BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

DOCUMENT No.	TB-379-316-010	Rev. No.	00		Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION			NAME	MVK	MM	AS
TITLE				SIGN			
ILLUMINATION SYSTEM				DATE	21.11.16	21.11.16	21.11.16
				GROUP	TBEM		

CUSTOMER	KARNATAKA POWER CORPORATION LIMITED
CONSULTANT	FICHTNER CONSULTING ENGINEERS (I) PVT LTD., BANGALORE
PROJECT	**220kV substation for Yelahanka CCPP (1x370 MW)**

CONTENTS

Section	Description	No. of Sheets
Section-1.	SCOPE, SPECIFIC TECHNICAL REQUIREMENTS & BILL OF QUANTITIES	12
	ANNEXURE - 1 (BILL OF QUANTITY)	
Section-2.	CUSTOMER SPECIFICATION	6
Section-3.	PROJECT DETAILS AND GENERAL SPECIFICATION	9
Section-4.	SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS	4
Section-5.	CHECK LIST	2
	ANNEXURE – A (Technical Deviation)	1

→ Shri V.P. Meena 23/11/16

Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS			
				Distribution	*TBMM*	*TBQM*	*TBCM*	*TBTS*
				Copies	2	-	-	-

SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0.1 This technical specification covers the requirements of design, manufacture, testing at works, packing, dispatch, storage, erection, testing & commissioning of complete Illumination and associated electrical auxiliary system, complete with accessories. No deviation from the requirements specified in various clauses of this specification shall be allowed. A certificate to this effect shall have to be furnished along with the offer as per attached Annexure-A.

1.0.2 The Contract shall be on Bill of Quantity basis for the package. In case of change in scope after award of the contract, the additions/ deletions to the scope shall be as per the breakup unit rates for all the equipment and services furnished by the bidder in his offer. The Contractor shall be responsible for the design and verification of the Illumination system, demonstration of lux levels and other criteria at site.

1.0.3 After placement of order, the bidder has to design the system as per relevant standard/codes to the satisfaction of BHEL/KPCL.

1.0.4 It is not the intent to specify herein all the details of design and manufacturing. 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 material, which in his judgment is not in full accordance herewith.

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

1.0.6 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.

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

Name of the Customer	:	KARNATKA POWER CORPORATION LIMITED
Name of the Consultant	:	FICHTNER Consulting Engineers (India) Pvt. Ltd., Bengaluru
Name of the Project	:	220kV Substation for Yelahanka CCPP (1x370 MW)

Refer Section-3 for Project Details and General Specifications.

1.1 ILLUMINATION & SMALL POWER SYSTEM REQUIREMENT FOR VARIOUS AREAS

The Illumination system shall be provided for the following areas:

- ❑ Switchyard Area
- ❑ Street lighting
- ❑ Tariff Metering Room

The roads & the area of the outdoor switchyard to be illuminated are as marked on the enclosed drawings under Annexure-3. Other relevant drawings are also enclosed under Annexure-3.

1.2 DESIGN CRITERIA

The illumination System for outdoor Switchyard shall comprise of:

- ❑ Normal AC lighting
- ❑ Emergency AC Lighting

20% of lighting fixtures shall be connected on AC emergency lighting.

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.

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

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

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

Refer Section-2 for further details.

1.3 SCOPE OF SUPPLIES & SERVICES

1.3.1 SCOPE OF SUPPLY MATERIAL & ERECTION MATERIAL

a) The main items to be furnished for Substation under this contract are detailed in Bill of Quantity (Annexure-1) and shall be read in conjunction with other clauses of this specification.

b) All associated 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.

c) Further, in case any type of luminaries/ panels etc not included below but are required to meet the technical specification shall be specifically brought out in the offer/shall be supplied.

d) 415V ACDB & 220V DCDB boards are being supplied and erected by the owner. Illumination contractor will terminate the cables in these panels.

e) Supply of necessary cable for consumption within the street light/lighting pole assembly, such as pole mounted JB to respective light fittings, battery etc shall be in Contractor's Scope.

f) 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.

g) Where cables are to be laid in GI Pipe, excavation, filling etc. deemed to be included in erection cost quoted.

h) 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.

i) 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.

1.3.2 FREE ISSUE ITEMS FROM PURCHASER

The following shall be free issue items from BHEL:

- Multicore power cables as listed in BOQ
- 75x12 mm GI flat for earthing
- 50x6 mm GI flat for earthing
- 110/50 mm GI / PVC pipe
- 40 mm dia MS rod for earthing

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

Erection, testing and commissioning of these cables, MS Rod & earth strip will be in bidder's scope. Supply of all other items such as cables, wires, steel wire, lugs, Cable glands, earthing material etc required to complete the works are in bidder's scope.

1.3.3 SCOPE OF SERVICES

The bidder shall quote for ETC, civil works, cabling including termination & earthing against each item as applicable. The list is attached as Annexure-1 (BOQ).

1.3.3.1 Erection, Testing & 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 cables from ACDB to MLDB/EDB, MLDB/EDB to Lighting Panels shall be in BHEL scope. Cabling from outdoor Lighting panel to JB & from JB to fittings etc for the equipment under the scope of this specification shall be in Bidders scope.

e) All material and consumables required for erection work shall be in Contractor's scope. Erection material shall cover, but not be limited to, Clamps etc for Luminaries, Connections between Junction Boxes and Luminaries in outdoor area, All cable glands, lugs and ferrules require for cabling/ wiring. Any other material required for erection shall deemed to be in Contractor's scope. Holes shall not be drilled on the Galvanised substation gantry and LM structures.

f) Earthing of all electrical equipment as per requirement is in Contractor's scope.

g) Contractor shall arrange all machinery tools & tackles, instruments and consumables required for erection, testing and commissioning of the system.

h) Contractor shall ensure that sufficient quantity of commissioning spares is made available for timely completion of commissioning of the system. The Contractor shall finalize the list with BHEL during detailed engineering stage. The unused commissioning spares shall be returnable to the Bidder.

1.3.3.2 Civil Works

a. Civil works such as foundation for Street Lighting Poles, 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 and filling 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

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.

1.4 TYPE TESTS

The offered equipment should have been successfully type tested as per relevant IS/IEC and valid test reports shall be submitted. Bidder shall submit valid reports of type tests for Circuit Breakers carried out within 10 years from date of LOA i.e. 03.11.2015. If these tests have been conducted more than 10 years prior from date of LOA or test reports are not valid, the type test shall be repeated with no extra cost to BHEL/KPCL.

1.5 QUALITY PLAN

Bidder to follow valid KPCL/BHEL approved Quality Plan.

1.6 HANDING & TAKING OVER

It is the responsibility of the Contractor to run and maintain the system supplied by them for a period of 3 months and subsequently hand over the same to BHEL/owner. Contractor shall assist BHEL to hand over the system supplied by them to owner.

1.8 TITLE BLOCK

The drawings / documents submitted shall be project and product specific and shall incorporate following details:

a) Project Name : 220 kV Switchyard - 1x370 MW Yelahanka CCPP
b) Customer Name : Karnataka Power Corporation Limited
c) Consultant Name : Fichtner Consulting Engineers (I) Pvt Ltd., Bangalore
d) Contractor : Bharat Heavy Electricals Limited
e) Customer LOA no.: CEGSW/YCCPP/Supply/1041a, Dated: 03/02/2016
CEGSW/YCCPP/Services/1041b, Dated: 03/11/2015

1.9 LIST OF DRAWINGS ENCLOSED (Refer Annexure-2)

Drawings for Yelahanka Project:

Sl No	Drwg. No.	Description
1	TB-0-379-316-002 (2 Sheets)	Layout Plan & Section Elevation of 220kV Switchyard
2	TB-0-379-316-005	Cable Trench Layout for 220kV Switchyard
3	TB-3-379-316-007	Single Line Diagram for LT AC & DC System - 220kV Switchyard

- - x x - -

ANNEXURE-A

It is confirmed that there are no deviations and the offer is in full compliance with the specification. It is also confirmed that there are no deviations in any other form such as comments, variations and/ or exceptions. Further it is confirmed that at all drawings / data sheets/QP/ type tests reports shall be submitted to BHEL for organizing approval of ultimate customer. Also, furnishing of all relevant information / repetition of type tests (if required for meeting the specification requirement) shall be carried out by us at no extra cost to BHEL & without affecting delivery requirements.

Signature of the authorized representative of Bidder
Name _____
Designation _____
Place _____
Date _____

Company seal

	220 kV Switchyard at 1x370MW Yelahanka CCPP		
Sl. No.	DESCRIPTION	UNIT	Qty.
1	**Supply** of Main Lighting Distribution Board (MLDB) comprising 415V, 63A, 3-Ph, 4-wire bus and two (2) no. Lighting transformer: 100kVA with Two (2) No. Incomer 63A TPN MCCB, One (1) No. Bus Coupler, Ougoing feeders 6 No. 32A TPN MCCB on each Bus Section (Inclusive of CT, Voltmeter, Ammeter, Contactor with timer, indicating lamps etc)	Nos.	1
2	**ETC** of Main Lighting Distribution Board (MLDB) comprising 415V, 63A, 3-Ph, 4-wire bus and two (2) no. Lighting transformer: 100kVA with Two (2) No. Incomer 63A TPN MCCB, One (1) No. Bus Coupler, Ougoing feeders 6 No. 32A TPN MCCB on each Bus Section (Inclusive of CT, Voltmeter, Ammeter, Contactor with timer, indicating lamps etc)	Nos.	1
3	**Supply** of wheel mounted adjustable aluminium ladder for the maintenance of street lights	No.	1
4	**Supply** of 415 V A.C. Outdoor type Lighting Panel (Normal/Emergency) comprising 1 No. 32A TP MCB & 8 Nos. outgoing 16A SP MCB. Control circuit with 0-24 hrs. timer, photo cell, push buttons, auto manual switch and indicating lamps	Nos.	3
5	**ETC** of 415 V A.C. Outdoor type Lighting Panel (Normal/Emergency) comprising 1 No. 32A TP MCB & 8 Nos. outgoing 16A SP MCB. Control circuit with 0-24 hrs. timer, photo cell, push buttons, auto manual switch and indicating lamps	Nos.	3
6	**Supply** of 415 V A.C. Outdoor type Street Lighting Panel comprising 1 No. 32A TP MCB & 8 Nos. outgoing 16A SP MCB. Control circuit with 0-24 hrs. timer, photo cell, push buttons, auto manual switch and indicating lamps	Nos.	1
7	**ETC** of 415 V A.C. Outdoor type Street Lighting Panel comprising 1 No. 32A TP MCB & 8 Nos. outgoing 16A SP MCB. Control circuit with 0-24 hrs. timer, photo cell, push buttons, auto manual switch and indicating lamps	Nos.	1
8	**SUPPLY** of Outdoor Junction boxes with 5 Nos. terminal blocks for LILO of cable upto 16sq.mm cable (JB shall be suitable for conduit size of upto 50mm)	Nos.	20
9	**ETC** of Outdoor Junction boxes with 5 Nos. terminal blocks for LILO of cable upto 16sq.mm cable (JB shall be suitable for conduit size of upto 50mm)	Nos.	20
10	**Supply** of 63A, 3-Phase interlocked Receptacle	Nos.	2
11	**ETC** of 63A, 3-Phase interlocked Receptacle	Nos.	2
12	**Supply** of Flood lighting fixtures complete with lamps, control gears etc. (Philips Cat No. RVP 302/2x400W or equivalent make)	Nos.	30
13	**ETC** of Flood lighting fixtures complete with lamps, control gears etc. (Philips Cat No. RVP 302/2x400W or equivalent make)	Nos.	30
14	**Supply** of Flood lighting Fixture complete with lamps, control gears etc. (Philips Cat No. SWF 330/1x400W or equivalent make)	Nos.	5
15	**ETC** of Flood lighting Fixture complete with lamps, control gears etc. (Philips Cat No. SWF 330/1x400W or equivalent make)	Nos.	5
16	**Supply** of 150W Street lighting fixtures with clear arcylic cover cut-off type with intergral mounted control gear and complete with lamps, fixing material etc. (Crompton Greaves Cat. No. SSGN1215IH or equivalent make fixture)	No.	12
17	**ETC** of 150W Street lighting fixtures with clear arcylic cover cut-off type with intergral mounted control gear and complete with lamps, fixing material etc. (Crompton Greaves Cat. No. SSGN1215IH or equivalent make fixture)	No.	12
18	**Supply** of 125W HPMV Post Top Lantern fixture complete with lamps, control gears etc. (Philips Cat No. HPC-101/125 HPF or equivalent make)	No.	4
19	**Civil works & ETC** of 125W HPMV Post Top Lantern fixture complete with lamps, control gears etc. (Philips Cat No. HPC-101/125 HPF or equivalent make)	No.	4
20	**Supply** of 2x28W T5, energy efficient 240V, Industrial Fluorescent fixture, surface/pendent mounting with Vitreous Reflector (Philips Cat No. TMS 122/228 HF or equivalent make fixture)	No.	4
21	**ETC** of of 2x28W T5, energy efficient 240V, Industrial Fluorescent fixture, surface/pendent mounting with Vitreous Reflector (Philips Cat No. TMS 122/228 HF or equivalent make fixture)	No.	4
22	**Supply** of 2x28W T5, energy efficient 240V, Industrial Fluorescent fixture, surface/pendent mounting polycarbonate body corrosion resistant CRCA gear tray cum Reflector is finished in white powder coating. IP-65 (Philips Cat No. TCW 450 or equivalent make fixture)	No.	1
23	**ETC** of of 2x28W T5, energy efficient 240V, Industrial Fluorescent fixture, surface/pendent mounting polycarbonate body corrosion resistant CRCA gear tray cum Reflector is finished in white powder coating. IP-65 (Philips Cat No. TCW 450 or equivalent make fixture)	No.	1
24	**Supply** of Single arm swaged and welded steel pole with junction box and all accessories (11m high Lighting Pole with 1.8m over-hang projection for Street-Lighting)	Nos.	12
25	**Civil works & ETC** of Single arm swaged and welded steel pole with junction box and all accessories (11m high Lighting Pole with 1.8m over-hang projection for Street-Lighting)	Nos.	12
26	**Supply** of 4.5m high Lighting Pole for Post-top Lantern	Nos.	4
27	**Civil works & ETC** of 4.5m high Lighting Pole for Post-top Lantern	Nos.	4
28	**Supply** of Receptacle 5/15A, 240V AC	Nos.	1
29	**ETC** of Receptacle 5/15A, 240V AC	Nos.	1
30	**Supply** of 32A DPMCB with Receptacle for split AC unit	Nos.	1
31	**ETC** of 32A DPMCB with Receptacle for split AC unit	Nos.	1
32	**Supply** of Modular switchboard with 6 Nos. 5A switches and one no. 5A receptacles	Nos.	1
33	**ETC** of Modular switchboard with 6 Nos. 5A switches and one no. 5A receptacles	Nos.	1
34	**Supply** of Galvanized rigid steel conduit of 20mm size with accessories	Mtr.	100

Sl. No.	DESCRIPTION	UNIT	Qty.
35	**ETC** of Galvanized rigid steel conduit of 20mm size with accessories	Mtr.	100
36	**Supply** of Galvanized rigid steel conduit of 25mm size with accessories	Mtr.	75
37	**ETC** of Galvanized rigid steel conduit of 25mm size with accessories	Mtr.	75
38	**Supply** of Galvanized rigid steel conduit of 40mm size with accessories	Mtr.	50
39	**ETC** of Galvanized rigid steel conduit of 40mm size with accessories	Mtr.	50
40	**Supply** of 1C, 2.5 sqmm PVC insulated stranded Cu. Wire	Mtr.	500
41	**ETC** of 1C, 2.5 sqmm PVC insulated stranded Cu. Wire	Mtr.	500
42	**Supply** of 1C, 4 sqmm PVC insulated stranded Cu. Wire	Mtr.	500
43	**ETC** of 1C, 4 sqmm PVC insulated stranded Cu. Wire	Mtr.	500
44	**Laying, Testing & Commissioning** of 2C, 2.5 sqmm PVC insulated, Armoured Cu. Cable	Mtr.	1000
45	**Laying, Testing & Commissioning** of 4C, 16 sqmm XLPE insulated, Armoured Al. Cable	Mtr.	250
46	**Supply** of 50 mm GI conduits	Mtr.	500
47	**Laying** of 50 mm GI conduits at a depth of 300 mm including excavation, backfilling, making & repairing of walls in trenches, cutting, threading, fixing of sockets/bends where required etc to complete. Also between pull pit boxes to JB/LP.	Mtr.	500
48	**Supply** of 100 mm GI conduits	Mtr.	500
49	**Laying** of 100 mm GI conduits at a depth of 300 mm including excavation, backfilling, making & repairing of walls in trenches, cutting, threading, fixing of sockets/bends where required etc to complete. Also between pull pit boxes to JB/LP.	Mtr.	500
50	**Construction** of Pull Pit Boxes of sizes 400mmx400mmx400mm at the free ends and turning of GI pipes if pipe length exceeds 4M	No.	10
51	**Supply of** 25x6 mm GI Flat for earthing.	Mtr.	100
52	**Earthing using** 25x6 mm GI Flat	Mtr.	100
53	**Earthing using** 40 mm dia. MS Rod Electrodes (provided by BHEL)	No.	12
54	**Earthing using** 50x6mm GI Flat (provided by BHEL)	Mtr.	500
55	**Earthing using** 75x12mm GI Flat (provided by BHEL)	Mtr.	100
56	**Supply** of 16 SWG GI Wire (For earthing of Lighting fixtures, receptacles, conduits, junction boxes & switch boxes etc.)	Mtr.	500
57	**Earthing of Fixtures etc. using** 16 SWG GI Wire	Mtr.	500
58	**Supply** of 8 SWG GI Wire (For earthing of street light pole/flood light pole and High mast etc.)	Mtr.	100
59	**Earthing of Fixtures etc. using** 8 SWG GI Wire	Mtr.	100
60	**Supply & ETC** of EXTRA ITEMS REQUIRED FOR COMPLETION OF JOB AS PER SPECIFICATION BUT NOT COVERED ABOVE, SHALL BE QUOTED SEPARATELY. DETAILS TO BE PROVIDED BY BIDDER AT TENDER STAGE. (Price to be quoted on Lumpsum basis)	Lot	1
61	**Services** - Lux measurement at site	Lot	1
62	Spares: Lighting fixtures (along with lamps) (5% of each type with a minimum of 2 Nos.)	Lot	1
63	Spares: Lighting Panels (1 No. of each type)	Lot	1
64	Spares: MCBs (5 No. of each rating & type)	Lot	1

Notes:

1 The above quantities(BOQ) are as per preliminary design only. The detail design wll be submitted by Vendor and subject to approval by Customer. The BOQ quantities which are finalised after approval has to be supplied. BHEL reserves the right for quantity variation due to any reason upto ±30% of total value at same unit rate and terms during execution of contract. The quantity of individual items may however vary upto any extent.

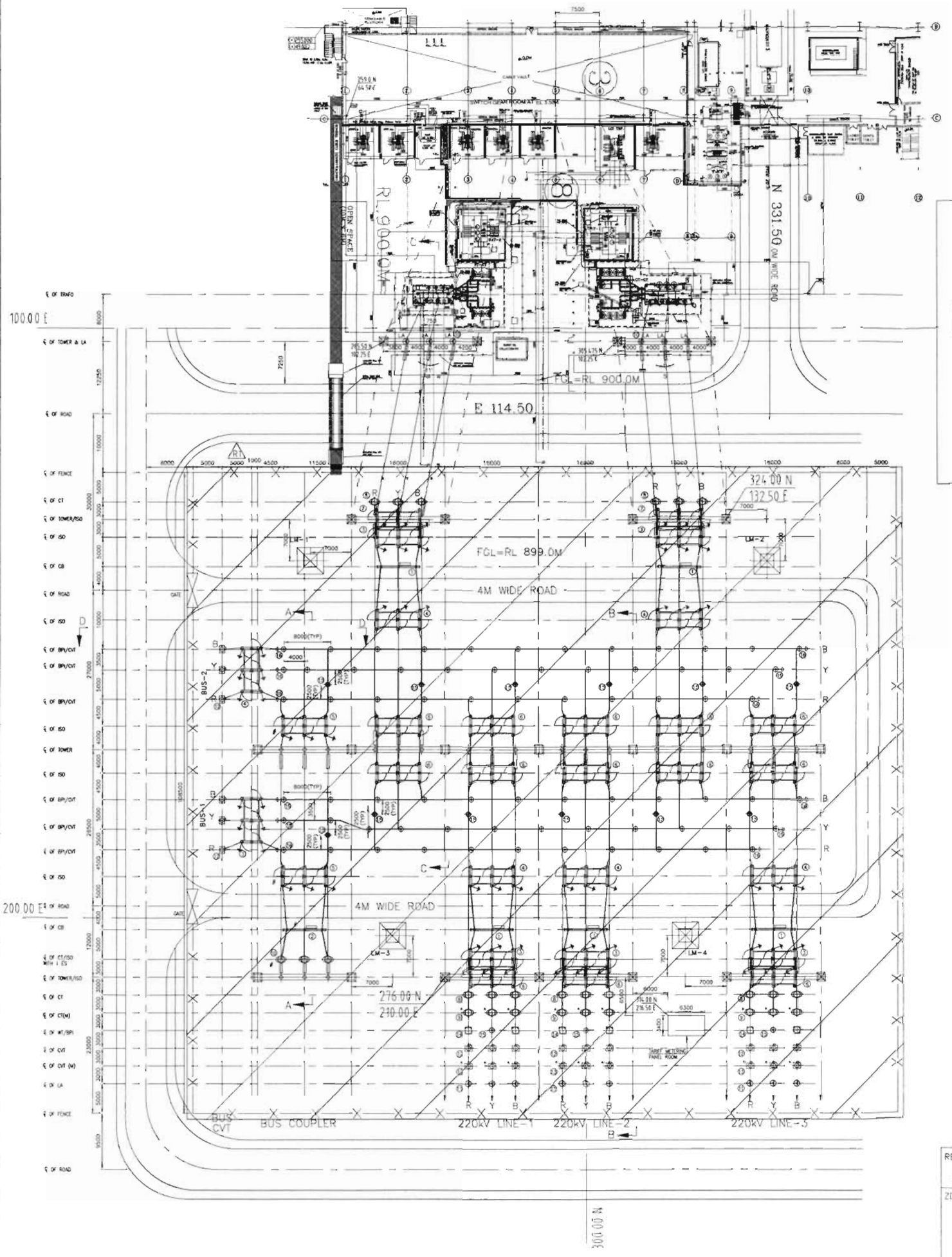
2 ETC items mentioned above are deemed to be inclusive of all the materials required for the erection of the item mentioned in supply i.e. structural steel, brackets, nut, bolts, washers, al flat, cleat, rubber bush etc.

3 All fixtures shall be of reputed make as specifed in Section-1/Section-2.

4 All Boards/ LPs shall be as per customer technical specification, unless other explicitly specified.

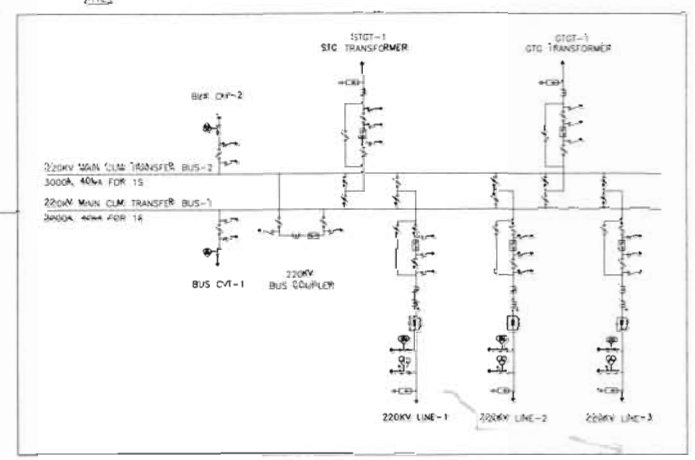
5 Civil Works such as foundation for Lighting Poles and minor civil works are deemed to be included in erection rates of respective items.

6 Calculation of KVA Rating of lighting transformers to be submitted by bidder during tender stage.

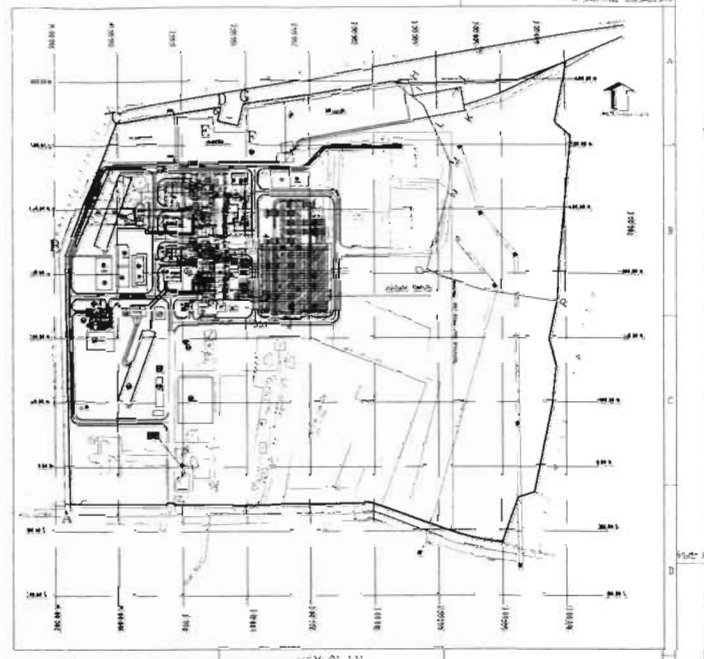


N
CONSTRUCTION NORTH

WIND ROSE



SINGLE LINE DIAGRAM



KEY PLAN

BILL OF QUANTITIES - (A2)

S.N.	ITEM DESCRIPTION	SYMBOL	QTY.
1	220 kV, 1600 A, 50KA FOR 1SEC, 3-PH CIRCUIT BREAKER		05
2	220 kV, 3000 A, 50KA FOR 1SEC, 3-PH CIRCUIT BREAKER		01
3.	220 kV, 1600 A, 40KA FOR 1SEC, 3-PH, MECHANICALLY GANGED (MOTOR & MANUAL OPERATED) HDB ISOLATOR WITH 2ES (MANUAL OPERATED)		07
4	220 kV, 1600 A, 40KA FOR 1SEC, 3-PH, MECHANICALLY GANGED (MOTOR & MANUAL OPERATED) HDB ISOLATOR WITH 1ES (MANUAL OPERATED)		05
5	220 kV, 3000 A, 40KA FOR 1SEC, 3-PH, MECHANICALLY GANGED (MOTOR & MANUAL OPERATED) HDB ISOLATOR WITH 1ES (MANUAL OPERATED)		02
6	220 kV, 1600 A, 40KA FOR 1SEC, 3-PH, MECHANICALLY GANGED (MOTOR & MANUAL OPERATED) HDB ISOLATOR WITHOUT ES		10
7	220 kV, 1600 A, 40KA FOR 1SEC, 3-PH, MECHANICALLY GANGED (MOTOR & MANUAL OPERATED) HDB ISOLATOR WITHOUT ES (GANTRY MOUNTED UNDERMUNG)		05
8	220 kV, 5-CORE,1600-1200-800-400/1A, 40KA FOR 1 S, 1-PH CURRENT TRANSFORMER WITH 120% EXTENDED RATING		15
9	220 KV, 2-CORE,1600-1200-800-400/1A, 40KA FOR 1 S, 1-PH TARIFF METERING CURRENT TRANSFORMER WITH 120% EXTENDED RATING		08
10	220 KV, 5-CORE,2500-1250/1A, 40KA FOR 1 S, 1-PH CURRENT TRANSFORMER WITH 120% EXTENDED RATING		03
11	198 kV, 1-PH, 10kA DISCHARGE CLASS SURGE ARRESTER		15
12	220 kV, 3 WINDING, 1-PH, CAPACITIVE VOLTAGE TRANSFORMER		15
13	220 kV, 2 WINDING, 1-PH, CAPACITIVE VOLTAGE TRANSFORMER		08
14	220 kV, 1PH, 0.5/1mH, 40kA FOR 1Sec WAVE TRAP		06
15	220KV BUS POST INSULATORS, HIGH LEVEL		12
16	220KV BPI, LOW LEVEL		73

LEGEND

	LM (LIGHTNING MAST)
	TOWER WITH PEAK
	TOWER WITHOUT PEAK
	SUSPENSION INSULATOR STRING (18 DISCS PER STRING SET)
	DOUBLE TENSION INSULATOR STRING (18 DISCS/1 TENSION INSULATOR STRING)
	AL. TUBE
	ACSR MOOSE CONDUCTOR
	END CAP/CORONA BELL FOR BUSBAR
	SHIELD WIRE (10.98MM¢)

CLEARANCE TABLE - (A1)

MINIMUM CLEARANCE TABLE	220kV
PHASE TO PHASE (PP)	2400
PHASE TO EARTH (PE)	2100
SECTION CLEARANCE (SC)	5000
HEIGHT OF TUBE/COND. CENTER LINE OF FIRST LEVEL FROM PLINTH LEVEL	9500
GROUND CLEARANCE TO NEAREST PART NOT AT EARTH POTENTIAL OF AN INSULATOR SUPPORTING LIVE CONDUCTOR	2440

NOTE -
1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.
2. THE PARAMETERS, FOR WHICH THE SYSTEM IS DESIGNED ARE -

(A)	SYSTEM VOLTAGE	220kV
(B)	LIGHTNING IMPULSE WITHSTAND VOLTAGE	810/850kV
(C)	POWER FREQUENCY WITH STAND VOLTAGE	460
(D)	MAX. FAULT LEVEL.	40kA FOR 1s
(E)	CREEPAGE DISTANCE	31MM/KV

3. CONDUCTOR DETAIL OF SWITCHYARD.

	220kV
MAIN BUS-I	4 INCH AL. TUBE /QUAD MOOSE
MAIN BUS-II	4 INCH AL. TUBE /QUAD MOOSE
EQUIPMENT INTERCONNECTION	SINGLE/TWIN/QUAD MOOSE 4 INCH AL.TUBE
JUMPERS/DROPPERS	SINGLE/TWIN/QUAD MOOSE
SUBCONDUCTOR SPACING	250mm

4. PROTECTION AGAINST DIRECT LIGHTING STROKE FOR SWITCHYARD AREA SHALL BE BY LM & SHIELD WIRE
5. LOCATION OF LM'S SHOWN TENTATIVE.
6. NO SEPARATE CONTROL ROOM BUILDING ENTRASSED. PANELS & DISTRIBUTION WILL BE PLACED IN POWER PLANT CONTROL ROOM.
7. SA PRESSURE RELIEF VALVE SHALL NOT BE TOWARDS TRANSFORMER SIDE / ANY EQUIPMENT DEPT NEAR SURGE ARRESTER
8. REMOVABLE TYPE STRUCTURE WILL BE PROVIDED FOR SA IN FRONT OF GT.
9. TARIFF METERING PANEL ROOM IS RCC BASED AND SHALL BE AS PER DRG NO. TB-3-379-510-022.

LEGEND:
INDICATES ADDITIONAL SCOPE
INDICATES PRESENT SCOPE

REF. DRAWING:
1. PLOT PLAN PE-RD-409-100-M001
2. SINGLE LINE DIAGRAM OF 220kV SWITCHYARD. DWG NO. TB-2-379-510-001

REV.	DATE		
02	05.11.2016	ALTERED	MVK
		CHECKED	MVK
		APPROVED	AS
ZONE	REVISED AS PER KPCL/PCE COMMENTS & MOM DT. 18.10.16.		

REV.	DATE		
01	29.06.2016	ALTERED	DM Sd/-
		CHECKED	MM Sd/-
		APPROVED	AS Sd/-
ZONE	REVISED AS PER CUSTOMER COMMENTS LETTER DATED 03.03.2016. BAY SEQUENCE CORRECTED AS PER SLD.		

OWNER:
KARNATAKA POWER CORPORATION LIMITED
1x370 MW YELAHANKA COMBINED CYCLE POWER PLANT

OWNER'S CONSULTANT:
FICHTNER Consulting Engineers (India) Private Limited, Chennai, Bengaluru.

EPC CONTRACTOR:
भारत हेवी इलेक्ट्रिकल्स लिमिटेड
ट्रांसमिशन प्रबंधोपक्रम विभाग
BHARAT HEAVY ELECTRICALS LTD
TRANSMISSION BUSINESS GROUP

DEPT CODE	DRN.	NAME	SIGN	DATE
M	DESN	DM	Sd/-	17/08/16
	CHD	MM	Sd/-	17/08/16
	APPD	AS	Sd/-	17/08/16

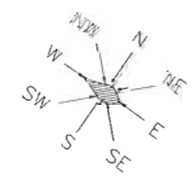
TITLE
LAYOUT PLAN & SECTION ELEVATION OF 220KV SWITCHYARD

DEPT	SCALE 1:3000	DRAWING NO. TB-0-379-316-002
SIGN		
DATE		SHEET 01 OF 02 REV. 02

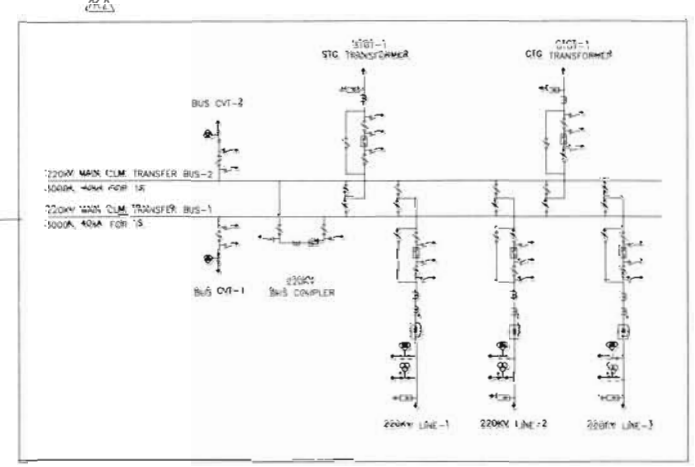
SIZE-A0

COMMENTS MARKED

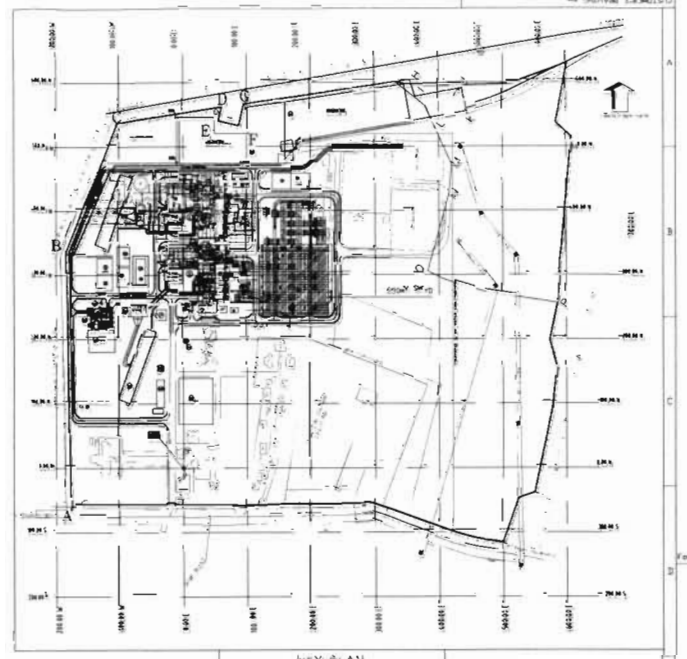
N
CONSTRUCTION NORTH



WIND ROSE



SINGLE LINE DIAGRAM


KEY PLAN

BILL OF QUANTITIES - R2

S.N.	ITEM DESCRIPTION	SYMBOL	QTY.
1	220 kV, 1600 A, 50kA FOR 1SEC, 3-PH CIRCUIT BREAKER		05
2	220 kV, 3000 A, 50kA FOR 1SEC, 3-PH CIRCUIT BREAKER		01
3	220 kV, 1600 A, 40kA FOR 1SEC, 3-PH, MECHANICALLY GANGED (MOTOR & MANUAL OPERATED) HDB ISOLATOR WITH 2ES (MANUAL OPERATED)		09
4	220 kV, 1600 A, 40kA FOR 1SEC, 3-PH, MECHANICALLY GANGED (MOTOR & MANUAL OPERATED) HDB ISOLATOR WITH 1ES (MANUAL OPERATED)		05
5	220 kV, 3000 A, 40kA FOR 1SEC, 3-PH, MECHANICALLY GANGED (MOTOR & MANUAL OPERATED) HDB ISOLATOR WITH 1ES (MANUAL OPERATED)		02
6	220 kV, 1600 A, 40kA FOR 1SEC, 3-PH, MECHANICALLY GANGED (MOTOR & MANUAL OPERATED) HDB ISOLATOR WITHOUT ES		10
7	220 kV, 1600 A, 40kA FOR 1SEC, 3-PH, MECHANICALLY GANGED (MOTOR & MANUAL OPERATED) HDB ISOLATOR WITHOUT ES. (GANTRY MOUNTED UNDERHUNG)		05
8	220 kV, 3-CORE,1600-1200-800-400/1A, 40kA FOR 1 S, 1-PH CURRENT TRANSFORMER WITH 120% EXTENDED RATING		15
9	220 kV, 2-CORE,1600-1200-800-400/1A, 40kA FOR 1 S, 1-PH TARIFF METERING CURRENT TRANSFORMER WITH 120% EXTENDED RATING		09
10	220 kV, 5-CORE,2500-1250/1A, 40kA FOR 1 S, 1-PH CURRENT TRANSFORMER WITH 120% EXTENDED RATING		03
11	198 kV, 1-PH , 10kA DISCHARGE CLASS SURGE ARRESTER		15
12	220 kV, 3 WINDING, 1-PH, CAPACITIVE VOLTAGE TRANSFORMER		14
13	220 kV, 2 WINDING, 1-PH, CAPACITIVE VOLTAGE TRANSFORMER		09
14	220 kV, 1PH, 0.5/1mH, 40kA FOR 1Sec WAVE TRAP		06
15	220kV BUS POST INSULATORS, HIGH LEVEL		13
16	220kV BPI, LOW LEVEL		73

LEGEND

	LM (LIGHTNING MAST)
	TOWER WITH PEAK
	TOWER WITHOUT PEAK
	SUSPENSION INSULATOR STRING (18 DISCS PER STRAG SET)
	DOUBLE TENSION INSULATOR STRING (18 DISCS/1 TENSION INSULATOR STRING)
	AL. TUBE
	ACSR MOOSE CONDUCTOR
	END CAP/CORONA BELL FOR BUSBAR
	SHIELD WIRE (1×9mm²)

CLEARANCE TABLE - R1

MINIMUM CLEARANCE TABLE	220kV
PHASE TO PHASE (PP)	2400
PHASE TO EARTH (PE)	2100
SECTION CLEARANCE (SC)	5000
HEIGHT OF TUBE/COND. CENTER LINE OF FIRST LEVEL FROM PLINTH LEVEL	7300
GROUND CLEARANCE TO NEAREST PART NOT AT EARTH POTENTIAL OF AN INSULATOR SUPPORTING LIVE CONDUCTOR	3440

NOTE -
1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.
2. THE PARAMETERS FOR WHICH THE SYSTEM IS DESIGNED ARE -

(A)	SYSTEM VOLTAGE	220kV
(B)	LIGHTNING IMPULSE WITHSTAND VOLTAGE	825kVP
(C)	POWER FREQUENCY WITH STAND VOLTAGE	460
(D)	MAX. FAULT LEVEL	40kA FOR 1S
(E)	CREEPAGE DISTANCE	31MM/KV

3. CONDUCTOR DETAIL OF SWITCHYARD:

	220kV
MAIN BUS-I	4 INCH AL- TUBE /QUAD MOOSE
MAIN BUS-II	4 INCH AL. TUBE /QUAD MOOSE
EQUIPMENT INTERCONNECTION	SINGLE/TWIN/QUAD MOOSE 4 INCH AL TUBE
JACKBUS/DROPPERS	SINGLE/TWIN/QUAD MOOSE
SUBCONDUCTOR SPACING	250mm

4. PROTECTION AGAINST DIRECT LIGHTNING STROKE FOR SWITCHYARD AREA SHALL BE BY LM & SHIELD WIRE
5. LOCATION OF LM'S SHOWN TENTATIVE.
6. NO SEPARATE CONTROL ROOM BUILDING ENVISAGED. PANELS & DISTRIBUTION WILL BE PLACED IN POWER PLANT CONTROL ROOM.
7. EA PRESSURE RELIEF VALVE SHALL NOT BE TOWARDS TRANSFORMER SIDE / ANY EQUIPMENT REFT NEAR SURGE ARRESTER
8. REMOVABLE TYPE STRUCTURE WILL BE PROVIDED FOR SA IN FRONT OF GT.
9. TARIFF METERING PANEL ROOM IS MAR BASED AND SHALL BE AS PER REF. NO. TB-0-379-318-006

LEGEND:
INDICATES ADDITIONAL SCOPE
INDICATES PRESENT SCOPE

REF. DRAWING:
1. PLOT PLAN: PE-DG-409-100-MG01
2. SINGLE LINE DIAGRAM OF 220kV SWITCHYARD, DWG NO. TB-2-379-310-001

OWNER: KARNATAKA POWER CORPORATION LIMITED
1x370 MW YELAHANKA COMBINED CYCLE POWER PLANT

OWNER'S CONSULTANT: FICHTNER Consulting Engineers (India) Private Limited, Chennai, Bengaluru.

EPC CONTRACTOR: भारत हेवी इलेक्ट्रिकल्स लिमिटेड
ट्रांसमिशन व्यापारिक विभाग
BHARAT HEAVY ELECTRICALS LTD
TRANSMISSION BUSINESS GROUP

REV.	DATE			
02	05.11.2018	ALTERED	MVK	
		CHECKED	MVK	
		APPROVED	AS	
ZONE	REVISED AS PER KPCL/FCE COMMENTS & MOM DT. 18.10.16.			

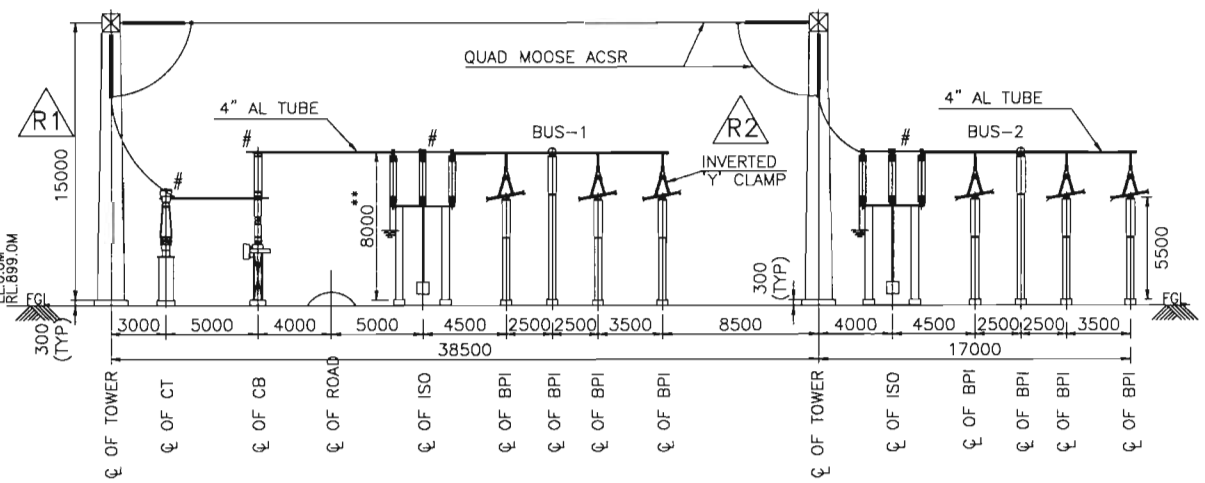
REV.	DATE			
01	29.06.2016	ALTERED	DM	Sd/-
		CHECKED	MM	Sd/-
		APPROVED	AS	Sd/-
ZONE	REVISED AS PER CUSTOMER COMMENTS LETTER DATED 03.03.2016. BAY SEQUENCE CORRECTED AS PER SLD.			

DEPT CODE	DSN.	NAME	SIGN	DATE
M	DESN	DM	Sd/-	17/02/16
	CHD	MM	Sd/-	17/02/16
	APPD	AS	Sd/-	17/02/16

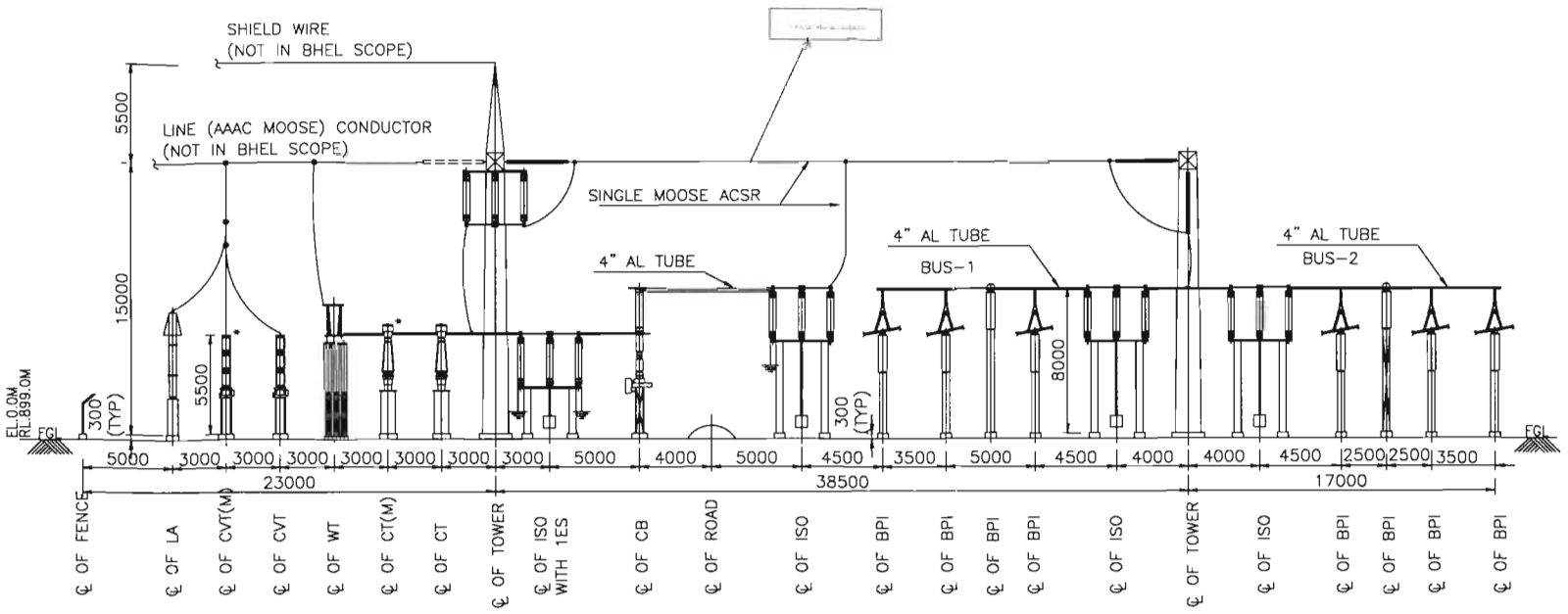
TITLE: LAYOUT PLAN & SECTION ELEVATION OF 220KV SWITCHYARD

DEPT
SIGN
DATE
SCALE 1:3000

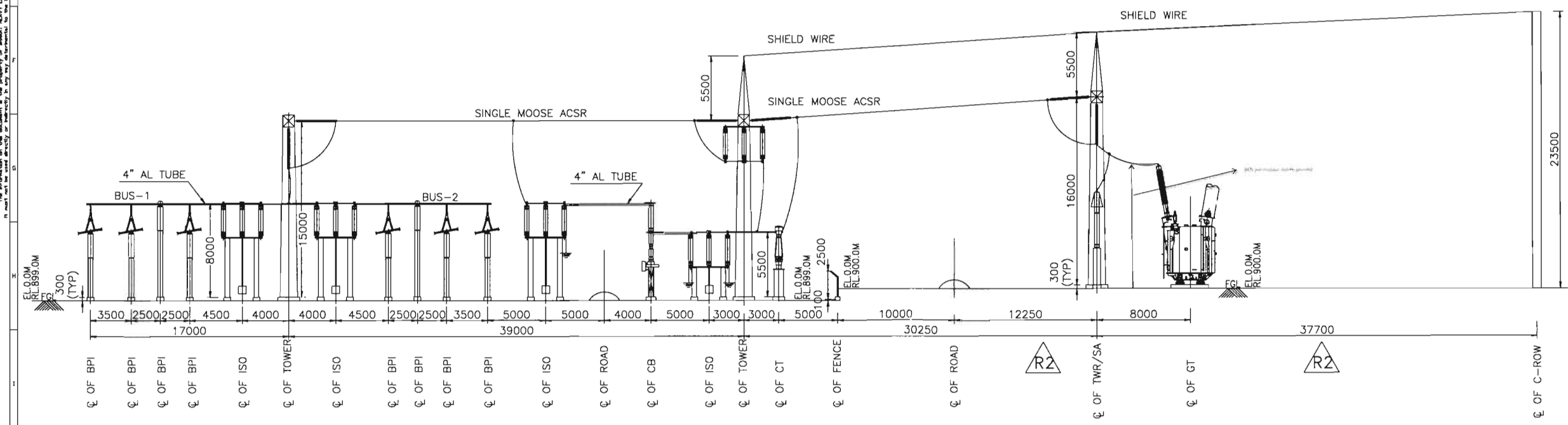
DRAWING NO. TB-0-379-318-002
SHEET 01 OF 02 REV. 02



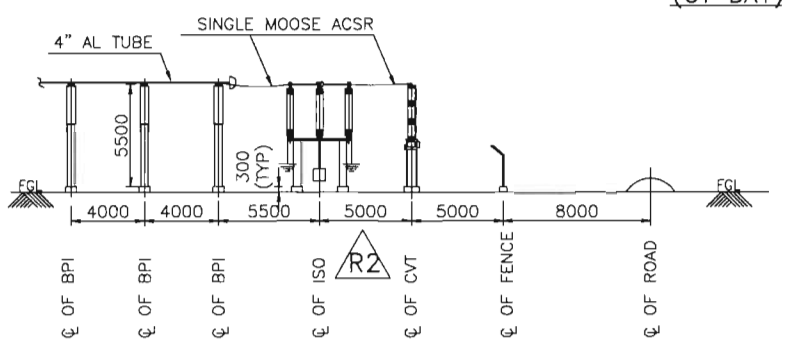
SECTION A–A
(BUS COUPLER)



SECTION B–B
(LINE BAY)



SECTION C–C
(GT BAY)



SECTION D–D
(BUS CVT)

NOTE:

** HEIGHT OF EQUIPMENT IS TENTATIVE & SHALL BE FINALIZED AS PER CIRCUIT BREAKER HEIGHT.

REV.	DATE		
02	05.11.2016	ALTERED	MVK
		CHECKED	MVK
		APPROVED	AS
ZONE	REVISED AS PER KPCL/FCE COMMENTS & MOM DT. 18.10.16.		

REV.	DATE			
01	29.06.2016	ALTERED	DM	Sd/-
		CHECKED	MM	Sd/-
		APPROVED	AS	Sd/-
ZONE	REVISED AS PER CUSTOMER COMMENTS LETTER DATED 03.03.2016			

OWNER: KARNATAKA POWER CORPORATION LIMITED
1x370 MW YELAHANKA COMBINED CYCLE POWER PLANT

OWNER'S CONSULTANT: FICHTNER Consulting Engineers (India) Private Limited, Chennai, Bengaluru.

EPC CONTRACTOR: भारत हेवी इलेक्ट्रिकल्स लिमिटेड
पारेषण परियोजना विभाग
BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP

DEPT CODE		NAME	SIGN	DATE
M	DRN			
	DESN	OM	Sd/-	19/02/16
	CHD	MSM	Sd/-	19/02/16
	APPD	AS	Sd/-	19/02/16

TITLE: LAYOUT PLAN & SECTION ELEVATION OF 220KV SWITCHYARD

DEPT.	SCALE 1:3000	DRAWING NO.
SIGN		TB-0-379-316-002
DATE		SHEET 02 OF 02 REV. 02

DRAWING No. TB-0-379-316-002

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

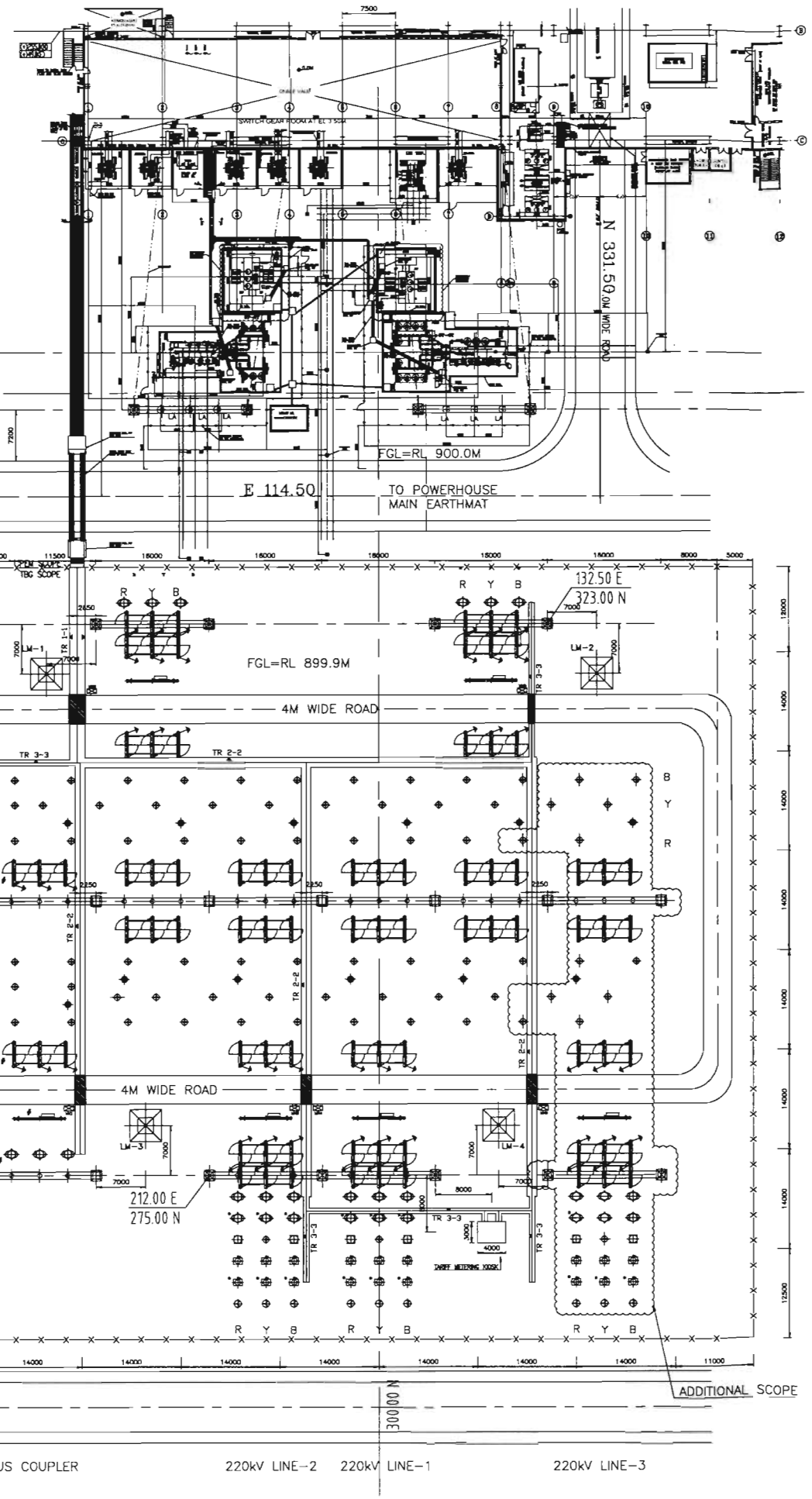
THIS DRAWING SUBMITTED

COPY RIGHT AND CONFIDENTIAL
The information on this document is the property of BHEL ELECTRICALS LIMITED
It must not be used directly or indirectly, in any way detrimental to the interest of the company.

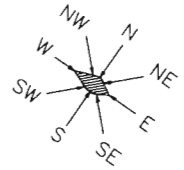
COMPUTER FILE NAME:

DRAWING NO. TB-0-379-316-005

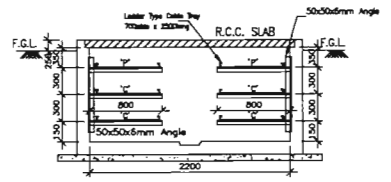
NO COMMENTS



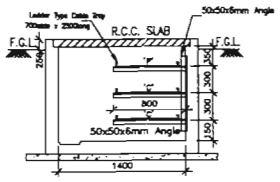
N
CONSTRUCTION NORTH



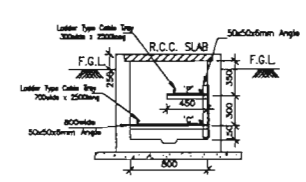
WIND ROSE



(TR 1-1)

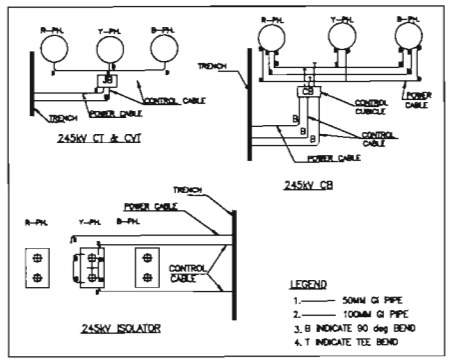


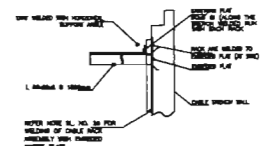
(TR 2-2)



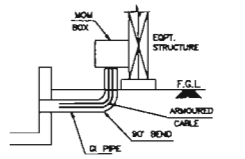
(TR 3-3)

GI PIPE DETAILS OF 245 kV EQUIPMENTS

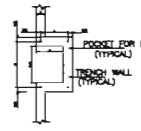




TYPICAL CABLE RACK FIXING DETAIL



ROUTING OF CABLE INSIDE GI PIPE/ CABLE TRENCH TO EQUIPMENT



MK FIXING DETAIL ON TRENCH
A & B DIMENSIONS ARE AS PER MK DRAWING.
X=TRENCH WALL THICKNESS.

NOTES :-

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. THE LOCATION OF CABLE TRENCHES MARKED IN THIS DRAWING MAY BE SLIGHTLY MODIFIED TO SUIT SITE CONDITIONS.
3. ALL CABLES FROM BAY CABLE TRENCH TO EQUIPMENTS INCLUDING AND ALL INTERPOLE CABLES (BOTH POWER AND CONTROL) FOR ALL EQUIPMENT, SHALL BE LAID IN GI PIPES WHICH SHALL BE BURIED IN THE GROUND AT A DEPTH OF 300MM (MAX) BELOW FINISH FORMATION LEVEL.
4. OPENINGS FOR TAKING OUT GI PIPES TO EQUIPMENTS SHALL BE PROVIDED IN CABLE TRENCHES. OPENING OF SIZE SUITABLE TO DIA. 50/100 PIPE SHALL BE PROVIDED BELOW TOP CABLE SUPPORT.
5. [MK] MK = INDICATES MARSHALLING KIOSK.
6. [MK] SHALL BE PLACED IN THE LOCATION SHOWN. EXACT COORDINATES TO BE SUITABLY DECIDED AT SITE.
7. 1.1kV CABLE SHALL BE PLACED IN MULTI LAYER ON 2.5M LONG GI TRAY SUPPORTED ON RACK (GI ANGLE).
8. CABLE SUPPORT SHALL BE PROVIDED AT EVERY 1500mm INTERVAL.
9. INSERTS MUST BE EMBEDDED AT EVERY 1500mm INTERVAL FOR FIXING CABLE SUPPORT.
10. AUXILIARY POWER CABLES (MKD. "P") SHALL BE LAID IN TOP TIERS AND CONTROL CABLES (MKD. "C") IN BOTTOM TIERS.
11. FIBER OPTIC CABLE BETWEEN TARIFF METERING KIOSK AND CONTROL ROOM SHALL BE LAID IN 50mm DIA GI PIPE AND SAME SHALL BE ROUTED THROUGH BOTTOM OF CABLE TRENCH. 50mm DIA GI PIPE USED FOR FIBER OPTICS CABLES SHALL BE SUITABLY CLAMPED TO AVOID MOVEMENT.
12. CABLES FOR LIGHTING PURPOSE SHALL BE LAID IN GI PIPE/ TRENCH. SEPARATE DRAWING SHALL BE SUBMITTED FOR LIGHTING SYSTEM.
13. EARTH CONDUCTOR 50X6 GS FLAT TO BE WELDED IN VERTICAL ON THE CABLE SUPPORT BEFORE INSTALLATION OF CABLES.
14. FOR POWER & CONTROL CABLES, SEPARATE PIPES SHALL BE USED CONSIDERING 60% VOID FOR EACH PIPE I.E., 40% FILLING CRITERIA.
15. GI PIPES SHALL BE SECURELY FIXED AT BOTH ENDS.
16. AFTER LAYING THE CABLES THE ENDS OF GI PIPES SHALL BE FULLY SEALED TO PREVENT INGRESS OF WATER INSIDE THE PIPE.
17. CONTROL CABLES & POWER CABLES MUST BE LAID IN SEPARATE GI PIPES.
18. CABLE TRENCH SHALL BE PROVIDED ON MARSHALLING BOX SIDE OF EQUIPMENT.
19. THE PURPOSE OF TRENCH LAYOUT DRAWING IS FOR USE AS FOLLOWS:
    - TO BE USED AS CIVIL INPUT FOR CABLE TRENCHES.
    - FOR ERECTION OF CABLE RACKS AT SITE.
    - FOR CABLE LAYING AND ROUTING AT SITE.
20. CONTROL CABLE SHALL BE LAID IN MULTILAYERS IN EACH TRAY.
21. THE CABLE OF CT /CVT BETWEEN SECONDARY TERMINAL BOX AND JUNCTION BOX SHALL BE LAID IN 100/50MM GI PIPE.
22. [ ] INDICATE PIPE CULVERT.
23. CABLES CROSSING ROAD SHALL BE LAID IN PIPE CULVERT.
24. LONGITUDINAL SLOPE IN CABLE TRENCH SHALL BE TYPICALLY 1:500.
25. ALL GI CONDUITS MUST BE SLOPED TOWARDS THE CABLE TRENCH TO PREVENT ACCUMULATION OF WATER INSIDE THE PIPES.
26. THE CABLE RACK ASSEMBLY SHALL BE WELDED TO EMBEDDED INSERT PLATE AS MENTIONED BELOW. "8mm WELD 50mm LONG ON BOTH SIDES OF VERTICAL FLAT AT TOP AND BOTTOM AND NEAR EVERY INTERMEDIATE HORIZONTAL CABLE SUPPORT ANGLE, IT MEANT THAT IF CABLE RACK ASSEMBLY HAS THREE TIERS THEN IT SHALL BE WELDED TO FIVE LOCATION AT BOTH SIDE".
27. SUMP AND DRAINAGE SHALL BE SHOWN IN SEPARATE CIVIL DRAWING.
28. RACK ASSEMBLIES FOR CABLE TRENCHES SHALL BE PROVIDED ON THE FACE OF TRENCH WALL MARKED ◄ THUS.
29. CABLES SHALL BE ROUTED THROUGH SHORTEST ROUTE AS POSSIBLE.
30. ALL OTHER DETAILS PERTAINING TO CIVIL WORKS SHALL BE REFLECTED IN THE RESPECTIVE CIVIL DRAWINGS. CIVIL DETAILS OF TRENCH WITH OPENINGS FOR ROUTING OF CABLES & LOCATION OF EQUIPMENT FOUNDATIONS WILL BE SHOWN IN A SEPARATE CIVIL DRAWING.

FICHTNER Consulting Engineers (India) Private Limited

VENDOR DOCUMENT REVIEW STATUS

- ☐ Action A — Drawing Approved as submitted. Release distribution prints.
- ☐ Action B — Drawing Approved with comments. Proceed with fabrication/ Manufacture / Construction following comments and resubmit for approval and stamping.
- ☐ Action C — Drawing Not Approved. Correct the original drawing.
- ☐ Action D — Do not use the original drawing. Duly incorporating our comments and submit for re-Info.
- ☑ Action E — Drawing not for approval, only for Information. Information furnished as this drawing is issued.

Review/Approval of document by the general compliance with the Contract does not constitute a blanket approval of the contents of document. The Vendor / Contractor is responsible for correctness of design and details. Approval of document does not relieve the Vendor / Contractor of his responsibility in carrying out the work correctly and fulfilling the complete requirements of the contract. Silent or implied nod does it limit the Purchaser's rights under the Contract.

FI Letter Ref. No. 3115161-KPCL-EL-VDT-1357 Date 03.10.2016

Signature — K. Muthusamy (LE - ELI) — Initials

TB-0-379-316-002	LAYOUT PLAN & SECTION ELEVATION OF 220kV SWITCHYARD
PE-DG-409-100-MG01	PLOT PLAN
REFERENCE NO.	DESCRIPTION

OWNER: KARNATAKA POWER CORPORATION LIMITED
1x370 MW YELAHANKA COMBINED CYCLE POWER PLANT

OWNER'S CONSULTANT: FICHTNER Consulting Engineers (India) Private Limited, Chennai, Bengaluru.

EPC CONTRACTOR: भारत हेवी इलेक्ट्रिकल्स लिमिटेड ट्रांसमिशन परियोजना विभाग
BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP

REV.	DATE		
01	29.09.16	ALTERED	MVK
		CHECKED	MM
		APPROVED	AS
ZONE	REVISED TO INCORPORATE KPCL/FTI COMMENTS & LATEST TRANSFORMER YARD DETAILS.		

DEPT CODE		NAME	SIGN	DATE
M	DRN			
	DESN	MVK	S6/-	03/09/16
	CHD	MM	S6/-	03/09/16
	APPD	AS	S6/-	03/09/16

TITLE: CABLE TRENCH LAYOUT OF 220KV SWITCHYARD

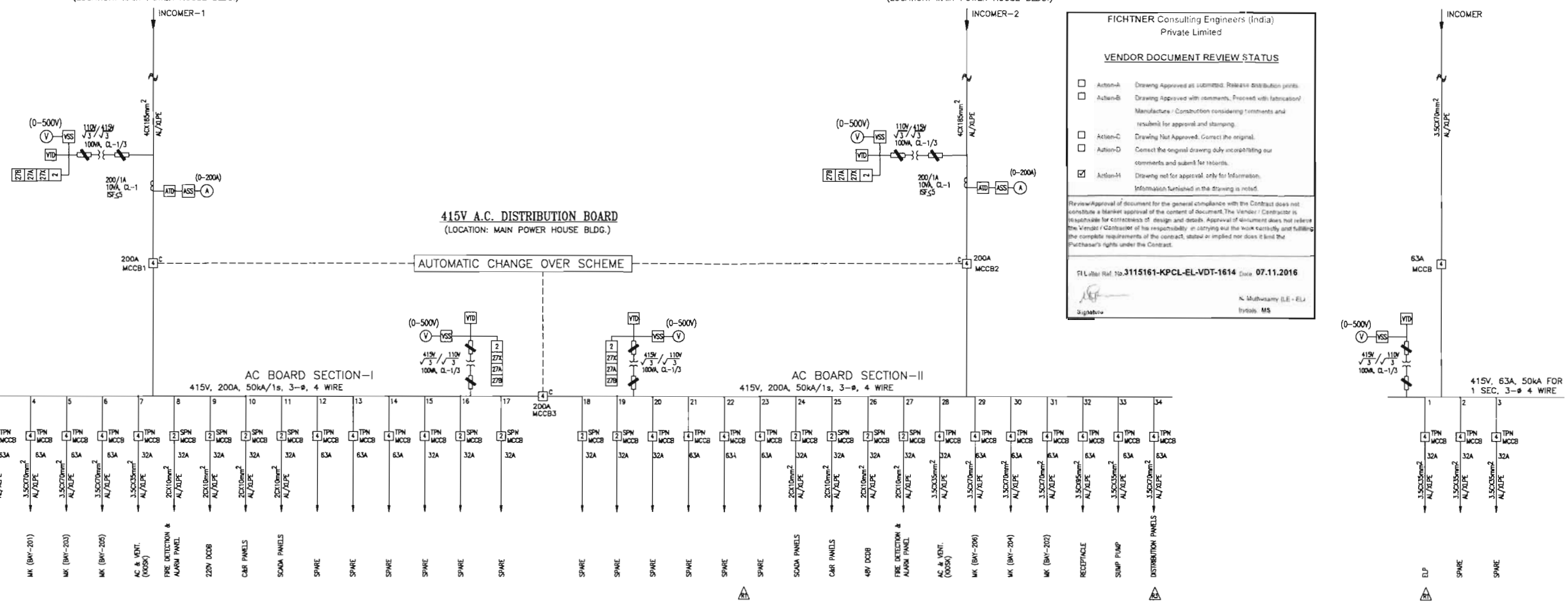
DEPT. | SCALE 1:1000 | DRAWING NO. TB-0-379-316-005
SIGN
DATE
SHEET 01 OF 01 | REV. 01

DRAWING No. TB-3-379-316-007

415V SUPPLY FROM
STN. SERVICE SWGR. # ODA
(LOCATION: MAIN POWER HOUSE BLDG.)

415V SUPPLY FROM
STN. SERVICE SWGR. # ODA
(LOCATION: MAIN POWER HOUSE BLDG.)

415V EMERGENCY SUPPLY FROM
UNIT EMERGENCY SWITCHBOARD



FICHTNER Consulting Engineers (India) Private Limited

VENDOR DOCUMENT REVIEW STATUS

- ☐ Action-A: Drawing Approved as submitted. Release distribution prints.
- ☐ Action-B: Drawing Approved with comments. Proceed with fabrication/ Manufacture / Construction considering comments and resubmit for approval and stamping.
- ☐ Action-C: Drawing Not Approved. Correct the original.
- ☐ Action-D: Correct the original drawing duly incorporating our comments and submit for records.
- ☑ Action-H: Drawing not for approval only for Information. Information furnished in the drawing is noted.

Review/Approval of document for the general compliance with the Contract does not constitute a blanket approval of the content of document. The Vendor / Contractor is responsible for correctness of design and details. Approval of document does not relieve the Vendor / Contractor of his responsibility in carrying out the work correctly and fulfilling the complete requirements of the contract, stated or implied nor does it limit the Purchaser's rights under the Contract.

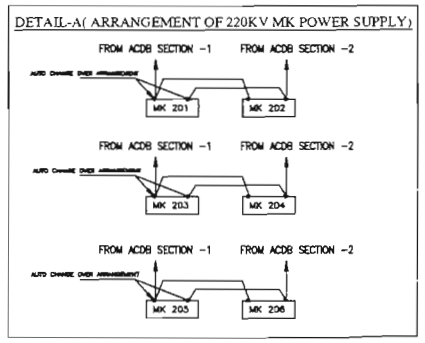
TI Letter Ref. No. 3115161-KPCL-EL-VDT-1614 Date 07.11.2016

Signature — N. Muthusamy (LE - EL) Initials: MS

SCADA SIGNALS

SIGNAL DESCRIPTION	SIGNAL ORIGIN	REMARKS
ACDB INCOMER VOLTAGE	ACDB I/C VOLTAGE TRANSDUCER	DISPLAY ON SCADA
ACDB INCOMER CURRENT	ACDB I/C CURRENT TRANSDUCER	DISPLAY ON SCADA
ACDB BUS SECTION VOLTAGE	ACDB BUS VOLTAGE TRANSDUCER	DISPLAY ON SCADA
ACDB I/C & B/C MCCB ON & OFF STATUS	ACDB	DISPLAY ON SCADA

DETAIL-A(ARRANGEMENT OF 220KV MK POWER SUPPLY)



LEGEND:-

- ⊡ : NON DRAW OUT TYPE MCCB
- Ⓥ : VOLTMETER
- Ⓐ : AMMETER
- C : CONTACTOR
- VSS : VOLTAGE SELECTOR SWITCH
- ASS : AMMETER SELECTOR SWITCH
- VTD : VOLTAGE TRANSDUCER
- ATD : CURRENT TRANSDUCER
- 2 : TIME DELAY PICKUP RELAY
- 27X : AC DOUBLE POLE INSTANTANEOUS UNDER VOLTAGE RELAY
- 27A/27B : UNDER VOLTAGE RELAY

NOTES:-

1. NO TWO AC SOURCE SHALL BE PARALLELED AT ANY STAGE. AUTOMATIC CHANGEOVER TO BE PROVIDED FOR INCOMER MCCB BY MEANS OF CONTACTORS.
2. ALL THE FEEDERS SHOWN IN THE SLD INCLUDING SPARES ARE IN THE SCOPE OF SUPPLY.
3. NORMALLY MCCB-3 SHALL BE OPEN. OTHER MCCB VIZ. MCCB-1 & MCCB-2, SHALL BE CLOSED. IN CASE OF OUTAGE OF ONE OF THE INCOMER SAY MCCB-2, THEN COUPLER MCCB-3 GETS CLOSED.
4. DEGREE OF PROTECTION IS IP52.
5. ACDB SHALL BE COMPARTMENTALIZED AND ALL MODULES SHALL BE NON-DRAWOUT TYPE.

BOQ OF 415V AC SYSTEM

SN.	ITEM	UNIT	QTY.
1	415V, 50kA/1s, 200A ACDB (COMPRISING TWO BUS SECTIONS)	NOS.	01

REV.	DATE			ZONE
03	03.11.16	ALTERED	MVK	REVISED AS PER KPCL/FI COMMENTS.
		CHECKED	MVK	
		APPROVED	AS	
02	26.10.16	ALTERED	MVK Sd/-	REVISED AS PER KPCL/FI COMMENTS.
		CHECKED	MVK Sd/-	
		APPROVED	AS Sd/-	
01	06.10.16	ALTERED	MVK Sd/-	REVISED AS PER KPCL/FI COMMENTS.
		CHECKED	MM Sd/-	
		APPROVED	AS Sd/-	

REFERENCE NO.	DESCRIPTION

OWNER: KARNATAKA POWER CORPORATION LIMITED
1x370 MW YELAHANKA COMBINED CYCLE POWER PLANT

OWNER'S CONSULTANT: FICHTNER Consulting Engineers (India) Private Limited, Chennai, Bengaluru

भारत हेवी इलेक्ट्रिकल्स लिमिटेड
ट्रांसमिशन परियोजना विभाग
BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP

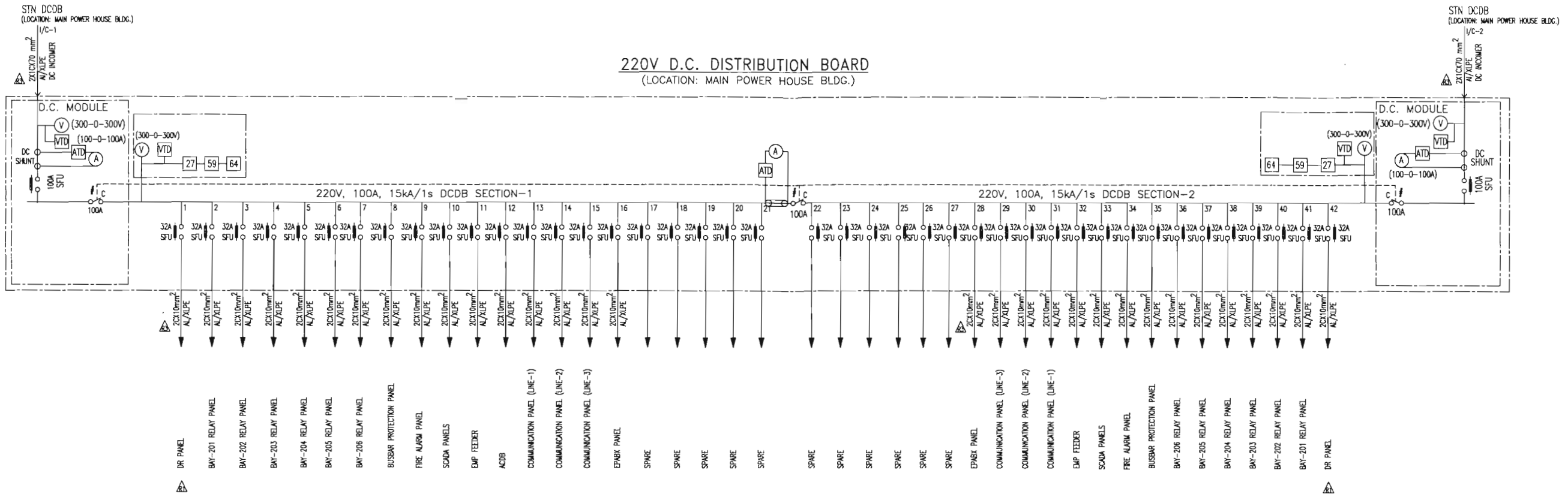
DEPT CODE		NAME	SIGN	DATE
M	DRN			
	DESN	MVK	Sd/-	26.09.16
	CHD	MM	Sd/-	26.09.16
	APPD	AS	Sd/-	26.09.16

TITLE: SINGLE LINE DIAGRAM FOR LT AC&DC SYSTEM – 220KV SWITCHYARD

DEPT. | SCALE: NTS | DRAWING NO. TB-3-379-316-007
SIGN | SHEET 01 OF 02 | REV. 03
DATE

SIZE-A3

220V D.C. DISTRIBUTION BOARD
(LOCATION: MAIN POWER HOUSE BLDG.)



SCADA SIGNALS

SIGNAL DESCRIPTION	SIGNAL ORIGIN	REMARKS
DCDB INCOMER VOLTAGE	DCDB I/C VOLTAGE TRANSDUCER	DISPLAY ON SCADA
DCDB INCOMER CURRENT	DCDB I/C CURRENT TRANSDUCER	DISPLAY ON SCADA
DCDB BUS VOLTAGE	DCDB BUS VOLTAGE TRANSDUCER	DISPLAY ON SCADA
DCDB BUS COUPLER CURRENT	DCDB BUS COUPLER CURRENT TRANSDUCER	DISPLAY ON SCADA
DCDB I/C & B/C ON & OFF STATUS	DCDB	DISPLAY ON SCADA
DCDB EARTH FAULT	EARTH FAULT RELAY	DISPLAY ON SCADA
DCDB UNDER/OVER VOLTAGE	UNDER/OVER VOLTAGE RELAY	DISPLAY ON SCADA

NOTES:–

1. BUS–BAR SHALL BE OF ALUMINIUM FLAT.
2. BUS–BARS WILL BE PROVIDED WITH 1.1KV GRADE HEAT SHRINKABLE TYPE PVC SLEEVES AND REMOVABLE SHROUDS (PRESS TO FIT TYPE) FOR JOINTS.
3. # TWO INCOMERS OF DCDB & BUS–COUPLER WITH LOCKABLE ARRANGEMENT SO THAT TWO NO. SWITCHES CAN BE CLOSED AT A TIME.
4. NECESSARY AUX. RELAYS / CONTACTORS, TIMERS ETC. SHALL BE PROVIDED TO ACHIEVE REQUIRED OPERATION OF SCHEME.
5. INTERCONNECTING POWER CABLES FOR INCOMER & OUTGOING FEEDERS SHOWN IN THE DRAWING ARE FOR REFERENCE ONLY. THESE ARE EXCLUDED FROM THE SCOPE OF DCDB SUPPLIER.
6. DEGREE OF PROTECTION SHALL BE : IP52
7. 220V DC SYSTEM IS UNGROUNDED.
8. NORMALLY BUS COUPLER SWITCH SHALL BE KEPT OPEN.
9. # ONLY TWO MCCB OUT OF THREE SHALL BE CLOSED AT A TIME FOR EACH DCDB.
10. ALL FAULT ALARMS SHALL BE GROUPED & WIRED TO COMMON CONTROL PANEL & SCADA.
11. 48V SUPPLY TO COMMUNICATION EQUIPMENT SHALL BE REALIZED USING DC/DC CONVERTER WHICH SHALL BE INSTALLED IN RESPECTIVE COMMUNICATION PANELS. SUPPLY OF 48V BATTERY & 48V BATTERY CHARGER FOR SWITCHYARD PACKAGE IS NOT ENVISAGED.
12. DCDB SHALL BE COMPARTMENTALIZED AND ALL MODULES SHALL BE NON–DRAWOUT TYPE.

LEGEND:–

- 27 : DC INSTANTANEOUS UNDER VOLTAGE RELAY
- 59 : DC INSTANTANEOUS OVER VOLTAGE RELAY
- 64 : EARTH LEAKAGE RELAY
- : DOUBLE POLE SWITCH FUSE UNIT
- : AIR BREAK SWITCH
- (V) : VOLTMETER
- (A) : AMMETER
- TD : TRANSDUCER
- C : CONTACTOR

BOQ OF 220V DC SYSTEM

SN.	ITEM	UNIT	QTY.
1	220V, 15kA/1s, 100A DCDB (COMPRISING TWO BUS SECTIONS)	NOS.	01

REV.	DATE			
03	03.11.16	ALTERED	MVK	
		CHECKED	MVK	
		APPROVED	AS	
ZONE	CABLE SIZES REVISED.			

REV.	DATE			
02	26.10.16	ALTERED	MVK	Sd/–
		CHECKED	MVK	Sd/–
		APPROVED	AS	Sd/–
ZONE	REVISED AS PER KPCL/FI COMMENTS.			

REV.	DATE			
01	06.10.16	ALTERED	MVK	Sd/–
		CHECKED	MM	Sd/–
		APPROVED	AS	Sd/–
ZONE	REVISED AS PER KPCL/FI COMMENTS.			

REFERENCE NO.	DESCRIPTION

OWNER: KARNATAKA POWER CORPORATION LIMITED
1x370 MW YELAHANKA COMBINED CYCLE POWER PLANT

OWNER'S CONSULTANT: FICHTNER Consulting Engineers (India) Private Limited, Chennai, Bengaluru.

EPC CONTRACTOR: भारत हेवी इलेक्ट्रिकल्स लिमिटेड
ट्रांसमिशन परियोजना विभाग
BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP

DEPT CODE		NAME	SIGN	DATE
M	DRN			
	DESN	MVK	Sd/–	26.09.16
	CHD	MM	Sd/–	26.09.16
	APPD	AS	Sd/–	26.09.16

TITLE: SINGLE LINE DIAGRAM FOR LT AC&DC SYSTEM – 220KV SWITCHYARD

DEPT. | SCALE: 1:100 | DRAWING NO.: TB–3–379–316–007
SIGN | SHEET 02 OF 02 | REV. 03
DATE | SIZE–A3

SECTION 2

GENERAL TECHNICAL REQUIREMENTS

This technical specification covers the requirements of design, manufacture, testing at works, packing, dispatch, storage, erection, testing & commissioning of complete Illumination and associated electrical auxiliary system, complete with accessories.

It shall comply with the requirements given in this section and in Section-3 - Project details and General Specification. In case of any conflicting information, this section shall prevail. Any deviation from the specification shall be clearly stated; otherwise the material shall be treated as meeting the specification fully.

APPLICABLE STANDARDS

The material shall comply with applicable parts of the following standards. The equipment to be furnished under this specification shall conform to latest issue with all amendments of standard specified under this section, unless specifically mentioned in the specification.

IS-513	Cold-rolled low carbon steet sheets and strips.
IS-694	PVC Insulated cables for working voltages upto and including 1100V.
IS-1258	Specification for Bayonet lamp holders.
IS-1293	Plug and socket outlets of rated voltage upto and including 250V and currents upto and including 16A.
IS-1534	Ballasts for Fluorescent lamps, for switch start circuit.
IS-1569	Capacitors for use in tubular fulorescent, HPMV, low pressure sodium, Vapour discharge lamp circuit.
IS-1777	Industrial lighting fittings with metal reflectors.
IS-1913	General and safety requirements for luminaries, Tubular fluorescent lamps.
IS-2148	Flame proof enclosures for electrical apparatus.
IS-2215	Starters for fluorescent lamps.
IS-2418	Tubular fluorescent lamps for general lighting, service: Requirement & tests.
IS-3323	Bi-pin lamp holders for tubular fluorescent lamps.
IS-3324	Holders for starters for tubular fluorescent lamps.
IS-3528	Water proof electric lighting fittings.
IS-3646	Code of practice for interior illumination principles for good lighting and aspects of design, schedule of illumination and glare index, calculation of coefficient of utilisation by the BZ method.
IS-4012	Dust proof electric lighting fittings.
IS-4013	Dust tight electric lighting fittings.
IS-5077	Decorative lighting outfits.
IS-6338	Clamping screws (fixtures)
IS-6616	Ballasts for HP Mercury vapor lamps.
IS-6665	Code of practice for industrial lighting.
IS-7027	Transistorised Ballasts for fluorescent lamps.

IS-7569 Cast acrylic sheets for use in luminaires.
IS-9974 HPSV lamps.
IS-13703 Low voltage fuses for voltages not exceeding 1000V AC & 1500V DC.
The Electricity (Supply) Act & Indian Electricity Rules.

2.0 CATEGORIES OF LIGHTING

2.1 The Switchyard lighting system shall comprise the following two(2) categories:

(a) Normal 240V AC Lighting System

(b) Normal-cum-Emergency 240V AC Lighting System

2.1.1 Normal 240V AC Lighting System

In this system, the lighting circuits shall be fed by the 3 phase, 4 wire normal AC supply available from the normal lighting distribution boards. All the lighting fixtures connected to this system shall be available as long as supply is available from normal source viz., unit auxiliary transformer or station transformer.

2.1.2 Normal cum emergency 240V AC Lighting System

Certain lighting fixtures considered essential shall be connected to this system. In this system the lighting circuits shall be fed from lighting distribution board connected to 415V Normal Emergency Switchgear. The lighting fixtures connected to this system will be available whenever normal supply is available in the plant and also whenever DG set supplies the power to 415V Normal emergency switchgear.

3.0 The area wise distribution of lighting fixtures connected to the three systems covered under Clause 2.1.1 to 2.1.2 is indicated below:

Area wise Distribution of Lighting System in the Plant

Area/building	Percentage Distribution of Lighting		
	Normal	Normal & Emergency	220V DC
Switchyard and all roads	80%	20%	-
Tariff Metering Room	80%	20%	-

4.0 LIGHTING SUPPLY DISTRIBUTION SYSTEM

4.1 Normal and Normal/Emergency AC System

4.1.1 For these systems, the distribution shall be by 415V, 3 phase 4 wire, 50 Hz supply with effectively earthed neutral. This supply shall be derived from 415V,

3 phase 4 wire, 50 Hz. Switchgear located nearby (for normal) and normal emergency switchgear for NE & lighting through delta/star lighting transformer. The secondary of lighting transformer will be connected to respective 415V, 3 phase 4 wire AC lighting distribution board (LDB). The LDBs will be provided with number of outgoing circuits controlled by MCBs to feed the lighting panels distributed in and around the plant as well as to directly feed three phase street lighting and yard lighting supplies. The lighting transformers shall be provided with OFTC with +/- 5 % in steps of 2.5 %.

4.1.2 AC lighting panels shall have three phase 4 wire incomer controlled by earth leakage circuit breaker and number of single phase outgoing circuits controlled by MCBs. Lighting panels feeding the switchyard shall be provided with contactors for control from a remote point. Lighting fixtures in indoor areas shall be controlled from the respective lighting panels. The control of all such lighting shall be done automatically through timer units. Manual switching 'ON and OFF' facility shall also be provided.

5.0 **Illumination Levels and Choice of Lighting Fixtures**

The area-wise distribution of average illumination levels and type of luminaires shall be as indicated below:

Sl. No.	Area/ Structure	Average Illumina-tion Level in Lux.	Type of Fixture	Type of Luminaire
2.0	**GENERAL**			
2.6	Tariff Metering Room	300	Industrial type with vitreous enamel reflector	2 x 28W Fluorescent lamp (T5)
4.0	**ROAD & YARD LIGHTING**			
4.1	Roads	20	Street light with clear acrylic cover cut-off type with integral mounted control gear	1 x 150W HPSV
4.2	Switchyard lighting	50 (at equipment level) & 20 (other non-equipment areas)	General purpose flood light. To be provided along with lightning masts also at equipment levels on the towers.	250W/400W HPSV

Contractor may change the type of fixture to be used in different area against indicated above, provided minimum illumination level as indicated above is maintained. Lighting shall appear aesthetically good. Contractor shall measure the lux levels in the above areas (measured at the working plane) using suitable

devices/meters as per relevant standards to prove the specified values. The working plane shall include the floor level also depending on the area.

Note: The area wise distribution of average illumination levels and type luminaries will be applicable only for all the buildings/plant/facilities which are in the scope of contractor.

6.0 LIGHTING SYSTEM DESIGN

6.1 The lighting system design shall comply with the acceptable norms and the best engineering practices. The system design shall consider principles of lighting specified in following paragraph. The lighting layout shall be designed to provide uniform illumination with minimum glare. The layout design shall meet all the statutory requirement, local rules etc.

6.2 Indoor Lighting

The recommended values of illlumination level for various areas in the plant are indicated in the Table above. Following factors shall be considered while arriving at the utilisation factor to determine the number of fixtures for each area/buildings in the plant.

6.2.1 Maintenance Factor :

(a)	Air conditioned, clean interiors like Control Room, Office rooms etc.	:	0.8

6.2.1.1 Reflection factor for wall/ceiling

(a)	White and very light colours	:	0.7
(b)	Light colours	:	0.5
(c)	Middle tints	:	0.3
(d)	Dark colours	:	0.1

6.2.3 Utilisation factor considering the room index at applicable surface reflection factors. The working plane shall be considered at 0.85 m from the floor level.

6.2.4 The value of the ratio of spacing (S) to mounting height (H) shall be commensurate with the type of fittings selected, uniformity of illumination. The suspension height for suspended fixtures shall not exceed 1 meter.

6.3 Outdoor Lighting

6.3.1 The recommended illumination levels for outdoor areas are indicated in the above table.

6.3.2 Mounting height, spacing of flood lights shall be based on lamp wattage, uniformity of illumination and vertical angles. Ratio of minimum to average

illumination shall not be less than 0.3 and for minimum to maximum shall not be less than 0.05.

6.3.3 Maintenance factor shall be generally 0.6 under average conditions.

6.4 **Road Lighting**

6.4.1 Road lighting provided shall consider the general visibility on the roads and reasonable uniformity in illumination levels.

6.4.2 Lighting design for roads shall consider a maintenance factor of 0.6 for average conditions.

6.4.3 Ratio of minimum to average illumination shall not be less than 0.3. The road lighting layout shall consider the width of the road to decide whether the lighting poles shall be located on one side, on either side.

6.4.4 The mounting height of the luminaries shall be generally 11 m.

6.4.5 For the yard lighting, suitable poles, towers distributed suitably shall be provided. The flood light towers shall be made of standard galvanised structural steel members, suitable ladder for accessing and platform at the lighting fitting levels shall be provided for maintenance.

7.0 LIGHTING DISTRIBUTION BOARDS (LDB) & LIGHTING PANELS (LP)

7.1 Each of the LDBs shall be provided with voltmeter and ammeter along with selector switches, 'Supply ON' indicating lamps, etc. The LDBs and LPs shall be sheet steel enclosed and shall be fully dust and vermin proof, with a degree of protection of IP 52 and lighting transformer shall be IP - 42. Outdoor panels shall be weather proof type with IP-54 degree of protection. The switch boxes, receptacle boxes etc. shall be made up of 18 SWG sheet steel. The LP's shall be located near door / entrances.

7.2 The distribution of lighting fixtures/receptacles shall be such that the loading on each phases of the LDB is approximately equal.

8.0 WIRING

8.1 1100 V grade stranded copper conductor, PVC insulated, colour coded wires conforming to IS 694 laid in GI conduits shall be used for lighting in non hazardous area. In outdoor areas like switchyard, and road lighting, cable wiring shall be adopted.

8.2 The cable and wires shall conform to relevant standards. Minimum size of wires in case of conduit wiring shall be 2.5 sq.mm Copper in case of lighting and 4

sq.mm copper in case of receptacle wiring. Minimum cable size in case of cable wiring shall be 2.5 sq.mm aluminium.

8.3 Wires of different phases shall run in separate conduits. However, wires of same phase but having different circuit nos. can be run in same conduit. Wires of lighting and power receptacles will be carried out in separate conduits and on separate circuits. Wires of AC and DC lighting systems shall be carried out in separate conduits.

8.4 For outdoor lighting, the cable shall be buried in PVC pipes at a minimum depth of 300 mm from ground level or run in cable trays.

8.5 Material used for saddles, clamps, JBs, etc., shall be galvanised.

9. 0 LIGHTING CIRCUIT DESIGN

9.1 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 different phases.

9.2 The circuit loading on each circuit shall be restricted to 80% of the MCB rating.

9.3 The voltage drop from LDB and any fixture shall not exceed 3%.

9.4 3 phase distribution shall be considered in all the rooms / areas. All the 3 phases shall be equally distributed /loaded

9.5 Normal cum emergency lighting shall also be distributed in all the 3 phases and they shall be equally distributed/ loaded.

10.0 EARTHING OF LIGHTING INSTALLATION.

10.1 Lighting fixtures, receptacles, switches, conduits and junction boxes will be properly earthed using galvanised iron wire of 16 SWG/8 SWG Earth wire shall run along the entire length of the conduit between the fixture and the corresponding lighting panel where it will be connected to the station earth.

10.2 For earthing of outdoor lighting poles and masts, 25 x 6 mm MS flat shall be run buried in ground along with road lighting cable and 12 SWG wire shall be tapped at each lighting pole.

SECTION-3

1.0 PROJECT DETAILS AND GENERAL SPECIFICATIONS

1.1 NIL

1.2 PROJECT INFORMATION AND SYSTEM PARAMETERS

a)	Customer	:	M/s Karnatka Power Corporation Ltd, Bangalore (KPCL).
b)	Project Title	:	220kV Yelahanka substaion
c)	Site location	:	Yelahanka, district Banglore
d)	Nearest Railway station	:	Yelahanka junction, 15km from Bangalore

The following system parameters shall prevail:

Nominal system voltage	**220 kV**
Highest system voltage	245 kV
Frequency	50 Hz
Rated short time current	40 kA for 1 sec
Dry and wet one minute power frequency withstand voltage	460 kV
Dry and wet impulse withstand voltage positive and negative	1050 kVp
Minimum total creepage	31 mm/kV
System Earthing	Effectively Earthed

1.3 SITE CONDITIONS

1.3.1 Design ambient temp. : 50 deg C

1.3.2 Altitude : < 1000 m from mean Sea level

1.3.4 Pollution severity : Highly polluted

1.3.5 Earth quake data

a) Seismic zone : III
b) Seismic acceleration : As per IS: 1893 latest revision

1.3.6 Average Annual rainfall : mm

1.3.7	Max. Mean Wind speed	:	33 m/s
1.3.8	Latitude	:	13°06'50"N
1.3.9	Longitude	:	77°35'54"E

1.4 MATERIAL/WORKMANSHIP

1.4.1 General Requirement

Where the specification does not contain characteristics with reference to workmanship, equipment, materials and components of the covered Equipment it is understood 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 purposes for which they are intended.

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 and shall be used throughout the design. 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 purchaser.

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 be interchangeable with, 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.

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 construed as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, 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 manufacture's limits. Suitable guards shall be provided for the protection of personal on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

The Contractor 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 Contractor shall apply all operational lubricants to the equipment installed by him.

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. If such is the case, he shall declare in the proposal where such oil or grease is available. He shall help purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

1.4.2 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 favorable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

1.5 COLOUR SCHEME AND CODES FOR PIPE SERVICE

The contractor shall propose a color scheme for those equipment/Items for which the colour scheme has not been specified in the specification for the approval of purchaser. The decision of purchaser shall be final. The scheme shall include:

Finishing colour of Indoor equipment

Finishing colour of Outdoor equipment.

Finish colour of all cubicles.

Finishing colour of various auxiliary system equipment including piping

Finishing colour of various building items.

All steel structures, plates etc. shall be painted with non-corrosive paint on a suitable primer. It may be noted that normally all electrical equipment in switchyard are painted with shade 631 of IS-5. All The indoor cubicles shall be of same colour scheme and for other miscellaneous items, colour scheme will be approved by the purchaser.

1.6 PAINTING

a) All sheet steel work shall be phosphated in accordance with the following procedure and in accordance with IS:6005 "Code of practice for Phosphating Iron and Steel".

b) Oil, grease, dirt and swerve shall be thoroughly removed from emulsion by cleaning.

c) 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.

d) After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute bichromate solution and over drying.

e) The phosphate coating shall be sealed by the 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.

f) After application of the primer, two coats of finishing epoxy paint shall be applied, each coat followed by stoving. The panel shall have colour conforming to shade 631 of IS-5 for outside and inside of the panel with black colour for base frame.

g) Each coat of primer and finishing paint shall be of a slightly different shade to enable inspection of the painting.

h) Finished painted appearance of panel shall present an asthetically pleasing appearance free from dents and uneven surface.

i) A small quantity of finishing paint shall be supplied for minor touching up required at site after the installation of the panels.

1.7 PROTECTION

a) All coated surfaces shall be protected against abrasion, impact, discoloration 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, pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

b) All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion.

c) The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

b) Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

1.8 FUNGISTATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on the 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 interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application to the varnish.

1.9 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be throughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible, shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for paintaing shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or other wise protected. All paints shall be carefully selected to withstand tropical heat

and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.

1.10 GALVANIZING

All ferrous parts including all sizes of nuts, bolts, Plain and spring washers, support channels, structures, shall be hot dip galvanised conforming to latest version of IS:2629 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvasized. Minimum weight of zinc coating shall be 610 gm/sq.mm and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6 mm thickness, requirement of coating shall be as per relevant ASTM.

1.11 AUXILIARY POWER SUPPLY

1.11.1 A.C power supply for auxiliaries will be available at 240 V, 50 C/s 1-phase, 2 wire and 415V, 50 C/s, 3-phase, 4 wire, neutral solidly earthed with variation in frequency of +/-5% and variation in voltage +/-10%

1.11.2 D.C. power supply at 220 V, 2-wire ungrounded will be available 187 V to 242 V.

1.12 INSPECTION AND TESTING

All tests and inspection of the equipment specified shall be performed to the extent and in the manner as stipulated in the relevant standards and in this specification. All type tests/routine tests/acceptance tests as specified shall be conducted in the presence of purchaser. Wherever equipment similar to the one being offered has already been type tested within 5 years from the date of opening the bid. Type tests done in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, the type test reports of the same shall be submitted for scrutiny /approval. If these are found suitable and technically acceptable, conducting of type tests shall be waived off. Otherwise the subcontractor will have to carry out the type tests without any extra cost and without any delivery implications.

1.13 PACKAGING

Aluminium Tube shall be partially packed with Hessians cloths. Similar items shall be grouped and tied with steel wires/strip for convenient handling during transits.

Markings

The following details are to be clearly indicated in the material forwarding documents:

a) Name and address of the consignee.

b) Purchase order number.

c) Name of supplier/s.

d) Description of equipment / material.

e) Tare weight.

f) Gross weight.

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 account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage wagons 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.

1.14 HANDLING, STORING AND INSTALLATION

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, and square and properly aligned and oriented. Commercial use of switchyard equipment means completion of all site tests specified and energisation at rated voltage.

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.

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.

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 expenses.

Contractor shall be responsible for examining all the shipment 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, pilferage and other such charges claimed by the transporters, railways etc. shall be to the Contractor' account.

The Contractor 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 to 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 such nature, corrosion, damages etc.

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

The words erection and installation used in the specification are synonymous. Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

The minimum phase to earth, phase to phase and section clearance along-with other technical parameters for the various switchyard voltage levels to be maintained shall be strictly as per the approved drawings.

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the Contractor shall immediately proceed to correct the discrepancy at his risks and costs.

1.15 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.

1.16 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.

1.17 QUALITY

BHEL quality plan to be followed subject to TBEM / customer's approval.

1.18 DOCUMENTATION

1.18.1 Drawings

All drawings shall be prepared in Auto-Cad and ultimate documentation would include drawings/documents on CDs. All dimensions and data shall be in SI metric units.

All items of the equipment should be clearly identified by proper part nos. in the contract drawings. Such parts, which are to be dispatched to site from works in dispatchable units and are reassembled

at site, should be marked by proper identification marks at works and indicated in the drawings and quantified. The shipping list should be sent along with the general arrangement drawings for engineer's approval. All the items of the shipping list should be identified in the drawing.

The drawing submitted by the supplier shall be reviewed by the purchaser as far as practicable within two weeks of receipt of drawings and shall be modified by the sub-contractor if any modifications and/or corrections are required by the purchaser. The sub-contractor shall incorporate such modifications and / or corrections and submit the final drawings for approval. Any delay arising out of failure of the subcontractor to rectify the drawings shall not alter the contract completion date.

Further work by the subcontractor shall be in strict accordance with these drawings and no deviation shall be allowed without the written approval of the purchaser.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at supplier's risk.

Approval of drawing or work by the purchaser/consultant shall not relieve the subcontractor of any of his responsibilities and liabilities under the contract.

In case of any modifications that may be necessary during erection or commissioning of the equipment, the subcontractor shall carry out modifications in the original drawing & submit 'As Built drawings' and required no. of prints thereof.

1.18.2 Instruction manuals

The supplier shall submit to the purchaser, draft instruction manuals for approval within 30 days of placement of order. The final instruction manuals complete in all respects shall be submitted 60 days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipment furnished, the erection procedures, testing, operation & maintenance procedures of the equipment.
If after the commissioning and initial operation of the plant, the instruction manuals require any modification/ addition / changes, the same shall be incorporated and the up- dated final instruction manuals shall be submitted as required.

1.18.3 DOCUMENTATION SCHEDULE AT CONTRACT STAGE

A.	For approval	No of Copies
	Copies of all drawings with project details, dimension, shipping weights, No. of cases & dimensions, fixing details, tolerance etc.	3
	Copies of type test reports.	3
	Copies of works quality plan & field quality plan.	3

	Copies of installation operation & maintenance manual.	3
	Copies of drawings on floppies/CDs	-
B.	<u>After approval and for information / distribution</u>	
	Copies of all drawings	12
	Copies of installation, operation & maintenance manual including Routine test reports	12
	Sets of RTF of drawings	-
	CDs of Drgs.	-
C.	<u>As Built Drawings</u>	
	Hard copies of Drawings	7
	CDs	4

SECTION-4
GENERAL TECHNICAL PARTICULARS

S.N.	ITEM	SECTION-4
1	FIXTURES & ACCESSORIES	
1.1	General	
1.1.1	Name of Manufacturer & Country for fixtures	
1.1.2	Manufacturer's type & Catalogue no. for fixtures	
1.2	Technical details (Separate details of each type of fixtures, each type of components and each type of lamps shall be furnished)	
1.2.1	Fixtures	
1.2.1.1	a) Starting current (A)	
	b) Full load input current at normal working voltage (A)	
1.2.1.2	Temperature rise of the fixture in continuous operation at the design air temp. of 40 deg. C	
1.2.1.3	Maximum estimated working temp. of the fixture, with the fixture mounted close to ceiling and operating in still air ambient temp. as specified.	
	a) Ambient within fixture housing	
	b) Ballast case hot spot temp. (deg C)	
	c) Average Ballast winding temp. (deg C)	
1.2.1.4	Estimate average life expectancy of complete fixture, including control gear continuously mounted.	
	a) In still air at ambient temp of 25 deg. C (Years)	
	b) In still air at 40 deg. C ambient temp. (Years)	
1.2.1.5	Average total light output per fixture as percentage of combined lamp light output at normal working voltage and frequency	
	a) In still air at ambient temp of 25 deg. C (Years)	
	b) In still air at 40 deg. C ambient temp. (Years)	
1.2.1.6	Average downward (0-90) light output per fixture as percentage of total fixture light output (%)	
1.2.1.7	Average downward (90-180) light output per fixture as percentage of total fixture light output (%)	
1.2.1.8	Maximum withstand voltage of fixture (50 Hz sine wave test) (V)	
1.2.1.9	Beam angle for flood light fixture in	
	a) Horizontal plane (Deg.)	
	b) Vertical plane (Deg.)	
1.2.2	Ballasts	
1.2.2.1	Type	
1.2.2.2	Make	
1.2.2.3	Catalogue No.	
1.2.2.4	Maximum permissible supply voltage variation (%)	
1.2.2.5	Power loss per Ballast at nominal working voltage and frequency (Watt)	

1.2.2.6	Recommended/ Designed maximum hot spot temp. of ballast case (deg C)	
1.2.2.7	Recommended/ Designed maximum average ballast winding temp (deg C)	
1.2.2.8	Conductor material of ballast	
1.2.2.9	Insulation class of ballast winding	
1.2.2.10	Average life of ballast (Hrs)	
1.2.3	Starters	
1.2.3.1	Type	
1.2.3.2	Make	
1.2.3.3	Catalogue No.	
1.2.3.4	Average life of starters (Hrs)	
1.2.3.5	Enclosure material of starters	
1.2.4	Capacitors	
1.2.4.1	Type	
1.2.4.2	Make	
1.2.4.3	Catalogue No.	
1.2.4.4	Power factor at nominal working voltage and frequency	
1.2.4.5	Type of capacitor	
1.2.4.6	Rating of capacitor (micro F)	
1.2.4.7	Tangent of loss angle per capacitor at nominal working voltage and frequency	
1.2.4.8	Recommended maximum working temp. of capacitor measured on case (deg C)	
1.2.5	Ignitors for HPSV lamps	
1.2.5.1	Type	
1.2.5.2	Make	
1.2.5.3	Catalogue No.	
1.2.5.4	Average life of ignitors (Hrs)	
1.2.5.5	Enclosure material of ignitors	
1.2.6	Fuses	
1.2.6.1	Type	
1.2.6.2	Make	
1.2.6.3	Catalogue No.	
1.2.6.4	Category of fuse duty	
1.2.6.5	Rated Current (A)	
1.2.6.6	Maximum prospective rms fault current interruption value of fuse at nominal voltage and frequency (A)	
1.2.7	Louvers	
1.2.7.1	Material of louvers	
1.2.7.2	Size of louvers	
1.2.7.3	Shielding angle of louver (Deg.)	
1.2.8	Diffusers	
1.2.8.1	Material of diffusers	
1.2.8.2	Thickness of diffuser (mm)	
1.2.9	Reflectors	

1.2.9.1	Material of reflector	
1.2.9.2	Thickness of reflector (mm)	
1.2.10	Lamps	
1.2.10.1	Type	
1.2.10.2	Make	
1.2.10.3	Catalogue No.	
1.2.10.4	Nominal voltage (V)	
1.2.10.5	Maximum permissible supply voltage variation	
	a) Incandescent (+/-) (%)	
	b) Fluorescent (+/-) (%)	
	c) HPSV (+/-) (%)	
1.2.10.6	Luminous output at specified design temp.	
	a) After 100 burning hours (Lumens)	
	b) After 1000 burning hours (Lumens)	
1.2.10.7	Average life expectancy of each type and each wattage of lamp when operated continuously	
1.2.10.8	Burning position of lamp	
1.2.10.9	Color of the light rendered by the lamps	
1.2.11	Lamp holders	
1.2.11.1	Type	
1.2.11.2	Make	
1.2.11.3	Material	
1.2.12	Termination at fixtures suitable for	
	a) Cable/ Conduit entry size	
	b) Size & type of cable	
1.2.13	Earthing terminal	
	a) Material	
	b) Suitable for earthing conductors of size (Sq. mm)	
1.2.14	Internal wiring size (Sq. mm)	
1.2.15	Terminal Blocks	
1.2.15.1	Type	
1.2.15.2	Make	
1.2.15.3	Material	
1.2.15.4	Rating	
1.2.15.5	Suitable for conductor size (Sq. mm)	
1.2.16	Aluminum/ Sheet Steel thickness of	
	a) Housing (SWG)	
	b) Reflector (SWG)	
1.2.16	Wire Guard	
1.2.17.1	Material	
1.2.17.2	Thickness	
1.2.17.3	Painting	
1.2.18	Weight of the fixture (Kg)	
2	LIGHTING SYSTEM INSTALLATION	
2.1	Point Wiring	
2.1.1	Wires/ Cables	

	a) Make	
	b) Galvanised (Yes/ No)	
	c) Minimum size/ gauge	
	d) Applicable standards	
2.1.3	Accessories	
2.1.3.1	Material and gauge for	
	a) Saddles	
	b) Spacers plates	
	c) Fixing hardware	
2.1.3.2	Accessories and hardware galvanized (Yes/ No)	
2.1.3.3	Junction/ Pull Boxes provided with necessary terminals	
	a) Material	
	b) Thickness	
	c) Dimensions	
	d) Galvanised (Yes/No)	
2.1.3.4	Applicable Standards	
2.1.4	Mounting/ Suspension Conduits	
2.1.4.1	Make	
2.1.4.2	Material and gauge for each size	
2.1.4.3	Size (mm)	
2.1.4.4	Galvanised (Yes/No)	
2.1.4.5	Applicable Standards	
2.1.5	Flexible Conduit	
	a) Material	
	b) Size	
	c) Make	
	d) Applicable Standards	
	e) Domestic type (Yes/ No)	
2.2	RECEPTACLES WITH MCB	
2.2.1	Receptacles	
	a) Make	
	b) Applicable Standards	
	c) Ratings as specified (Yes/No)	
2.2.2	MCBs	
	a) Make	
	b) Rating	
	c) Applicable Standards	
2.2.3	Catalogue enclosed (Yes/No)	
2.2.4	Boxes with Sunmica sheet top for housing switches/ receptacles/ MCBs	
	a) Applicable Standards	
	b) Material and gauge of Box	
	c) Galvanise (Yes/No)	
	d) Thickness of Sunmica Sheet	
	e) Earthing terminal provided (Yes/ No)	
	f) Material and thickness of cover sheet	

SECTION - 5

CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED

PLEASE NOTE:

a)The offer may not be considered if the following information and this Checklist are not enclosed with the Offer.

Hence bidder shall ensure the completeness of their offer in this regard.

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 :

EQUIPMENT: Illumination System

Sl.no	Parameter	Data	Bidder's conformation	Reason for non-compliance
(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.	Lighting transformer included company with specification requirements		YES / NO	
6.	Lighting poles included as per spec.		YES / NO	
7.	Sockets, Plugs & other items included as per spec.		YES / NO	
8.	ETC of Package included in the offer		YES / NO	
9.	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	
10.	ETC of BHEL supplied Cables included in the offer		YES / NO	
11.	ETC of BHEL supplied earthing strip included in the offer		YES / NO	
12.	Additional flood light luminaries in switchyard for maintenance of equipment specified in specification included in offer.		YES / NO	
13.	Type and lumen output of lamps included in the offer are as per specification.		YES / NO	
14.	Whether any new item other than the BOQ given required to meet the		YES / NO	

	specification requirement.			
15.	If new item is required whether these are listed with quantities in the offer		YES / NO	
16.	Equipment included suitable for operation on voltage & frequency Variation limits specified in the specification without effecting their performance		YES / NO	
17.	Power factor of lamp circuit is as per specification		YES / NO	
18.	Fully filled in GTP enclosed		YES / NO	
19.	Auto change over arrangement for emergency AC included in EAC boards		YES / NO	
20.	Auto switching arrangement for outdoor flood lighting / street lighting through Timer / Photo cell included		YES / NO	
21.	Spares included in the offer (a) Mandatory (b) Commissioning		 YES / NO YES / NO	
22.	Activity Schedule enclosed		YES / NO	
23.	Type test reports	Type test reports furnished shall be in line with clause 1.4 (Section-1)	Yes	
24.	Type test	If type test reports are not acceptable to KPCL/BHEL then above tests shall be conducted by the bidder free of cost	Yes	
25.	Mandatory spares quoted in line with Annexure-1 (BOQ) of section-1	Yes	Yes/No	
26.	Bidder to confirm that it will offer approved make of components & fitments at Contract stage. In case the offered make is not approved by the Customer, then alternate make shall be supplied without any commercial implication to BHEL.	Yes	Yes/No	

Bidder's

Sign :

Date :

Name :

Design :

ANNEXURE - A
SCHEDULE OF TECHNICAL DEVIATIONS

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

S.No.	Page No.	Clause No.	Deviation	Reason / Justification

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