green Energy Corridors: Inter-State Transmission Scheme (ISTS) – Part B

Bharat Heavy Electricals Ltd.

Illumination System

Doc. No. TB-384-316-140 Section- 1

Complete lighting and illumination for the above shall be provided by the bidder as per BOQ.

The roads & the area of the outdoor switchyard to be illuminated are as marked on the enclosed drawings under Annexure -2. Other relevant drawings are also enclosed under Annexure -2.

The Contract shall be on item rate basis for the Outdoor Switchyard. In case of change in the requirement for Outdoor Switchyard during detailed design after placement of order, additions / deletions to the scope shall be settled as per unit rates furnished in the Contract.

After placement of order, the bidder has to design the system as per relevant standards/codes, practice to the satisfaction of BHEL/ ultimate Customer i.e. PGCIL.

It is not the intent to specify herein all the details of design and manufacture. The equipment and the system shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to Purchaser / Owner, who will interpret the meaning of drawings and specifications and shall be entitled to reject any work and material, which in his judgment is not in full accordance herewith.

☐ The Bidder shall have deemed to have understood completely all the The Bidder shall have deemed to have understood completely all the tender drawings and documents and quoted accordingly.

In case of any deviation, the bidder shall indicate separately the clause wise deviation with respect to the specification in the "Schedule of deviations". Deviations in any other form including clarifications / assumptions etc. will not be considered and it will be construed as the bid conforming strictly to the specification. Deviations pertaining to non-availability of specified equipment / material in the market or pertaining to economy in offer will only be considered.

The term " Owner" appearing in this specification shall refer to ultimate Customer, the term " Purchaser " shall refer to BHEL and the term " Contractor " shall refer to the successful Bidder.

It is the responsibility of the successful Bidder to obtain necessary approval/clearance from statutory organizations wherever applicable for the equipment/system under the scope specified.

2.0 DESIGN CRITERIA

Substation Package - SS02 for Construction of 765/400/220kV Banaskantha S/S and Extension of 400kV Sankhari (GETCO) S/S including 400kV Transformer and Reactor associated with Green Energy Corridors: Inter-State Transmission Scheme (ISTS) - Part B

Bharat Heavy Electricals Ltd.

Illumination System

Doc. No. TB-384-316-140 Section- 1

- 2.1 The illumination System for outdoor Switchyard shall comprise of:

- ☐ Normal AC lighting
- ☐ Emergency AC Lighting

25% of lighting fixtures shall be connected on AC emergency lighting.

- 2.2 The outdoor switchyard shall be illuminated using LED flood lights as mentioned in customer's section project for illumination system. BOQ has been given in specification.

- 2.3 In an area, the lighting fixtures shall be arranged in different phase / LPs such that even in case one lighting panel is faulty complete lighting is not affected. In case of any location the lighting shall be arranged from all three phases for normal as well as normal/emergency supply.

- 2.4 Detailed lighting design calculations considering the number of fittings as per BOQ shall be submitted by contractor for approval of BHEL / ultimate customer.

- 2.5 The contractor shall submit detailed calculation for reaching the above Lux level for Employer's approval during detailed engineering.

- 2.6 The detailed drawings showing lighting layout, disposition and location of lighting fixtures, receptacles, switchboards, wiring scheme, fixing details, OGAs of all equipment, Cable schedule for switchyard etc shall be submitted for approval.

- 2.7 Earthing of Junction box & Lighting Panels etc is to be done by 50X6 GI Flat.

- 2.8 Earthing of Lighting Poles (for lighting poles outside switchyard) is to be done by **20** mm dia 3000 mm long rod electrode.

- 2.9 All lighting panels, junction boxes, receptacles fixtures, conduits etc. shall be grounded in compliance with the provision of I.E. rules.

3.0 SCOPE OF SUPPLIES & SERVICES

- 3.1 The equipment / services to be furnished for Substations under this contract are detailed hereunder and shall be read in conjunction with other clauses of this specification. All such items

45

Substation Package - SS02 for Construction of 765/400/220kV Banaskantha S/S and Extension of 400kV Sankhari (GETCO) S/S including 400kV Transformer and Reactor associated with Green Energy Corridors: Inter-State Transmission Scheme (ISTS) - Part B

Bharat Heavy Electricals Ltd.

Illumination System

Doc. No. TB-384-316-140 Section- 1

though not specifically mentioned but required to meet specification and for safe and satisfactory operation of equipment/ system will also be treated as included and the same shall be supplied at NO EXTRA COST to Purchaser. Further, in case any item not included below but are required to meet the technical specification, to be brought out by bidder at tender stage itself. Such items may be mentioned and included under separate head in the table below.

- 3.2 Tentative quantities are mentioned in BOQ. Actual quantities to be supplied shall be as per the quantities approved based on design drawings. Bidder has to workout the design and indicate at bid stage, if change in quantity is required.
- 3.3 The Following shall be free issue items from BHEL :
- (a) Multicore Power Cables as listed in BOQ
 - (b) 50X6 mm Galvanized strip for earthing
 - (c) 2 wire telephone set along with wire
 - (d) 110mm / 50mm PVC Pipe for buried cable trench
 - (e) MLDB, ELDB shall be in BHEL scope.
 - (f) MS Rod & Rod electrode

The sizes of cables indicated are tentative. Actual size required shall be as decided at detailed engineering stage. ETC rate quoted shall remain same even if size changes.

- 3.4 Erection, testing and commissioning of BHEL supplied items will also be in bidder's scope.
- 3.5 Supply of necessary cable for consumption within the street light / solar lighting pole assembly, such as pole mounted JB to respective light fittings, battery e.t.c shall be in contractor's scope.
- 3.6 LIGHTING JUNCTION BOX - The Contractor shall supply and install junction boxes complete with terminals as required. The brackets, bolts, nuts, screws etc required for erection are also included in the scope of the Contractor.
- 3.7 Where cables to be laid in GI Pipe / PVC Pipe, excavation, filling etc. deemed to be included in erection cost quoted.

Substation Package – SS02 for Construction of 765/400/220kV Banaskantha S/S and Extension of 400kV Sankhari (GETCO) S/S including 400kV Transformer and Reactor associated with Green Energy Corridors: Inter-State Transmission Scheme (ISTS) – Part B

Bharat Heavy Electricals Ltd.

Illumination System

Doc. No. TB-384-316-140 Section- 1

- 3.8 Bidder shall indicate in his offer catalogue numbers of all equipment offered.
- 3.9 A continuous ground conductor of 16 SWG GI wire shall be run all along each conduit run. The conductor shall be connected to each panel ground bus. All junction boxes, receptacles, switches, lighting fixtures etc. shall be connected to this 16 SWG ground conductor. Supply of 16SWG ground conductor is in contractor's scope.
- 3.10** Buried cable trench can be used in outdoor area. Contractor shall construct the cable trenches required for directly buried cables. The scope of work shall include excavation, preparation of sand bedding, soil cover, supply and installation of brick or concrete protective covers, back filling and ramming, **supply and installation of route markers and joint markers.**
- 3.11 Supply of all other items such as wires, steel wire, lugs, Cable glands, earthing material etc required to complete the works are in bidder's scope.
- 3.12 *Commissioning Spares :*
Contractor shall take commissioning spares required to site to commission the system without delay. The Contractor shall finalize the list with BHEL during detailed engineering stage.
- 3.13 SCOPE OF SERVICES**
The bidder shall quote for ETC, civil works, cable termination & earthing against each item as applicable.

Substation Package - SS02 for Construction of 765/400/220kV Banaskantha S/S and Extension of 400kV Sankhari (GETCO) S/S including 400kV Transformer and Reactor associated with Green Energy Corridors: Inter-State Transmission Scheme (ISTS) - Part B

Bharat Heavy Electricals Ltd.

Illumination System

Doc. No. TB-384-316-140 Section- 1

ERECTION, TESTING AND COMMISSIONING

- a. The Contractor shall give the offer for Erection, Testing and Commissioning of the Illumination Equipment at Site.
- b. The scope of ETC shall include receipt of material at site, safe storage of material, handling of equipment/ material at site, erection of equipment / material at site including fabrication, equipment and system testing, commissioning of the entire system.
- c. Conducting lux level measurement as per approved designs to the satisfaction of owner / purchaser.
- d. Laying and termination of power and control cable from LPs to JB and JB to fitting for equipment under scope of this specifications.
- e. All material and consumables required for erection for erection work shall be in contractor's scope.
- f. Earthing of all the electrical equipment as per requirement.

CIVIL WORKS

- a. Civil works such as foundation for street lighting poles and lighting panels etc. shall be done by the bidder. The rates for these civil works shall be deemed included in the erection rates of respective items.
- b. Wherever cable is laid in buried trench, the excavation, backfilling & compaction shall be done by bidder free of cost.
- c. All final adjustment of foundation levels, chipping and dressing of foundation surfaces, setting and grounding of anchor bolts, sills, inserts and fastening devices shall be carried out by the contractor including minor modification of civil works as may be required for erection.
- d. Any cutting of masonry / concrete work, which is necessary shall be done by the contractor at his own cost and shall be made good to match the original work.
- e. Civil works such as grouting, filling up of crevices/ cut outs etc during installation of equipment shall also be in contractor's scope. Any other damage caused to civil works during ETC work of the equipment/ system shall be made good to the original finish by the Contractor at no extra cost to the Purchaser.

3.14 BILL OF QUANTITY - refer attached Annexure BOQ

Substation Package - SS02 for Construction of 765/400/220kV Banaskantha S/S and Extension of 400kV Sankhari (GETCO) S/S including 400kV Transformer and Reactor associated with Green Energy Corridors: Inter-State Transmission Scheme (ISTS) - Part B

Bharat Heavy Electricals Ltd.

Illumination System

Doc. No. TB-384-316-140 Section- 1

4.0 TYPE TESTING

Bidder shall submit valid type test reports (as per relevant IEC/IS standard) for the tests carried out within last ten years from the date **24.02.15**. The reports should have been conducted on identical or similar equipment/components to those offered. In case type test reports are more than 10 years old or if any type report is found to be technically unacceptable, such type test(s) shall be conducted by the vendor without cost and delivery implication to BHEL.

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43

Substation Package - SS02 for Construction of 765/400/220kV Banaskantha S/S and Extension of 400kV Sankhari (GETCO) S/S including 400kV Transformer and Reactor associated with Green Energy Corridors: Inter-State Transmission Scheme (ISTS) - Part B

Bharat Heavy Electricals Ltd.

Illumination System

Doc. No. TB-384-316-140 Section- 1

ANNEXURE - 2

DRAWINGS

1. PLAN LAYOUT	TB-384-510-002
2. 765KV SECTION LAYOUT	TB-384-510-003
3. 400KV SECTION LAYOUT	TB-384-510-004
4. LT AC DC SLD	TB-384-510-010

BOQ for supply, receipt of material at Site, Unloading, Inspection, Verification, Storage, Up-keeping, Erection Testing & Commissioning (ETC) Works & handing over of illumination system for 765/400/220 KV Switchyard Banaskantha

Customer : POWERGRID CORPORATION OF INDIA LTD.

Project / Site : 765kV/400kV/ 220KV S/Stn BANASKANTHA

Sl. No.		Item Description	Unit	Part-I qty (Present scope)	HSN Number/ SAC CODE
		SUPPLY			
A		Illumination System: Outdoor Switchyard and Street Lighting at 765/400/220kV Banaskantha S/S			
1.0	Supply	Lighting fixtures and Receptacles including junction box, lighting wires & flexible conduit (if required) from junction box to lighting fixture, mounting arrangement such as bracket / hardware and other accessories/ materials etc. as required for complete installation and commissioning of lighting fixture as per technical specification.			
i	Supply	LED type Lighting Fixture Type-FL1 (LED flood light luminaries)	Nos.	20	94051090
ii	Supply	LED type Lighting Fixture Type-FL2 (LED flood light luminaries)	Nos.	231	94051090
iii	Supply	LED Street Light Luminaire - Type SL-L1	Nos.	100	94051090
iv	Supply	Pole Mounted LED Post Top Luminaire - Type SL-D1	Nos.	40	94051090
v	Supply	Portable Box with LED fixture having two 250W fixture as per attached drawing	Nos.	2	94051090
2.0	Supply	Lighting Poles			
i	Supply	Steel Tubular Pole 6 meter height, Type SL-L1 including Junction Box complete as per attached drawing and specification	Nos.	100	94059900
ii	Supply	Earthing of Lighting Poles by 20 mm dia 3000 mm long rod electrode	Nos.	100	76169990
B	Supply	ERECTION MATERIAL FOR BANASKANTHA SS			

BOQ for supply, receipt of material at Site, Unloading, Inspection, Verification , Storage, Up-keeping, Erection Testing & Commissioning (ETC) Works & handing over of illumination system for 765/400/220 KV Switchyard Banaskantha

Customer : POWERGRID CORPORATION OF INDIA LTD.

Project / Site : 765kV/400kV/ 220KV S/Stn BANASKANTHA

Sl. No.		Item Description	Unit	Part-I qty (Present scope)	HSN Number/ SAC CODE
1.0	Supply	Supply, Fixing and Erection of Mounting Brackets, Aluminium Flat, GI Bolt with nut and washer, GI Earthwire form JB to lighting fixtures, cable gland and all other accessories required for successful completion of project etc. Glands shall be Tin/ Nickel, Nichel/chromium - Plated (coating thickness not less than 10 microns) Powergrid approved / Sunil & Co. / Arup/ Comet / QPIE make brass cable glands, double compression heavy-duty type. Supply of cable glands deemed included in the scope. Erection material required for complete installation of system under this specification is deemed included in the scope of bidder, and not limited to the followings.			
i	Supply	Erection Material required for mounting of LED type Lighting Fixture Type-FL1	Nos.	20	94059900
ii	Supply	Erection Material required for mounting of LED type Lighting Fixture Type-FL2	Nos.	231	94059900
iii	Supply	Erection Material required for mounting of LED Street Light Luminaire - Type SL-L1	Nos.	100	94059900
iv	Supply	Erection Material required for mounting of Pole Mounted LED on Post Top Luminaire - Type SL-D1 on Post top Lantern tubular pole of dia. 88mm as per attached drawing.	Nos.	40	94059900
		ERECTION TESTING AND COMMISSIONING			
C		Illumination System: Outdoor Switchyard and Street Lighting at 765/400/220kV Banaskantha S/S			

BOQ for supply, receipt of material at Site, Unloading, Inspection, Verification , Storage, Up-keeping, Erection Testing & Commissioning (ETC) Works & handing over of illumination system for 765/400/220 KV Switchyard Banaskantha

Customer : POWERGRID CORPORATION OF INDIA LTD.

Project / Site : 765kV/400kV/ 220KV S/Stn BANASKANTHA

Sl. No.		Item Description	Unit	Part-I qty (Present scope)	HSN Number/ SAC CODE
1.0	ETC	Lighting fixtures and Receptacles including junction box, lighting wires & flexible conduit (if required) from junction box to lighting fixture, mounting arrangement and other accessories/materials etc. as required for complete installation and commissioning of lighting fixture including mounting bracket / hardware as per technical specification.			
i	ETC	LED type Lighting Fixture Type-FL1	Nos.	20	998731
ii	ETC	LED type Lighting Fixture Type-FL2	Nos.	231	998731
iii	ETC	LED Street Light Luminaire - Type SL-I.1	Nos.	100	998731
iv	ETC	Pole Mounted LED Post Top Luminaire - Type SL-D1	Nos.	40	998731
2.0	ETC	Lighting Poles			
i	ETC	Steel Tubular pole 6 meter height, Type SL-L1 refer attached drawing.	Nos.	100	998731
ii	ETC	Earthing of Lighting Poles by 20 mm dia 3000 mm long rod electrode (Supply of 3000 mm long rod electrode is not in bidders scope)	Nos.	100	998731
D		Illumination System: Outdoor Systems of 765/400/220kV Banaskantha S/S			

40

BOQ for supply, receipt of material at Site, Unloading, Inspection, Verification , Storage, Up-keeping, Erection Testing & Commissioning (ETC) Works & handing over of illumination system for 765/400/220 KV Switchyard Banaskantha

Customer : POWERGRID CORPORATION OF INDIA LTD.

Project / Site : 765kV/400kV/ 220KV S/Stn BANASKANTHA

Sl. No.		Item Description	Unit	Part-I qty (Present scope)	HSN Number/ SAC CODE
1.0	ETC	Cabling including laying, tagging , dressing, ferruling, lugging, installation of cable gland, soldering, tapping, jointing, crimping, termination, and drilling/ cutting holes in cable gland plates- laying can be either on trays, supports, underground, buried in ground or through GI/PVC pipe over/under ground, through wall, on structures including lightning mast tower etc. All erection materials viz. double compression cable glands, ferrules, copper lugs, cable ties / straps, Aluminium flat for clamping, Aluminium tags, markers, GI / PVC wall sleeves with rubber / nylon bushes and flexible steel conduits shall be supplied by bidder. (Only Cable supply shall be in the scope of BHEL)			
i	ETC	2 Core X 2.5 Sq mm, Cu cable, PVC insulated	M	10000	998736
ii	ETC	4 Core x 16 Sq mm, Al cable, PVC insulated	M	500	998736
2.0		Directly Buried Cable Laying - 4Cx16 sqmm Al cable, PVC insulated, Cabling including laying, tagging , dressing, ferruling, lugging, installation of cable gland ,soldering, tapping, jointing, crimping, termination, and drilling/ cutting holes in cable gland plates- laying is directly burried in ground. All erection materials viz. double compression cable glands, ferrules, copper lugs, cable ties / straps, Al. tags, markers shall be supplied by bidder alongwith civil activities which shall include excavation, sand cushioning, protective covering and refiling of trench etc as required alongwith supply and laying of bricks etc. (Only Cable supply shall be in the scope of BHEL)	M	2000	998736
3.0	ETC	GS strip including cutting, bending, welding with 40 mm dia MS rod riser/earth strip, applying zinc rich paint, clamping to structure/building wall etc. to complete. Hardware required for connecting flat on pads of structure & equipment included in scope.			
i	ETC	50 x 6 mm GI Flat	M	300	998731

Substation Package – SS02 for Construction of 765/400/220kV
Banaskantha S/S and Extension of 400kV Sankhari (GETCO) S/S.

Bharat Heavy Electricals Ltd.

Illumination System,

Doc. No. TB-384-316-140 Section 1,

ANNEXURE - BOQ

Notes:

1. BOQ furnished above is as per the preliminary estimate. Bidder shall submit detailed calculation for achieving the required lux levels (approx. 20 at ground level and equipment level for switchyard & approx. 50 for Transformer / Reactor area) & submit final BOQ for approval at contract stage.
2. The Bidder should quote the prices on unit rate basis for the Outdoor Switchyard package. In case of change in the requirements during detailed design after placement of order, additions/deletions to the scope shall be settled as per unit rates furnished in the Contract.
3. After placement of order, the bidder has to design the system as per relevant standards/codes to the satisfaction of BHEL/PGCIL.
4. Total quantity may vary upto +/- 50% at contract stage. However individual item wise quantities may vary upto any extent.

Section -LIGHTING SYSTEM (Rev.06)

Sl. No.	Description	Page No.
1.	GENERAL	1
2.	GENERAL DESIGN CRITERIA	1
3.	GRID INTERACTIVE SOLAR PV POWER PLANT	2
4.	LIGHTING SYSTEM DESCRIPTION	2
5.	LIGHTING SYSTEM INSTALLATION WORKS	11

Annexure-I Bill of Quantity

Annexure-II Details of Lighting Fixture

Annexure-III Technical Specification of Grid Interactive Solar PV Power Plant

Annexure-IV Drawing of Portable Flood Light Panel (PFL)

Annexure-V Drawing of Lighting Pole

Section -LIGHTING SYSTEM (Rev.06)

Major Changes in Technical Specification Lighting System (Rev.06):-

1. Quantities of Indoor Lighting Fixtures for Control Room cum Administrative Building, GIS Building, FFPH and SPR have been specified in the Specification thus avoiding the designing requirement of Indoor Lighting System. In view of the same LUX Level for various building has not been mentioned in specification.
2. For Outdoor Lighting, LED fixtures of 150W & 250W has been specified in place of Conventional Sodium Vapor Lamps (to be supplied as per BPS).
3. Bidder shall be required to submit LM-79, LM-80 and TTC reports for LED Luminaries.
4. Firewall mounted Flood Lights have been envisaged for Transformer & Reactors (to be supplied as per BPS).
5. Portable Flood Light Panel for Maintenance purpose has been specified. Typical Drawing is also enclosed (to be supplied as per BPS).
6. Roof top Solar Grid System with battery **has been replaced** by Grid Interactive Roof Top Solar Grid System of 15kW to be integrated in ACDB. (to be supplied as per BPS).
7. Considering maintenance issue of Pole mounted battery, **Solar Panel alongwith battery** used for Street Lighting System has been deleted and Street Lighting using LED Luminaries is retained.
8. AC Emergency Lighting in GIS building, SPR, DG Area and LT Transformer Area has been specified.
9. DC Emergency Lighting added for GIS building.
10. Lighting System for Township Area deleted.
11. Stainless steel Panels/Junction Boxes of thickness 1.5 mm for Outdoor application has been specified.
12. Indoor Lighting Panels Bus Bar has been changed from Copper to Aluminum Alloy.
13. Technical Specification for Receptacle RQ-1 (250A) & RQ-2 (400A), 415V, 3-phase has been included for Oil filtration purpose.
14. All concealed Conduit shall be PVC type and all surface mounted conduit shall be of Galvanized steel.
15. Lighting Steel tubular Poles **painting** changed to hot deep galvanizing with PU (Polyurethane) coating in Suzuki Silver color.
16. Fixtures Model and Vendor names have been deleted and general technical parameters of LED fixtures have been included for Indoor as well as Outdoor Fixtures.

Note: Above are major changes made in the Model TS , however Bidder is advised to refer Technical Specification in detail for other changes in the specification.

Section -LIGHTING SYSTEM (Rev.06)

1 GENERAL

The scope of work comprises of design, engineering, testing, supply, installation, testing and commissioning of various lighting fixtures complete with lamps, supports and accessories, ceiling fans with electronic regulators, exhaust fans with accessories, lighting panels, Sub-Lighting Panels, lighting poles with distribution boxes, PVC conduits, lighting wires, G.I. earth wire, receptacles, tag block & telephone socket, switchboards, modular switches, junction boxes, pull out boxes, aluminum ladders for maintenance, **solar grid system** complete with accessories. The bidder shall quote on unit rate basis as indicated in bid proposal sheets for outdoor Illumination and lump sum basis for Indoor Illumination. Various type of outdoor & indoor Lighting fixtures required are detailed in Annexure-II.

The following specific areas are included in the scope of lighting as applicable (as per BPS):

i) Indoor Lighting

- a) Control Room cum administrative building
- b) Firefighting pump house
- c) Switchyard panel rooms
- d) GIS Building
- e) Other Buildings

ii) Outdoor Lighting

- a) Switchyard Area including DG Set & LT Transformer area
- b) Street Lighting
- c) Open Store

2 General Design Criteria

The illumination system shall be designed on the basis of best engineering practice and shall ensure uniform, reliable, aesthetically pleasing and glare free illumination. The finish of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection. The diffusers/ louvers used in the lighting fixtures shall be made of impact resistant polystyrene sheet and shall have no yellowing property over a prolonged period Illumination. The Lighting Fixture to be used in different areas shall be as per Annexure-I.

For Indoor and Outdoor Illumination, detailed drawings showing the lighting layout, Conduit layout and electrical distribution diagram shall be prepared by the Contractor and submitted for approval. The above layout drawings will include disposition and location of lighting fixtures, receptacles, lighting panels etc. While finalizing the detailed layout of lighting fixtures, the position/location and layout of equipments should be taken into account to have adequate illumination at desired locations with Bill of Quantities requirement as per Annexure-I.

Section -LIGHTING SYSTEM (Rev.06)

2.1 Indoor Illumination

Indoor illumination shall be done by LED Luminaries as per the requirement of false ceiling and non-false ceiling of buildings.

2.2 Outdoor Illumination

Outdoor illumination shall be done by LED luminaries as per the requirement. For Outdoor Switchyard area, LED fixtures shall be installed at gantry structures (For 400kV & below voltage level) & available lightning masts (if any). However for 765kV Switchyard, LED fixtures will be installed at 28 meter height on the towers. For other outdoor areas, Street Lighting, lighting poles & nearby buildings (if any) shall be used for installation of LED fixtures. Mounting structure /Accessories for Mounting of LED Lighting Fixtures will be prefabricated and will be hot dip galvanized. Additional firewall mounted Flood Lights have to be provided for Transformer & Reactors as specified in the BPS.

Portable Flood Light Panel (PFLP): Portable Flood Light Panel alongwith fixture is to be supplied as per BPS for maintenance purpose of the Substation. The detailed drawing for the FLP shall be as per the drawing attached in the specification (Annexure-IV).

3 GRID INTERACTIVE SOLAR PV POWER PLANT

Solar Grid System (if specified in BPS) shall be supplied as per detail mentioned in as per Annexure-III.

4 LIGHTING SYSTEM DESCRIPTION

The lighting system shall comprise of the following:

4.1 AC Normal Lighting System

All the Lighting fixtures connected to the AC Normal Lighting system in different areas will be fed from the 415 V main lighting distribution board through Lighting Panel & Sub-lighting panels (SLP).

4.2 AC Emergency Lighting System

This system will be provided in Control Room building, GIS Building, Switchyard Panel Room, Fire fighting pump house, Switchyard Area including DG Set & LT Transformer Area. AC Emergency lighting load will be connected to this system which will be normally 'ON'. The lighting panels of this system will be connected to the 415 V Emergency lighting distribution board (ELDB) which is fed from diesel generator during the emergency. Approximate 25 % of lighting fixtures (distributed over all above areas) shall be connected on AC emergency lighting system.

Section -LIGHTING SYSTEM (Rev.06)

4.3 D.C. Emergency lighting System

DC emergency lighting fixtures with 60 W GLS Lamp shall be operated on the 220/110V DC system (as per available Station DC Supply) and will be provided in the strategic locations including Control Room Building, Fire Fighting Pump House, GIS Building and other critical areas etc.

The supply to the DC lighting panels shall be automatically switched ON in case of loss of Normal & Emergency AC supply at station or when under voltage occurs in the AC MLDB. The DC supply will be automatically switched OFF after about 3 minutes following the restoration of supply to normal AC or emergency AC lighting system.

Exit Lightings Signage are to be provided in the all rooms of Control Room Building, Fire fighting pump house & GIS Building including Corridors & Staircase so that the operating personnel can safely find their way even during emergency of total AC failure.

4.4 DESCRIPTION OF ITEMS

The Contractor shall supply and install the following equipment and accessories in accordance with the specification and applicable standards:

4.4.1 LED LUMINAIRES

LED Luminaries shall be used for the lighting of all the indoor and outdoor areas. In false ceiling area LED luminaries shall be recessed mounting type & in non-false ceiling area the LED luminaries shall be surface mounting type.

Suitable heat sink with proper thermal management shall be provided in the luminaries. All LED Luminaries LED luminaries shall be POWERGRID approved make. The marking on luminaries & safety requirements of luminaries shall be as per IS standards.

Necessary Care shall be taken so that there is no water stagnation anywhere in the Luminaries. The entire housing shall be dust and water proof protection as per IS 12063.

4.4.2 LIGHTING PANELS

4.4.2.1 CONSTRUCTIONAL FEATURES OF LIGHTINNG PANELS

- i) Each panel shall be provided with one incoming triple pole Miniature Circuit Breaker (MCB) with neutral link and outgoing MCBs. The panels shall conform to IS-8623.
- ii) All Outdoor Lighting Panels shall be Stainless sheet steel of Grade 304 and shall be dust, weather and vermin proof. Panels shall be of thickness not less than 1.5 mm smoothly finished, leveled and free from flaws. Stiffeners shall be provided wherever necessary.

Section -LIGHTING SYSTEM (Rev.06)

- iii) The panels shall be of single front construction, front hinged and front connected, suitable for either floor mounting on channels, sills or on walls/columns by suitable M.S. brackets. Indoor Lighting panels shall be modular flush mounted and wall embedded of slim depth.
- iv) All panels shall have a dead front assembly provided with hinged door(s) and with suitable locking arrangement.
- v) All Outdoor panel's removable covers and doors shall be gasketed all around with neoprene/EPDM gaskets/ puff arrangement.
- vi) The outdoor panels shall be suitable for cable/conduit entry from the bottom. Suitable removable cable gland-plate shall be provided in the bottom of panels. For indoor lighting panels the provision of cable/conduit entry shall be from both top and bottom side with suitable removable gland plate. The thickness of the gland plate shall be 3 mm. Necessary number of double compression brass type cable gland shall be supplied, fitted on to these gland plates.
- vii) The panels shall be so constructed as to permit free access to connection of terminals and easy replacement of parts.
- viii) Each panel shall have a caution notice fixed on it.
- ix) Each panel will be provided with laminated as built circuit diagram suitably pasted in the panel.
- x) **Main Bus Bars**
Bus bars shall be of aluminum alloy conforming to IS: 5082 and shall have adequate cross-section to carry the rated continuous current and withstand short circuit currents. Maximum operating temperature of the bus bars shall not exceed 85 deg. C. The bus bars shall be able to withstand a fault level of 9 kA for 1 sec. for AC panels and 4 kA for 1 sec. for DC panels.

4.4.2.2

CONFIGURATION OF INDOOR AND OUTDOOR LIGHTING PANELS

Type of Panel	Description	Detail Of Feeders
ACP 1	Indoor AC Lighting panel	Bus Bars: 415V, 63A, 3 phase 4 wire bus bars with Colored LED indication lamps with fuse for each phase. Incomer: One no. 415V, 63A TPN MCB with 300mA 63A Four Pole RCCB. Outgoings: 12 nos. 230V, 16A Single Phase feeder with Single Pole MCB and 1 no. 5/15A Switch with Socket. Mounting: The indoor ACP shall be of slim depth suitable for embedding in the wall and will be flush mounted.

Section -LIGHTING SYSTEM (Rev.06)

ACP 2	Outdoor-Switchyard AC Lighting panel	Bus Bars: 415V, 63A, 3 phase 4 wire bus bars with Colored LED indication lamps with fuse for each phase. Incomer: One no. 415V, 63A TPN MCB. Outgoings: 6 nos., 230V, 20A Single Phase feeder with Single Pole MCB and 3 Nos. 230V, 32A TPN MCB with suitable timer and contactor for automatic switching and 1 no. 5/15A Switch with Socket. Mounting: Suitable for Outdoor applications.
ACP 3	Outdoor - Street AC Lighting Panel	Bus Bars: 415V, 63A, 3 phase 4 wire bus bars with Colored LED indication lamps with fuse for each phase. Incomer: One no. 415V, 63A TPN MCB. Outgoings: 3 nos. 32A TPN MCB with suitable timer and contactor for automatic switching and 1 no. 5/15A Switch with Socket. Mounting: Suitable for Outdoor applications.
DCP	Indoor-DC Lighting panel	Bus Bars: 220/110V DC (as applicable) 32A two wire Bus Bar. Incomers: 220/110V DC (as applicable) with one 32A DP Contactor backed up by 32A double pole MCB. Outgoings: 6 nos.16 A Double Pole MCB Mounting: The indoor DCP shall be of slim depth suitable for embedding in the wall and will be flush mounted
SLP	Outdoor Sub-lighting panel	Incomers: 4 pole 32A TPN MCB suitable for 415V AC supply Outgoings: 8 nos. terminal blocks suitable for cable upto 16 sq. mm cable. Mounting: Suitable for Outdoor applications with Loop in and Loop out facility.

Section -LIGHTING SYSTEM (Rev.06)

Sub-DB	Indoor Type AC Sub Distribution Box	Incomers: 32A TPN MCB suitable for 415V AC supply. Outgoings: 6 nos. 230V, 16A Single Phase feeder with Single Pole MCB. Mounting: The MCB Box shall be of slim depth suitable for embedding in the wall and will be flush mounted/surface mounted as per site requirement.
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4.4.2.3 AUXILIARY ITEMS FOR LIGHTING PANELS

(i) TERMINAL BLOCKS

Each terminal shall be suitable for termination of suitable size of Cable/Wire Conductors without any damage to the conductors or any looseness of connections.

(ii) RESIDUAL CURRENT CIRCUIT BREAKERS (RCCB)

For indoor panels (ACP 1), 63A, 4pole 300 mA RCCB conforming IS 12640 will be provided along with incomer.

(iii) MINIATURE CIRCUIT BREAKER (MCB)

- a) The miniature circuit breakers shall be suitable for manual closing, opening, automatic tripping under overload and short circuit. The MCBs shall also be trip free. MCB of Type C tripping characteristics as per IS 8828 will be used for Illumination purposes.
- b) The MCBs and MLDB panel MCCBs together shall be rated for full fault level. In case the MCB rating is less than the specified fault level the bidder shall co-ordinate these breaker characteristics with the backup MCCB in such a way that if fault current is higher than breaker rating, the MCCB should blow earlier than the MCB. If the fault current is less than MCB breaking capacity, MCB shall operate first and not the incomer MCCB.
- c) The MCBs shall be suitable for housing in the lighting panels and shall be suitable for connection with stranded copper wire connection at both the incoming and outgoing side by copper lugs or for bus bar connection on the incoming side.
- d) The terminals of the MCBs and the 'open/trip' and 'close' conditions shall be clearly and indelibly marked.

(iv) CONTACTORS

Contactors shall be of the full voltage, direct-on line air break, single throw, electro-magnetic type. They shall be provided with at least 2'NC' and 2'NO' auxiliary contacts. 3-Phase Contactor shall be provided with the three

Section -LIGHTING SYSTEM (Rev.06)

elements, positive acting, ambient temperature compensated time lagged, hand reset type thermal overload relay with adjustable settings to suit the rated current. Hand reset button shall be flush with the front of the cabinet and suitable for resetting with starter compartment door closed. The bidder shall check the adequacy of the Contactors rating, wire with respect to lighting load.

(v) PUSH BUTTONS

All push buttons shall be of push to actuate type having 2 'NO' and 2 'NC' self-reset contacts. They shall be provided with integral escutcheon plates engraved with their functions. Push buttons shall be of reputed make.

(vi) LABELS

- a) Designation labels shall be provided on the front of lighting Panels. The panel designation labels shall be of 3 mm thick plastic plate. The letter shall be black engraved on white back ground.
- b) All incoming and outgoing circuits shall be provided with labels. Labels shall be made of non-rusting metal or 3 ply lamicaid. Labels shall have white letters on black or dark blue background.

(vii) EARTHING TERMINALS

Panels shall be provided with two separate and distinct earthing terminals suitable to receive the earthing conductors of size 50x6 G.S. Flat.

4.4.3 RECEPTACLES

Suitable number of 63A, 3ph, 415V AC receptacles shall be provided for welding purposes in GIS Halls and near major equipments in switchyard. 250A/400A Receptacle shall be provided for oil filtration purpose near alternate Transformer/Reactor. All receptacles shall be of heavy duty type, suitable for fixing on wall/column and complete with individual switch. The outdoor Receptacles shall have IP 55 protection. The receptacles shall be of following types:

Type RO-20A, 240V, 3 pin type (third pin grounded) plug and socket with body earthing arrangement with Single Pole MCB, metal clad with gasket having cable gland entry suitable for 2Cx6 sq.mm. PVC/aluminum armoured cable and a metallic cover tied to it with a metallic chain and suitable for installation in moist outdoor location. Receptacles shall be housed in an enclosure made out of 2 mm thick Stainless Steel of Grade 304 with hinged doors with suitable locking arrangements. Door shall be lined with good quality gasketing.

Type RP - 63A, 415V, 3 phase, 4 pin interlocked plug and socket with body earthing arrangement with TPN MCB. The receptacle shall be suitable for 3.5C x 35/3.5Cx70 sq.mm and suitable for installation in moist outdoor location. Aluminum conductor cable entry and shall also be suitable for loop-

Section -LIGHTING SYSTEM (Rev.06)

in and loop out connection of cables of similar size. Receptacles shall be housed in a box made out of 2mm thick Stainless Steel of Grade 304, with hinged door with suitable locking arrangement. Door shall be lined with good quality gasketing.

Type RQ-1 for 250A/ Type RQ-2 for 400A, 415V, 3 phase, 4 pin, Switch Box with body earthing arrangement with TPN MCB, suitable for outdoor application. The enclosure shall be made out of 2mm thick Stainless Steel of Grade 304, with hinged door with padlocking arrangement and having cable gland entry suitable for 3.5C X 300 sq.mm XLPE armoured cable. The bus bar shall have adequate cross-section to carry the rated continuous current and withstand short circuit currents. The receptacle shall be suitable for loop-in and loop out connection of cables of similar size. Door shall be lined with good quality gasketing.

4.4.4 LIGHTING ACCESSORIES

(i) JUNCTION BOXES

- a) The Indoor junction boxes shall be provided with 4 way knockouts suitable for two numbers 10 sq. mm. wire/ Cable. These junction boxes shall be concealed type for indoor lighting.
- b) The outdoor junction boxes shall be complete with conduit knockouts/threaded nuts and provided with terminal strips. The junction boxes shall be suitable for termination of Cable glands of required size. The junction boxes shall be provided with 4 way knockouts suitable for street lighting/switchyard lighting terminals suitable for 2 numbers 4C x 16 Sq.mm Al. cable or as per requirement. All Outdoor Junction boxes shall be of Stainless Steel of thickness 1.6mm of grade 304. Outdoor Junction Boxes shall be suitable for mounting on columns, structures etc for Outdoor Lighting. The outdoor Junction shall have IP 55 protection.
- c) The junction boxes shall have the following indelible markings
 - (i) Circuit Nos. on the top.
 - (ii) Circuit Nos. with ferrules (inside) as per drawings.
 - (iii) DANGER sign in case of 415 volt junction box.

(ii) OCCUPANCY SENSORS:

Occupancy sensors for indoor use shall be provided in the toilets, stairs area, corridors, Relay room (in case of Centralized Control room), Local Control Room (LCR) in GIS Building. Each occupancy sensor shall be used with suitable programmable time delay to control the illumination in the area. Cost of Occupancy Sensors and associated wiring shall be deemed included in the Illumination System of respective Buildings.

(iii) SWITCH AND SWITCHBOARD

- a) All Switch board/boxes and electronic fan regulators (Step wise) located in office/building areas shall be modular flush mounted type.

Section -LIGHTING SYSTEM (Rev.06)

- b) Switch boards/boxes shall have conduit knock outs on all the sides.
- c) The exact number of Switches including regulator for fans and layout of the same in the switchboard shall be suitable as per the requirement during installation.
- d) The maximum number of luminaries controlled by one no. 6 Amp Switch shall be 8 nos. However each Switchboard shall have minimum 2 Nos. of 6A Switches to control the Luminaries. For DC fixtures there will be no switch and the same shall be directly controlled from DCP.
- e) The Luminaries shall be wired in such a fashion that luminaries on each phase are evenly distributed all over the room.
- f) 6/16A, 240V AC modular flush mounted socket with switch outlet shall be provided in indoor areas like offices, cabins, Switchyard Panel Room etc.
- g) 25A, 240V AC modular flush mounted socket with switch shall be provided at strategic locations in GIS Halls, ACDB/Switchgear room etc.

(iv) CONDUITS & CONDUIT ACCESSORIES

- a) The conduits shall be Rigid PVC conduits of 20/25 /32 mm dia for Lighting, Telephone wiring & LAN Cabling and shall be ISI marked.
- b) Flexible conduits wherever required shall be PVC type.
- c) All conduits accessories shall be ISI marked.
- d) Galvanized Steel Conduits for Surface Conductor (e.g. GIS Hall).

(v) PULL OUT BOXES

- a) The pull out boxes shall be concealed type for indoor lighting and suitable for mounting on column, structures etc., for outdoor lighting. The supply of bolts, nuts and screws required for the erection shall be included in the installation rates.
- b) The pull out boxes shall be circular of minimum 16 SWG sheet steel and shall have cover with good quality gasket lining.
- c) The pull out boxes shall be completed with conduit knock outs/threaded hubs and provided at approximately 3 meters intervals in a conduit run.

(vi) CEILING, WALL MOUNTED & EXHAUST FANS AND REGULATORS

- a) The bidder shall supply and install 1400 mm sweep ceiling fans complete with electronic regulator and board for mounting switch, suspension rod,

Section -LIGHTING SYSTEM (Rev.06)

canopy and accessories. The electronic regulator for Ceiling fans will be housed in common switchboard for lighting and shall be of similar make and model as that of modular switches. The wall mounted fans shall be of 400 mm sweep. Exhaust fans shall be of 300mm size.

- b) Winding of the fans shall have Class-E insulating material. Winding shall be of copper wire.

(vii) LIGHTING WIRES

- a) Wiring from Lighting/Sub-Lighting Panels to junction boxes / Switchboards/ fixtures etc. is covered under Lighting Wires. The wiring used for lighting shall be standard products.
- b) The wires shall be of 630V grade (Phase to ground), PVC insulated products.
- c) The conductor sizes for wires used for point wiring beyond lighting panels shall be 1.5 sq.mm, 2.5 sq.mm, 4 sq.mm and 6 sq.mm stranded copper wire as required.
- d) The wires used for connection of a lighting fixture from a nearest junction box or for loop-in loop-out connection between two fixtures shall be single core copper stranded conductor, 630V grade (Phase to ground) flexible PVC insulated cords, unsheathed, conforming to IS:694 with nominal conductor cross sectional areas of 2.5 sq. mm.
- e) The wires shall be colour coded as follows:

Red for R - Phase
Yellow for Y - Phase
Blue for B - Phase
Black for Neutral
White for DC (Positive)
Grey for DC (Negative)
Green for Earth

4.4.5 LADDER

Following ladders shall be supplied as per BPS for maintenance purpose of illumination system:

- (i) A type Aluminum ladder of 3 Mtr vertical height.
- (ii) Cartwheel mounted aluminum ladder Vertical Extendable from 5.1m to 11m.

4.4.6 LIGHTING POLES

- (i) The bidder shall supply, store and install the following types of galvanized steel tubular lighting poles required for street lighting and decorative lighting, as per the attached drawing of poles.
 - (i) Type L1 Street Lighting Pole of 6 meter - for SL-L1 type fixture

Section -LIGHTING SYSTEM (Rev.06)

- (ii) Type D1 Post top lantern pole of 4 meter - for SI-D1 type fixture
- (ii) "L1" type poles shall be used for street lighting. "D1" type (Decorative post top lantern) poles and Bollards shall be installed In front of control room building, Fire Fighting Buildings as finalized during detailed engineering.
- (iii) Lighting poles shall be complete with fixing brackets. Cable termination box will be built inside the pole itself as per drawing enclosed.
- (iv) Poles and its Cable termination box shall be hot dip galvanized and PU (Polyurethane) coated in Suzuki silver color and inside with bituminous paint.
- (v) Terminal strips provided in street - lighting poles shall be suitable for terminating up to 2 nos. 4C x 16 sq. mm aluminum cables.
- (vi) Wiring from junction box at the bottom of the pole to the fixture at the top of the pole shall be done through 2.5 sq. mm Copper wire laid inside the tubular pole.
- (vii) Distance of center of pole from street edge should be approximately 1000 to 1200 mm or as per site conditions.
- (viii) Earthing of the poles should be connected to the switchyard main earth mat wherever it is available, else, the same should be earthed through 3M long, 20 mm dia, earth electrode.

4.4.7

TYPE TEST REQUIREMENT:

- a) Lighting Panels, Receptacles, Junction Boxes etc. shall conform to following degree of protection:
 - (i) Installed outdoor: IP- 55
 - (ii) Installed indoor in air conditioned area: IP-31
 - (iii) Installed in covered area: IP-52
 - (iv) Installed indoor in non-air conditioned area where possibility of entry of water is limited: IP-41.
- b) Lighting fixtures LED type shall conform to type test requirements of LM-79, LM-80 and TTC.

5

LIGHTING SYSTEM INSTALLATION WORKS

5.1

General

In accordance with the specified installation instructions as shown on manufacturer's drawings or as directed by Employer, Contractor shall unload, erect, install, test and put into commercial use all the electrical equipment included in the contract. Equipment shall be installed in a neat, workmanship manner so that it is level, Plumb Square and properly aligned and oriented. Tolerances shall be as established in manufacturers drawing or as stipulated by Purchaser.

Section -LIGHTING SYSTEM (Rev.06)

All apparatus, connections and cabling shall be designed so as to minimize risk of fire or any damage which will be caused in the event of fire. All Lighting accessories mentioned in Clause 1.5.4 shall be supplied and erected as a part of Lighting System Installation works. Cost of all Lighting Accessories, Conduit System, Wiring Cabling work, Foundation & Civil Works is built up in the Cost of the Fixture and no extra payment shall be made for any accessories items for the same.

5.2

Conduit System

- (i) Contractor shall supply, store and install conduits required for the lighting installation as specified. All accessories/fittings required for making the installation complete, including but not limited to pull out boxes (as specified in specification ordinary and inspection tees and elbow, check nuts, male and female bushings (brass or galvanized steel), caps, square headed make plugs, nipples, gland sealing fittings, pull boxes, conduits terminal boxes, glands, gaskets and box covers, saddle terminal boxes, and all steel supporting work shall be supplied by the Contractor. In case of false ceiling surface conduiting is permissible however all down run conduits will be concealed in wall below the false ceiling. The conduit fittings shall be of the same material as conduits. Separate Conduit should be laid for Communication purpose. The contractor shall also supply & install 20 mm PVC conduit and accessories for telephone wiring and LAN Cabling wherever feasible, telephone and LAN cabling can be laid in the same conduit.
- (ii) All unarmored cables/wires shall run within the conduits from lighting panels to lighting fixtures, receptacles, etc.
- (iii) Size of conduit shall be suitably selected by the bidder.
- (iv) Conduit support shall be provided at an interval of 750 mm for horizontal runs and 1000 mm for vertical runs.
- (v) Conduit supports shall be clamped-on spacer plates or brackets by saddles or U-bolts. The spacer plates or brackets in turn, shall be securely fixed to the building steel by welding and to concrete or brick work by grouting or by nylon raw plugs. Wooden plug inserted in the masonry or concrete for conduit support is not acceptable.
- (vi) For directly embedding in soil, the conduits shall be coated with an asphalt-base compound. Concrete pier or anchor shall be provided wherever necessary to support the conduit rigidly and to hold it in place.
- (vii) For long conduit run, pull boxes shall be provided at suitable intervals to facilitate wiring.
- (viii) Conduit shall be securely fastened to junction boxes or cabinets, each with a lock nut inside and outside the box.
- (ix) Conduits joints and connections shall be made through water-tight and rust proof by application of a thread compound which insulates the joints. White

Section -LIGHTING SYSTEM (Rev.06)

lead is suitable for application on embedded conduit and red lead for exposed conduit.

- (x) The entire GI conduit system (if used) shall be embedded, electrically continuous and thoroughly grounded. Where slip joints are used, suitable bounding shall be provided around the joint to ensure a continuous ground circuit.
- (xi) Conduits and fittings shall be properly protected during construction period against mechanical injury. Conduit ends shall be plugged or capped to prevent entry of foreign material.

5.3 Wiring

- i) The scope also includes wiring from nearest Lighting/Sub-Lighting Panel to the Controlling Switch/MCB/Lighting Fixtures.
- ii) Wiring shall be generally carried out by PVC insulated wires in conduits. All wires in a conduit shall be drawn simultaneously. No subsequent drawings of wires is permissible.
- iii) Wires shall not be pulled through more than two equivalent 90 deg. bends in a single conduit run. Where required, suitable junction boxes shall be used.
- iv) Wiring shall be spliced only at junction boxes with approved type terminal strip.
- v) For lighting fixtures, connection shall be teed off through suitable round conduit or junction box, so that the connection can be attended without taking down the fixture.
- vi) For vertical run of wires in conduit, wires shall be suitably supported by means of wooden/hard rubber plugs at each pull/junction box.
- vii) Maximum two wires can be terminated to each way of terminal connections.
- viii) Separate neutral wires are to be provided for each circuit.
- ix) AC and DC wiring should run through the separate conduits. Similarly Communication wire/cable shall run in separate conduits.

5.4 Lighting Panels

- i) The lighting panels shall be erected at the locations to be finalized during detailed engineering.
- ii) Suitable foundations/supporting structures for all outdoor type lighting panels shall be provided by the Contractor.
- iii) The Sub lighting Panel shall be provided where independent switch of fixtures are required.

Section -LIGHTING SYSTEM (Rev.06)

5.5 General Requirements for Cabling Work

- i) Each cable run shall be tagged with number that appears in the cable schedules. Cables shall be tagged at their entrance and/or exit from any piece of equipment, junction or pull box, floor opening etc.
- ii) The tag shall be made up of aluminum with the number punched on it and securely attached to the cable by not less than two turns of G.I. wire. Cable tags shall be rectangular in shape for power cables and circular shape for control cables.
- iii) Location of cables laid directly under ground shall be indicated clearly by cable marker made of galvanized iron plate embedded in concrete block.
- iv) The location of underground cable joints if any shall be clearly indicated with cable marker with an additional inscription "cable joint".
- v) The marker, which is a concrete block, shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change of direction. It shall also be located on both sides of the road or drain crossing.
- vi) Road crossing of cables through suitable size of GI pipe/Hume pipe as required at site.

5.6 Foundation & civil works

- i) Foundation for street lighting poles and panels shall be done by the Contractor.
- ii) All final adjustment of foundation levels, chipping and dressing of foundation surfaces, setting and grouting of anchor bolts, sills, inserts and fastening devices shall be carried out by the Contractor including minor modification of civil works as may be required for erection.
- iii) Any Cutting of masonry/concrete work, which is necessary shall be done by the Contractor at his own cost and shall be made good to match the original work.

32

Section -LIGHTING SYSTEM (Rev.06)

ANNEXURE-I

BILL OF QUANTITY

Sr. No	Locations	Type & No of Lighting Fixture	With Anti Glare Film over the Fixture(Yes/No)
01.	Control Room cum Administrative Building-Single Storey (As applicable)		
(i)	Control Room	RSQ-I: 10 Nos.	Yes
(ii)	Station- In Charge (DGM Room)	RSQ-I: 4 Nos. and RC-I : 4 Nos.	Yes
(iii)	Administrative Area	RSQ-I: 12 Nos. and RC-I : 9 Nos.	Yes
(iv)	Conference Room	RSQ-I: 9 Nos. and RC-I : 4 Nos.	Yes
(v)	Electrical Room/Telecommunication Room	RSQ-I: 4 Nos. and RC-I : 2 Nos.	Yes
(vi)	ACDB/DCDB Room	SL-I: 16 Nos.	Yes
(vii)	Battery & Battery Charger Room	SL-I: 6 Nos.	Yes
(viii)	Corridor & Reception	SC-I: 8 Nos. and SL-I: 2Nos.	Yes
(ix)	Toilets	SC-I: 8 Nos.	No
(x)	Pantry	SL-I: 2 Nos. and SC-I: 1 No.	Yes
(xi)	Periphery of the Building	BL: 10Nos.	No
02.	Control Room cum Administrative Building- Double Storey (As applicable)		
(i)	Control Room	RSQ-I: 12 Nos.	Yes
(ii)	Station- In Charge (Sr. Officer Room)	RSQ-I: 4 Nos. and RC-I : 2 Nos.	Yes
(iii)	Administrative Area	RSQ-I: 16 Nos. and RC-I : 12 Nos.	Yes
(iv)	Conference Room	RSQ-I: 9 Nos. and RC-I : 5 Nos.	Yes
(v)	Electronic Test Lab/Telecommunication Room	RSQ-I: 4 Nos.	Yes
(vi)	ACDB Room	SL-I: 16 Nos.	Yes
(vii)	DCDB Room	SL-I: 9 Nos.	Yes
(viii)	Battery & Battery Charger Room	SL-I: 6 Nos.	Yes
(ix)	Store	SL-I: 6 Nos.	No
(x)	Lobby/ Waiting Area	SSQ-I: 5 Nos. and RC-I : 4 Nos.	Yes
(xi)	Toilet	SC-I: 12 Nos.	No
(xii)	Pantry	SL-I: 2 Nos. and SC-I: 1 No.	Yes
(xiii)	Corridors	SC-I: 36 Nos. and SL-I: 6 Nos.	No
(xiv)	Periphery of the Building	BL: 15 Nos.	No
03.	GIS Building*		
(i)	765kV GIS Hall	IHB: 10 Nos. per 100 Sq. meter	No
(ii)	400kV GIS Hall	IHB: 8 Nos. per 100 Sq. meter	No
(iii)	220kV GIS Hall	IHB: 6 Nos. per 100 Sq. meter	No
(iv)	AHU Room	SL-I: 8 Nos. per 100 Sq. meter	Yes
(v)	C&R Room	RSQ-I: 10 Nos. per 100 Sq. meter	Yes
04.	Fire Fighting Pump House		
(i)	FFPH Building	SL-I: 9 Nos.	Yes
(ii)	Periphery of the Building	BL: 4 Nos.	No
05.	Switchyard Panel Room (SPR) (9 meter)	SSQ-I: 10 Nos.	Yes
06.	Switchyard Panel Room (SPR) (6 meter)	SSQ-I: 8 Nos.	Yes
07.	Switchyard and Outdoor Substation Area	FL-1 & FL-2: As per BPS	No
08.	Street lighting roads	SL-LI & SL-DI: As per BPS	No

Sr. No	Items	Quantity & Locations
1.	Ceiling Fans	15 Nos.-ACDB/DCDB Room , Reception, FFPH Building & Staff Room
2.	Wall Mounted Fans	6 Nos. Test Lab, Admin. Area & Control Room
3.	Exhaust Fans	8 Nos. FFPH Building, Pantry & Toilets

For GIS Building (Sl. No.3), based on actual area, the Quantity of Lighting Fixtures shall be supplied as per Pro-rata basis for which Bidder has to include in his offer total Quantity of Lighting Fixtures required for entire area of GIS Building to be constructed under the package.

Section -LIGHTING SYSTEM

ANNEXURE-II

Details of Lighting Fixture

(a) Indoor Application

Sr. No	Technical Specification	SL-I (Surface Mounted Linear LED Tube with Box)	RL-I (Recessed Mounted 4 x 1 Feet LED Panel)	SC-I (Surface Mounted Circular LED Downlight Luminaire)	Type RC-I (Recessed Mounted Circular LED Downlight Luminaire)	Type SSQ-1 (Surface Mounted 2X2 LED Luminaire)	Type RSQ-1 (Recessed Mounted 2x2 LED Luminaire)	Type IHB (LED Indoor High Bay)
1	System Wattage	≤ 2 X 20 W	≤ 40 W	≤ 15 W	≤ 15 W	≤ 40 W	≤40 W	≤150W
2	System Lumen Output	≥ 3600	≥ 3600	≥ 1200	≥ 1200	≥ 3400	≥ 3400	≥14000
3	System efficacy (Lumens/Watt)	≥ 100	≥ 100	≥ 80	≥ 80	≥ 85	≥ 85	≥ 100
4	Housing	CRCA Housing	CRCA Housing	Pressure Die Cast Housing	Pressure Die Cast Housing	CRCA Housing	CRCA Housing	Pressure Die Cast Aluminum Housing
5	Ingress Protection	IP20	IP-20	IP20	IP-20	IP-20	IP-20	IP-65
6	Surge Protector	2kV	2kV	2kV	2kV	2kV	2kV	4kV (Internal) & 10kV (External)
7	Mounting	Surface Mounted	False Ceiling	Surface Mounted	False Ceiling	Surface Mounted	False Ceiling	Hanging Type under Shed
8	THD	<10%	<10%	<10%	<10%	<10%	<10%	<10%
9	CRI	>80	>80	>80	>80	>80	>80	>70
10	CCT	5700k±300k	5700k±300k	5700k±300k	5700k±300k	5700k±300k	5700k±300k	5700k±300k
11	Power Factor	>0.95	>0.95	>0.95	>0.95	>0.95	>0.95	>0.95
12	Ik Protection	NA	NA	NA	NA	NA	NA	IK-05
13	Operating Humidity	90% RH	90% RH	90% RH	90% RH	90% RH	90% RH	90% RH
14	Burning Hours	50,000	50,000	50,000	50,000	50,000	50,000	50,000
15	Operating Temperature	-5°C to 45°C						
16	Lumen Maintenance	70% at the End of Burning Hours						

Section -LIGHTING SYSTEM

Details of Lighting Fixture

(b) Outdoor Application

Sr.No	Technical Specification	BL (Surface Mounted Bulk Head)	Type SL-L1 (LED Street Light Luminaire)	Type SL-D1 (Pole Mounted LED Post Top Luminaire)	Type FL-1 (LED Flood Light Luminaries)	Type FL-2 (LED Flood Light Luminaries)
1	System Wattage	≤ 10W	≤45W	≤ 30W	≤150W	≤250W
2	System Lumen Output	≥ 800	≥4000	≥ 2600	≥ 14000	≥ 23000
3	System efficacy (Lumens/Watt)	≥ 80	≥ 100	≥ 90	≥ 100	≥ 100
4	Housing	Pressure Die Cast Housing and with Polycarbonate diffuser	Pressure Die Cast	Die Cast Aluminum	Pressure Die Cast Housing	Pressure Die Cast Housing
5	Ingress Protection	IP-65	IP-65	IP-65	IP-65	IP-65
6	Surge Protector(Internal)	3kV	3kV	3kV	3kV	3kV
7	Surge Protector(External)	10kV	10kV	10kV	10kV	10kV
8	Mounting	Wall Mounting	Pole Mounting for 40mm max O.D	Suitable for 60mm max O.D	On Lattice Structure	On Lattice Structure
9	THD	<20%	<10%	<10%	<10%	<10%
10	CRI	>70	>70	>70	>70	>70
11	CCT	5700k±300k	5700k±300k	5700k±300k	5700k±300k	5700k±300k
12	Power Factor	>0.90	>0.95	>0.95	>0.95	>0.95
13	Ik Protection	IK-09	IK-05	IK-05	IK-05	IK-05
14	Operating Humidity	90% RH	90% RH	90% RH	90% RH	90% RH
15	Burning Hours	50,000	50,000	50,000	50,000	50,000
16	Operating Temperature	-5°C to 45°C				
17	Lumen Maintenance	70% at the End of Burning Hours				

31

Section -LIGHTING SYSTEM

Annexure-III

Technical Specification of Grid Interactive Solar PV Power Plant

1.0 Scope of Work

Design, manufacture, supply, erection, testing and commissioning of "Grid Interactive Solar PV Power Plant of PV array capacity 15 kWp over Control Room . This installation shall be a supplement source to ACDB Bus, to save on conventional energy supply from the grid during solar energy generation from the plant.

The equipment and materials for grid interactive Solar PV Power Plant of array capacity 15 kWp shall include but not limited to the following:

- a) PV Modules (Crystalline)
- b) Module Mounting Structure and frames
- c) Array Terminal Box
- d) Grid Interactive Inverters
- e) AC Sub Junction Box
- f) Grid interfacing LT Panel
- g) Three Phase Import/ Export Energy Meter
- h) Cable & Wires
- i) Chemical Gel Earthing system
- j) Civil works for Foundation of PV Array
- k) Integration with SAS
- l) Signage (Project Name Plate and caution as per IS)

All civil works associated with the installation & commissioning of PV Array shall have to be done by the Contractor including the necessary structural work. The Solar PV Module will be installed over the Control Room Building while the LT panels Inverters etc will be placed in ACDB Room of Control Room Building. The Contractor shall specify and submit detail GA drawing indicating indoor equipments as well as PV Array.

Special maintenance tools and tackle kits which are proprietary in nature) as identified by the Contractor and other associated materials and accessories, which is necessary or usual for satisfactory and trouble-free operation and maintenance of the above equipment

2.0 Codes and Standards

All equipment and materials to be furnished under this specification shall be designed, manufactured and tested in accordance with the latest revisions of the relevant Indian Standard (IS)/IEC as applicable.

The electrical installation shall meet the requirement of Indian Electricity Act, and Indian Electricity Rules as amended up-to-date and also the applicable section of the latest revision of the relevant IS Code of Practice.

3.0 Completeness of Supply

It is not the intent to specify completely herein all details of the equipment. Nevertheless, the equipment shall be complete and operative in all aspects and shall

Section -LIGHTING SYSTEM

conform to highest standard of engineering, design and workmanship in order to suit with installation site with optimal output.

Such works, not listed in the schedule of works but required for completion of the project shall be deemed to have been included in the scope of this bid.

4.0 Solar PV Modules

Desired specification of Solar PV module shall include but not limited to the following:-

- Total power plant capacity of Solar PV Array shall be 15 kWp
- Cell of the Modules shall be mono or poly crystalline high power silicon cells. The solar cells shall have surface anti-reflective coating to help to absorb more light in all weather conditions
- Each PV module capacity shall be minimum of 300Wp nominal rating (without any negative tolerance)
- The PV modules must qualify the latest edition of relevant IEC 61215 or IS 14286. The module shall also qualify for IEC 61730 for safety qualification: Part 1-requirement for construction and Part-2 requirements for testing. It should also comply IEC 61701 for Salt Mist Corrosion resistant & IEC 62716 for Ammonia Corrosion resistant.
- Photo Electric Conversion Efficiency of SPV module shall not be less than 15.5%
- Fill factor of the module shall not be less than 0.7
- Each module shall have superior light transmission, low iron, tempered & textured glass with anti reflective coating. It shall also have tough multi-layered polymer back sheet for environmental protection against moisture & provide high voltage electrical insulation.
- Solar PV module shall be highly reliable, light weight and shall be designed to have a long service life.
- The rated output of any supplied module shall not vary by more than 3% from average power rating of all ratings. Each module, therefore, has to be tested and rating displayed.
- The solar modules should have suitable encapsulation & sealing arrangements to protect the silicon cells from the environment. The encapsulation arrangement shall ensure complete moisture proofing for the entire life of solar modules.
- Contractor must consider shading losses as per the relevant industry standard & Practice while designing the proposed power plant.
- The bird spike shall be provided to avoid bird sitting on the solar modules at the highest point of the array/module structure.
- The Solar PV modules are to be installed & fixed with the module mounting structures with appropriate size nuts & bolts made with stainless steel.
- It shall perform satisfactory in relative humidity up to 95% and temperature between -40° C to 85° C. It shall be able to withstand wind gusts as per IS-875 (Part-3) as applicable for respective site.
- PV module junction box shall be IP67 protection class as per IEC 529

Section -LIGHTING SYSTEM

- The Contractor shall provide the sample solar PV module electrical characteristics including current-voltage (I-V) performance curves and temperature coefficients of power, voltage and current of the proposed PV Module (s).
- The following information must be mentioned on the Nameplate used on each module :
 - Name of the manufacturer of PV Module
 - Name of the manufacturer of Solar cells
 - Month and year of the manufacture (separately for solar cells and modules)
 - Country of origin (separately for solar cells and module)
 - I-V curve for the module
 - Peak Wattage, I_m , V_m and Fill Factor for the module
 - Unique Serial No. and Model No. of the modules
 - Date and year of obtaining IEC PV module qualification certificate
 - Name of the test lab issuing IEC certificate
 - Other relevant information on traceability of solar cells and module as per ISO 9000.
- Manufacturer of proposed PV modules must have ISO 9001:2008/ ISO 14001 Certification for their manufacturing unit for the said manufacturing item.

5.0 Module Mounting Structure and frames

- Entire system to be placed by providing necessary steel structures properly grouted on the ground. Any damage done to the roof to be made right after the installation.
- The array structure shall be made of hot dip galvanized MS angles or galvanized tubular frame. The minimum thickness of the galvanization shall be as per Section-GTR.
- The structure shall be designed for simple mechanical and electrical installation. It shall support SPV modules at a given orientation, absorb and transfer the mechanical loads to the ground properly.
- The array structure shall be so designed that it will occupy minimum space without sacrificing the output from SPV panels. The structure shall be designed to allow easy replacement of any module & shall be in line with the site requirement. Array structure shall also have tilt arrangement to adjust the plane of the array for optimum tilt.
- The module mounting structure shall have to be designed and fabricated with alignment & optimum tilt angle shall be calculated to provide the maximum annual energy output. This shall be decided based on the location of array installation.
- Minimum Ground Clearance of the lowest part of the module structure should be at least 700mm.
- The support structure design & foundation shall be designed to withstand wind gust as per IS -875 (Part-3) for the respective site conditions.

Section -LIGHTING SYSTEM

- All fasteners for supporting conduits, Nut & Bolts shall be of stainless steel (Grade SS 304), supporting structures including module mounting structure shall have to be adequately protected against all climatic condition
- The array structure shall be grounded properly using maintenance free earthing kit. Since Solar PV Module are roof top mounted , all arrangement for grounding is in the scope of the Contractor.

6.0 Array foundation

The legs of the structures shall be made with hot dip GI angles or tubular supports, which shall be grouted on the concrete foundation. The base plate arrangement may be made on RCC blocks. Grade of concrete for all RCC blocks shall be 1:1.5:3 mix.

The minimum ground clearance from the lowest part of any module shall be 700 mm. While making design, due consideration will be given to weight of module assembly, maximum wind gust as per IS -875 (Part-3) for the respective site conditions. The work includes concreting, reinforcement, shuttering etc. as per direction of POWERGRID.

7.0 Array Terminal Box/Array Junction Box/DCDB

- The junction boxes will have suitable cable entry points fitted with cable glands of appropriate sizes for both incoming and outgoing cables.
- The array combiner box shall have IP 65 protection level as per IEC 529 and shall be dust and water proof.
- The array combiner box shall be fitted with input and output terminals, surge suppressors and DC MCBs.
- Suitable markings shall be provided on the lugs or bus-bar for easy identification and cable ferrules will be fitted at the cable termination points for identification.
- The mounting of the accessories in the Combiner Box should be DIN Rail type.
- The Junction Boxes shall have suitable arrangement for the followings:
 - Combine groups of modules into independent charging sub-arrays.
 - Provide arrangement for disconnection for each of the groups.
 - Provide a test point for each sub-group for quick fault location.
 - To provide group array isolation.
 - Current carrying rating of the Junction Boxes shall be suitable with adequate safety factor to inter connect the Solar PV array.
- The make of Junction Boxes/associated accessories like surge suppressors, DC MCBs shall be as per acceptability of POWERGRID

The array combiner box and all of its accessories should be such that it is specifically rated/made for the use of PV system as to be declared by the original manufacturer.

Note : Switches/Circuit Breakers/Connectors wherever used must comply to IEC 60947 Part-1,II,III/ EN 50521 towards General requirements Connectors-Safety (AC/DC)

8.0 Grid Connected Inverter Panel

The inverter shall be pure sine wave inverter of high efficiency. Inverters shall have display to show its own parameters along with the parameters of PV array connected to the Inverter. The inverter shall be compatible as On Grid Connected Mode (Synchronization with grid). The proposed inverter must have test certificates /

Section -LIGHTING SYSTEM

reports from any of the NABL/ IEC Accredited Testing Laboratories or MNRE approved test centers. Desired specification of inverter shall include but not limited to the following:

- The inverter shall be highly efficient based on Maximum Power Point Tracking (MPPT) control with IGBT based design. MPPT must be able to extract maximum energy from Solar array and produce 415 V, 3-ph, 50Hz AC to synchronize with the grid through LT panels.
- MPPT controller, inverter and associated control and protection devices etc. all shall be integrated into Inverter. MPPT voltage range shall be compatible with the array voltage.
- The rating of Inverter(s) shall be suitable to meet Solar PV array capacity
- Inverter shall provide 3 phase, $415 \pm 10\%$ V, $50 \pm 3\%$ Hz supply on AC side with THD < 3%.
- DC voltage ripple content shall not be more than 3%.
- Inverter should have built in Module Level Monitoring.
- Rated AC Output Power should be 16000 watt and must have fixed voltage 750V.
- Maximum input voltage should not be less than 900 V.
- Maximum DC Power Module should not be less than 21600 watt.
- Efficiency (Maximum) of Inverter shall not be less than 98% and Euro efficiency (weighted) shall not be less than 97%.
- Degree of protection should not be less than IP-21 (in case of Indoor placements) or IP-65 (in case of Outdoor placement) as per IEC 529
- It shall have protection features such as over voltage, under voltage, Short circuit, over temperature, Over Current, over and under grid frequency protection and Anti islanding protection on AC side.
- The system should be capable of providing all the data including that of meter and Inverter to the central software. All the equipments /hardware /software for complying to the same will be in the Contractor's scope.
- Inverter shall be grid interactive in nature.
- Inverter shall be capable of complete automatic operation, including wake-up, synchronization & shut down. Inverter shall have DSP control and shall operate in sleeping mode, when there is no power connected consuming least power consumption to the extent possible.
- Inverter shall continuously monitor the condition of the grid. In the event of grid failure, it shall resynchronize with system in less than two (2) minutes time after the restoration of grid or DG set.
- The Inverter shall not produce Electromagnetic interference (EMI) which may cause malfunctioning of electronic and electrical instruments including communication equipment, which are located within the facility in which the inverter is housed.
- Inverter shall conform to IEC 61683 standard for efficiency measurements, IEC 60068-2 (1, 2, 14, 30)/ equivalent BIS std. for environmental testing.

Section -LIGHTING SYSTEM

- Inverter to be communicable for remote monitoring through SCADA system. Inverter shall have facility to display basic parameters of the system through LEDs & LCD display.

Display

- Grid Voltage & Frequency
- Export Power
- Import Power
- Cumulative Export and Import Energy

Indications

- Line Status
- Inverter under voltage/ over voltage
- Inverter over load
- Inverter over temperature.

Protections

- Over voltage both at input & output
- Over current both at input & output
- Over/ under grid frequency
- Over temperature
- Short circuit
- Protection against lightning
- Surge voltage induced at output due to external source.

9.0 Power Optimizer

- Power Optimizer must Provide Module Level Monitoring.
- Efficiency should not be less than 99.5%.
- Rated DC Input Power should be 700 watt.
- MPPT Operating range should be within 12.5-105 V.
- Unique Safe DC which ensure rapid shutdown when AC grid turned off.
Safety Output voltage per Power Optimizer should be 1Vdc.
- It should have real time power measurement characteristic.
- Short circuit current must be 10.1 A & Output current 15A.

10.0 Power Quality Requirements

- DC Injection into the grid:** The injection of DC power into the grid shall be avoided by using an isolation transformer or other suitable means at the output of the inverter. It is proposed to limit DC injection within 1% of the rated current of the inverter as per IEC 61727.
- Harmonics on AC side**
 - The limits for harmonics shall preferably be as stipulated in the CEA Regulations on grid connectivity.

Section -LIGHTING SYSTEM

(b) Voltage Unbalance-The Voltage Unbalance in the grid shall not exceed the permissible limits.

(iii) Voltage Fluctuation

(a) The permissible limit of voltage fluctuation for step changes which may occur repetitively is 1.5%.

(b) For occasional fluctuations other than step changes the maximum permissible limits is 3%.

11.0 Integration with Substation Automation System

Solar PV Plant System shall have provision of following digital inputs for owner's substation automation purpose. These digital inputs shall be made available in the form of potential free contacts to be provided in respective modules. These potential free contacts shall be wired up to respective terminal blocks.

- Monitoring of PV Array/String Power & Energy (Daily/Monthly/Energy) .
- Monitoring of Inverter output data like export/ import of Power & energy, power factor etc.

12.0 AC Distribution/Grid Interface Panel

AC power output of the inverter shall be fed to the AC Distribution Board (metering panel & isolation panel) which also houses energy meter.

All the output of Inverter shall be terminated to the Solar AC Panel through MCCB at the incoming bus (Inverter side). The incoming bus shall be connected to ACDB Bus through a MCCB and an Isolator. Output of Solar AC panel shall be terminated at ACDB bus through separate feeders in such a manner that in the event of non availability of one bus/feeder, Solar PV should continue to feed other healthy bus.

13.0 Energy Meter

3 Ø, 4 wire, 415V AC, Import/ Export Energy Meter (0.5 Class accuracy) of suitable current capacity of any reputed make acceptable to POWERGRID. Meter must be provided with the necessary data cables. The Meter to be supplied must be tested from any of the NABL/ BIS Accredited Testing-Calibration Laboratories. It shall also comply with the requirements of CEA Regulations on "Installation and Operation of Meters". The Energy meter shall be installed at the incoming of the Grid interfacing LT panel.

14.0 Cables & Wirings:

The Specification of wiring material shall include but not limited to the following:

- Rated Voltage for AC/DC cables suitable/ compatible for Installation (AC:0.6/1.1kV, DC:0.9/1.5kV)
- Temp. Range (-)10°C to (+)85°C.
- Will comply IEC 60502/ IS 7098 General Test and Measuring Method XLPE cables for working voltage up to and including 1100 V and UV resistant for outdoor installation]

Section -LIGHTING SYSTEM

- Excellent resistance to Heat, Fire, Oil, cold, water, abrasion, UV radiation
 - Flexible
- i) All cables except the cable from Solar panel to DC junction box i.e. solar cable must be armored.
 - ii) Conductor size of cables and wires shall be selected based on efficient design criteria such that the overall electrical energy loss in any section of cable or wire is not more than 3% under the designed operating conditions. Also wiring size of PV array shall be designed such that maximum voltage drop at full power from the PV modules to Inverter should be less than 3%.
 - iii) Cable terminations shall be made with suitable cable lugs & sockets etc, crimped properly and cables shall be provided with dry type compression glands wherever they enter junction boxes/ panels/ enclosures at the entry & exit point of the cubicles. The panels bottoms should be properly sealed to prevent entry of snakes/lizard etc. inside the panel. All cables shall be adequately supported. Outside of the terminals / panels / enclosures, shall be protected by conduits. Cables and wire connections shall be soldered, crimp-on type or thimble or bottle type.
 - iv) Only terminal cable joints shall be accepted. Cable joint to join two cable ends shall not be accepted.
 - v) The cable must be laid through PVC conduit or metallic pipe. In case of using metallic pipe as conduit proper grounding of the conduit must be done.
 - vi) All cable/wires shall be marked with good quality letter and number ferrules of proper sizes so that the cables can be identified easily.
 - vii) All cable shall be suitably marked or coded for easy identification. Cables and wires shall confirm to the relevant standards like IS etc.
 - viii) Cable tray (metallic preferably aluminum) of suitable size must be used for laying of cable wherever required to protect cable from physical damage.
 - ix) All fasteners shall be made of Stainless steel.

14.1 Lightning & Over Voltage Protection

- SPV Power Plants will be provided with Lightning and Over Voltage Protection connected to proper earth mats.
- The Lightning conductors shall be provided as per Indian Standards (IS) in order to protect the entire Solar Array yard from Lightning strikes.
- Necessary concrete foundation for holding the lightning arresters in position will be made after giving due consideration to maximum wind speed.
- Lightning arresters shall be earthed through flats and connected to earth mats as per applicable IS with Chemical Gel earth pits.
- Necessary Masonry enclosure with proper protection of the earth pit to be provided.

14.2 Earthing

- The complete Solar PV power Plant with all its accessories will be grounded, so that in the event of a lightning strike or utility over voltage, current will find a safe path to earth. Note that a separate grounding would be provided for this purpose, separate from the one used for lightning conductor.
- Solar PV array structure shall be grounded properly as per IS standard.

Section -LIGHTING SYSTEM

- The earth conduction shall run through appropriate pipes partly buried and partly on the surface. The complete earthing system shall be mechanically & electrically connected to provide independent return path to earth.

15.0 Signage:

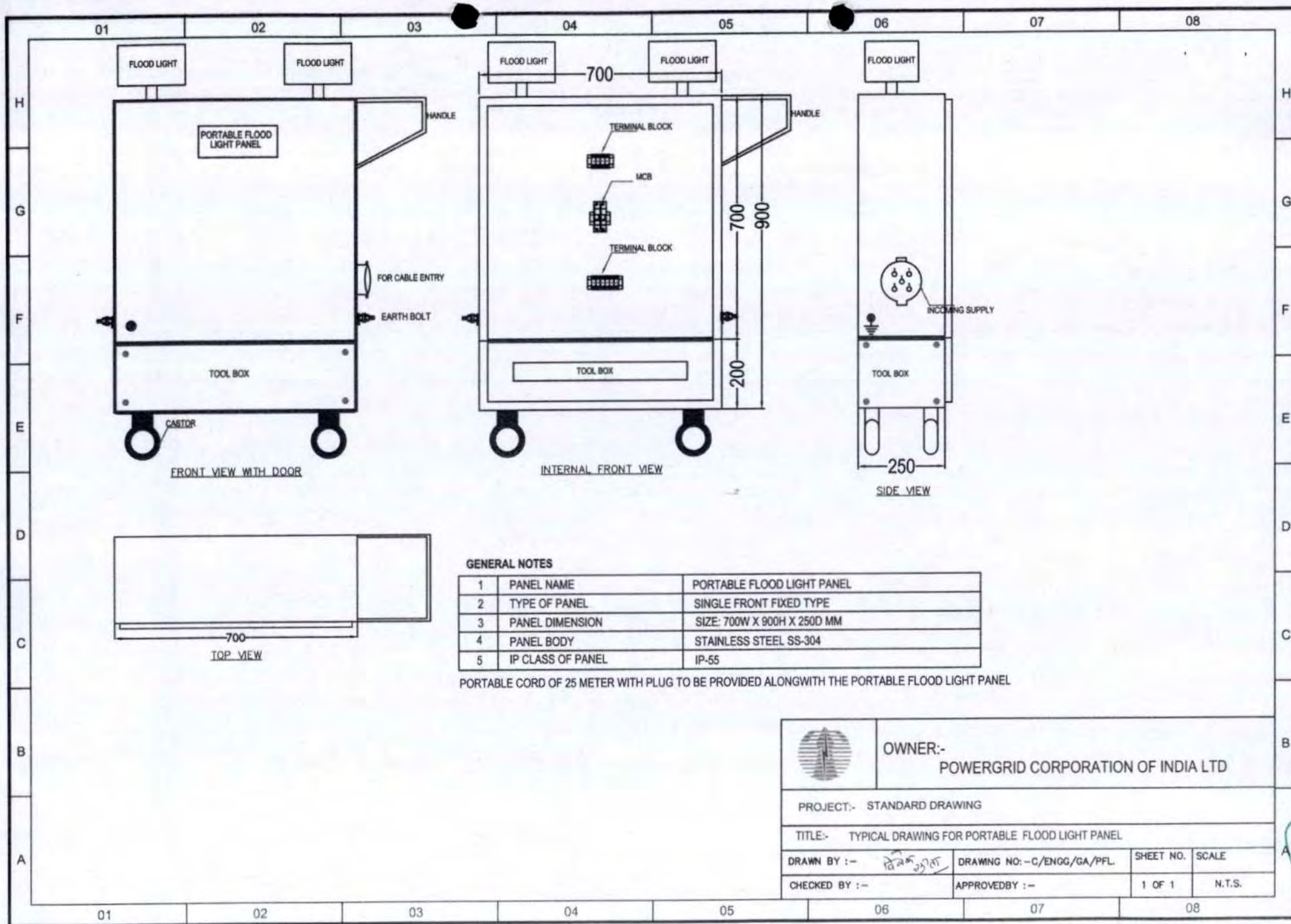
Project information Signage: The Signage shall be made up of rust free steel or equivalent materials of minimum size 3'x 2'. The Signage provide with detail of the project as approved by POWERGRID. The signage shall be prominently embossed.

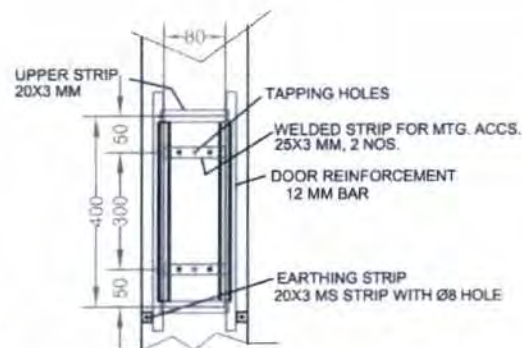
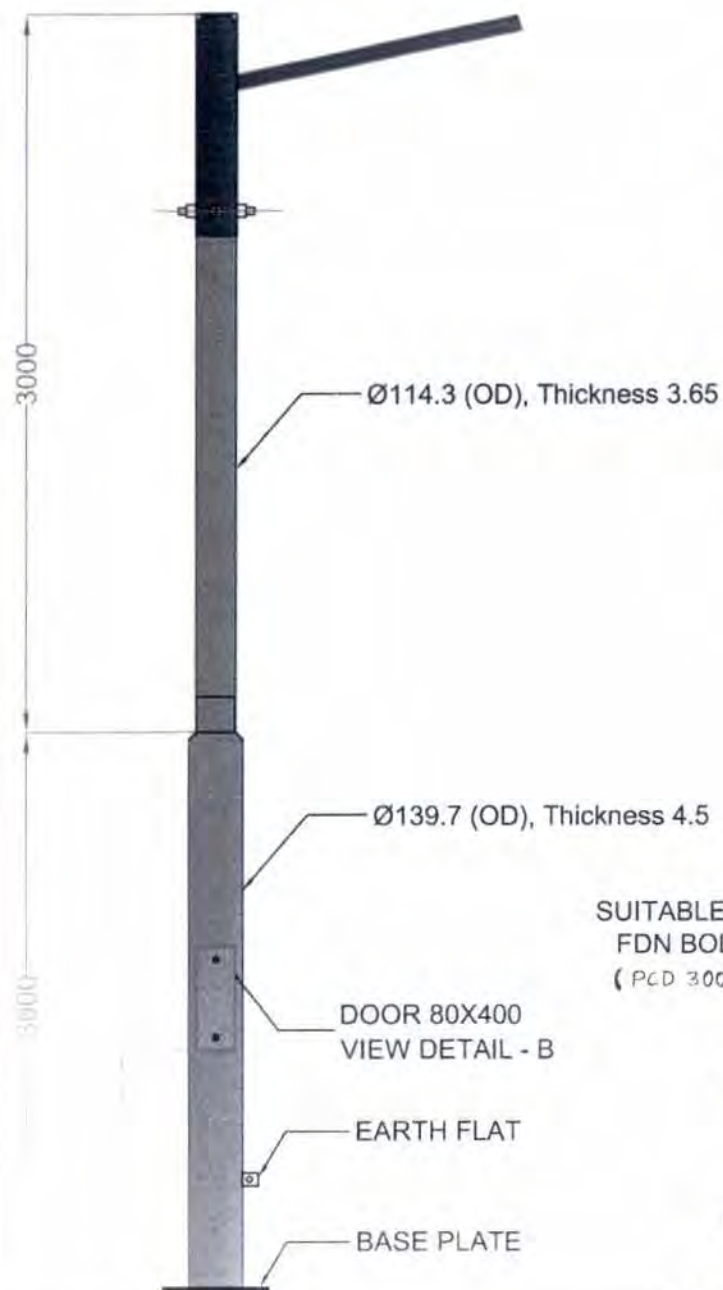
Safety Signage: Safety Signage must be provided mentioning the level and type of voltage and symbols as per IE Rule at different position as may be required.

16.0 Provision for Module Cleaning

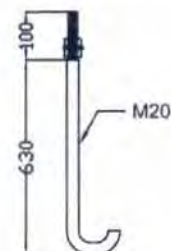
Plumbing: For cleaning of the PV Modules, plumbing work should be done in tune with the existing pipeline, so that water is easily available near the PV modules for cleaning the PV Modules.

Module Cleaning: Necessary equipment is to be provided to facilitate easy cleaning of the PV Modules.

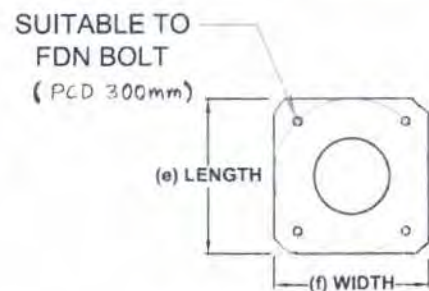




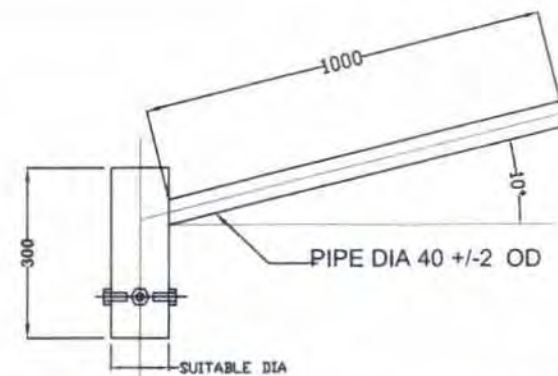
DETAIL - B
(AFTER REMOVE DOOR COVER)



FOUNDATION BOLTS J-TYPE
WITH HARDWARE



BASE PLATE 300 x 300 x 12mm
BOTTOM VIEW



SINGLE ARM BRACKET

With Internal / External Junction Box
complete as per Powergrid approval

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. STEEL PIPES AS PER IS: 1161. & MS PLATES AS PER IS 2062.
3. TOLERANCES AS PER IS 1161 - 1979 & AS PER IS 2713.
4. POLE SHALL BE HOT DIP GALVANISED INSIDE & OUTSIDE & PU PAINTED IN APPROVED SHADE ON OUTSIDE OF POLE.

OWNER:- POWERGRID CORPORATION OF INDIA LIMITED

PROJECT:- STANDARD DRAWINGS

TITLE:- GA DRAWING FOR 6 METER STEEL TUBULAR POLE-SL-L1

DRAWN BY: *[Signature]*

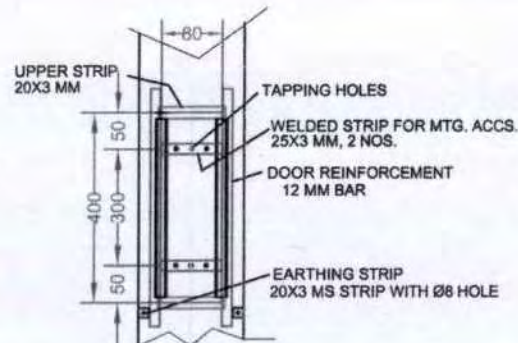
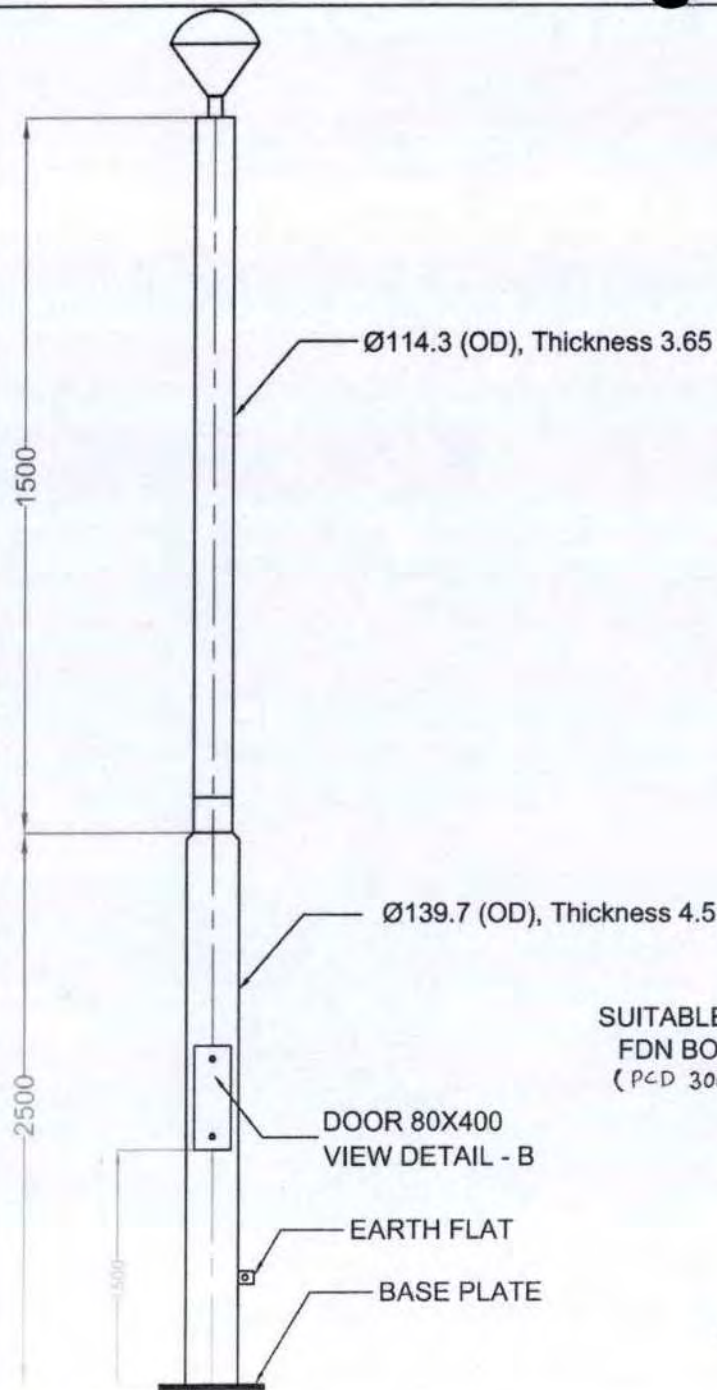
DRG. NO: C/ENGG/GA/POLE/SL-L1

CHECKED BY: *[Signature]*

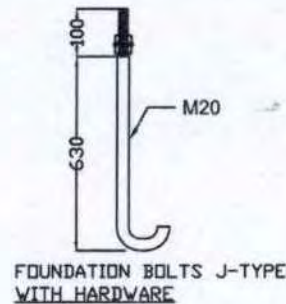
APPROVED BY:-

1 OF 3

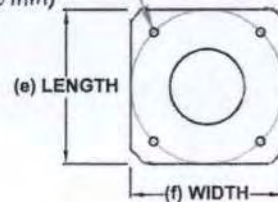
NTS



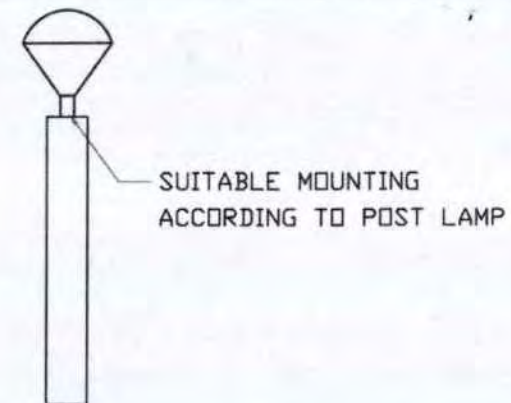
DETAIL - B
(AFTER REMOVE DOOR COVER)



SUITABLE TO
FDN BOLT
(P.C.D 300 mm)



BASE PLATE 300 x 300 x 12mm
BOTTOM VIEW



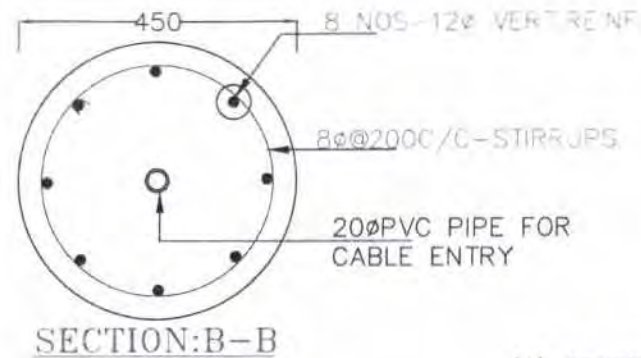
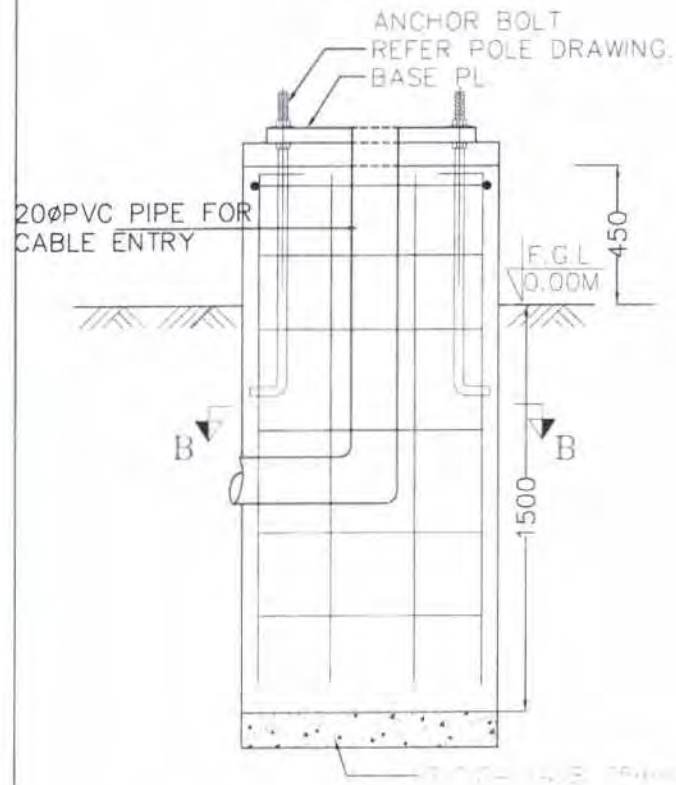
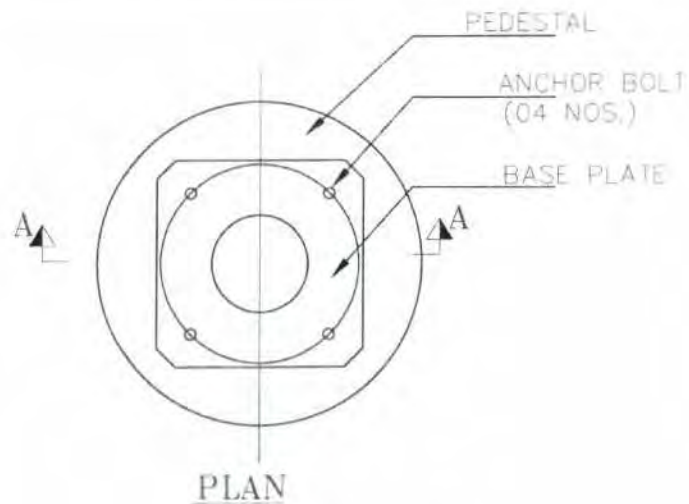
DETAIL - A
POST TOP LAMP

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. STEEL PIPES AS PER IS: 1161. & MS PLATES AS PER IS 2062.
3. TOLERANCES AS PER IS 1161 - 1979 & AS PER IS 2713.
4. POLE SHALL BE HOT DIP GALVANISED INSIDE & OUTSIDE & PU PAINTED IN APPROVED SHADE ON OUTSIDE OF POLE.

OWNER:- POWERGRID CORPORATION OF INDIA LIMITED			
PROJECT:- STANDARD DRAWINGS			
TITLE:- GA DRAWING FOR 4 METER POST LAMP -SL-D1			
DRAWN BY: <i>AAH 20/01</i>	DRG. NO:C/ENGG/GA/POLE/SL-D1		
CHECKED BY: <i>KS</i>	APPROVED BY:-	2 OF 3	NTS

520



(A) GENERAL NOTES:

ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES.
ONLY WRITTEN DIMENSIONS SHALL BE FOLLOWED. THE DRAWINGS SHALL NOT BE SCALED.
ALL STRUCTURAL DRAWINGS SHALL BE READ IN CONJUNCTION WITH ARCHITECTURAL.
DISCREPANCY IN DRAWINGS IF ANY SHALL BE BROUGHT TO THE NOTICE OF THE
DESIGN OFFICE PRIOR TO CONSTRUCTION.
EXECUTION OF R.C.C. WORKS/STRUCTURAL STEEL WORK AS PER OUR DRAWINGS SHALL BE
THE RESPONSIBILITY OF SITE ENGINEER.

(B) SPECIFICATION NOTES FOR R.C.C WORK:

(GRADE OF CONCRETE)

CONCRETE FOR ALL WORKS AS PER BPS.

(REINFORCING STEEL)

ALL REINFORCING STEEL EXCEPT M/S LUGS FOR INSERT PLATES SHALL BE HIGH YIELD
STRENGTH DEFORMED BARS CONFORMING TO GRADE Fe 415 OR Fe 500 AS

LUGS FOR INSERT PLATES SHALL BE PLAIN M/S BARS CONFORMING TO GRADE I OF IS:432
(PART-1) 1966. IF PLATS OR ANGLES ARE USED AS LUGS, THEY SHALL CONFORM TO

(CLEAR COVER TO MAIN REINFORCEMENT)

UNLESS SHOWN OTHERWISE MIN CLEAR COVER TO MAIN
REINFORCEMENT SHALL BE AS FOLLOWS

80 mm
TOP SIDES 40 mm

(LAP LENGTH OR DEVELOPMENT LENGTH FOR DEFORMED BARS SHALL BE AS FOLLOWS)

40x dia OF BAR

NOT MORE THAN 50% BARS SHALL BE SPICED AT A SECTION
(LOCATION OF SPICE SHALL BE DECIDED IN CONSULTATION WITH THE ENGINEER & PRIOR
APPROVAL OF DESIGN OFFICE)

IMP. NOTE: THIS DRAWING IS NOT APPLICABLE FOR MARSHY
LANDS

OWNER:- POWERGRID CORPORATION OF INDIA LIMITED

PROJECT:- STANDARD DRAWINGS

TITLE:- FOUNDATION DRAWING FOR POLE

DRAWN BY: *[Signature]* DRG. NO: C/ENGG/FDN/POLE,

CHECKED BY: *[Signature]* APPROVED BY:-

3 OF 3 NTS