

BHARAT HEAVY ELECTRICALS LIMITED TRANSMISSION PROJECTS ENGINEERING MANAGEMENT									
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CUSTOMER		Power Grid Corporation of India Ltd.							
CONSULTANT		N/A							
PROJECTS		Substation Package -SS01 for Construction of 765/400/220kV Bhuj Pool (New) S/S and Extension of 765kV Banaskantha S/S under Green Energy Corridors: Inter-State Transmission Scheme (ISTS) – Part C; [Part-I] & [Part-2].							
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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 -SS01 for Construction of 765/400/220kV Bhuj Pool (New) S/S and Extension of 765kV Banaskantha S/S under Green Energy Corridors: Inter-State Transmission Scheme (ISTS) – Part C; [Part-I] & [Part-II].

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

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 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

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 contact are detailed hereunder and shall be read in conjunction with other clauses of this specification. All such items 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) 40MM MS Rod

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.
- 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.

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

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 **07 April 2015**. 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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Substation Package – SS02 for Construction of 765/400/220kV BHUJ
S/S and Extension of 765kV Banaskantha S/S.

Bharat Heavy Electricals Ltd.

Illumination System,

Doc. No. TB-385-316-140 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.

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 ~~Sanasariya~~ **BHUJ**

Customer : POWERGRID CORPORATION OF INDIA LTD.

Project Site : 765kV/400kV/ 220KV S/Stn BHUJ SITE

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 BHUJ 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.	230	94051090
iii	Supply	LED Street Light Luminaire - Type SL-L1	Nos.	120	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.	120	94059900
ii	Supply	Earthing of Lighting Poles by 20 mm dia 3000 mm long rod electrode	Nos.	120	76169990
B	Supply	ERECTION MATERIAL FOR BHUJ 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~~ **BHUJ & BANASKANTHA EXTN**

Customer : POWERGRID CORPORATION OF INDIA LTD.

Project Site : 765kV/400kV/ 220KV S/Stn BHUJ SITE

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.	230	94059900
iii	Supply	Erection Material required for mounting of LED Street Light Luminaire - Type SL-L1	Nos.	120	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 BHUJ 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~~ **BHUJ & BANASKANTHA EXTN**
 Customer : POWERGRID CORPORATION OF INDIA LTD.

Project Site : 765kV/400kV/ 220KV S/Stn BHUJ SITE

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.	230	998731
iii	ETC	LED Street Light Luminaire - Type SL-L1	Nos.	120	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.	120	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.	120	998731
3.0	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

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~~ BHUJ & BANASKANTHA EXTN
 Customer : POWERGRID CORPORATION OF INDIA LTD.

Project Site : 765kV/400kV/ 220KV S/Stn BHUJ SITE

Sl. No.		Item Description	Unit	Part-I qty (Present scope)	HSN Number/ SAC CODE
ii	ETC	4 Core x 16 Sq mm, Al cable, PVC insulated	M	500	998736
4.0		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
5.0	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	330	998731

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 BHUJ & Banaskantha Extension

Customer : POWERGRID CORPORATION OF INDIA LTD.

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

Sl. No.		Item Description	Unit	Part-I qty (Present scope)	HSN Number/ SAC CODE
		SUPPLY			
D		Illumination System: Outdoor Switchyard and Street Lighting at 765/400/220kV BANASKANTHA EXTENSION 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.	5	94051090
	ii	Supply LED type Lighting Fixture Type-FL2 (LED flood light luminaries)	Nos.	70	94051090
E	Supply	ERECTION MATERIAL FOR BANASKHATHA EXTENSION SS			
1.0	Supply	Supply, Fixing and Erection of Mounting Brackets, Aluminium Flat, GI Bolt with nut and washer, GI Earthwire from 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.			

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 BHUJ & Banaskantha Extension

Customer : POWERGRID CORPORATION OF INDIA LTD.

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

Sl. No.		Item Description	Unit	Part-I qty (Present scope)	HSN Number/ SAC CODE
i	Supply	Erection Material required for mounting of LED type Lighting Fixture Type-FL1	Nos.	5	94059900
ii	Supply	Erection Material required for mounting of LED type Lighting Fixture Type-FL2	Nos.	70	94059900
		ERECTION TESTING AND COMMISSIONING			
F		Illumination System: Outdoor Switchyard and Street Lighting at 765 kV Banaskantha EXTENSION S/S			
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.	5	998731
ii	ETC	LED type Lighting Fixture Type-FL2	Nos.	70	998731

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 BHUJ & Banaskantha Extension

Customer : POWERGRID CORPORATION OF INDIA LTD.

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

Sl. No.		Item Description	Unit	Part-I qty (Present scope)	HSN Number/ SAC CODE
2.0	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	3000	998736
ii	ETC	4 Core x 16 Sq mm, Al cable, PVC insulated	M	100	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	50	998731

Substation Package – SS02 for Construction of 765/400/220kV BHUJ
S/S and Extension of 765kV Banaskantha S/S.

Bharat Heavy Electricals Ltd.

Illumination System,

Doc. No. TB-385-316-140 Section 1,

ANNEXURE - ~~1~~ 2

ANNEXURE-2

List of Drawings:

Drwg. No.	Description
TB-385-510-002	Layout Plan for 765/400 BHUJ S/S.
TB-385-510-003	Section Elevation 765 KV Yard
TB-385-510-004	Section Layout 400KV YARD
TB-385-510-010	Single Line Diagram for LT AC & DC System for BHUJ SS
TB-385-510-022	Layout Plan for 765 kV BANASKANTHA Extension S/S.

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Section -LIGHTING SYSTEM (Rev.06)

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3.	GRID INTERACTIVE SOLAR PV POWER PLANT	2
4.	LIGHTING SYSTEM DESCRIPTION	2
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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.

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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.

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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.

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- 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.

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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.

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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

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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-

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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.

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- 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,

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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

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- (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.

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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

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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.

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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.

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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-1 (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	THID	<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						

Technical Specification, Section: L.S

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ENG / SPEC / L.S REV.NO: 06

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				

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

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

10.0 Power Quality Requirements

- (i) **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.

(ii) Harmonics on AC side

- (a) 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:

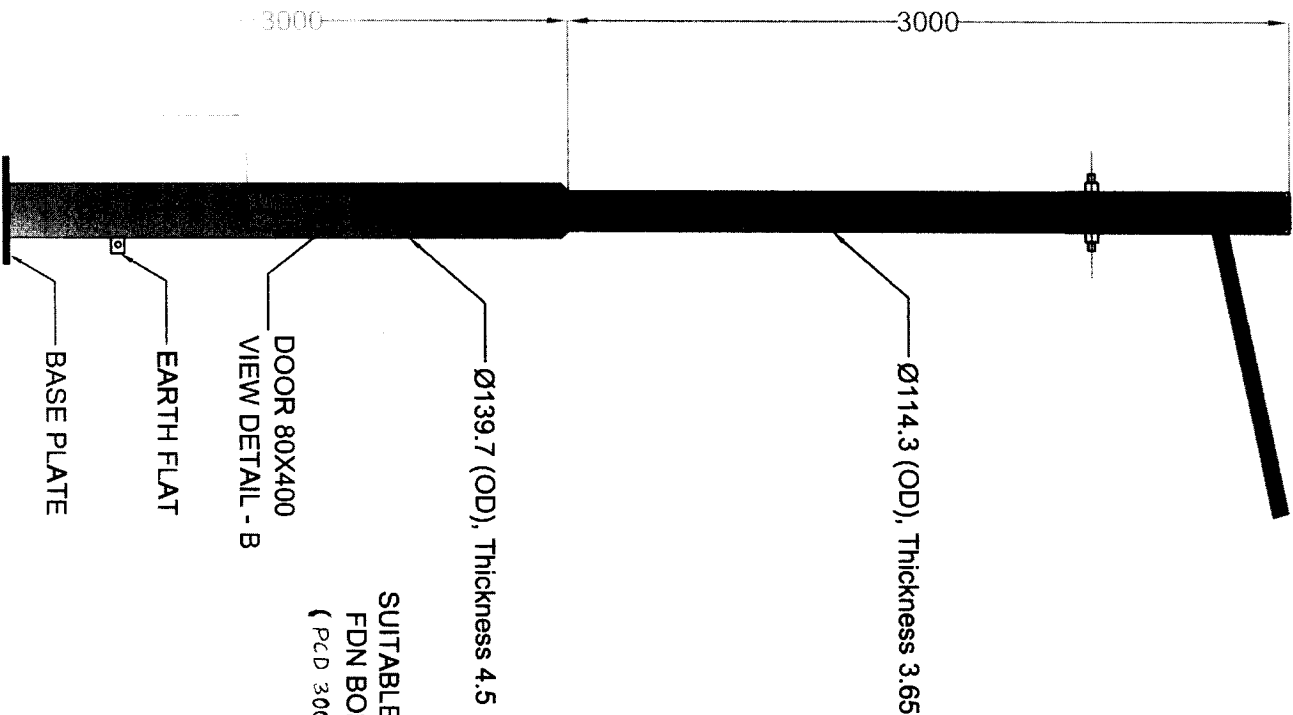
Project information Signage: The Signage shall be made up of rust free steel or equivalent materials of minimum size 3'x 2'. The Signage provide with detail of the project as approved by POWERGRID. The signage shall be prominently embossed.

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.

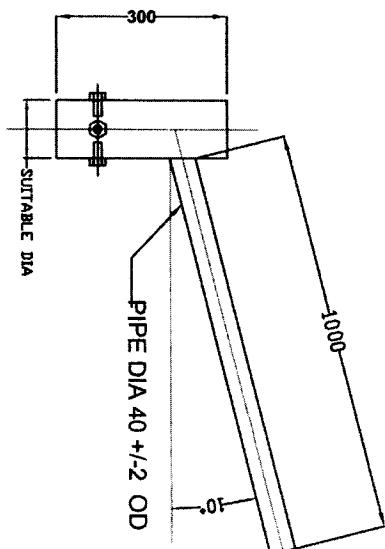
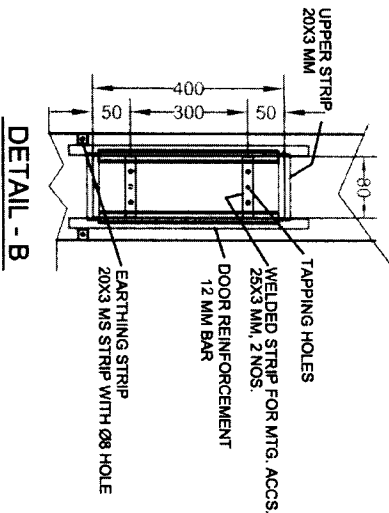
16.0 Provision for Module Cleaning

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.



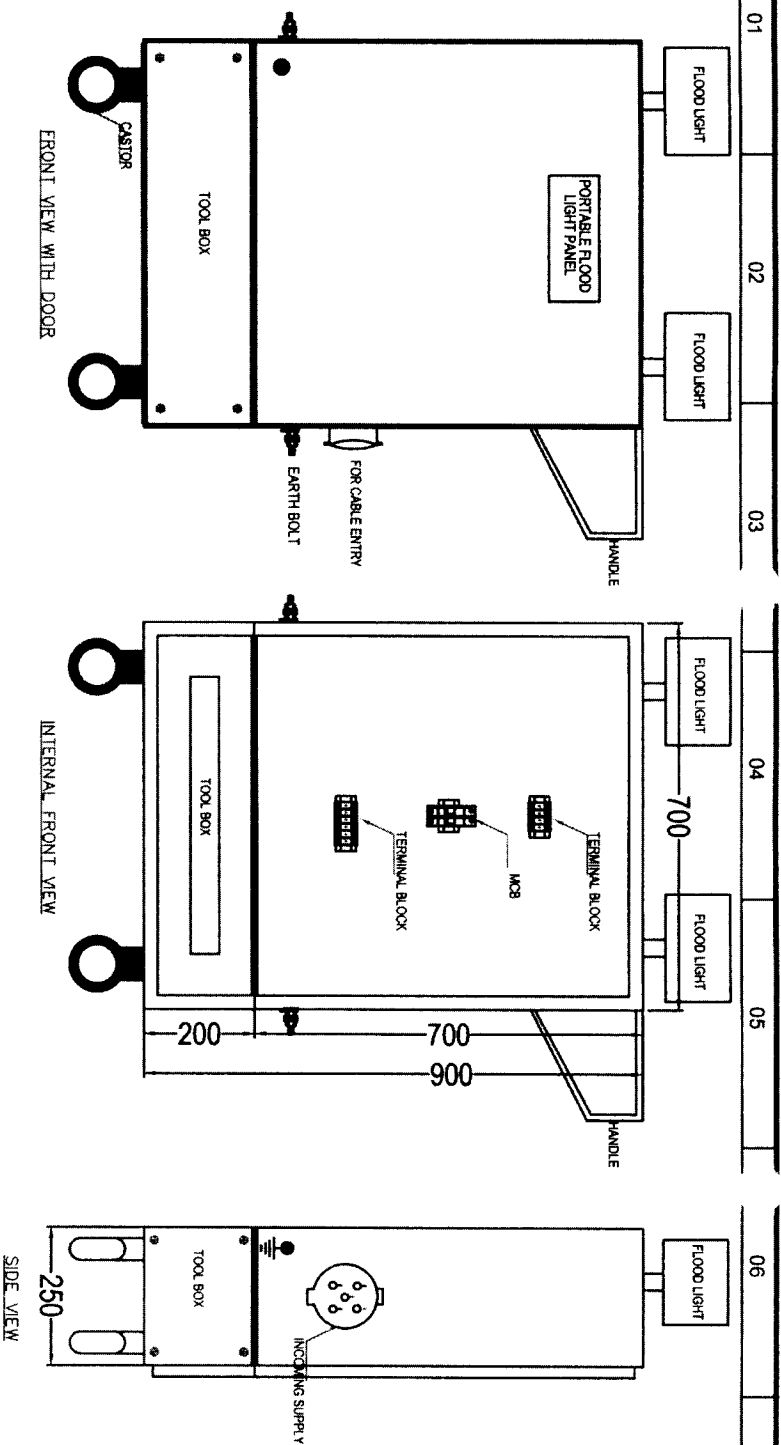
(AFTER REMOVE DOOR COVER)



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: <i>[Signature]</i>	DRG. NO./ENGG/GA/POLE/SL-L1		
CHECKED BY: <i>[Signature]</i>	APPROVED BY:-		1 OF 3
			NTS

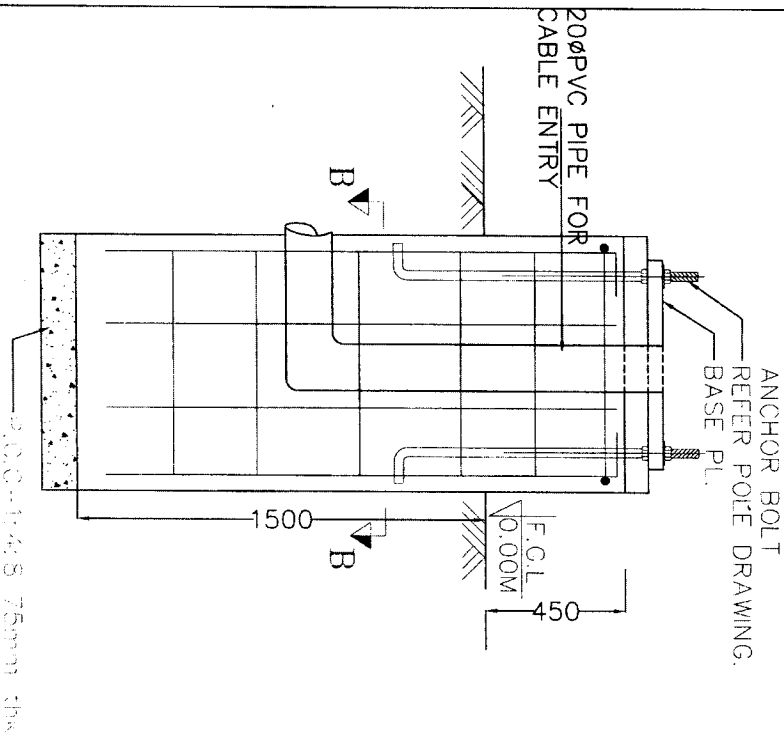
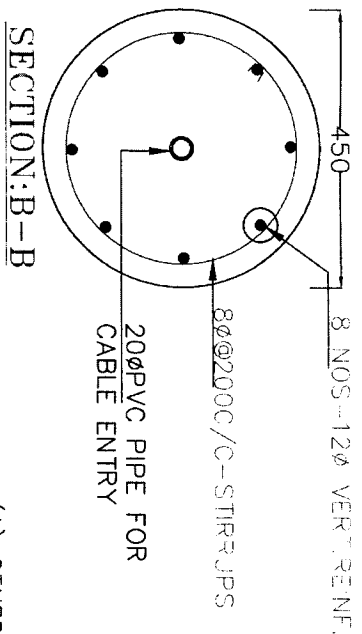
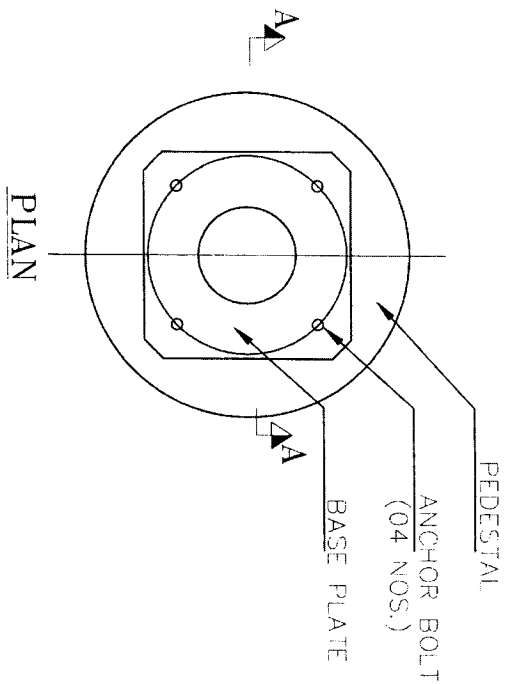


GENERAL NOTES

1	PANEL NAME	PORTABLE FLOOD LIGHT PANEL
2	TYPE OF PANEL	SINGLE FRONT FIXED TYPE
3	PANEL DIMENSION	SIZE: 700W X 900H X 250D MM
4	PANEL BODY	STAINLESS STEEL SS-304
5	IP CLASS OF PANEL	IP-55

PORTABLE CORD OF 25 METER WITH PLUG TO BE PROVIDED ALONGWITH THE PORTABLE FLOOD LIGHT PANEL

		OWNER:-	
		POWERGRID CORPORATION OF INDIA LTD	
PROJECT:- STANDARD DRAWING			
TITLE:- TYPICAL DRAWING FOR PORTABLE FLOOD LIGHT PANEL			
DRAWN BY :-		DRAWING NO:-C/ENG/GA/PFL	SHEET NO. SCALE
CHECKED BY :-		APPROVED BY :-	1 OF 1 N.T.S.



(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 IS 456

(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 PLAN M.S. BARS CONFORMING TO GRADE 1 OF IS 432
(PART-1) 1966 IF FLATS OR ANGLES ARE USED AS LUGS THEY SHALL CONFORM TO

(CLEAR COVER TO MAIN REINFORCEMENT)

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

TOP SIDES 40mm

BOTTOM 40mm

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

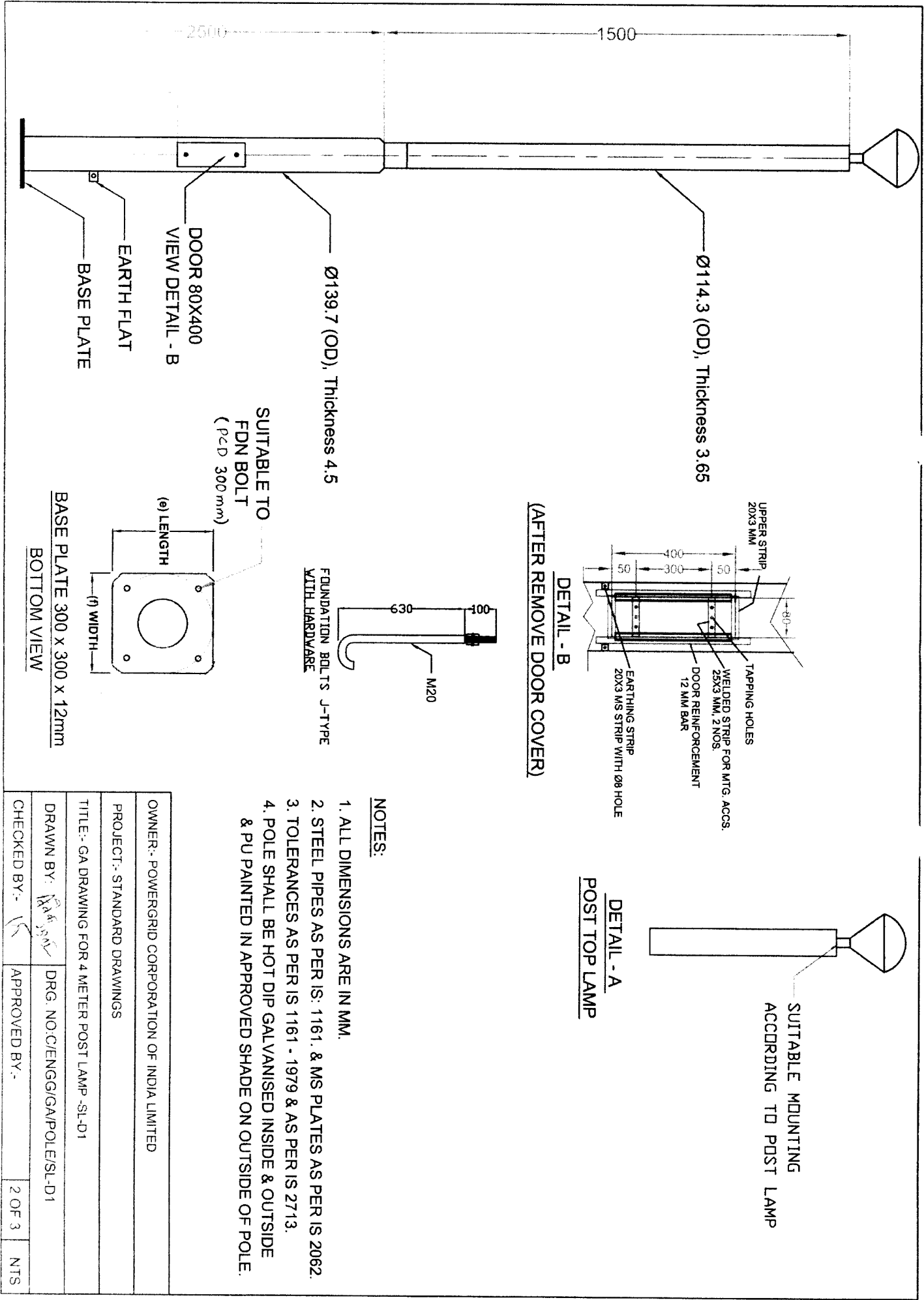
AS PER IS 456

NOT MORE THAN 50% BARS SHALL BE SPICED AT A SECTION
(LOCATION OF SPICE SHALL BE DECIDED IN CONSULTATION WITH SITE 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:	DRG. NO./ENG/FGN/POLE
CHECKED BY:	APPROVED BY:
	3 OF 3
	NTS

SECTION: A-A



SECTION –2

GENERAL TECHNICAL REQUIREMENTS

2.0 GENERAL :

2.0.1 The lighting System design shall comply with acceptable norms and the best engineering practices. The lighting shall be designed to provide uniform illumination with minimum glare. The lighting system shall meet all the statutory requirements, local rules etc.

2.0.2 Feeders required for lighting shall be given from Main LVAC /DC boards. Further distribution using lighting DB's panels for Illumination shall be in Illumination contractor scope .Laying & termination of cables from LVAC /DC boards onwards shall be in illumination contractor scope.

2.0.3 APPLICABLE CODES AND STANDARDS

All material / work shall conform to the following standards & codes unless otherwise stated. All standards and codes of practice referred to herein shall be the latest edition including all applicable official amendments & revisions as on date of bid opening. In case of conflict between this specification and those (codes, standards etc) referred to herein, the former shall prevail.

(i)	IS:1913	General and safety requirements for electric light fittings
(ii)	IS:418	Tungsten filament lamp for domestic and similar general lighting purposes
(iii)	IS:10322	Luminaires
(iv)	IS:10276	Edison Screw lamp holders
(v)	IS:2418	Tubular fluorescent lamps
(vi)	IS:9974	High pressure sodium Vapour lamps
(vii)	IS:9900	High Pressure mercury vapour lamps.
(viii)	IS:6616	Ballasts for high pressure mercury Vapour lamps
(ix)	IS:1258	Specification for bayonet lamp holders
(x)	IS:3323	Bi-pin lamp holders for tubular fluorescent lamps
(xi)	IS:13021	AC Supplied electronic ballasts for tubular fluorescent lamps
(xii)	IS:1534	Ballasts for use in fluorescent lighting fittings
(xiii)	IS:1569	Capacitors for use in tubular fluorescent high pressure mercury vapour and low pressure sodium Vapour discharge lamp circuit.
(xiv)	IS:2215	Starters for fluorescent lamps
(xv)	IS:3324	Holders for starters for tubular fluorescent lamps
(xvi)	IS:418	GLS lamps
(xvii)	IS:13021	AC supplied electronic ballasts for tubular fluorescent lamps
(xviii)	IS:2713	Tubular steel poles
(xix)	IS:280	MS Wire for general Engg. Purpose.

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2.0.4.1 Conduits, Pipes and Accessories

(i)	IS:9537	Rigid Steel conduit for electrical wiring
(ii)	IS:3480	Flexible steel conduits for electrical wiring
(iii)	IS:2667	Fitting for rigid steel conduits for electrical wiring
(iv)	IS:3837	Accessories for rigid steel conduits for electrical wiring.
(v)	IS:4649	Adaptors for flexible steel conduits

2.0.4.2 Lighting panels, Switch boxes, receptacles and junction boxes.

(i)	IS:13947	Specification for LV switchgear and control gear (Parts 1to 5)
(ii)	IS:8828	Circuit breakers for over current protection for house hold and similar installations.
(iii)	IS:5	Colours for ready mixed paints and enamels
(iv)	IS:2551	Danger notice plates
(v)	IS:5133	Steel and cast iron boxes
(vi)	IS:2629	Recommend practice for hot dip galvanizing of iron & steel.
(vii)	IS:3854	Switches for domestic and similar purposes
(viii)	IS:6875	Control switches (Switching devices for Control and auxiliary Circuits including contactor relays) for Voltages upto and including 1000V AC and 1200V DC.
(ix)	IS:13703	Low voltage fuses for voltages not exceeding 1000V AC or 1500V DC
(x)	IS:9224	HRC Cartridge fuse links for voltage above 650V(Part2)
(xi)	IS:5082	Wrought aluminum and Al. alloys, bars, rods, tubes and section for electrical purposes.
(xii)	IS:8623	Factory built assemblies of switchgear and control gear for voltages upto and including 1000 V AC and 1200V DC.
(xiii)	IS:1248	Direct acting electrical indicating instruments .
(xiv)	IS:1293	Plugs & socket outlets of rated voltage upto and including 250 Volts & rated current upto and including 16 amps

2.0.4.3 Lighting Wires / Cables

(i)	IS:694	PVC Insulated cables for working voltages upto and including 1100V.
(ii)	IS:3961	Recommended current ratings for cables (PVC Insulated and PVC sheathed heavy duty cables and light duty cables)
(iii)	IS:8130	Conductors for insulated electric cables and flexible cords.
(iv)	IS:10810	Methods of tests for Cables

2.0.4.4 Electrical Installation & Miscellaneous :

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(i)	IS:2062	Steel for general structural purposes.
(ii)	IS:6665	Code of practice for industrial lighting.
(iii)	IS:374	Electric ceiling fans & regulators
(iv)	IS:5216	Recommendations on safety procedures and practices in electrical work.
(v)	IS:732	Code of practice for electrical wiring installation (System voltage not exceeding 650 Volts)
(vi)	IS:1255	Code of practice for installation and maintenance of power cables upto and including 33kV rating.
(vii)	IS:3043	Code of practice for earthing.
(viii)	IS:3646	Code of practice of Interior Illumination.
(ix)	IS:1944	Code of practice for lighting of public through fares.
(x)	IS:5571	Guide for selection of electrical equipment for hazardous areas.
(xi)	IS:800	Code of practice for use of structural steel in general building construction
(xii)	IS:2633	Methods of testing uniformity of coating on Zinc coated articles.
(xiii)	IS:6005	Code of Practice for phosphating iron and steel.
(xiv)	IS:371	Ceiling roses
(xv)	BS:6121	Mechanical cable glands
(xvi)	IS:6631	Specification for Steel pipes
(xvii)		INDIAN ELECTRICITY ACT
(xviii)		INDIAN ELECTRICITY RULES
(xix)		NATIONAL ELECTRICAL CODE

2.1 TESTS :

2.1.1.1 All equipments to be supplied shall be of type tested quality. The Contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

2.1.1.2 In case the Contractor is not able to submit report of the type test (s) conducted within last five year from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract free of cost to the BHEL / Owner and submit the reports for approval.

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- 2.1.1.3** All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.
- 2.1.2** Selection of samples for type test, acceptance test & routine test and acceptance criteria for all the items shall be as per relevant I.S.
- 2.1.3** Type test reports of the following items as per relevant standards shall be submitted for approval. – **for the items under scope of supply**

Sl.NO.	DESCRIPTION
i.	Lighting fixtures of each type.
ii.	Lamps of each type and rating (life cycle and rating test only)
iii.	Lighting panel of each type (Degree of Protection) – not
iv.	Junction Box of each type (Degree of protection)
v.	Receptacles of each rating.
vi.	M.C.B. of each rating.
vii.	Lighting transformer – not applicable
viii.	Ballasts

2.1.4 Acceptance Test and Routine Test :

- 2.1.4.1** All lighting fixtures, lamps and other items shall be subjected to acceptance and routine test, as per relevant specified standards.
- 2.1.4.2** Junction boxes, switch boxes, receptacle enclosure etc. shall be subjected to physical and dimensional checks.

2.1.5 Galvanizing Tests :

- 2.1.5.1** The quality of galvanizing shall be smooth, continuous, free from flux, stains and shall be inspected visually.
- 2.1.5.2** In addition following test shall be conducted as acceptance tests.
- (a) Uniformity of coating – The coating of any article shall withstand four 1 minute dips in standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal.

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- (b) The quality of cadmium/ Zinc plating on items with screw threads shall be free from visible defects such as unplated areas, blisters and modules and shall be inspected visually.
- (c) In addition the plating thickness shall be determined microscopically / chemically or electronically.

2.1.6 COMMISSIONING CHECKS :

- 2.1.6.1** On completion of Installation work the Contractor shall request the Project manager for inspection and test with minimum of fourteen (14) days advance notice.
- 2.1.6.2** The Project Manager shall arrange for joint inspection of the installation for completeness and correctness of the work. Any defect pointed out during such inspection shall be promptly rectified by the Contractor.
- 2.1.6.3** The installation shall be then tested and commissioned in presence of the Project Manager.
- 2.1.6.4** The contractor shall provide all, men material and equipment required to carry out the tests.
- 2.1.6.5** All rectifications, repair or adjustment work found necessary during inspection, testing and commissioning shall be carried out by the Contractor without any extra cost.
- 2.1.6.6** The testing shall be done in accordance with the applicable Indian Standards and codes of practices. The following tests shall be specifically carried out for all lighting installation.
 - (a) Insulation Resistance
 - (b) Testing of earth continuity path.
 - (c) Polarity Test of single phase switches
 - (d) Functional checks
- 2.1.6.7** The lighting circuits shall be tested in the following manner :
 - (a) All switches ON and consuming devices in circuit, both poles connected together to obtain resistance to earth.
 - (b) Insulation resistance between poles with lamps and other consuming devices removed and switches ON.

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- 2.1.6.8** Lux level measurement to prove guaranteed Illumination levels. The contractor shall submit a document on methodology of measurement for approval of BHEL / ultimate customer . This will become basis for measurements .

2.2 QUALITY PLAN :

Bidder shall submit immediately after award of Contract Manufacturing Quality plan & field Quality plan in prescribed format for approval of BHEL & customer. These approved Quality plans shall be followed for manufacture and ETC. Where standard quality plans of BHEL or customer are available , these shall be followed after written consent of BHEL/ Customer.

2.3 HANDING & TAKINGOVER :

It is the responsibility of bidder to handover the complete system to BHEL/ ultimate customer. Bidder shall assist BHEL to handover the system supplied by them to ultimate customer.

2.4 DOCUMENTATION :

- 2.4.1.** Information / documents to be submitted by the bidder at tender stage shall be as follows :

- (a) Check list
- (b) Technical offer with equipment details & the makes, detailed unpriced schedule of equipment / material & spares .
- (b) Guaranteed technical particulars.
- (c) Activity Schedule.
- (d) Catalogues & technical details of equipment / material offered.

- 2.4.2.** Information / documents to be submitted by the Contractor at contract stage shall be as follows :

- (a) Type test reports
- (b) Manufacturing Quality plan. Where standard Quality plan of BHEL / Customer is available, this shall be followed.
- (c) Field Quality plan for receipt, storage, installation, testing & commissioning with details of tests to be conducted and acceptance values .
- (d) Outline and general assembly drawings of equipment, lighting layout conduit layout, wiring scheme, Catalogues of equipment, fixing details etc.
- (e) Detailed photometric data of luminaires .

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(f) Operation & maintenance manuals

(e) End documentation.

For approval 4 copies to be submitted and after approval 10 copies to be submitted unless otherwise specied else where.

SECTION-3

PROJECT DETAILS & GENERAL SPECIFICATION

SITE INFORMATION

	Particular	Details
a)	Owner	POWERGRID
b)	Customer	POWERGRID
c)	Project Title	Substation Package – Substation Package -SS01 for Construction of 765/400/220kV Bhuj Pool (New) S/S and Extension of 765kV Banaskantha S/S under Green Energy Corridors: Inter-State Transmission Scheme (ISTS) – Part C.
d)	Location	Bhuj, Gujrat Banaskantha , Gujrat
e)	Transport Facilities	ROAD/TRAIN, For Bhuj Nearest Rail Head: Bhuj ROAD/TRAIN, For Banaskantha Nearest Rail Head: Palanpur
SITE CONDITIONS		
a)	Max. ambient air temp.	50°C
b)	Min. ambient air temp.	0°C
c)	Max. design ambient temp.	50°C
d)	Design reference temp.	50°C
e)	Average Humidity	Max. 100%
f)	Special corrosion conditions	No
g)	Solar Radiation	1.2kW/sqmtr
h)	Atmospheric UV radiation	High
i)	Altitude above sea level	Less than 1000meter
j)	Pollution Severity	High Pollution level (31mm/kV) For BHUJ High Pollution (25mm/kV) for Banaskantha
k)	Seismic Zone	As per the seismic zone defined in the relevant BIS / IEC-62271-300 but not less than 0.3g horizontal
WIND DATA		
	Wind velocity	As per IS

	Average No. of thunderstorm days per annum	As per IS
	Main Electrical Parameters:	
	Fault Levels:	765kV: 50kA for 1 sec 400kV: 63kA for 1 sec 220kV: 40kA for 1 sec
	Creepage Distance	31mm/kV for 765kV/400kV/220kV BHUJ S/S 25mm/kV for Extn. of 765kV Banaskantha S/S

Remark – (1.) All switchgear/equipment's, insulator strings, bushings (including bushings for 400/220kV Autotransformers & 420kV Reactor), bus post insulators at **Bhuj Pool substation shall be designed for minimum creepage distance of 31mm/kV instead of 25mm/kV mentioned elsewhere in other sections of technical specification.** For Banaskantha substation, minimum creepage distance shall be 25mm/kV.

1.0 GENERAL

This Chapter covers Technical Requirements and requirements of auxiliary items.

- a) Equipment 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 unless included in the list of exclusions.
- b) Material and components not specifically stated in this specification but which are necessary for satisfactory operation of the equipment and accessories specified in this specification shall be deemed to be included unless specifically excluded and shall be supplied at no extra cost.
- c) Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition.
- d) In case any Deviation Schedule, Bid Proposal Sheet, Schedule of Data Requirements (DRS), test reports or any other document/information are not furnished along-with the bid, the bid is liable to be rejected. Unless brought out clearly, the Bid will be deemed to conform to the specification scrupulously. All deviations from the specification shall be clearly brought out in the respective deviation schedule.
- f) The Bidder shall clearly indicate in the bid, the specific standards in accordance with which the works will be carried out.

- g) The equipment must be new, of highest grade, the best quality of their kind, to best engineering practice and latest state of art, and in accordance with purpose for which they are intended and ensure satisfactory performance throughout the service life.
- h) All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same materials and workmanship as the corresponding parts of the equipment. Where feasible, common components, units shall be employed in different pieces of equipment in order to optimize the spare part stock-up and utilization.
- i) The requirement regarding external RIV as specified for equipment shall include the terminal fittings and the equipment shall have been tested preferably with fittings, if any.

2.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

- a) The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, restrike etc.
- b) The equipment shall be able to withstand forces due to wind load, short circuit, system over voltages, fluctuations, frequency variations etc., all forces considered together.

3.0 SUPPORT STRUCTURES (If in the scope of Bidder)

- a) The support structures should be hot dip galvanised with minimum **610 gm/sq-m** net of zinc.
- b) **Zinc coating for galvanized lattice and pipe structures (excluding foundation bolts & fasteners) at Bhuj Pool substation shall not be less than 900 gm/sq-m irrespective of other values mentioned elsewhere in technical specification/ drawings.**
- b) The design calculations taking into account the environmental conditions of the substations shall be furnished for sizing of the structures.

4.0 STANDARDS

- a) The equipment to be furnished under this specification shall conform to latest issue with all amendments of standard specified under respective Chapters of this Specification. The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other. The bidder shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC. When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.
- b) Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards referred shall also be accepted.
- c) In case governing standards for the equipment is different from IS or IEC, the

salient points of difference shall be clearly brought out in additional information schedule alongwith English language version of standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to POWERGRID's approval.

5.0 ENGINEERING DATA AND DRAWINGS

- 5.1 The list of drawings/documents which are to be submitted to the Purchaser shall be discussed and finalised by the Purchaser at the time of award. The supplier shall necessarily submit all the drawings/ documents unless anything is waived.
- 5.2 The Contractor shall submit 4 (four) sets of drawings/ design documents /data / detailed bill of quantity and 1 (one) set of test reports for the approval of the Purchaser. The contractor shall also submit the softcopy of the above documents in addition to hardcopy.
- 5.3 Drawings
 - 5.3.1 All drawings submitted by the Contractor shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, dimensions, internal & the external connections, fixing arrangement required and any other information specifically requested in the specifications.
 - 5.3.2 Drawings submitted by the Contractor shall be clearly marked with the name of the Purchaser, the unit designation, the specifications title, the specification number and the name of the Project. POWERGRID has standardized a large number of drawings/documents of various make including type test reports which can be used for all projects having similar requirements and in such cases no project specific approval (except for list of applicable drawings alongwith type test reports) is required. However, distribution copies of standard drawings/documents shall be submitted as per provision of the contract. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in SI units.
 - 5.3.3 The review of these data by the Purchaser will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. This review by the Purchaser may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Purchaser shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.
- 5.4 All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Purchaser. Approval of Contractor's drawing or work by the Purchaser shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.
- 5.5 All engineering data submitted by the Contractor after final process including

review and approval by the Purchaser shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the Purchaser in Writing.

5.7 Approval Procedure

The scheduled dates for the submission of the drawings as well as for, any data/information to be furnished by the Purchaser would be discussed and finalised at the time of award. The following schedule shall be followed generally for approval and for providing final documentation.

- | | | |
|-------|--|---|
| i) | Approval/comments/
Purchaser on initial | As per agreed by
schedule submission |
| ii) | Resubmission
(whenever
required) | Within 3 (three) weeks
from date of comments |
| iii) | Approval or comments | Within 3 (three) weeks of
receipt of resubmission. |
| iv) | Furnishing of distribution
copies (5 hard copies per
substation and one scanned
copy (pdf format) for Corporate
Centre) | 2 weeks from the date
of approval |
| v) | Furnishing of distribution copies of test reports | |
| (a) | Type test reports
(one scanned softcopy in
pdf format per substation plus one for corporate centre
& one hardcopy per substation) | 2 weeks from the date
of final approval |
| (b) | Routine Test Reports
(one copy for each substation) | -do- |
| vi) | Furnishing of instruction/
manuals (2 copies
per substation and one softcopy
(pdf format) for corporate centre
& per substation) | As per agreed schedule operation |
| (vii) | As built drawings (two sets of
hardcopy per substation & one
softcopy (pdf format) for
corporate centre & per substation) | On completion of entire works |

NOTE :

- (1) The supplier may please note that all resubmissions must incorporate all comments given in the earlier submission by BHEL/POWERGRID or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.
- (2) All drawings should be submitted in softcopy form, however substation design drawings like SLD, GA, all layouts etc. shall also be submitted in AutoCAD Version. SLD, GA & layout drawings shall be submitted for the entire substation in case of substation extension also.

- (3) The instruction Manuals shall contain full details of drawings of all equipment being supplied under this contract, their exploded diagrams with complete instructions for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and overhauling procedures.
- (4) If after the commissioning and initial operation of the substation, the instruction manuals require any modifications/ additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the supplier to BHEL/POWERGRID.
- (5) The manufacturer shall furnish to the Purchaser catalogues of spare parts.
- (6) All As-built drawings/documents shall be certified by site indicating the changes before final submission.

6.0 MATERIAL WORKMANSHIP

6.1 General Requirement

- 6.1.1 Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended.
- 6.1.2 Incase where the equipment, materials or components are indicated in the specification as "similar" to any special standard, the Purchaser shall decide upon the question of similarity. When required by the specification or when required by the Purchaser the Contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the supplier.
- 6.1.3 The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads.
The use of other thread forms will only be permitted when prior approval has been obtained from the BHEL/POWERGRID.
- 6.1.4 Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.
- 6.1.5 All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be considered as being the erection of equipment at its permanent location. This, unless

otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, levelling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances, instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits suitable guards shall be provided for the protection of personnel on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purposes. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

- 6.1.6 The supplier shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The supplier shall apply all operational lubricants to the equipment installed by him.
- 6.1.7 All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help POWERGRID in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.
- 6.1.8 Corona and radio interference voltage test and seismic withstand test (for 132kV and above voltage level) procedures for equipments shall be in line with the procedure given at Annexure-A and B respectively.

6.2 Provisions For Exposure to Hot and Humid climate

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favourable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

6.2.1 Space Heaters

- 6.2.1.1 The heaters shall be suitable for continuous operation at 240V as supply voltage. On-off switch and fuse shall be provided.
- 6.2.1.2 One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.
- 6.2.1.3 Suitable anti condensation heaters with the provision of thermostat shall be provided.

6.2.2 FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the

operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

6.2.3 Ventilation opening

Wherever ventilation is provided, the compartments shall have ventilation openings with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds and suitable provision shall be made so as to avoid any communication of air / dust with any part in the enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc.

6.2.4 Degree of Protection

The enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide degree of protection as detailed here under:

- a) Installed out door: IP- 55
- b) Installed indoor in air conditioned area: IP-31
- c) Installed in covered area: IP-52
- d) Installed indoor in non air conditioned area where possibility of entry of water is limited: IP-41.
- e) For LT Switchgear (AC & DC distribution Boards) : IP-52

The degree of protection shall be in accordance with IS:13947 (Part-I) / IEC-60947(Part-I) / IS 12063 / IEC-60529. Type test report for degree of protection test, shall be submitted for approval.

6.3 RATING PLATES, NAME PLATES AND LABELS

Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Purchaser. The rating plate of each equipment shall be according to IEC requirement.

All such nameplates, instruction plates, rating plates of transformers, reactors, CB, CT, CVT, SA, Isolators, C & R panels and PLCC equipments shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

6.4 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment covered under the scope of the specifications, into successful Operation, shall be furnished by the supplier unless specifically excluded under the exclusions in these specifications and documents.

7.0 DESIGN IMPROVEMENTS / COORDINATION

- 7.1 The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply. However, the Purchaser or the Contractor

may propose changes in the specification of the equipment or quality thereof and if the Purchaser & contractor agree upon any such changes, the specification shall be modified accordingly.

- 7.2 If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.
- 7.3 The supplier shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.
- 7.4 The supplier has to coordinate designs and terminations with the agencies (if any) who are Consultants/Contractor for the Purchaser. The names of agencies shall be intimated to the successful bidders.
- 7.5 The supplier will be called upon to attend design co-ordination meetings with the Engineer, other Contractor's and the Consultants of the Purchaser (if any) during the period of Contract. The Contractor shall attend such meetings at his own cost at POWERGRID Corporate Centre, Gurgaon (Haryana) or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

8.0 QUALITY ASSURANCE PROGRAMME

- 8.1 To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the supplier's Works or at his Sub-contractor's premises or at the Purchaser's site or at any other place of Work are in accordance with the specifications, the supplier shall adopt suitable quality assurance programme to control such activities at all points necessary. The detailed programme shall be submitted by the contractor after the award for reference. A quality assurance programme of the supplier shall generally cover the following:
- (a) His organisation structure for the management and implementation of the proposed quality assurance programme;
 - (b) Documentation control system;
 - (c) Qualification data for bidder's key personnel;
 - (d) The procedure for purchases of materials, parts components and selection of sub-Contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
 - (e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly control;
 - (f) Control of non-conforming items and system for corrective actions;
 - (g) Inspection and test procedure both for manufacture and field activities.
 - (h) Control of calibration and testing of measuring instruments and field activities;

- (i) System for indication and appraisal of inspection status;
- (j) System for quality audits;
- (k) System for authorising release of manufactured product to the Purchaser.
- (l) System for maintenance of records;
- (m) System for handling storage and delivery; and
- (n) A quality plan detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

POWERGRID/BHEL or his duly authorised representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the supplier/his vendor's quality management and control activities.

8.2 Quality Assurance Documents

The supplier would be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of POWERGRID/BHEL inspection of equipment/material

9.0 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

- 9.1 All equipment being supplied shall conform to type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections.
- 9.2 The reports for all type tests as per technical specification shall be furnished by the supplier alongwith equipment / material drawings. However, type test reports of similar equipments/ material already accepted in POWERGRID shall be applicable for all project with similar requirement. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by POWERGRID or representative authorized by POWERGRID or Utility or representative of accredited test lab or reputed consultant.

The test reports submitted shall be of the tests conducted within last 10 (ten) years prior to the date of bid opening i.e. 26.08.11. In case the test reports are of the test conducted earlier than 10 (ten) years prior to the date of bid opening, the contractor shall repeat these test(s) at no extra cost to BHEL.

However, in case of instrument transformers, the following type tests should have been conducted within 5 (five) years prior to the date of bid opening.

- i) Lightning Impulse Test
- ii) Switching Impulse Test
- iii) Multiple Chopped Impulse Test (For CT)
- iv) Chopped Impulse Test (For CVT)

In case the test reports are of these tests (for instrument transformers) as mentioned above are conducted earlier than 5 (five) years prior to the date of bid opening i.e. 26.08.11, the contractor shall repeat these test(s) at no extra cost to the purchaser.

Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification or any/all type tests not carried out, same shall be carried out without any additional cost implication to the Purchaser.

The supplier shall intimate the BHEL/POWERGRID the detailed program about the tests atleast two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

Further, in case type tests are required to be conducted/repeated and the deputation of Inspector/Purchaser's representative is required, then all the expenses shall be borne by the supplier.

- 9.3 The Purchaser intends to repeat the type tests on Power Transformer and Shunt Reactor except Dynamic short circuit tests on transformers, for which test charges shall be payable as per provision of contract. The price of conducting type tests shall be included in Bid price and break up of these shall be given in the relevant schedule of Bid Proposal Sheets. These Type test charges would be considered in bid evaluation. In case Bidder does not indicate charges for any of the type tests or does not mention the name of any test in the price schedules, it will be presumed that the particular test has been offered free of charge. Further, in case any Bidder indicates that he shall not carry out a particular test, his offer shall be considered incomplete and shall be liable to be rejected. BHEL/POWERGRID reserves the right to witness any or all the type tests. The BHEL/POWERGRID also reserves the right to waive the repeating of type tests partly or fully and in case of waiver, test charges for the same shall not be payable.

The Purchaser shall bear all expenses for deputation of purchaser's representative(s) for witnessing the type tests under this clause except in the case of re-deputation if any, necessitated due to no fault of the purchaser.

For outdoor receptacles, trefoil clamps, diesel engine, alternator, motors, cable glands, lighting fixtures, ACSR/AAC conductor, IPS aluminum tube and junction boxes, type test reports are not required to be submitted for the makes indicated at Annexure-E /POWERGRID approved list of subvendors. For the new makes(other than those indicated at Annexure-E / POWERGRID approved list of subvendors), type test reports as per relevant standard shall be submitted for POWERGRID's approval.

- 9.4 The Purchaser, his duly authorised representative and/or outside inspection agency acting on behalf of the Purchaser shall have at all reasonable times free access to the Contractor's/sub-vendors premises or Works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the Works during its manufacture or erection if part of the Works is being manufactured or assembled at other premises or works, the Contractor shall obtain for the Engineer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. Inspection may be made at any stage of manufacture, despatch or at site at the option of the Purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

- 9.5 The supplier shall give the Purchaser /Inspector fifteen (15) days written notice for on-shore and six (6) weeks notice for off-shore material being ready for joint testing including contractor and POWERGRID. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Purchaser/inspector, unless witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Contractor may proceed alone with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of tests in triplicate.
- 9.6 The Purchaser or Inspector shall, within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Purchaser /Inspector giving reasons therein, that no modifications are necessary to comply with the Contract.
- 9.7 When the factory tests have been completed at the Contractor's or Sub- Contractor's works, the Purchaser/inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Purchaser /Inspector, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the Engineer/Inspector. Failure of the Purchaser /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the Works. The completion of these tests or the issue of the certificate shall not bind the Purchaser to accept the equipment should, it, on further tests after erection, be found not to comply with the Contract. The equipment shall be dispatched to site only after approval of test reports and issuance of CIP by the Purchaser.
- 9.8 In all cases where the Contract provides for tests whether at the premises or at the works of the Contractor or of any Sub-Contractor, the Contractor except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Purchaser /Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Purchaser /Inspector or to his authorised representative to accomplish testing.
- 9.9 The inspection by Purchaser and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract.
- 9.10 The Purchaser will have the right of having at his own expenses any other test(s) of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material comply with the specification.
- 9.11 The Purchaser reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipments for these

tests shall be provided by the Purchaser.

10.0 TESTS

10.1 Pre-commissioning Tests

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Purchaser and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The list of pre-commissioning tests to be performed are given in respective chapters and shall be included in the Contractor's quality assurance programme.

10.2 Commissioning Tests

10.2.1 The available instrumentation and control equipment will to be used during such tests and the Purchaser will calibrate, all such measuring equipment and devices as far as practicable.

10.2.2 Any special equipment, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.

10.2.3 The specific tests requirement on equipment have been brought out in the respective chapters of the technical specification.

10.3 The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning the equipment and the switchyard. However necessary fee shall be reimbursed by POWERGRID on production of requisite documents.

11.0 PACKAGING & PROTECTION

11.1 All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the Purchaser, the Contractor shall also submit packing details/associated drawing for any equipment/material under his scope of supply, to facilitate the Purchaser to repack any equipment/material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken into account. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. Purchaser takes no responsibility of the availability of the wagons.

11.2 All coated surfaces shall be protected against abrasion, impact, discolouration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

12.0 FINISHING OF METAL SURFACES

12.1 All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts & bolts and spring washers shall be electro galvanized to service condition 4. All steel conductors including those used for

earthing/grounding (above ground level) shall also be galvanized according to IS:2629.

12.2 HOT DIP GALVANISING

12.2.1 The minimum weight of the zinc coating shall be 610 gm/sq.m and minimum average thickness of coating shall be 86 microns for all items having thickness 6mm and above. For items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq. m minimum.

12.2.2 The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

12.2.3 After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

12.2.4 The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.

12.2.5 Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.

- Coating thickness
- Uniformity of zinc
- Adhesion test
- Mass of zinc coating

12.2.6 Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

12.3 PAINTING

12.3.1 All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS-6005 "Code of practice for phosphating iron and sheet". All surfaces, which will not be easily accessible after shop assembly, shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

12.3.2 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready

mixed, stoving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.

12.3.3 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.

12.3.4 The exterior and interior colour of the paint in case of new substations shall preferably be RAL 7032 for all equipment, marshalling boxes, junction boxes, control cabinets, panels etc. unless specifically mentioned under respective sections of the equipments. Glossy white colour inside the equipments /boards/panels/junction boxes is also acceptable. The exterior colour for panels shall bematching with the existing panels in case of extension of a substation. Each coatof primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments.

12.3.5 In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc., the procedure shall be submitted alongwith the Bids for Purchaser's review & approval.

12.3.6 The colour scheme as given below shall be followed for Fire Protection and Air Conditioning systems

S.No.	PIPE LINE	Base colour	Band colour
Fire Protection System			
1	Hydrant and Emulsifier system pipeline	FIRE RED	-
2	Emulsifier system detection line – water	FIRE RED	Sea Green
3	Emulsifier system detection line – Air	FIRE RED	Sky Blue
4	Pylon support pipes	FIRE RED	
Air Conditioning System			
5	Refrigerant gas pipeline – at compressor suction	Canary Yellow	-
6	Refrigerant gas pipeline – at compressor discharge	Canary Yellow	Red
7	Refrigerant liquid pipeline	Dark Admiralty Green	-
8	Chilled water pipeline	Sea Green	-
9	Condenser water pipeline	Sea Green	Dark Blue

12.3.7 For aluminium casted surfaces, the surface shall be with smooth finish. Further, in case of aluminium enclosures the surface shall be coated with powder (coating thickness of 60 microns) after surface preparation for painting.

13.0 HANDLING, STORING AND INSTALLATION

13.1 In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Purchaser or his representative,

- the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented. Commercial use of switchyard equipment means completion of all site tests specified and energisation at rated voltage.
- 13.2 Contractor may engage manufacturer's Engineers to supervise the unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer's supervisory Engineer(s) and shall extend full cooperation to them.
- 13.3 The contractor shall have to ensure that the hard and flat indoor and outdoor storage areas are in place prior to commencement of delivery of material at site. Contractor shall also ensure availability of proper unloading and material handling equipment like cranes etc. and polyester/nylon ropes of suitable capacity to avoid damage during unloading and handling of material at site. All indoor equipments shall be stored indoors. Outdoor equipment may be stored outdoors but on a hard and flat raised area properly covered with waterproof and dustproof covers to protect them from water seepage and moisture ingress. However, all associated control panels, marshalling boxes operating boxes etc. of outdoor equipments are to be stored indoors only. Storage of equipment on top of another one is not permitted if the wooden packing is used. Material opened for joint inspection shall be repacked properly as per manufacturer's recommendations. During storage of material regular periodic monitoring of important parameters like oil level / leakage, SF6 / Nitrogen pressure etc. shall be ensured by the contractor.
- 13.4 In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the Purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.
- 13.5 Where assemblies are supplied in more than one section, Contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.
- 13.6 Supplier shall be responsible for examining all the shipment and notify the Purchaser immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. The Contractor shall submit to the Purchaser every week a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.

13.7 The supplier shall be fully responsible for the equipment/material until the same is handed over to the Purchaser in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken over by Purchaser, as well as protection of the same against theft, element of nature, corrosion, damages etc.

13.8 Where material / equipment is unloaded by Purchaser before the Contractor arrives at site or even when he is at site, Purchaser by right can hand over the same to Contractor and there upon it will be the responsibility of Contractor to store the material in an orderly and proper manner.

13.9 The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment which requires indoor storage.

13.10 The words 'erection' and 'installation' used in the specification are synonymous.

13.11 Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

13.12 Equipment Bases

A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base unless otherwise agreed to by the Purchaser. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

14.0 TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipment. However, these tools and tackles shall be separately, packed and brought on to Site.

15.0 AUXILIARY SUPPLY

15.1 The sub-station auxiliary supply is normally met through a system indicated under section "Electrical & Mechanical Auxiliaries" having the following parameters. The auxiliary power for station supply, including the equipment drive, cooling system of any equipment, air-conditioning, lighting etc shall be designed for the specified Parameters as under. The DC supply for the instrumentation and PLCC system shall also conform the parameters as indicated in the following.

Normal Voltage	Variation in Voltage	Frequency in HZ	Phase/Wire	Neutral connection
415V	± 10%	50 ± 5%	3/4 Wire	Solidly Earthed.
240V	± 10%	50 ± 5%	1/2 Wire	Solidly Earthed.
220V	190V to 240V	DC	-	Isolated 2 wire System
48V	-	DC	-	2 wire system (+) earthed

Combined variation of voltage and frequency shall be limited to ± 10%.

16.0 SUPPORT STRUCTURE (If in the scope of supplier)

16.1 The equipment support structures shall be suitable for equipment connections at the first level i.e 14.0 meter, 8.0 meter and 5.9 meter from plinth level for 765 kV, 420 kV and 245 kV substations respectively. All equipment support structures shall be supplied along with brackets, angles, stools etc. for attaching the operating mechanism, control cabinets & marshalling box (wherever applicable) etc.

16.2 Support structure shall meet the following mandatory requirements:

16.2.1 The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or supporting insulators to the bottom of the equipment base, where it rests on the foundation pad shall be 2.55 metres.

17.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

17.1 All power clamps and connectors shall conform to IS:5561 & NEMA CC1 and shall be made of materials listed below :

- | | | |
|----|--|---|
| a) | For connecting ACSR conductors | Aluminum alloy casting, conforming to designation A6 of IS:617 and all test shall conform to IS:617 |
| b) | For connecting equipment terminals made of copper with ACSR conductors | Bimetallic connectors made from aluminum alloy casting, conforming to designation A6 of IS:617 with 2mm thick bimetallic liner and all test shall conform to IS:617 |
| c) | For connecting G.I | Galvanised mild steel shield |
| d) | i) Bolts, nuts & Plain, washers | i) Electro-galvanised for sizes below M12, for others hot dip galvanised. |
| | ii) Spring washers items 'a' to 'c' | ii) Electro-galvanised mild for steel suitable for atleast service condition-3 as per IS:1573 |

17.2 Necessary clamps and connectors shall be supplied for all equipment and connections. The requirement regarding external corona and RIV as specified for any equipment shall include its terminal fittings. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of work.

17.3 Where copper to aluminum connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress.

17.4 Low voltage connectors, grounding connectors and accessories for grounding of equipment as specified in each particular case, are also included in the scope of Work.

17.5 No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminum body or 2 mm thick bi-

metallic strips shall be provided for Bi-metallic clamps.

- 17.6 All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
- 17.7 Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through (fixed/sliding) type connection of 4" IPS AL. tube as required. In both the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.
- 17.8 Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/connector is designed with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on the hardware.
- 17.9 All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- 17.10 Clamps and connectors shall be designed to be corona controlled.

17.11 Tests

- 17.11.1 Clamps and connectors should be type tested as per IS:5561 and shall also be subjected to routine tests as per IS:5561. Following type test reports shall be submitted for approval as per clause 9.2 above except for sl. no.(ii) & (iii) for which type test once conducted shall be applicable (i.e. the requirement of test conducted within last ten years shall not be applicable).
 - i) Temperature rise test (maximum temperature rise allowed is 35°C over 50°C ambient)
 - ii) Short time current test
 - iii) Corona (dry) and RIV (dry) test (for 220 KV and above voltage level clamps)
 - iv) Resistance test and tensile test

18.0 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

- 18.1 All types of boxes, cabinets etc. shall generally conform to & be tested in accordance with IS-5039/IS-8623, IEC-60439, as applicable, and the clauses given below:
- 18.2 Control cabinets, junction boxes, Marshalling boxes & terminal boxes shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be atleast 2.0 mm thick cold rolled or 2.5 mm hot rolled or alternately 1.6 mm thick stainless steel can also be used. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminum enclosed box the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.

- 18.3 A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes / Control cabinets to prevent ingress of rain water.
- 18.4 Cabinet/boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of the gasket shall be such that it does not get damaged/cracked during the operation of the equipment.
- 18.5 All doors, removable covers and plates shall be gasketed all around with suitably profiled EPDM/Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan, IS:11149 and IS:3400. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.
- 18.6 All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. Gland plate shall have provision for some future glands to be provided later, if required. The Nickel plated glands shall be dust proof, screw on & double compression type and made of brass. The gland shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall conform to BS:6121.
- 18.7 A 240V, single phase, 50 Hz, 15 amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.
- 18.8 For illumination, a fluorescent tube or CFL of approximately 9 to 15 watts shall be provided. The switching of the fittings shall be controlled by the door switch. .
For junction boxes of smaller sizes such as lighting junction box, manual operated earth switch mechanism box etc., plug socket, heater and illumination is not required to be provided.
- 18.9 All control switches shall be of MCB/rotary switch type and Toggle/piano switches shall not be accepted.
- 18.10 Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire shall be terminated on to the earthing pad and secured by the use of self etching washer. Earthing of hinged door shall be done by using a separate earth wire.
- 18.11 The bay marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/wiring by pasting the same on the inside of the door.
- 18.12
 - a) The following routine tests along with the routine tests as per IS:5039 shall also be conducted:
 - i) Check for wiring
 - ii) Visual and dimension check
 - b) The enclosure of bay marshalling kiosk, junction box, terminal box shall conform to IP-55 as per IS:13947 including application of, 2.5 KV rms for 1

(one) minute, insulation resistance and functional test after IP-55 test.

19.0 Deleted.

20.0 TERMINAL BLOCKS AND WIRING

- 20.1 Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All interphase and external connections to equipment or to control cubicles will be made through terminal blocks.
- 20.2 Terminal blocks shall be 650V grade and have continuous rating to carry the maximum expected current on the terminals and non breakable type. These shall be of moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type of Elmex or Phoenix or Wago or equivalent make.
- 20.3 Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.
- 20.4 The terminal shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.
- 20.5 The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable.
- 20.6 The terminal blocks shall be of extensible design.
- 20.7 The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.
- 20.8 The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.
- 20.9 Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.
- | | | |
|----|------------------------------------|--|
| a) | All circuits except CT/PT circuits | Minimum of two of 2.5 sq copper flexible. |
| b) | All CT/PT circuits | Minimum of 4 nos. of 2.5 sq copper flexible. |
- 20.10 The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live.
- 20.11 Atleast 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.
- 20.12 There shall be a minimum clearance of 250 mm between the First/bottom row of terminal block and the associated cable gland plate for outdoor ground mounted marshalling box and the clearance between two rows of terminal blocks shall be a minimum of 150 mm.
- 20.13 The supplier shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as

between phases and common terminal boxes or control cabinets. For equipments rated for 400 kV and above the wiring required in these items shall be run in metallic ducts or shielded cables in order to avoid surge overvoltages either transferred through the equipment or due to transients induced from the EHV circuits.

- 20.14 All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The Contractor shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

21.0 LAMPS & SOCKETS

21.1 Sockets

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

21.2 Hand Lamp:

A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF Switch for connection of hand lamps.

21.3 Switches and Fuses:

- 21.3.1 Each panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breaker / switchfuse units. Selection of the main and Sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.
- 21.3.2 All fuses shall be of HRC cartridge type conforming to IS:9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

22.0 Bushings, Hollow Column Insulators, Support Insulators:

- 22.1 Bushings shall be manufactured and tested in accordance with IS:2099 & IEC- 60137 while hollow column insulators shall be manufactured and tested in accordance with IEC-62155/IS:5621. The support insulators shall be manufactured and tested as per IS:2544/IEC-60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable. The bidder may also offer composite hollow insulators, conforming to IEC-61462.
- 22.2 Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.
- 22.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.
- 22.4 Support insulators/bushings/hollow column insulators shall be designed to

have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

- 22.5 When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.
- 22.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.
- 22.7 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by machining. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.

22.8 Tests

In bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS: 2099 & IS:2544 & IS : 5621.

23.0 MOTORS

Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.

23.1 Enclosures

- a) Motors to be installed outdoor without enclosure shall have hose proof enclosure equivalent to IP-55 as per IS: 4691. For motors to be installed indoor i.e. inside a box, the motor enclosure, shall be dust proof equivalent to IP-44 as per IS: 4691.
- b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.
- c) Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor casing.
- d) Motors weighing more than 25 Kg. shall be provided with eyebolts, lugs or other means to facilitate lifting.

23.2 Operational Features

- a) Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point and the motor shall not be over loaded at any operating point of driven equipment that will rise in service.
- b) Motor shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system

having the particulars as given in Clause 15.0 of this Section.

23.3 Starting Requirements:

- a) All induction motors shall be suitable for full voltage direct-on-line starting. These shall be capable of starting and accelerating to the rated speed alongwith the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.
- b) Motors shall be capable of withstanding the electrodynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.
- c) The locked rotor current shall not exceed six (6) times the rated full load current for all motors, subject to tolerance as given in IS:325.
- d) Motors when started with the driven equipment imposing full starting torque under the supply voltage conditions specified under Clause 15.0 shall be capable of withstanding atleast two successive starts from cold condition at room temperature and one start from hot condition without injurious heating of winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition.
- e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Bidder shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speed lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

23.4 Running Requirements:

- a) The maximum permissible temperature rise over the ambient temperature of 50 degree C shall be within the limits specified in IS:325 (for 3 - phase induction motors) after adjustment due to increased ambient temperature specified.
- b) The double amplitude of motor vibration shall be within the limits specified in IS: 4729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.
- c) All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes with rated load commencing from hot condition.

23.5 TESTING AND COMMISSIONING

An indicative list of tests is given below. Contractor shall perform any additional test based on specialities of the items as per the field Q.P./Instructions of the equipment Contractor or Purchaser without any extra cost to the Purchaser. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates and shall furnish the list of instruments to the Purchaser for approval.

- (a) Insulation resistance.

- (b) Phase sequence and proper direction of rotation.
- (c) Any motor operating incorrectly shall be checked to determine the cause and the conditions corrected.

ANNEXURE-A

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1. General

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external corona (for 400kV & above) both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage (RIV) for 132kV and above.

2. Test Levels:

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3. Test Methods for RIV:

- 3.1 RIV tests shall be made according to measuring circuit as per International Special-Committee on Radio Interference (CISPR) Publication 16-1(1993) Part -1. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 Mhz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.
- 3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107-1964, except otherwise noted herein.
- 3.3 In measurement of, RIV, temporary additional external corona shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.
- 3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, and 110% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 765kV, 400 kV, 220 KV is listed in the detailed specification together with maximum permissible RIV level in microvolts.
- 3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.

- 3.6 The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to voltage read by noise meter.

4. Test Methods for Visible Corona

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 110% of specified corona extinction voltage and maintained there for five minutes. In case corona inception does not take place at 110%, test shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e. 85%, 100%, and 110%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energised connectors. The photographs shall be framed such that test object essentially, fills the frame with no cut-off.

For recording purpose, modern devices utilizing UV recording methods such as image intensifier may also be used.

- 4.1 The test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.
- 4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Purchaser's inspector, after determining the best camera locations by trial energisation of test object at a voltage which results in corona.
- 4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.

- 4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Purchaser's inspector if, in his opinion, it will not prejudice other test.

5. Test Records:

In addition to the information previously mentioned and the requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in test report:

- a) Background noise before and after test.
- b) Detailed procedure of application of test voltage.
- c) Measurements of RIV levels expressed in micro volts at each level.
- d) Results and observations with regard to location and type of interference sources detected at each step.
- e) Test voltage shall be recorded when measured RIV passes through 100microvolts in each direction.
- f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

ANNEXURE-B

SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstanding test on the complete equipment (for 132kV and above) shall be carried out along with supporting structure.

The Bidder shall arrange to transport the structure from his Contractor's premises/POWERGRID sites for the purpose of seismic withstand test only. The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the Purchaser. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the POWERGRID.

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SECTION -4

(This shall be reviewed and approved during contract stage only)

GUARANTEED TECHNICAL PARTICULARS

(A)	Lighting Fixtures & Accessories (Data to be submitted separately for each type and Size)	
1.	Manufacture's Name and country of manufacture a) Fixture b) Accessories	
2.	Applicable Standards for a) Fixture b) Accessories	
3.	Manufacturer's type and Catalogue no. for a) Fixture b) Accessories	
4.	Nominal working Voltage (Volts)	
5.	Maximum permissible supply Voltage Variation for satisfactory operation of : a) Fixture (+ / -) b) Accessories (+ / -)	
6.	Power factor at nominal working Voltage and frequency	
7.	Full load input current at Nominal working voltage (Amps)	
8.	Power loss per ballast at nominal working voltage and frequency (Watts)	
9.	Maximum hot spot temperature of ballast case (°C)	
10.	Maximum average ballast winding temperature (°C)	
11.	Ambient temperature within the fitting in continuous operation at the design ambient air temperature (°C)	
12.	Insulation class of ballast winding (°C)	
13.	Average life expectancy of : a) Ballasts b) Capacitors c) Lamps	
14.	Lamp output at the design temperature a) After 100 burning hours (lumens) b) After 1000 burning hours (lumens)	

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15.	Lamp output at the end of the expected Life period (lumens)	
16.	Average light output of the fitting as a percentage of lamp output. a) Downwards (%) b) Upwards (%)	
17.	Beam angle for flood lights in a) Horizontal plane (Degrees) b) Vertical plane (Degrees)	
18.	Cable / conduit entry size	
19.	Earthing terminal a) Material b) Size and type of cable	
20.	Weights of Fixtures (Kg.)	
21.	a) Starting Current & PF for lamp (Amps) b) Operating current (Amps) c) Time Vs mains current & PF Characteristics during starting to be enclosed. d) Reference cat. No.	
B.	Junction Boxes (for each type and size)	
1.	Manufacturer's name and country of manufacture	
2.	Manufacturer's type designation	
3.	Material Specification	
4.	Type of enclosure	
5.	Terminals a) Make b) Current rating (Amps) c) Voltage rating (Volts) d) Stud type (yes /no) e) Provision of insulated Barriers (yes /no)	
6.	Whether descriptive pamphlet is enclosed (yes/no)	
C.	Lighting Panels (For each type & size)	
1.	General	
	a) Manufacture's name and country of manufacture	
	b) Indoor /outdoor application	
	c) Design ambient air temp (°C)	
	d) Thickness of sheet steel(mm)	
	e) Degree of protection provided	

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	(as per IS:2147 or equivalent)	
	f) Bill of material for various equipment giving make, type, rating etc enclosed.	
	g) Colour of finish paint i) Outside ii) Inside h) Busbar i) Material ii) Temp. rise at rated current over specified ambient (50 ° C) iii) Continuous current rating at 50 ° C ambient temp. iv) Whether suitable for one second current rating of 5 kA, AC or 4kA D.C as applicable . v) Cross Section vi) Applicable Standard	
	l) Control Wing i) Material of conductor ii) Size of conductor /dia of wire (mm ²)	
	j) Conductor - Solid / Stranded	
	k) Terminal Block i) Make ii) Current rating a) Power terminals (Amps) b) Other terminals (Amps)	
	l) All tests as specified in specifications will be carried out (yes/no)	
2.	Air Break Switches (For each type & size) a) Manufacturer's name and country of manufacture b) Manufacturer's type, description c) Applicable Standard d) Rated voltage (Volts) & Frequency (Hz) e) Rated current (Amps) f) Rated Breaking Current (Amps) g) Maximum through fault current withstand . Derating factor for use under site ambient conditions h) Temperature rise of contacts when carrying continuous rated current under site	

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	conditions (°C)	
3.	Fuses (For each type & size) a) Manufacturer's name and country of manufacture b) Manufacture's type, description c) Applicable Standard d) Rated Voltage (Volts)	
	e) Rated current (Amps) f) Whether fuse is mounted on an insulated carrier (yes / no) g) Whether fuse carrier has an aperture for fuse failure indication(yes/no) h) Category of duty (IS:2208) i) Rupturing capacities (Prospective current)(kA) j) Maximum let through current for 1 sec. (kA) k) Whether time/ current characteristics are enclosed (Yes/No.)	
4.	Miniature Circuit Breakers (For each type and rating) a) Manufacturer's name and country of manufacture b) Type c) Rated voltage d) No. of poles e) Frequency f) Current Rating i) Continuous at 50°C ambient (Amps) g) Breaking Capacity (Single pole/Double pole / Tripple pole) i) Symmetrical (kArms) ii) Asymmetrical(kArms) h) Total interrupting Cycle time i) Type of SC Tripping j) Type of overload (thermal/magnetic) k) Terminal Suitable for cable size l) Upto what fault current discrimination between incomer fuse & M.C.B will be obtained m) Miniature breaker conform to	
5.	Contactors for each type(DC/AC) & Size a) Manufacturer's name and Country of manufacture b) Rated voltage & permissible Variation(Volts)	

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	c) Rated Burden (kA) d) Rated current (thermal) of main contacts e) No. & type of Aux. Contacts (if any) f) Rated Voltage of coil (Volts) g) Pick up voltage h) Rated duty class i) Drop off voltage j) Applicable standard	
--	--	--

D)	Lighting Poles (For each type and size)	
1	Manufacturer's name and country of Manufacturer	
2.	Standards applicable	
3.	Dimensions	
4.	Painting / galvanisation details	
5.	Whether descriptive Pamphlet is enclosed ?	
E)	Lighting Wires (For each type and Size)	
1.	Manufacturer's name and country of Manufacturer	
2.	Standard applicable	
3.	Rated Voltage (Volts)	
4.	Continuous current rating when laid in conduit in an ambient temperature of 50°C (Amps)	
5.	Conductor	
	a) Material	
	b) Nominal Cross sectional area	
	c) Number and diameter of wires	
6.	Insulation	
	a) Composition of insulation	
	b) Thickness of insulation	
	c) Tolerance on thickness of insulation	
	d) Specific insulation resistance at 60 deg.C.	
7.	Colors scheme for identification of wires	
8.	Whether descriptive Pamphlet is enclosed ?	
G.	Painting , Prime , Finish Coat	
1.	Paints (For each type)	
	a) Manufacturer's name and country of manufacture	
	b) Manufacturer's type designation/ brand	

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	name	
	c) Shade	
2.	Number of coats provided & Microns	
3.	Applicable Standards	

Section-5

CHECK LIST FOR ILLUMINATION SYSTEM

TO BE FILLED AND RETURNED WITH THE OFFER DULY SIGNED

Please mark "YES" if the specified requirement is met or
put a mark "NO" if the specified requirement is not met and give reason in column 5

BHEL Enquiry no :

Bidder offer reference :

Illumination System

Doc. No. TB-385-316-140 Section-5

Sl.no	Parameter	Data	Bidder's conformat ion	Reason for non-complian ce
-1	-2	-3	-4	-5
1.	Provision of illumination for specified areas as per spec.		YES / NO	
2.	Guaranteeing the illumination levels specified as per spec.		YES / NO	
3.	Type of lighting luminaries included as per spec.		YES / NO	
4.	Lighting DBs & LPs included as per spec.		YES / NO	
5.	Sockets, Plugs & other items included as per spec.		YES / NO	
6.	ETC of Package included in the offer		YES / NO	

Illumination System**Doc. No. TB-385-316-140 Section-5**

Sl.no	Parameter	Data	Bidder's conformat ion	Reason for non-complian ce
7.	Supply & ETC of all wires / Cables / earthing material required for the package other than the items supplied by BHEL included in the package.		YES / NO	
8.	ETC of BHEL supplied Cables included in the offer		YES / NO	
9.	ETC of BHEL supplied earthing strip included in the offer		YES / NO	
10.	Type and lumen output of lamps included in the offer are as per specification.		YES / NO	
11.	Whether any new item other than the BOQ given required to meet the specification requirement.		YES/ NO	
12.	If new item is required whether these are listed with quantities in the offer		YES/ NO	
13.	Equipment included suitable for operation on voltage & frequency Variation limits specified in the specification without effecting their performance			
14.	Power factor of lamp circuit is as per specification		YES/NO	
15.	Fully filled in GTP enclosed		YES/NO	

Illumination System**Doc. No. TB-385-316-140 Section-5**

Sl.no	Parameter	Data	Bidder's conformat ion	Reason for non-complian ce
16.	Auto change over arrangement for emergency AC/ emergency DC included in EAC & DC boards			
17.	Auto switching arrangement for outdoor flood lighting / street lighting through Timer / Photo call is included		YES / NO.	
18.	Activity Schedule enclosed		YES /NO	

Sr.No	Technical Specification	BL	Type SL-L1	Type SL-D1	Type FL-1	Type FL-2	Bidder's conformat ion	Remark / Reason for non-complian ce
		(Surfac e Mounte d Bulk Head)	(LED Street Light Lumina ire)	(Pole Mounte d LED Post Top Lumina ire)	(LED Flood Light Lumina ries)	(LED Flood Light Lumina ries)		
19	System Wattage	≤ 10W	≤45W	≤ 30W	≤150W	≤250W	YES / NO	
20	System Lumen Output	≥ 800	≥4000	≥ 2600	≥ 14000	≥ 23000	YES / NO	
21	System efficacy (Lumens/Watt)	≥ 80	≥ 100	≥ 90	≥ 100	≥ 100	YES / NO	

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Sl.no	Parameter						Data	Bidder's conformat ion	Reason for non-complian ce
22	Housing	Pressur e Die Cast Housin g and with Polycar bonate diffuser	Pressur e Die Cast	Die Cast Alumin um	Pressur e Die Cast Housin g	Pressur e Die Cast Housin g	YES / NO		
23	Ingress Protection	IP-65	IP-65	IP-65	IP-65	IP-65	YES / NO		
24	Surge Protector(Internal)	3kV	3kV	3kV	3kV	3kV	YES / NO		
25	Surge Protector(External)	10kV	10kV	10kV	10kV	10kV	YES / NO		
26	Mounting	Wall Mounti ng	Pole Mounti ng for 40mm max O.D	Suitabl e for 60mm max O.D	On Lattice Structu re	On Lattice Structu re	YES / NO		
27	THD	<20%	<10%	<10%	<10%	<10%	YES / NO		
28	CRI	>70	>70	>70	>70	>70	YES / NO		

Illumination System**Doc. No. TB-385-316-140 Section-5**

Sl.no	Parameter						Data	Bidder's conformat ion	Reason for non-complian ce
29	CCT	5700k ± 300k	5700k ± 300k	5700k ± 300k	5700k ± 300k	5700k ± 300k	5700k ± 300k	YES / NO	
30	Power Factor	>0.90	>0.95	>0.95	>0.95	>0.95	>0.95	YES / NO	
31	Ik Protection	IK-09	IK-05	IK-05	IK-05	IK-05	IK-05	YES / NO	
32	Operating Humidity	90% RH	90% RH	90% RH	90% RH	90% RH	90% RH	YES / NO	
33	Burning Hours	50,000	50,000	50,000	50,000	50,000	50,000	YES / NO	
34	Operating Temperature	-5°C to 45°C						YES / NO	
-	Lumen Maintenance	70% at the End of Burning Hours						YES / NO	

ANNEXURE - A
SCHEDULE OF TECHNICAL DEVIATIONS

Bidder shall list below all technical deviation clause wise w.r.t. tender specifications:

<u>S.No.</u>	<u>Page No.</u>	<u>Clause No.</u>	<u>Deviation</u>	<u>Reason / Justification</u>
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Any deviation not specifically brought out in this section shall not be admissible for any commercial implication at later stage. Except to the technical deviations listed in this schedule, bidder's offer shall be considered in full compliance to the tender specifications irrespective of any such deviation indicated / taken elsewhere in the submitted offer.

Date:

Tenderer's Stamp & Signature