



BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

DOCUMENT No.	TB-404-316-026	Rev. No.	00		Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION			NAME	GV	MM	VK/A6
TITLE LT SWITCHGEAR (AC & DC BOARDS)				SIGN	गौरव	Murti	Ujwal
				DATE	26.03.19	29.03.19	29/3/19
				GROUP	TBEM		
CUSTOMER	UP POWER TRANSMISSION CORPORATION LTD. (UPPTCL)						
PROJECT	400/220/132 kV UPPTCL GIS SS at Rasra, Ballia (U.P.)						

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Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS				
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SECTION-1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE:

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch, supervision of erection, testing and commissioning of metal enclosed, indoor floor mounted, compartmentalized double front construction and free standing type AC and DC Distribution Board as listed in clause **1.2** below.

This section covers the scope and quantities of LT AC & DC DB. The specific technical Requirements for the above item as specified by the customer are given in Section-2. The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

In case of any discrepancies between the requirements mentioned under Section-1/Section-2 and those specified in the Section-3, the specifications given under Section-1/Section-2 shall prevail and shall be treated as binding requirements.

The term "Owner/Customer/Employer" appearing in this specification shall refer to ultimate customer, the term "Purchaser/Contractor" shall refer to BHEL and the term "Sub-contractor/Bidder/Manufacturer" shall refer to the successful Bidder.

The equipment is required for the following project:

Name of Customer: UP POWER TRANSMISSION CORPORATION LTD. (UPPTCL)

Name of the Project: 400/220/132 kV UPPTCL GIS SS at Rasra, Ballia (U.P.)

Refer Section - 3 for Project Details and General Specifications.

1.1 SPECIFIC TECHNICAL REQUIREMENTS:

Please refer attached drawing number

TB-0-404-316-026	SLD FOR LT AC & DC SYSTEM AT BALLIA
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For further technical requirements refer Section-2

1.2 BILL OF QUANTITY:

Bidder must quote addition /deletion price for each and every type of complete module (Type of modules are defined in Section-2). This is required to account for any changes in the Single Line Diagram during detailed contract engineering stage.

For details of fitments of each module, refer Section 2 and enclosed Single Line diagram.

Annexure-1 attached for Detailed BOQ.

Fault rating is as per attached S.L.D

The bill of material of each type of module as mentioned in the Single Line Diagram for LT

AC & DC System shall be as below –

- | | | |
|----|------------------------|-------------------------------------|
| a) | Module Type AE | : Refer clause 6.26.4 of Section 2 |
| b) | Module Type – M1 | : Refer clause 6.26.5 of Section 2 |
| c) | Module Type E | : Refer clause 6.26.6 of Section 2 |
| d) | Module Type G - 1 | : Refer clause 6.26.7 of Section 2 |
| e) | Module Type G - 2 | : Refer clause 6.26.8 of Section 2 |
| f) | Module Type H & H (BC) | : Refer clause 6.26.9 of Section 2 |
| g) | Module Type S | : Refer clause 6.26.10 of Section 2 |
| h) | Module Type X | : Refer clause 6.26.11 of Section 2 |
| i) | Module Type - DC | : Refer clause 6.26.12 of Section 2 |
| j) | Module Type DG - 1 | : Refer clause 6.26.13 of Section 2 |
| k) | Module Type H1 | : Refer clause 6.26.14 of Section 2 |
| l) | Module Type EL | : Refer clause 6.26.15 of Section 2 |

1.3 TYPE TESTING, ERECTION, TESTING & COMMISSIONING

- a. Type tests shall be in line with Clause 6.22 of Section 2.
- b. Commissioning check tests shall be as per clause 6.24 of Section 2.
- c. The type test reports submitted shall be of tests conducted after **17.04.2013**. The bidder should have conducted type test on identical or similar equipment/ components to those offered. In case type test reports are found to be technically unacceptable to BHEL/UPPTCL, the type test shall be conducted without cost and delivery implication to BHEL/UPPTCL.

1.4 DEVIATIONS

The bidder shall list all the deviation from the specification separately. Offers without specific deviation will be deemed to be totally in compliance with the specification and NO DEVIATION on any account will be entertained at a later date.

1.5 PACKING

- 1.5.1** All equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and outdoor storage (for a minimum period of 1 years) at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of transportation facilities in India should be taken into account. The Bidder shall be responsible for any loss or damage during transportation, handling and storage.
- 1.5.2** The Bidder shall include and provide for security, protection and packing the equipment so as to avoid loss or damage during transport by any mode.
- 1.5.3** All packing shall allow for easy removal and checking at site. Wherever necessary, proper arrangement for attaching slings for lifting shall be provided. All packages shall be clearly marked for with signs showing 'UP' and 'DOWN' side of boxes, and handling and unpacking instructions as considered necessary. Special precautions shall be taken to prevent rusting of steel and iron parts during transit and storage. Gas seals or other methods proposed to be adopted for protection against moisture during transit shall be to the satisfaction of the purchaser.
- 1.5.4** The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbols i.e. FRAGILE, HANDLE WITH CARE, USE NO HOOKS etc.

- 1.5.5** Each package delivered under the contract shall be marked by the Bidder at his expense and such marking must be distinct (all previous irrelevant marking being carefully obliterated). Such marking shall show the description and quantity of contents, the name of consignee and address, the gross and net weights of the package, the name of Bidder with a distinctive number of mark sufficient for purpose of identification. All markings shall be carried out with such materials as to ensure quickness of drying, fastness and legibility.
- 1.5.6** Each Package shall contain a note quoting specifically the name of the Bidder, the number and date of contract or order and the name of office placing the contract, nomenclature of the stores and include a schedule of parts for each complete equipment giving the parts number with reference to the General Arrangement/ Assembly drawing and the quantity of each part, drawing number and tag numbers.
- 1.5.7** All equipment/ material shall be suitably packed for transport, carriage at site and outdoor storage during transit. The Bidder shall be responsible for any damage to the equipment during transit. The contents of each package shall bear marking that can be readily identified from the package list and packing shall provide complete protection from moisture, termites and mechanical shocks etc.
- 1.5.8** Any material found short inside the packing cases shall be supplied by the Bidder without any extra cost.
- 1.5.9** Notwithstanding anything stated in this clause the Bidder shall be entirely responsible for any loss, damage or depreciation to the stores.

1.6 MANUFACTURING QUALITY PLAN:

Bidder shall follow UPPTCL approved Quality Plan at contract stage.

BILL OF QUANTITY FOR LT SWITCHGEAR

S.No.	Description	Unit	Qty
A.	Main Items		
1	415V, 3Ph 4 wire ,1250A, 25kA for 1 sec MAIN SWITCHBOARD	Set	1
2	415V, 3Ph, 4 wire, 800A, 20kA for 1s AC DISTRIBUTION BOARD	Set	1
3	415V,3ph 4 wire, 500A, MAIN LIGHTING DISTRIBUTION BOARD (including 2 nos. 150 kVA, 415/415V Lighting transformer)	Set	1
4	415V,3ph 4 wire, 400A, COLONY LIGHTING DISTRIBUTION BOARD (including 2 nos. 150 kVA, 415/415V Lighting transformer)	Set	1
5	415V, 3ph 4 wire , 200A, EMERGENCY LIGHTING DISTRIBUTION BOARD (including 1 nos. 50 kVA, 415/415V Lighting transformer)	Set	1
6	220V, 400A, 20kA (DC) for 1s DC DISTRIBUTION BOARD	Set	2
7	48V, 400A, 20kA (DC) for 1s DC DISTRIBUTION BOARD	Set	2
B.	Mandatory Spares		
1	Relays of each type and rating	Set	1
2	CTs and PTs of each type and rating	Set	1
3	Switches/ Push buttons and Meters of each type	Set	1
4	TPN Switches/ MCB of each type	Set	1
5	MCCB of each rating	Set	1
6	L.T. Breaker spares		
	a) Spring charging motor	No.	1
	b) Aux. Contact sets (2 nos. of each type and rating)	Set	2
	c) Busbar Seal off insulators	Nos.	5
	d) Arc Chutes (2 nos. of each type and rating)	Set	2
	e) Moving contacts (1 nos. of each type and rating)	Set	1
	f) Arcing contacts (Fixed/Moving) (1 nos. of each type and rating)	Set	1
	g) Springs (Closing/Opening)	No.	1
	h) Closing Coil	No.	1
	i) Tripping Coil	No.	1
	j) Aux. finger contact (1 nos. of each type and rating)	Set	1
	k) Limit Switches (1 nos. of each type and rating)	Set	1
	l) Jaw contacts (1 nos. of each type and rating)	Set	1
	m) Busbar insulators	Nos.	5
	n) Interphase barrier	Nos.	2
	o) Busbar strip 1mm (Aluminium)	MTR	5
		LOT	1
C.	Supervision of Erection Testing & Commissioning.		
D.	Unit Rate Items:		
1	Module AE – 1250A	Nos.	1
2	Module AE – 800A	Nos.	1
3	Module AE – 630A	Nos.	1

4	Module E – 500A	Nos.	1
5	Module E – 400A	Nos.	1
6	Module E – 200A	Nos.	1
7	Module E – 100A	Nos.	1
8	Module E – 63A	Nos.	1
9	Module E – 32A	Nos.	1
10	Module X – 32A	Nos.	1
11	Module X – 40A	Nos.	1
12	Muti Function Meter (MFM)	Nos.	1

NOTE:

- 1 Unit Prices of Individual Equipment included here or in mandatory spares are required for any Addition/Deletion of Equipment and replacement of damaged items. Vendor to ensure that the unit prices have a logical relationship with prices of assemblies in main items (Boards).
- 2 Quoting for unit prices is mandatory and shall be considered for evaluation.
- 3 If any of the unit rate items is not quoted, but is required due to damages, theft, replacement, change in feeder rating etc. or any other reason during execution, the required quantity shall be supplied free of cost within guarantee period.
- 4 It will be the bidders responsibility to organise deputation of OEM of protection relays and devices. Equipments required for testing of protection relays is in Bidders scope.

415V MAIN SWITCH BOARD (1A)

415V MLDB (3A)

415V COLONY LIGHTING DB (4A)

415V ELDB (5A)

415V AC DISTRIBUTION BOARD (2A)

220V DC DISTRIBUTION BOARD-1 (1D)

220V DC DISTRIBUTION BOARD-2 (2D)

48V DC DISTRIBUTION BOARD-1 (3D)

48V DC DISTRIBUTION BOARD-2 (4D)

NOTES:-

- NO TWO AC SOURCE SHALL BE PARALLELED AT ANY STAGE.
- DC SET SHALL BE AUTO START TYPE.
- MECHANICAL INTERLOCK SHALL BE PROVIDED TO ENSURE BREAKER OF DC SET WILL CLOSE ONLY WHEN SWITCHES 1 & 5 ARE OPEN
- FOR COMPLETE DESCRIPTION OF EACH TYPE OF MODULE, PLEASE REFER TECHNICAL SPECIFICATION.
- CABLE SIZES SHOWN ARE AS PER THE TECHNICAL SPECIFICATION.
- ALL THE FEEDERS SHOWN IN THE SLD INCLUDING FUTURE/ SPARE (SHOWN DOTTED) ARE INCLUDED IN SCOPE OF SUPPLY.
- TRANSFORMERS/AUX. CONTACTS REQUIRED FOR ANALOG AND DIGITAL INPUT SHALL BE AN INTEGRAL PART OF LT AC/DC BOARDS.
- ONE DC "X" TYPE MODULE IN EACH 220V DCOB SHALL BE PROVIDED FOR EACH LINE, TRANSFORMER, BUS REACTOR, DC & BUS-SECTION BAY FOR PRESENT & FUTURE BAYS AS SHOWN IN SUBSTATION SLD.
- ONE DC "X" TYPE MODULE IN EACH 48V DCOB SHALL BE PROVIDED FOR EACH LINE BAY FOR PRESENT & FUTURE BAYS AS SHOWN IN SUBSTATION SLD.
- MODULE "X" REFERRED ABOVE, IS APPLICABLE WITH DP MCCB, MAXIMUM 2Nos. OF DP MCCB SHALL BE CONNECTED IN ONE MODULE OF OFFERED PANEL.
- ALL (DCOA, ACB) MODULE SHALL HAVE ONLY ACB WITHOUT SEPARATE PROTECTIVE RELAYS, BUT SHOULD HAVE IN-BUILT THERMO-MAGNETIC RELEASE, HOWEVER, AUX. RELAYS/CONTACTORS SHALL BE INCLUDED AS PER SCHEME REQUIREMENT.
- ALL DIGITAL / ANALOG INPUTS/OUTPUTS REQUIRED FOR SAS SHALL BE CONSIDERED.
- GLAND PLATE SHALL BE OF NON MAGNETIC WHEREVER SINGLE CORE POWER CABLE ARE USED.
- UNLESS SPECIFIED, SOURCE 1 WILL BE FED FROM BUS 1 AND SOURCE 2 FROM BUS 2.
- INSTANT OUTAGE OF COLONY LIGHTING IN CASE OF OUTAGE OF SEB FEEDER.
- RATING OF BUSBAR/FEEDER INDICATED IN THIS DRAWING ARE MIN. REQUIREMENT AND MAY BE INCREASED DURING DETAILED ENGINEERING IF FOUND INADEQUATE WITH RESPECT TO OFFERED LOADS/SYSTEM.

LEGEND:-

- 50N : INSTANTANEOUS EARTH FAULT RELAY (Tripple pole)
50 : TRIPLE POLE INSTANTANEOUS OVER CURRENT RELAY
51 : DOUBLE POLE INVERSE DEFINITE MINIMUM TIME RELAY
50/2 : SINGLE POLE ADJUSTABLE DEFINITE TIME DELAY RELAY FOR MOTOR OVERLOAD ALARM
2 : TIME DELAY PICKUP RELAY
27X : AC DOUBLE POLE INSTANTANEOUS UNDER VOLTAGE RELAY
27 : DC INSTANTANEOUS UNDER VOLTAGE RELAY
59 : DC INSTANTANEOUS OVER VOLTAGE RELAY
96 : EARTH LEAKAGE RELAY
51V : THREE POLE VOLTAGE CONTROLLED DEFINITE TIME DELAY OVER CURRENT RELAY
87 : THREE POLE DIFFERENTIAL PROTECTION RELAY
95 : SINGLE POLE DEFINITE TIME OVER CURRENT RELAY . DG OVER LOAD RELAY
64 : RESTRICTED EARTH FAULT PROTECTION

LEGEND:-

- DRAW OUT TYPE
AIR CIRCUIT BREAKER
NON DRAW OUT TYPE
4-POLE MCCB
NON DRAW-OUT
2-POLE MCCB
NON DRAW OUT TYPE
2-POLE MCCB
CONTROL FUSE
BATTERY LINES/FUSES
TIMER

Minimum indication requirement of Analog signal, Potential Free contacts & Command signals which should be available at respective equipment for remote indication & control from Auxiliary PLC located in 95% control room			COMMAND SIGNALS FROM REMOTE INDICATION
EQUIPMENT	ANALOG SIGNAL FOR REMOTE INDICATION	POTENTIAL FREE CONTACT FOR REMOTE INDICATION	COMMAND SIGNALS FROM REMOTE INDICATION
415V Main Switchboard			
BUS 1 Voltage 8 V	Main VC-1 Breaker ON/OFF	VC-1 Breaker TRIP CMD	VC-1 Breaker TRIP CMD
BUS 1 Voltage 8 V	Main VC-2 Breaker ON/OFF	VC-2 Breaker TRIP CMD	VC-2 Breaker TRIP CMD
BUS 1 Voltage 8 V	Main VC-3 Breaker ON/OFF	VC-3 Breaker TRIP CMD	VC-3 Breaker TRIP CMD
VC-1 Current 8 Phase	VC-1 Breaker ON/OFF	VC-1 Breaker TRIP CMD	VC-1 Breaker TRIP CMD
VC-2 Current 8 Phase	VC-2 Breaker ON/OFF	VC-2 Breaker TRIP CMD	VC-2 Breaker TRIP CMD
VC-3 Current 8 Phase	VC-3 Breaker ON/OFF	VC-3 Breaker TRIP CMD	VC-3 Breaker TRIP CMD
BUS 2 Voltage 8 V	Main Bus 1 UV	VC-1 Breaker TRIP CMD	VC-1 Breaker TRIP CMD
BUS 2 Voltage 8 V	Main Bus 2 UV	VC-2 Breaker TRIP CMD	VC-2 Breaker TRIP CMD
BUS 2 Voltage 8 V	Main Bus 3 UV	VC-3 Breaker TRIP CMD	VC-3 Breaker TRIP CMD
VC-1 Current 8 Phase	VC-1 Breaker ON/OFF	VC-1 Breaker TRIP CMD	VC-1 Breaker TRIP CMD
VC-2 Current 8 Phase	VC-2 Breaker ON/OFF	VC-2 Breaker TRIP CMD	VC-2 Breaker TRIP CMD
VC-3 Current 8 Phase	VC-3 Breaker ON/OFF	VC-3 Breaker TRIP CMD	VC-3 Breaker TRIP CMD
ACDB			
VC-1 Breaker ON/OFF	VC-1 Breaker ON/OFF	VC-1 Breaker TRIP CMD	VC-1 Breaker TRIP CMD
VC-2 Breaker ON/OFF	VC-2 Breaker ON/OFF	VC-2 Breaker TRIP CMD	VC-2 Breaker TRIP CMD
VC-3 Breaker ON/OFF	VC-3 Breaker ON/OFF	VC-3 Breaker TRIP CMD	VC-3 Breaker TRIP CMD
VC-1 Breaker ON/OFF	VC-1 Breaker ON/OFF	VC-1 Breaker TRIP CMD	VC-1 Breaker TRIP CMD
VC-2 Breaker ON/OFF	VC-2 Breaker ON/OFF	VC-2 Breaker TRIP CMD	VC-2 Breaker TRIP CMD
VC-3 Breaker ON/OFF	VC-3 Breaker ON/OFF	VC-3 Breaker TRIP CMD	VC-3 Breaker TRIP CMD
220V & 48V DCDB			
DCDB-1 Voltage	DCDB-1 10V ALARM	DCDB-1 10V ALARM	DCDB-1 10V ALARM
DCDB-2 Voltage	DCDB-2 10V ALARM	DCDB-2 10V ALARM	DCDB-2 10V ALARM
Incomer-1 Current from Battery set-1	CHARGER-1: AC power failure	CHARGER-1: AC power failure	CHARGER-1: AC power failure
Incomer-2 Current from Battery set-2	CHARGER-2: AC power failure	CHARGER-2: AC power failure	CHARGER-2: AC power failure
Incomer-3 Current from Battery set-3	CHARGER-3: AC power failure	CHARGER-3: AC power failure	CHARGER-3: AC power failure
220V & 48V BATTERY CHARGER			
CHARGER-1: AC power failure	CHARGER-1: AC power failure	CHARGER-1: AC power failure	CHARGER-1: AC power failure
CHARGER-2: AC power failure	CHARGER-2: AC power failure	CHARGER-2: AC power failure	CHARGER-2: AC power failure
CHARGER-3: AC power failure	CHARGER-3: AC power failure	CHARGER-3: AC power failure	CHARGER-3: AC power failure
CHARGER-1: AC power failure	CHARGER-1: AC power failure	CHARGER-1: AC power failure	CHARGER-1: AC power failure
CHARGER-2: AC power failure	CHARGER-2: AC power failure	CHARGER-2: AC power failure	CHARGER-2: AC power failure
CHARGER-3: AC power failure	CHARGER-3: AC power failure	CHARGER-3: AC power failure	CHARGER-3: AC power failure
LT Transformer			
LT transformer-1: Buchholz Alarm	LT transformer-1: Buchholz Alarm	LT transformer-1: Buchholz Alarm	LT transformer-1: Buchholz Alarm
LT transformer-2: Buchholz Alarm	LT transformer-2: Buchholz Alarm	LT transformer-2: Buchholz Alarm	LT transformer-2: Buchholz Alarm
LT transformer-3: Buchholz Alarm	LT transformer-3: Buchholz Alarm	LT transformer-3: Buchholz Alarm	LT transformer-3: Buchholz Alarm
LT transformer-1: OTI Alarm	LT transformer-1: OTI Alarm	LT transformer-1: OTI Alarm	LT transformer-1: OTI Alarm
LT transformer-2: OTI Alarm	LT transformer-2: OTI Alarm	LT transformer-2: OTI Alarm	LT transformer-2: OTI Alarm
LT transformer-3: OTI Alarm	LT transformer-3: OTI Alarm	LT transformer-3: OTI Alarm	LT transformer-3: OTI Alarm
LT transformer-1: WTI Alarm	LT transformer-1: WTI Alarm	LT transformer-1: WTI Alarm	LT transformer-1: WTI Alarm
LT transformer-2: WTI Alarm	LT transformer-2: WTI Alarm	LT transformer-2: WTI Alarm	LT transformer-2: WTI Alarm
LT transformer-3: WTI Alarm	LT transformer-3: WTI Alarm	LT transformer-3: WTI Alarm	LT transformer-3: WTI Alarm
Air Conditioning System			
IN CRB	Main Control room temperature	Room temperature High Alarm	Room temperature High Alarm
Air Conditioning System for Switchyard Panel Room	Switchyard Ambient temperature	Switchyard Ambient temperature High Alarm	Switchyard Ambient temperature High Alarm
Air Conditioning System for Switchyard PANEL ROOM	Switchyard Panel Room's Temperature	Switchyard Panel Room's Temperature High Alarm	Switchyard Panel Room's Temperature High Alarm

TECHNICAL REQUIREMENT

Name of Project: - 400/220/132kV GIS at Rasra (Ballia)

Name of Item : - LT Switchgear

Sr. No	Description	Supporting Document to be attached	Reference of attached documents								
01	The Manufacturer whose LT Switchgear are offered, should be a manufacturer of LT Switchboards of the type and rating being offered. He should have designed manufactured, tested and supplied at least 50 nos. draw out circuit breaker panels, out of which at least 5 nos. should have been with relay and protection schemes with current transformer. He should have also manufactured at least 50 nos. MCC panels comprising of MCCBs (i.e. Moulded Case Circuit Breakers) modules of the type offered which should be in successful operation as on date of bid Opening i.e. 17.04.2018 The Switchgear items (such as circuit breakers, fuse switch units, contactors etc.), may be of his own make or shall be procured from reputed manufacturers and of proven design. At least one hundred circuit breakers of the make and type being offered shall be operating satisfactory# as on date of bid opening i.e. 17.04.2018. #: satisfactory operation means certificate issued by the Employer/Utility certifying the operation without any adverse remark.	1. Bidder to Provide Compliance/Confirmation of fulfilling SL No.1 Technical Requirement. 2. Performance certificate /Letter /MOM etc. issued by end customer for Satisfactory operation 3. PO Copy / PO list in following format <table><tr><th>Sr No</th><th>ITEMS SUPPLIED TO</th><th>ORDER REFERENCE No. & DATE</th><th>ITEMS</th><th>QTY</th><th>ORDER FULLY EXECUTED</th><th>STATUS, IF ORDER UNDER</th><th>REMARK</th></tr></table> 4. Type test certificates 5. Dispatch instructions/ Material receipt at site/ lorry receipt details etc. 6. Factory License and certificate	Sr No	ITEMS SUPPLIED TO	ORDER REFERENCE No. & DATE	ITEMS	QTY	ORDER FULLY EXECUTED	STATUS, IF ORDER UNDER	REMARK	
Sr No	ITEMS SUPPLIED TO	ORDER REFERENCE No. & DATE	ITEMS	QTY	ORDER FULLY EXECUTED	STATUS, IF ORDER UNDER	REMARK				

SECTION-2

LT SWITCH GEAR
(AC & DC DISTRIBUTION BOARDS)

**LT SWITCH GEAR
(AC & DC DISTRIBUTION BOARDS)**

CONTENTS

Clause No.	Particulars
1.0	Scope
2.0	Standards
3.0	Tropical Protection
4.0	Interchangeability
5.0	Technical Particular of LT Switchgear
6.1	Constructional Details of Switch Board and Distribution Boards
6.2	Derating of Equipments
6.3	Power Bus Bars and Insulators
6.4	Earth Bus
6.5	Air Circuit Breakers
6.6	Protection Co-Ordination
6.7	Moulded Case Circuit Breaker (MCCB) and MCB
6.8	Relays
6.9	Contactors
6.10	Instrument Transformers
6.11	Indicating Instruments
6.12	Control & Selector Switches
6.13	Air Break Switches
6.14	Push Buttons
6.15	Indicating Lamps/LED
6.16	Fuses
6.17	Terminal Blocks
6.18	Name Plates and Labels
6.19	Space Heater
6.20	Control and Secondary Wiring
6.21	Power Cables Termination
6.22	Type Tests
6.23	Erection, Testing and Commissioning
6.24	Commissioning Check Tests
6.25	Special Tools and Tackles
6.26	Equipment to be Furnished
6.27	Parameters
6.28	Automatic Control of Outdoor Lighting
6.29	Automatic Supply Changeover
Annexure-1	LT Panels AC Distribution Arrangements
Annexure-2	Contingency / Emergency Situation Switching Arrangements

TECHNICAL SPECIFICATION OF LT SWITCH GEAR (AC & DC DISTRIBUTION BOARDS)

1.0 SCOPE

- 1.1 This specification covers the design manufacture, testing and supply of LT switchgear (including the AC & DC Distribution Boards) for control of various AC & DC supply to various auxiliaries in 400 kV Substation alongwith all materials and accessories for efficient and trouble free operation.
- 1.2 It is not the intent to specify completely herein all details of the equipment. Nevertheless, the equipment shall be complete and operative in all aspects and shall conform to highest standard of engineering and design and workmanship.
- 1.3 Any material or accessory which may not have been specifically mentioned but which is necessary for satisfactory and trouble free operation and maintenance of the equipment shall be supplied without extra charges.
- 1.4 The contractor shall supply all brand new equipment and accessories as specified herein with such modification and alteration as agreed upon in writing, after mutual discussion.

2.0 STANDARDS

The LT Switchgears shall conform to the latest revisions with amendments available of relevant standards, rules and codes some of which are listed herein for ready reference, unless otherwise specified elsewhere in this specification.

S.No.	Standard	Description
i)	IS 8623	Specification for low voltage switch-gear and control-gear assemblies for voltage upto and including 1000V AC and 1200VDC
ii)	IS 13947 -Part-1	General requirement for switchgear and control gear for voltage not exceeding 1000V
iii)	IS 13947	Degree of protection provided by enclosures for low voltage switch gears and control gear
iv)	IS 13947	Air Circuit Breakers
v)	IS 3156	Voltage transformers
vi)	IS 2705	Current Transformers
vii)	IS 3231	Electrical Relays
viii)	IS 8544	A.C.Motor starter of voltage not exceeding 1000V

ix)	IS 9244	Low voltage fuses
x)	IS 13947- Part-v	Switches and push buttons
xi)	IS 13779	A/C Meters
xii)	IS 6005	Code of practice for phosphating of iron and steel
xiii)	IS 8623(Part -I) IEC60439 (Part -I)	AC & DC Power Distribution Boards
xiv)	IS 13947 Part - II IEC 60947	MCB/MCCB
xv)	IS 1248	Measuring Instruments
xvi)	IS 2633	Method of testing, uniformity of coating of zinc coated articles.
xvii)	IS 5578/11353	Marking and arrangement for switchgear bus bars main connections & Auxiliary wiring.
xviii)	IS 8828 IEC 898	Circuit breakers for over current protection for house hold and similar installations.
xix)	IS 5082	Wrought Aluminum and Aluminum Alloy Bars, Rods, Tubes & sections for electrical purposes.

3.0 TROPICAL PROTECTION

- 3.1 All equipments, accessories and wiring shall have fungus protection involving special treatment of insulation & material against fungus insects and corrosion, screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent the entrance of insects.

4.0 INTERCHANGEABILITY

- 4.1 All similar component parts supplied shall be interchangeable with one another physically and electrically.

5.0 TECHNICAL PARTICULAR OF LT SWITCHGEAR

5.1 Construction Requirements

The AC & DC distribution board's panel shall comprise of sheet steel clad dust and vermin proof compartmentalized double front cubicle type panel. The panels shall be of floor mounting and free standing type and suitable for indoor installation.

Industrial LT A.C. panels are not acceptable. Panels shall consist of cubicles bolted together to form a flush front switch board with door on rear, compartmental doors on front with cable entry from bottom and with the following specifications :

Sheet steel thickness - 2 mm CRCA sheet steel

Height - 2000 mm

Depth - 600 mm

Width - As required to accommodate incoming, out going and spare circuits

Base channel - 75 x 40 mm fabricated out of 3 mm sheet steel

Door interlock - Each compartment which incorporates switch Fuse units or load break switches or MCCB is to be with door interlock.

Barrier between - Each compartment is to be segregated feeders and closed on all sides except for the bus bar/cable connector opening.

Switch connections-	Feeders above 63 A to be connected by bus bar links. Switches of 63 A and below to be connected by PVC copper wires using suitable crimped, copper lugs of Dowells make.
Bus bars	Three Phase Neutral aluminium PVC sheathed Phase size 62x 10 mm Neutral 31 x 10 mm Aluminium alloy used for bus bars shall be equivalent to E91E quality of IS 5082 Bus bars to be supported on unbreakable non-hygroscopic insulated supports. Bus bars to be fully shrouded.
Terminals for-	Suitable bus bar links for connections 100 A and outgoing higher size feeders and terminals for 63 A and smaller size feeder to be provided.
Incoming MCCB-	MCCB with clearly marked ON-OFF positions with rotary mechanism provided with front handle shaft and door interlock.
Switch fuse units-	Combination switch fuse units double break mechanism AC 23 duty rating with door inter-lock and pad locking mechanism.

Panels shall be completely factory wired, ready for connecting to the equipment. Control wiring shall be done with **2.5 Sq.mm 1100 V grade PVC insulated stranded copper cables**. Panels shall be given two coats of light grey paint finish after thorough pre-treatment and application of corrosion resistant primer.

Earthing shall be done for all the equipment and the panel. The minimum size of earthing bus shall be **3x25 mm copper**.

Further construction details are given in the subsequent paras.

AC & DC Distribution Boards shall be Equipped and Wired with the Following

The schematic diagram of AC & DC distribution boards shall be submitted by successful bidder during detailed engineering for the approval of the purchaser.

The tentative LT AC Distribution and switching arrangement is shown in the Annexure-1 & 2 for various supply source failures/ conditions. The bidder is required to design the complete scheme so as to automatically achieve the supply change-overs and switching arrangement/ sequences during source supply failure (s) to maintain uninterrupted LT Supply to Substation Auxiliaries.

The scheme and each panel shall be complete with switching devices, relays, contactors, fuses, bus bars, buscouplers, switches, panel meters, cable glands, cable lugs etc. as per the functional need of the scheme. The indicative arrangement with tentative item list have been furnished below for the bidders reference, however these are not limited and bidder is required to provide any other item if required for achieving the desired functionalities and satisfactory operation without any further cost implication to the purchaser.

1 No. Main AC Incoming Board from 630 kVA, 33kV/ 0.4kV Station Transformer consisting of: (MSB-1A)

- | | |
|--------|--|
| 3 Nos. | 1250 Amps 25 kA ACB |
| 2 No. | 800 Amps 25 kA ACB |
| 1 No. | 630 Amps 25 kA ACB |
| 3 Nos. | 96 Sq.mm flush mounted Multifunction Panel Meter (with RS-485 communication port with Modbus Protocol and LED display) having suitable ampere range & Voltage Range suitable for 3Phase, 4 wire measurement. The meter shall have keypad for current selection of various phases. The meter shall have keypad for voltage selection of Phase to phase and Phase to neutral measurements. |
| 2 Set. | Air cooled ring type current transformer for metering purpose with a ratio 500-250/5 Amps of Class-I accuracy*. |
| 1 No. | 6 way voltmeter selector switch / MFM Inbuilt |
| 6 Nos. | Pilot indicating lamps/LED's for incoming supply |
| 6 Nos. | Fuses for above lamps |
| 1Set | 'TPN' electrolytic aluminum bus bars, suitable rating of suitable size supported on non-hygroscopic SRBP supports. |
| 1 Set | Cable glands and cable supports |
| 1 Set | Circuit designation label. |

* CT details as per S.L.D.

1 Set	Earth Bus 3 x 25mm copper
1Set	Name plates for all the equipment mounted on panel (front side and inside)
1Set	Cubicle illumination consisting 60 watt incandescent lamp with door controlled switch.
1Set	Terminal block/containing terminals for outgoing circuits.
1Set	Cable lugs.
1Set	15A/5A/2A plug socket with ON/OFF switch.
2 Nos.	Outgoing circuits to AC Distribution Board and Lighting Board (Refer S.L.D.)

1 No. Incoming (Part of ACDB-2A) from 250 kVA, Diesel Generator consisting of:

1 Nos.	400 A 20 kA ACB
1 No.	96 Sq.mm flush mounted Multifunction Panel Meter (with RS-485 communication port with Modbus Protocol and LED display) having suitable ampere range & voltage range for 3 Phase, 4 wire measurement. The meter shall have keypad for current selection of various phases. The meter shall have keypad for voltage selection of P-P and P-N measurements.
3 Nos.	400 A HRC fuses, if applicable
1 Set	Air cooled ring type current transformer for metering purpose with a ratio 500-250/1 Amps of Class-I accuracy*.
1 No.	6 way voltmeter selector switch/ MFM Inbuilt
3 Nos.	Pilot indicating lamps for incoming supply
3 Nos.	Fuses for above lamps
1 Set	'TPN' electrolytic aluminum bus bars, 500 Amps rating of suitable size supported on non-hygroscopic SRBP supports.
1 Set	Cable glands and cable supports
1 Set	Circuit designation label.
1 Set	Earth Bus 3 x 25mm copper
1 Set	Name plates for all the equipment mounted on panel (front side and inside)

* CT details as per S.L.D.

1 Set	Cubicle illumination consisting 60 watt incandescent lamp with door controlled switch.
1 Set	Terminal block/containing terminals for outgoing circuits.
1 Set	Cable lugs.
1 Set	15A/ 5A/ 2A plug socket with ON/OFF switch.
2 Nos.	250A outgoing circuits to AC Distribution Board and Lighting Board each consisting of:
1 No.	250 A 'TPN' Switch
3 Nos.	250 A 'HRC' fuses

1 No. AC Distribution Board (ACDB-2A)

1 No.	800 A Incoming circuit from main AC Distribution Board consisting of:
3 Nos.	800 A 20 kA ACB
3Nos.	250 A 'HRC' fuses , if applicable
2 Nos.	100A Outgoing Circuit to Battery and Battery charger and Emergency lighting Board consisting of:
1 No. *	100 A 'TPN' Switch
3Nos. *	100 A 'HRC' fuses
10 Nos.	Outgoing circuits from AC Distribution Board each consisting of:
1 No. *	63 A 'TPN' switch
3 Nos. *	63 A 'HRC' fuses.
2 Nos.	96 Sq.mm flush mounted Multifunction Panel Meter (with RS-485 communication port with Modbus Protocol and LED display) having suitable ampere range & Voltage Range suitable for 3Phase, 4 wire measurement. The meter shall have keypad for current selection of various phases. The meter shall have keypad for voltage selection of Phase to phase and Phase to neutral measurements.
3 Nos.	Pilot indicating lamps/LED for incoming supply
3 Nos.	Fuses for above lamps
1 Set	Cable glands and cable supports
1 Set	Circuit designation label.
1 Set	Earth Bus 3 x 25mm copper
1 Set	Name plates for all the equipment mounted on panel (front side and inside)
1 Set	Cubicle illumination consisting 60 watt incandescent lamp with door
* Refer S.L.D for details	

	controlled switch.
1 Set	Terminal block/containing terminals for outgoing circuits.
1 Set	Cable lugs.
1 Set	15A/ 5A/ 2A plug socket with ON/OFF switch.
1 No.	DG Incomer Bus with Bus Coupler arrangement as per enclosed S.L.D. at Annexure- B

1 No AC Lighting Board (MLDB-3A)

1 No.	250A Incoming circuit from main AC Distribution Board consisting of:
2 Nos.	250 A 20 kA moulded case circuit breaker TPN
3 Nos.	250 A 'HRC' fuses , if applicable
6 Nos. *	63 A Outgoing circuits from AC Lighting Board each consisting of:
1 No. *	63 A 'TPN' switch
3 Nos. *	63 A 'HRC' fuses.
4 Nos. *	32 A Outgoing circuits from AC Lighting Board
1 No. *	32 A 'TPN' switch
3 Nos. *	32 A 'HRC' fuses.
2 Nos.	96 Sq.mm flush mounted Multifunction Panel Meter (with RS-485 communication port with Modbus Protocol and LED display) having suitable ampere range & Voltage Rangesuitable for 3Phase, 4 wire measurement. The meter shall have keypad for current selection of various phases. The meter shall have keypad for voltage selection of Phase to phase and Phase to neutral measurements.
3 No.	Pilot indicating lamps/LED for incoming supply
3 No.	Fuses for above lamps
1 Set	Cable glands and cable supports
1 Set	Circuit designation label.
1 Set	Earth Bus 3 x 25mm copper
1 Set	Name plates for all the equipment mounted on panel (front side and inside)
1 Set	Cubicle illumination consisting 60 watt incandescent lamp with door controlled switch.
1 Set	Terminal block/containing terminals for outgoing circuits.

* Refer S.L.D for details

- 1 Set Cable lugs.
- 1 Set 15 A/ 5 A/ 2A plug socket with ON/OFF switch.



1 Set AC Emergency Lighting Board (ELDB-5A)

- 1 No. 200A incoming circuit from main AC Distribution Board consisting of:
- 1 No. 200A 'TPN' MCCB
- 3 Nos. 100A 'HRC' Fuses , if applicable
- 4 Nos.* Outgoing circuits from AC Lighting Board
- 1 No. * 32 A 'TPN' switch
- 3 Nos. 32 A 'HRC' fuses.
- 1 No. 96 Sq.mm flush mounted Multifunction Panel Meter (with RS-485 communication port with Modbus Protocol and LED display) having suitable ampere range & Voltage Range suitable for 3Phase, 4 wire measurement. The meter shall have keypad for current selection of various phases. The meter shall have keypad for voltage selection of Phase to phase and Phase to neutral measurements.
- 1 No. 5 position R-Y-B-N off ammeter selector switch. / Inbuilt MFM
- 1 No. 6 way voltmeter selector switch / Inbuilt MFM 3
- 3 Nos. Pilot indicating lamps for incoming supply
- 3 Nos. Fuses for above lamps
- 1 Set Cable glands and cable supports
- 1 Set Circuit designation label.
- 1 Set Earth Bus 3 x 25mm copper
- 1 Set Name plates for all the equipment mounted on panel (front side and inside)
- 1 Set Cubicle illumination consisting 60 watt incandescent lamp with door controlled switch.
- 1 Set Terminal block/containing terminals for outgoing circuits.
- 1 Set Cable lugs.
- 1 Set 15A/ 5A/ 2A plug socket with ON/OFF switch.

* Refer S.L.D. for details

DC Distribution Boards:**220V DC System:**

1. The D.C. Distribution boards shall be provided with 2Nos. busbars of electrolytic copper of adequate capacity duly tinned supported by bus-bar supporters.
2. These bus-bars will be connected to **220V D.C.** 2 wire systems consisting of **220V**, 1000AH batteries or battery charger rated for **220V D.C.** output.
3. The D.C. distribution boards required under this specification are to feed control circuits, and other auxiliary DC equipment of the Substations.
4. The D.C. distribution boards shall be of rugged construction, designed for working satisfactorily under the severest operating and climatic conditions and shall conform to the relevant ISS of latest issue.
5. The D.C. distribution boards shall be complete with all accessories and fittings necessary for the efficient and satisfactory operation whether they are specifically mentioned or not in the specification. The D.C. distribution boards shall be provided with the necessary reputed make switches, fuses, in the incoming and outgoing circuits and the equipment offered shall be complete in itself.
6. The typical arrangement of DC distribution board is give below:

1 No. DC Distribution Board

- | | |
|-----------|--|
| 1 No. | 400A Incoming Circuit from Battery and Battery charger consisting of: |
| 1 No. * | 100 A Double Pole Switch |
| 2 Nos. * | 100 A fuses , if applicable |
| 20 Nos. * | 10A Outgoing feeders consisting of |
| 1 No. * | 10 A Double pole Switch |
| 2 Nos. * | 10 A fuses. |
| 40A/32A * | Outgoing feeders consisting of |
| 40A/32A * | Double pole Switch |
| 2 Nos. * | 32 A fuses. |
| 1 No. | DC Digital Panel Ammeter of suitable rating (If digital panel meter is not communicable on RS-485, Modubus RTU , a separate suitable analog transducer shall be provided for connecting to analog input of Bay Control Units .) |
| 1 No. | Digital Voltmeter of suitable rating selector switch (If digital panel meter is not communicable on RS-485, Modubus RTU , a separate suitable analog transducer shall be provided for connecting to analog input of Bay Control Units .) |

* Refer S.L.D. for details

1 No.	Instantaneous under voltage relay
1 No.	Instantaneous over voltage relay
1 No.	Earth leakage relays
2 Nos.	Indicating Lamps/LED

48V DC System (D.C. Distribution/ Switching Cubicle)

1. Switching arrangement should be essentially provided for:
 - a) Termination of Communication equipment loads.
 - b) Termination of 48V stationery battery/ SMF Batteries.
2.
 - a) Adequately rated, insulated copper bus bars should be provided for charging bus and load bus.
 - b) Switch is to be provided to isolate the battery from the charging bus.
 - c) Suitable cable glands are to be provided for all the external cables.
 - d) * 12 Nos. of 6A MCB's in negative potential line, feeding various DC loads are to be provided. The positive wires are to be brought to a common terminal.
 - e) * 4 Nos. of 230V/AC 6A single phase outputs with MCB protection in each circuit to be provided.
 - f) Both the chargers are generally in ON condition with one of the chargers feeding the load. Battery is always floated across the charging bus load & battery should be transferred to the hot stand by unit automatically without any break of DC supply even for milliseconds.

The details of construction, the components, the erection, testing and commissioning procedures are given here under. The equipment shall conform to these specifications unless otherwise mentioned in the requirements.

6.1 CONSTRUCTIONAL DETAILS OF SWITCH BOARD AND DISTRIBUTION BOARDS

- 6.1.1 All boards shall be of metal enclosed, indoor floor mounted, compartmentalized double front construction and free standing type.
- 6.1.2 All board frames, shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness not less than **2.0 mm**. Frames shall be enclosed in cold-rolled sheet steel of thickness not less than 1.6mm. Doors and covers shall also be of cold rolled sheet steel of thickness not less than **1.6 mm**. Stiffeners shall be provided wherever necessary.
- 6.1.3 All panel edges and cover/door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members.

* Refer S.L.D. for details

- 6.1.4 The complete structures shall be rigid, self-supporting free from flaws, twists and bends. All cut-outs be true in shape and devoid of sharp edges.
- 6.1.5 All boards shall be of dust and vermin proof construction and shall be provided with a degree of protection of IP:42 as per IS 2147. Provision shall be made in all compartments for providing IP:42 degree of protection, when Circuit breaker or module trolley, has been removed. All cut-outs shall be provided with neoprene/Synthetic rubber gaskets.
- 6.1.6 Provision of louvers on boards would not be preferred. However, louvers backed with metal screen are acceptable on the busbar chambers where continuous busbar rating exceeds 1000 Amps.
- 6.1.7 **All boards shall be uniform height not exceeding 2450 mm.**
- 6.1.8 Boards shall be easily extendible on both sides, by the addition of the vertical sections after removing the end covers.
- 6.1.9 Boards shall be supplied with base frames made of structural steel sections, alongwith all necessary mounting hardware required for welding the base frames to the insert plates.
- 6.1.10 All boards shall be divided into distinct vertical sections, each comprising of :
- i) A completely enclosed busbar compartment for running horizontal and vertical busbars. Busbar chamber shall be completely enclosed with metallic portions. Bolted covers shall be provided for access to horizontal and Vertical bus bars and all joints for repair maintenance, which shall be feasible without disturbing feeder compartment.
 - ii) Completely enclosed switchgear compartment(s) one for each circuit for housing circuit breaker or MCCB or motor starter.
 - iii) A compartment or alley for power and control cables. Cable alley door shall preferably be hinged. Cable alley shall have no exposed live parts, and shall have no communication with busbar chamber. It shall be of atleast 350mm width.
 - iv) A compartment for relays and other control devices associated with a circuit breaker.
- 6.1.11 Sheet steel barriers shall be provided between two adjacent vertical panels running to the full height of the switchboard, except for the horizontal busbar compartment. Each shipping section shall have full metal sheets at both ends for transport and storage.
- 6.1.12 All equipments associated with a single circuit except MCB circuits shall be housed in a separate compartment of the vertical section. The Compartment shall be sheet steel enclosed on all sides with the withdrawal units in position or removed. The front of the compartment shall be provided with the hinged single leaf door, with locking facilities.

The main switch shall be operable from outside and will be interlocked with the compartment door such that the latter can be opened only when the switch is off. However, it shall be possible to defeat this interlock and open and close the door with the switch ON. The main switch shall have the facility of being pad-locked in both ON and OFF positions. The switch handle shall clearly indicate the position of main switch.

- 6.1.13 After isolation of power and control circuit connections it shall be possible to safely carryout maintenance in a compartment with the busbar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose over the cable terminations located in cable alley.
- 6.1.14 The minimum clearance in air between phases and between phase and earth for the entire run of horizontal and vertical busbars, shall be 25mm. For all other components, the clearance between “two live parts”, “A live part and an earthed part” and isolating distance shall be atleast ten (10) mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by sleeving or barriers. However, for horizontal run of busbar minimum clearance of 25mm should be maintained even if they are sleeved.
- 6.1.15 The temperature rise of horizontal & vertical busbars when carrying rated current along its full run shall in no case exceed 55⁰C, with silver plated joints and 40⁰C with all other type of joints over an outside ambient temperature of 50⁰C.
- ~~6.1.16 All single front boards shall be provided with removable bolted covers at the rear. The covers shall be provided with danger labels.~~
- 6.1.17 All identical circuit breakers and module chassis of same test size shall be fully interchangeable without having to carryout modifications.
- 6.1.18 All Circuit breaker boards shall be of Single Front type, with fully drawout circuit breakers, which can be drawn out without having to unscrew any connections. The circuit breakers shall be mounted on rollers and guides for smooth movement between SERVICE, TEST and ISOLATED positions and for withdrawal from the Switchboard. Testing of the breaker shall be possible in the TEST position.
- 6.1.19 Wherever two breaker compartments are provided in the same vertical section, insulating barriers and shrouds shall be provided in the rear cable compartment to avoid accidental touch with the live parts of one circuit when working on the other circuit.
- 6.1.20 All disconnecting contacts for power circuits shall be of robust design and fully self aligning. Fixed and moving contacts of the power drawout contact system shall be silver plated. Both fixed and moving contacts shall be replaceable.
- 6.1.21 All AC & DC boards shall be of double Front type.

- 6.1.22 AC & DC Distribution Boards shall be divided into vertical sections. Each vertical section shall be provided with a cable alley, which shall cover the entire height and shall be atleast 35mm width.
- 6.1.23 All module shall be fixed type except air circuit breaker module, which shall be drawout type.
- 6.1.24 The connections from busbars to the main switch shall be fully insulated/shrouded, and securely bolted. The partition between the feeder compartment and cable alley may be non-metallic and shall be such construction as to allow cable cores with lugs to be easily inserted in the feeder compartment for termination.
- 6.1.25 All equipment and components shall be neatly arrangement and shall be easily accessible for operation and maintenance. The internal layout of all modules shall be subject to PURCHASER approval. Bidder shall submit dimensional drawings showing complete internal details of Busbars and module components for each type and rating for approval.
- 6.1.26 The tentative power and control cable entries shall be from bottom. However, Purchaser reserves the right to alter the cable entries, if required, during detailed engineering, without any additional commercial implications.
- 6.1.27 Adaptor panels and dummy panels required to meet the various busbar arrangements and layouts required shall be included in Bidder's scope of work.
- 6.1.28 All sheet work shall be pre-treated, in tanks, in accordance with IS:6005. Degreasing shall be done by alkaline cleaning. Rust and scale shall be removed by pickling with acid. After pickling the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall 'Class-C' as specified in IS:6005. The phosphated surfaces shall be rinsed and passivated prior to application of stoved lead oxide primer coating after primer application, two coats of finishing synthetic enamel paint on panels shall be applied, Electrostatic painting shall also be acceptable.
- 6.1.29 Finishing paint on panels shall be **shade 631 of IS:5** unless required otherwise by the PURCHASER. The inside shall be properly stoved. The paint thickness shall be coated by peelable compound by spraying method to protect the finished surfaces from scratches grease dirt and oily spots during testing, transportation, handling and erection.

6.2 DERATING OF EQUIPMENTS

- 6.2.1 The current ratings of all equipments as specified in the 'Bill of Materials are the minimum standards current ratings at a reference ambient temperature of 50⁰ C as per relevant Indian Standards.

- 6.2.2 The Bidder shall indicate clearly the derating factors employed for each component and furnish the basis for arriving at these derating duly considering the specified ambient temperature of 50⁰ C.

6.3 POWER BUS BARS AND INSULATORS

- 6.3.1 All AC Distribution Boards shall be provided with three phase buses and a neutral bus bars and the DC Distribution Boards shall be provided with two busbars.
- 6.3.2 Busbars and jumper connections shall be high conductivity aluminium/copper of adequate size the bus bar size calculations shall be submitted for approval.
- 6.3.3 The Cross-Section of the busbars shall be uniform through out the length of Switchgear and shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents.
- 6.3.4 All busbars shall be adequately supported by Non-hygroscopic, non-combustible, track resistant & high strength type Polyester fibre glass Moulded Insulators. Separate supports shall be provided for each phase and neutral busbar. If a busbar support is provided anti-tracking barriers shall be provided between the supports.
- 6.3.5 All busbars joints shall be provided with high tensile steel bolts. Belleville/spring washers and nuts, so as to ensure good contacts at the joints. Non-silver plated Busbars joints shall be thoroughly cleaned at the joint locations and suitable contact grease shall be applied just before making a joint.
- 6.3.6 All busbars shall be colour coded as per IS:375.
- 6.3.7 The Bidder shall furnish calculations alongwith the bid, establishing the adequacy of busbar sizes for specified current ratings, on the basis of short circuit current and temperature rise consideration at specified ambient temp.

6.4 EARTH BUS

- 6.4.1 A galvanised steel earthing shall be provided at the bottom of each panel and shall extend throughout the length of each switchboard. It shall be welded/bolted to the frame work of each panel and breaker earthing contact bar vertical bus shall be provided in each vertical section which shall in turn be bolted/welded to main horizontal ground bus.
- 6.4.2 The earth bus shall have sufficient cross-section to carry the momentary short circuit and short time fault currents to earth as indicated in 'Bill of Material's without exceeding the allowable temperature rise.
- 6.4.3 Suitable arrangements shall be provided at each end of the horizontal earth bus for bolting to Purchaser's earthing conductors. The horizontal earth bus shall project out the switchboard ends and shall have predrilled holes for this

connection. A joint spaced and taps to earth bus shall be made through at least two bolts.

- 6.4.4 All non-current metal work of the Switchboard shall be effectively bonded to the earth bus. Electrical conductivity of the whole switchgear enclosures frame work and the truck shall be maintained even after painting.
- 6.4.5 The truck and breaker frame shall get earthed while the truck is being inserted in the panel and positive earthing of the truck and breaker frame shall be maintained in all positions. SERVICE & ISOLATED, as well as through out the intermediate travel.
- 6.4.6 Each module frame shall get engaged to the vertical earth bus, before the disconnecting contacts on these module are engaged to the vertical busbar.
- 6.4.7 All metallic cases of relays, instruments and other panel mounted equipments shall be connected to earth by independent standard copper wires of size not less than 2.5mm^2 . Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connections and soldering is not acceptable. Looping of earth connections which would result in loss of earth connection to the devices when a device is removed is not acceptable. However, looping of earth connections between equipment to provide alternative paths or earth bus is acceptable.
- 6.4.8 VT and CT secondary neutral point earthing shall be at one place only, on the terminal block. Such earthing shall be made through links so that earthing on one secondary circuit shall be removed without disturbing the earthing of other circuit.
- 6.4.9 All hinged doors shall be earthed through flexible earthing braid.
- 6.4.10 Caution nameplate 'Caution-Live Terminals' shall be provided at all points where the terminals are like to remain live and isolation is possible only at remote end.

6.5 AIR CIRCUIT BREAKERS

- 6.5.1 Circuit breakers shall be three-pole air break horizontal drawout type and shall have inherent fault making and breaking capacities as specified in "Technical Parameters". The circuit breakers which meet specified parameter only after provision of releases or any other devices shall not be acceptable.
- 6.5.2 Circuit breakers shall be mounted along with operating mechanism on a wheeled carriage. Suitable guides shall be provided to minimise misalignment of the breaker.
- 6.5.3 There shall be 'Service', 'Test' and 'Fully withdrawn positions for the breakers. In "Test" position the circuit breaker shall be capable of being tested for operation without energizing the power circuits i.e. the power contacts shall be disconnected while Control circuits shall remain undisturbed. Locking facilities shall be provided so as to prevent movement of the circuit breaker

from the 'SERVICE', 'TEST' or FULLY WITHDRAWN' position. It shall be possible to close the door in TEST position.

- 6.5.4 All circuit breakers shall be provided with 4 NO and 4 NC potential free auxiliary contacts. These contacts shall be addition to those required for internal mechanism of the breaker. Separate limit switches each having required number of contacts shall be provided in both 'SERVICE & 'TEST' position of the breaker. All contacts shall be rated for making continuously carrying and breaking 10 Amps at 240V AC and 1 Amp (Inductive) at 220V DC.
- 6.5.5 Suitable mechanical indications shall be provided on all circuit breakers to show 'OPEN', 'CLOSE', 'SERVICE', TEST' and 'SPRING CHARGED' positions.
- 6.5.6 Main poles of the circuit breakers shall operate simultaneously in such a way that the maximum difference between the instants of contacts touching during closing shall not exceed half cycle of rated frequency.
- 6.5.7 All circuit breakers shall be provided with the interlocks as explained in further clauses.
- 6.5.8 Movement of a circuit breaker between SERVICE AND TEST positions shall not be possible unless it is OPEN position. Attempted with drawl of a closed circuit breaker shall trip the circuit breaker.
- 6.5.9 Closing of a circuit breaker shall not be possible unless it is in SERVICE, TEST POSITION or in FULLY WITHDRAWN POSITION.
- 6.5.10 Circuit breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage to cover the stationery isolated contacts when the breaker is withdrawn. It shall however, be possible to open the shutters intentionally, against spring pressure for testing purpose.
- 6.5.11 A breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.
- 6.5.12 Circuit breakers shall be provided with electrical anti-pumping and trip feature, even if mechanical antipumping feature is provided.
- 6.5.13 Mechanical tripping shall be possible by means of front mounted RED 'TRIP' push-button. In case of electrically operated breakers these push buttons shall be shrouded to prevent accidental operation.
- 6.5.14 Breaker controlled motors shall operate satisfactorily under the following conditions :-
- i) Direct on-line starting of Induction Motors rated 110 kW to 220 kW with a locked rotor current of seven times the rated current, and starting time of up to 30 seconds.

- ii) Breaking on-load, full load and locked motor currents of Induction Motors for rated 110 kW to 220 kW.
- 6.5.15 Means shall be provided to slowly close the circuit breaker in withdrawn position. If required for inspection and setting of Contacts, in service position slow closing shall not be possible.
- 6.5.16 Power operated mechanism shall be provided with a universal motor suitable for operation **220V DC** Control supply with voltage variation from 90% to 110% rated voltage. Motor insulation shall be class 'E' or better.
- 6.5.17 The motor shall be such that it requires not more than 30 seconds for fully charging the closing spring.
- 6.5.18 Once the closing springs are discharged, after the one closing operation of circuit breaker, it shall automatically initiate, recharging of the spring.
- 6.5.19 The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply at least one open-close open operation shall be possible.
- 6.5.20 Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically get mechanically decoupled.
- 6.5.21 All circuit breakers shall be provided with closing and trip coils. The closing coils shall operate correctly at all values of Voltage between 85% to 110% of rated control voltage. The trip coil shall operate satisfactorily under all values of supply voltage between 70% to 110% of rated control voltage.
- 6.5.22 Provision for mechanical closing of the breaker only in 'TEST' and 'WITHDRAWN' positions shall be made.

6.6 PROTECTION CO-ORDINATION

- 6.6.1 It shall be the responsibility of the Contractor to fully co-ordinate the overload and short circuit tripping of the circuit breakers with the upstream and down stream circuit breakers/fuses/motor starters, to provide satisfactory discrimination.

6.7 MOULDED CASE CIRCUIT BREAKER (MCCB) and MCB

- 6.7.1 MCCB shall in general conform to IS:13947 Part-2, All MCCB shall be P2 duty.
- 6.7.2 MCCB shall be flush mounted on the AC/DC distribution boards.
- 6.7.3 MCCBs shall be provided with thermo-magnetic type release for over current and short circuit protection. The setting of the thermal release shall be adjustable between 75% to 100% of the rated current. The MCCB shall have

breaking capacity not less than **20kA**. The magnetic release setting shall be adjustable between 300% to 600% of the thermal release setting at site.

- 6.7.4 MCCBs in AC application shall also be provided with under voltage release with time delay. MCCBs shall also have 2 NO and 2 NC auxiliary contact either built-in or using auxiliary switch for purchaser's use.
- 6.7.5 MCCBs used for ACDB incomers and Bus coupler shall be equipped with stored energy mechanism for electrical closing and tripping.
- 6.7.6 MCCBs shall be manually operated. The operating handle should give a clear trip indication.
- 6.7.7 Miniature circuit breaker (MCB) shall conform to IEC:898-1998 and IS:8828.

6.8 RELAYS

- 6.8.1 All relays and timers in protective circuits shall be flush mounted on panel front with connections from the inside. They shall have transparent dust tight covers removable from the front. All protective relays shall have a drawout construction for easy replacement from the front. They shall either have built-up test facilities, or shall be provided with necessary test blocks and test switches located immediately below each relay. The auxiliary relays and timers may be furnished in non-drawout cases.
- 6.8.2 All AC relays shall be suitable for operation, at 50 Hz with 110 Volts VT secondary and 1 amp or 5 amp CT secondary.
- 6.8.3 All protective relays and timers shall have at least two potentially free output contacts. Relays shall have contacts as required for protection schemes. Contacts of relays and timers shall be silver faced and shall have a spring action. Adequate number of terminals shall be available on the relay cases for applicable relaying schemes.
- 6.8.4 All protective relays auxiliary relays and timers shall be provided with hand reset operation indicators (flags) and analysing the cause of operation.
- 6.8.5 All relays shall withstand a test voltage of **2 kV (rms) for one minute**.
- 6.8.6 Motor starters shall be provided with three element, ambient temperature compensated, time lagged, hand reset type overload relays with adjustable settings. The setting ranges shall be properly selected to suit the motor ratings. These relays shall have a separate black coloured hand reset push button mounted on compartment door and shall have at least one changeover contact.
- 6.8.7 All fuse-protected contactors-controlled motors shall have phasing protection, either as a distinct feature in the overload relays (by differential movement of bimetallic strips), or as a separate device. The single phasing protection shall operate even with 80% of the set current flowing in two of the phases.

6.9 CONTACTORS

- 6.9.1 Motor starter contactors shall be air break, electromagnetic type rated for uninterrupted duty as per IS:13947 (Part 4).
- 6.9.2 Contactors shall be **double break, non-gravity type and their main contacts shall be silver faced.**
- 6.9.3 Direct on line starter contactors shall be utilisation category AC2. These contactors shall be as IS:13947 (Part 4).
- 6.9.4 Each contactor shall be provided with two (2) normally open (NO) and two (2) normally close (NC) auxiliary contacts.
- 6.9.5 Operating coils of contactors shall be of 240V AC Unless otherwise specified elsewhere. The Contactors shall operate satisfactorily between 85% to 110% of the rated voltage. The Contactor shall drop out at 70% of the rated voltage.

6.10 INSTRUMENT TRANSFORMERS

- 6.10.1 All current and voltage transformers shall be completely encapsulated cast resin insulated type suitable for continuous operation at the temperature prevailing inside the switchgear enclosure, when the switchgear is operating at its rated condition and the outside ambient temperature is 50° C.
- 6.10.2 All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit and momentary current ratings of the associated switchgear.
- 6.10.3 All instrument transformer shall have clear indelible polarity markings. All secondary terminals shall be wired to a separate terminal on an accessible terminal block where star-point formation and earthing shall be done.
- 6.10.4 Current transformers may be multi or single core type. All voltage transformers shall be single phase type. The bus VTs shall be housed in a separate compartment.
- 6.10.5 All VTs shall have readily accessible HRC current limiting fuses on both primary and secondary sides.

6.11 INDICATING INSTRUMENTS

- 6.11.1 All indicating and integrating meters shall be flush mounted on panel front. The instruments shall be of at least 96 mm square size with 90 degree scales, and shall have an **accuracy class of 1.0 or better.** The covers and cases of instrument and meters shall provide a dust and vermin proof construction.
- 6.11.2 All instruments shall be compensated for temperature errors and factory calibrated to directly read the primary quantities.
- 6.11.3 The specification of Multifunction Panel Meter (MFM) shall be as under:
- i) It shall be able to do measurement for 3-Phase, 4- Wire unbalanced loads.
 - ii) It shall be of 1.0 or better class accuracy and shall be able to measure

following parameters mentioned below:-

- Phase to Phase and Phase to Neutral Voltages
- Phase Currents
- Neutral Current
- Frequency
- Power Factor
- Reactive Power
- Active Power
- Apparent Power
- Per Phase: kW, KV AR, KV A, PF
- Total Harmonic Distortion of Voltage and Currents
- Import/ Export (MWh, MVarh) & MVAh
- Max/Min Voltages, Currents
- Max MW/MVA

iii) Input Requirements:

- a) Voltage:
 - Input: 500 V (P-P) and 280 V (P-N)
 - Burden: <0.15VA
- b) Current:
 - Range: 1 A or 5A
 - Continuous: 1A CT: 3A
5A CT: 12A
 - Surge with-stand: 1A CT: 80A for 1 Sec.
5A CT: 200A for I Sec.

- iv) The device shall be able to accommodate the ratios of installed CT/PT as provided in the respective panels/boards.
- v) The device shall have the communication port **RS-232/ RS-485** having **Modbus Protocol** or any other open protocol for communication with Substation Automation System.
- vi) Power Supply: **AC/DC 220-230V**
- vii) The device shall conform to ISO/IEC/UL/CE/ANSI, standard/quality norms for Electrostatic Discharge, Radio Frequency Inteferece, Electrical Fast. Transients, Surge withstand Capability, Electromagnetic Interference etc, so that it shall perform satisfactorily in Electrically hostile environment of EHV substations.

6.11.4 Multifunction Meter Current range shall be suitable to handle the starting currents on Motor feeders.

6.12 CONTROL & SELECTOR SWITCHES

- 6.12.1 Control & Selector switches shall be of rotary type with escutcheon plates clearly marked to show the function and positions. The switches shall be of sturdy construction suitable for mounting on panel front. Switches with shrouding of live parts and sealing of contacts against dust ingress be preferred.
- 6.12.2 Circuit breaker selector switches for breaker controlled motor shall have three stay put positions marked 'Switchgear', 'Normal' and 'Trial' respectively. They shall have two contacts of each of the three positions and shall have black shade handles.
- 6.12.3 Ammeter and voltmeter selector switches shall have four stay put position with adequate number of contacts for three phase 4 wire system. These shall have oval handles Ammeter selector switches shall have make before break type contacts to prevent open circuiting of CT secondaries.
- 6.12.4 Contacts of the switches shall be spring assisted and shall be of suitable material to give a long trouble free service.
- 6.12.5 The contact ratings shall be at least the following :
- | | | |
|------|-----------------------------|---------------------------|
| i) | Make and carry continuously | 10 Amp. |
| ii) | Breaking current at 220V DC | 1 Amp (Inductive) |
| iii) | Breaking current at 240V DC | 5 Amp (at 0.3 pf lagging) |

6.13 AIR BREAK SWITCHES

- 6.13.1 Air breaker switch shall be of the heavy duty, single throw group operated, load break, fault make type complying with IS:4064.
- 6.13.2 The Bidder shall ensure that all switches are adequately rated so as to be fully protected by the associated fuses during al abnormal operating conditions such as overload, locked motor, short circuit etc.
- 6.13.3 Switch operating handles shall be provided with padlocking facilities to lock them in 'OFF' position.
- 6.13.4 Interlocks shall be provided such that it is possible to open the cubicle door only when the switch is in 'OFF' position and to close the switch only when the door is closed. However suitable means shall be provided to intentionally defeat the interlocks explained above.
- 6.23.5 Switches and fuses for AC/DC control supply and heater supply wherever required shall be mounted inside and cubicles.

6.14 PUSH BUTTONS

- 6.14.1 Push-buttons shall be of spring return, push to actuate type. Their contacts shall be rated to make, continuously carry and break 10A at 240V and 0.5A (inductive) at 220V DC.

- 6.14.2 All push-buttons shall have one normally open and one normally closed contact, unless specified otherwise. The contact faces shall be of silver or silver alloy.
- 6.14.3 All push-buttons shall be provided with integral escutcheon plates marked with its function.
- 6.14.4 The colour of the button shall be as follows :-
- i) GREEN : For motor START, Breaker CLOSE
 - ii) RED : For motor TRIP, Breaker OPEN
 - iii) BLACK : For overload reset
- 6.14.5 All push-buttons on panels shall be located in such a way that Red-push-buttons shall always be to the left of green push-buttons.
- 6.15 INDICATING LAMPS/LED**
- 6.15.1 Indicating lamps shall be of the panel mounting cluster LED / filament type and low watt consumption. Lamps shall be provided with series resistor, preferably built-in the lamps assembly. The lamps shall have escutcheon plates marked with its function, wherever necessary.
- 6.15.2 Lamps shall have translucent lamp-covers of the following colours, as warranted by the application :
- i) RED : For motor ON, Breaker CLOSED
 - ii) GREEN : For motor OFF, Breaker OPEN
 - iii) WHITE : For motor Auto-trip
 - iv) BLUE : For all healthy conditions (e.g. control supply, and also for ‘SPRING CHARGED’)
 - v) AMBER : For all alarm conditions (e.g. overload) Also for ‘SERVICE’ and ‘TEST’ positions indicators.
- 6.15.3 Bulbs and Lamps-covers shall be easily replaceable from the front of the cubicle.
- 6.15.4 Indication lamps should be located just above the associated push buttons/control switches. Red Lamps shall invariable be located to the right of green lamps. In case a white lamp is also provided, it shall be placed between the red and green lamps along with the centre line of control switch/push button pair. Blue and Amber lamps should normally be located above the Red and Green Lamps.
- 6.15.5 When associated with push-buttons, red lamps shall be directly above the green push button, and green lamps shall be directly above the red push-button. All indicating lamps shall be suitable for continuous operation at 90 to 110% of their rated voltage.

6.16 FUSES

- 6.16.1 All fuses shall be of HRC cartridge fuse link type. Screw type fuses shall not be accepted. Fuses for AC Circuits shall be of class 2 type, 20 kA (RMS) breaking current at 415 AC, and for DC circuits Class 1 type 5 kA breaking current.
- 6.16.2 Fuses shall have visible operation indicators.
- 6.16.3 Fuses shall be mounted on fuses carriers, which are mounted on fuse bases, wherever it is not possible to mount fuses on carriers fuses shall be directly mounted on plug in type of bases, In such cases one set of insulated fuse pulling handles shall be supplied with each switchgear.
- 6.16.4 Fuse rating shall be chosen by the Bidder depending upon the circuit requirements and these shall be subject to approval of PURCHASER.

6.17 TERMINAL BLOCKS

- 6.17.1 Terminal blocks shall be of 1100 volts grade and have continuous rating to carry the maximum expected current on the terminals. It shall be complete with insulating barriers, clip-on-type/stud type terminals for Control Cables and identification strips. Marking on terminal strip shall correspond to the terminal numbering on wiring on diagrams. It shall be similar to 'ELEMEX' standard type terminals, cage clamp type of Phoenix or WAGO or equivalent.
- 6.17.2 Terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall be provided distributed on all terminal circuiting and earthing facilities. It shall be similar to 'Elem', 'CATD' – Type.
- 6.17.3 In all circuit breaker panels at least 10% spare terminals for external connections shall be provided and these spare terminals shall be uniformly distributed on all terminal blocks. Space for adding another 10% spare terminals shall also be available.
- 6.17.4 All terminals blocks shall be suitable for terminating on each side, two (2) nos. of 2.5 mm square size standard copper conductors.
- 6.17.5 All terminals shall be numbered for identification and grouped according to the function. Engraved white-on-black labels shall be provided on the terminal blocks.
- 6.17.6 Wherever duplication of a terminal block is necessary it shall be achieved by solid bonding links.
- 6.17.7 Terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal block. The minimum clearance between the first row of terminal block and the associated cable gland plate shall be 250 mm.

6.18 NAME PLATES AND LABELS

- 6.18.1 All switchgears AC/DC distribution boards shall be provided with prominent, engraved identification plates. The module identification plate shall clearly give the feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.
- 6.18.2 All name plates shall be of non-rusting metal or 3-ply lamicoid with white engraved lettering on black back ground. Inscriptions and lettering sizes shall be subject to PURCHASER approval.
- 6.18.3 Suitable plastic sticker labels shall be provided for easy identification of all equipments, located inside the panel/module. These labels shall be positioned so as to be clearly inside visible and shall give the device number as mentioned in the module wiring drawings.

6.19 SPACE HEATER

- 6.19.1 Space heater shall be provided in all the boards for preventing harmful moisture condensation.
- 6.19.2 The space heaters shall be suitable for continuous operation on 240V, AC, 50 Hz, single phase supply, and shall be automatically controlled by thermostats. Necessary isolating switches and fuses shall also be provided.

6.20 CONTROL AND SECONDARY WIRING

- 6.20.1 All switchboards shall be supplied completely wired internally upto the terminal blocks ready to receive Purchaser's control cables.
- 6.20.2 All inter cubicle and inter panel wiring and connections between panels of same switchboard including all bus wiring for AC and DC supplies shall be provided by the bidder.
- 6.20.3 All internal wiring shall be carried out with **1100V grade, single core, 1.5 sq. mm or larger stranded copper wires** having colour coded, PVC insulation. CT circuits shall be wired with **2.5 sq. mm copper wires**. Voltages and insulation shall be same as above.
- 6.20.4 Extra-flexible wires shall be used for wiring to device mounted on moving parts such as hinged doors.
- 6.20.5 All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminals blocks.

6.21 POWER CABLES TERMINATION

- 6.21.1 Cable termination compartment and arrangement for power cables shall be suitable for stranded aluminium conductor, armoured **XLPE/PVC** insulated and sheathed, single core/three core, 1100V grade cables.

- 6.21.2 All necessary cable terminating accessories such as Gland plates, supporting clamps and brackets, power cable lugs, hardware etc., shall be provided by successful bidder, to suit the final cable sizes which would be advised later.
- 6.21.3 The gland plate shall be removable type and shall cover the entire cable alley. Bidder shall also ensure that sufficient space is provided for all cable glands. Gland plates shall be factory-drilled according to the cable gland sizes and number which shall be informed to the Contractor later. For all single core cables, gland plates shall be of non-magnetic Material.

6.22 TYPE TESTS

- 6.22.1 Type test reports of Panels (Switchgear and Control gear assemblies) as per IS 8623 Part-I shall be submitted for the following tests before the fabrication of switchgear is started :

- i) Verification of temperature rise limits
- ii) Verification of the dielectric properties
- iii) Verification of short circuit strength
- iv) Verification of the continuity of the protective circuit
- v) Verification of clearances and creepage distances
- vi) Verification of mechanical operation
- vii) Verification of degree of protection

- 6.22.2 Contractor shall submit type test reports for the following Switchgear and Control gears before the fabrication of switchgear is started :

- 1. Circuit Breakers / MCCB as per IS 13947 Part-II
- 2. Protective Relays as per IEC:60255
- 3. Busbar and Panels, Contactors, Instrument Transformers, meters, Isolating switches and fuses etc.

The reports shall cover all applicable type tests listed in relevant Indian Standards for all component for each type and ratings being supplied.

6.23 ERECTION, TESTING AND COMMISSIONING

- 6.23.1 Supervision of Erection, testing and commissioning is in bidder's scope.
- 6.23.2 Equipment shall be installed in a neat, workman like manner so that it is level, plumb, square and properly aligned and oriented. Tolerance shall be as established in Contractor's drawings or as stipulated by purchaser. No equipment shall be permanently bolted down to foundations until the alignment has been checked and found acceptable by the purchaser.
- 6.23.3 Contractor shall furnish all supervision, labour tools equipment rigging materials, bolts, wedges, anchors, concrete inserts etc. in proper time required to completely install, test and commission the equipment.

- 6.23.4 Manufacturer's and purchaser's instructions and recommendations shall be correctly followed in handling, setting, testing and commissioning of all equipment.
- 6.23.5 Contractor shall move all equipment into the respective room through the regular door or openings specifically provided for this purpose. No part of the structure shall be utilized to lift or erect any equipment without prior permission of Purchaser.
- 6.23.6 All boards shall be installed in accordance with Indian Standards IS:3072 and at Purchaser's instructions. All boards shall be installed on finished surfaces, concrete or steel stills. Contractor shall be required to install and align any channel sills which form part of foundations. In joining shipping sections of switchboards together adjacent housing of panel sections or flanged throat sections shall be bolted together after alignment has been complete. Power bus, enclosures ground and control splices of conventional nature shall be cleaned and bolted together being drawn up with torque spanner of proper size or by other approved means.
- 6.23.7 All boards shall be made completely vermin proof.
- 6.23.8 Contractor shall take utmost care in holding instruments, relaying and other delicate mechanism wherever the instruments and relays are supplied separately they shall be mentioned only after the associated panels have been erected and aligned. The packing materials employed for safe transit of instrument and relays shall be removed after ensuring that panel have been completely installed and no further movement of the same should be necessary. Any damage shall be immediately reported to Purchaser.
- 6.23.9 Equipment furnished with finished coats of paint shall be touched by up Contractor if their surface is specified or marred while handling.
- 6.23.10 After installation of panels, power and control wiring and connections, Contractor shall perform operational tests on all switchboards, to verify proper operation of switchboards/panels and correctness of all equipment in each and every respect. The cable opening and cables entries for cables terminating to the panels shall be sealed with fire sealing materials.

6.24 COMMISSIONING CHECK TESTS

The contractor shall carry out the following commissioning checks, in addition to the other checks and tests recommended by the manufacturers.

6.24 .1 General

- 6.24.1.1 Check name plate details according to the specification.
- 6.24.1.2 Check for physical damage.
- 6.24.1.3 Check tightness of all bolts, clamps, joints connecting terminals.
- 6.24.1.4 Check earth connections

6.24.1.5 Check cleanliness of insulators and bushings

6.24.1.6 Check all moving parts for proper lubrication

6.24.1.7 Check settings of all the relays

6.24.2 Circuit Breakers

6.24.2.1 Check alignment of breaker truck for free movement

6.24.2.2 Check correct operation of shutters

6.24.2.3 Check control wiring for correctness of connections, continuity and IR values

6.24.2.4 Manual operation of breaker completely assembled

6.24.2.5 Power closing/opening operation, manually and electrically

6.24.2.6 Breaker closing and tripping time

6.24.2.7 Trip free and anti-pumping operation

6.24.2.8 IR values, minimum pick up voltage and resistance of coils

6.24.2.9 Contact resistance

6.24.2.10 Simultaneous closing of all the three phases

6.24.2.11 Check electrical & mechanical interlocks provided

6.24.2.12 Check on spring charging motor, correct operation of limit switches and time of charging.

6.24.2.13 All functional checks

6.24.3 Current Transformers

6.24.3.1 Meggar between winding and winding terminals to body

6.24.3.2 Polarity test

6.24.3.3 Ratio identification checking of all ratios on all cores by primary injection of current.

6.24.3.4 Spare CT cores, if available, to be shorted and earthed.

6.24.4 Voltage Transformer

6.24.4.1 Insulation resistance test

6.24.4.2 Ratio test on all cores

6.24.4.3 Polarity test

6.24.4.4 Line connections as per connection diagram

6.24.5 Cubicle Wiring

- 6.24.5.1 Check all switch developments
- 6.24.5.2 Each wire shall be traced by continuity tests and it should be made sure that the wiring is as per relevant drawing. All interconnections between panels/equipment shall be similarly checked.
- 6.24.5.3 All the wires shall be meggered to earth
- 6.24.5.4 Functional checking of all control circuit e.g. closing, tripping control, interlock, supervision and alarm circuit.

6.24.6 Relays

- 6.24.6.1 Check connections and wiring
- 6.24.6.2 Megger all terminals to body
- 6.24.6.3 Megger AC to DC terminals
- 6.24.6.4 Check operating characteristics by secondary injection
- 6.24.6.5 Check minimum pick up voltage of DC coils
- 6.24.6.6 Check operation of electrical/mechanical targets
- 6.24.6.7 Relays settings
- 6.24.6.8 Check CT and VT connections with particular reference to their polarities for directional relays wherever required.

6.24.7 Meters

- 6.24.7.1 Check calibration by comparing it with a sub-standard.
- 6.24.7.2 Megger all insulated portions.
- 6.24.7.3 Check CT and VT connections with particulars reference to their polarities for power type meters.

6.25 SPECIAL TOOLS AND TACKLES

- 6.25.1 The Bidder shall include in his proposal any special tools and tackles required for erection, testing commissioning and maintenance of the equipments offered.
- 6.25.2 The list of these special tools and tackles shall be given in the bid proposal sheets along with their respective prices.
- 6.25.3 The total price of the special tools and tackles shall be included in proposal sheets.

6.26 EQUIPMENT TO BE FURNISHED

- 6.26.1 The Bidder shall quote for various AC/DC distribution boards as given in Bill of Materials and in accordance with this specification.

- 6.26.2 Standard scheme of interconnection of switchboards and distribution boards along with tentative feeder disposition for each board shall be provided by the bidder for the approval of the employer. Any other feeder required as per system requirement for efficient and reliable operation shall be deemed to be included in bidder's scope.
- 6.26.3 The Bill of Materials for each type of module shall be as under. These are minimum indicative requirement of the system. The necessary auxiliary relays, push buttons and indicating lamps shall be provided as per scheme requirement. Any other item / component required within a module for efficient and reliable operation shall be deemed to be included in bidder's scope. The scheme shall have provision for remote annunciation for the followings :
- a) Station LT (415V) AC incomer supply unhealthy.
 - b) **220V DC DB** U/V, O/V & Earth leakage relay operated.
 - c) **48V DC DB** U/V & O/V relay operated.
 - d) DG set start
 - e) DG set protection
- 6.26.4 **Module Type AE (Electrically controlled circuit breaker for incoming and Bus Coupler Circuit).**
- i) One (1) Triple pole air circuit breaker complete with all accessories and power operated mechanism as specified.
 - ii) Two (2) Neutral Link.
 - iii) Three (3) Current Transformer for metering.
 - iv) One (1) Ammeter with selector switch/MFM.
 - v) Three (3) Current Transformer for relaying.
 - vi) One (1) Triple pole instantaneous over-current relay having the setting range of 200-800% or 500-2000% of CT secondary and adjustable definite minimum time.
 - vii) One (1) Instantaneous earth fault relay having and adjustable setting range of 10-40% or 20-80% of CT secondary current and adjustable definite minimum time. The earth fault relay shall be provided with a stabilizing resistor.
- 6.26.5 **Module Type – M1 (Circuit Breaker Controlled Motor Feeder)**
- i) One (1) Triple pole Air Circuit Breaker complete with accessories, and power operated mechanism as specified.
 - ii) One (1) Three position 6 pole selector switch

‘SWITCHGEAR / NORMAL / TRIAL’.

- iii) Three (3) Current Transformer for metering.
- iv) One (1) Ammeter with Ammeter Selector Switch/MFM.
- v) Three (3) Current Transformer for relaying.
- vi) One (1) Triple pole instantaneous over-current relay for providing positive sequence current protection in all the three phases. The relay setting range shall be continuously adjustable between 200-800% or 400-1600% of CT secondary rated current as required.
- vii) One (1) Double pole inverse definite minimum time over current relays connected in R&B phases for over current protection of motor rated 110kw–200kw. The relay shall have an adjustable setting range of 50%–200% of CT Secondary current and time setting range of 0–30 Second. The relay shall be CDGM-22 of EE or equivalent.
- viii) One (1) Single pole adjustable definite time delay relay for motor overload alarm connected in Y-phase only. The relay shall have resetting ratio of not less than 90%. The relay shall have continuously adjustable time delay range of 2.5 to 25 Sec.
- ix) One (1) Instantaneous earth fault relay having an adjustable setting range of 10–40% or 20–80% of CT secondary current. The earth fault relay shall be provided with a stabilizing resistor.

6.26.6 **Module Type E**

- i) One (1) Four pole MCCB

6.26.7 **Module G-1 (VT Module with under Voltage Relay)**

- i) Three (3) $415/\sqrt{3}$ / $110/\sqrt{3}$ volts single phase voltage transformer star / star connect with star point solidly earthed mounted on common draw out chassis. **Accuracy Class 0.5** for protection and metering with **50VA Burden**.
- ii) Six(6) HRC Fuses mounted on the above chassis.
- iii) One (1) Four Position voltmeter selector switch/MFM.
- iv) One (1) Voltmeter (0-500V)/MFM
- v) One (1) Double pole instantaneous under voltage relays with continuous variable setting range of 40-80% of 110 Volts.
- vi) One (1) Time delay pick up relay having a time setting range of 0.5 to 3 secs. With 3 ‘NO’. Self reset contacts, suitable for **220V DC**.
- vii) One (1) Auxiliary relay **220V DC** with 2 No. self reset contacts.

- viii) Three (3) Indicating lamps with series resistor and colour lenses (Red, Blue & Yellow).

6.26.8 **Module Type G-2**

- i) Three (3) HRC Fuse
- ii) One (1) Voltmeter (0-500V) /MFM.
- iii) One (1) Voltmeter selector switch four position (R-Y, Y-B, B-R OFF) /MFM.
- iv) Three (3) Indication lamps (Red, Blue & Yellow)

6.26.9 **Module Type H & H (BC) (Isolating Switch Controlled Incoming Circuit)**

- i) One (1) Four pole MCCB
- ii) One (1) Red Indicating lamp to indicate isolating switch closed position.

6.26.10 **Module Type S : (DC Metering and Protection Module)**

- i) One (1) Voltmeter 300-0-300V DC for **220V DC DB** / Voltmeter 0-75V DC for **48V DC DB** (MFM or with suitable transducer)
- ii) One (1) Three (3) position voltmeter selector switch/MFM.
- iii) One (1) Instantaneous under voltage relay with 95% of **220V DC**. The resetting ratio of relay should not be more than 1.25. the relay shall be provided with a series resistor and a push button across it for resetting (pick up) the relay at about 105% of the drop out voltage.
- iv) One (1) Instantaneous over voltage relay with setting range of 110% of **220V DC**. The resetting ratio of relay should not be less than 0.8. the relay shall have a push button in series for resetting the relay at about 95% of the operating voltage.
- v) One (1) Earth leakage relay only for **220V DC** system having adjustable pick up range between 3 to 7 milliamps the relay shall be suitable for **220V DC**/240V AC Auxiliary supply.

6.26.11 **Module Type X**

- One (1) Double pole 250V MCB

6.26.12 **Module Type-DC (Incomer from Battery & Chargers)**

- i) One (1) Double pole 250V DC MCCB for incomer from Battery.

- ii) One (1) DC ammeter with shunt and range of 90-0-400 Amps. for **220V DC DB** and 90-0-200 Amp. for **48V DC DB**.
- iii) Two (2) Double pole 250V DC MCCB / MCB.
- iv) One (1) Double pole single throw 250V DC air Break switch connecting battery & charger sections to DC DB.

6.26.13 **Module Type DG-1 (Electrically Controlled Circuit Breaker for Incomer from DG Set)**

- a) One (1) Triple pole circuit breaker complete with all accessories and power operated mechanism as specified.
- b) One (1) Frequency meter/MFM in built.
- c) One (1) Voltmeter with selector switch/MFM in built.
- d) One (1) Remote/Local Selector switch.
- e) Three (3) Current Transformer for Metering.
- f) Six (6) Current Transformers for differential protection (out of this 3 Nos. will be supplied loose for mounting in DG set panel).
- g) Three (3) Current Transformer for relaying.
- h) One (1) Ammeter Selector Switch/MFM in built.
- i) One (1) Ammeter/ MFM in built.
- j) One (1) Wattmeter of range 0-300 KW/ MFM in built.
- k) One (1) Three pole voltage controlled definite time delay relay having current setting range of 50-200% of CT secondary current and adjustable time delay 0.3 to 3 secs.
- l) One (1) Watt hour meter with six (6) digits and minimum count of one (1) kwh/ MFM in built.
- m) One (1) Single pole definite time over current relay having a continuous setting range of 50-200% of CT secondary current and a time delay of 2.5-25 secs connected in CT of Y phase for overload alarm. The relay shall have a setting ratio of not less than 90%.
- n) One (1) Three pole differential protection relay having an operating current setting range of 10-40% of generator full load current. The relay shall be high impedance type, with necessary stabilizing resistors.
- o) Two (2) Push Buttons for Remote starting & stopping of DG Set (Red, Green).

6.26.14 **Module Type H1**

One (1) Double pole DC Switch with pad locking facility in off position.

6.26.15 Module Type EL

- i) One (1) Four pole MCCB
- ii) One (1) Contactor
- iii) Two (2) Electronic Timer suitable for continuous operation, push button and selector switch be as per scheme requirement.
- iv) Two (2) (Toggle) Control Switch.

6.27 PARAMETERS

6.27.1 Power Supply

- 6.27.1.1 AC System 3 phase, 4 wire, solidly earthed
- a) Voltage 415 Volts, $\pm 10\%$
 - b) Frequency 50 Hz $\pm 5\%$
 - c) Combined variation $\pm 10\%$ Absolute Sum in Voltage & frequency
 - d) fault Level 20 kA (rms)

6.27.1.2 **DC System** 2 Wire, unearthed

- a) System Voltage 220V $\pm 10\%$
- b) Fault Level 20 kA for 1 s
- c) System Voltage 50 V $\pm 10\%$
- d) Fault level --

6.27.2 Control Supply Voltage

- a) Trip and closing 220 V DC Unearthed coils
- b) Spring charging 220 V DC Unearthed

6.27.3 Cubicle Data

6.27.3.1 Busbar Rating

- a) Continuous current ratings:
 - i) AC Distribution Boards Main incoming Board 1250A
 - AC Distribution Board 800A
 - Lighting Board 500A

Emergency Lighting Board 200A

ii)DC Distribution Boards 400A

b) Short time (1 sec.
kA (rms) 20 kA

c) Momentary (kA) 45 kA

d) Ambient Temperature 50⁰ C

e) One Minute Power Frequency Withstand

I. Power Circuit 2500 Volts (rms)

II. Control Circuit 2500 Volts (rms)

6.27.3.2 **Cubicle Colour Finish**

a) Interior Glossy White

b) Exterior Smoke Grey shade No. 692 of IS:5

6.27.4 **Circuit Breaker**

a) Type Air break

b) No. of Poles 3

c) Voltage & Frequency 415 ± 10%, 50 HZ ± 5%

d) Rated Operating Duty B-3 Min, M-B-3 Min. -MB

e) Symmetrical Interrup-
ting rating 20 kA (RMS)

f) Short Circuit
making current 45 kA (Peak)

g) Short time withstand
Current for 1 sec.
Duration 20 kA (RMS) for 1 Sec.

h) Operating Mechanism
Current for 1 sec.
Duration 20 kA (RMS) for 1 Sec.

i) No. of auxiliary
contacts 4 NO & 4 NC contacts for purchaser's
use on fixed portion of the cubicle

j) Short Circuit

breaking current

I. AC Component 20 kA (RMS)

II. DC Component As per IS:13947 (Part 2)

6.27.5 **MOULDED CASE CIRCUIT BREAKER**

	AC System	DC System
a) No. of poles	4	2
b) Voltage & Frequency	415 $\pm$ 10% 50 HZ $\pm$ 5%	250 V
c) Rated Operating Duty	P2	P2
d) Symmetrical interrupt- ing rating	20 kA (RMS)	4 KA
e) Short Circuit making current	45 kA (Peak)	--
f) No. of auxiliary contacts	2 NO & 2 NC	2 NO & 2 NC
g) Short Circuit breaking current		
I. AC Component	20 kA (RMS)	As per IS
II. DC Component	As per IS 13947	As per IS 13947

6.27.6 **Meters**

a) Accuracy Class	2.5
b) One minute power frequency withstand test voltage in KV	2.0

6.27.7 **Current Transformers**

a) Type	Cast resin, Bar primary
b) Voltage class and frequency	1100 V, 50 Hz
c) Class of Insulation	E or better

- | | |
|--|--|
| d) Accuracy class
metering CT | Class 1, VA adequate for application
but not less than 7.5 VA |
| e) Accuracy class
protection CT | 5P 15, VA adequate for application,
but not less than 7.5 VA |
| f) Accuracy class
differential protection | PS, KPV = 300 V |
- g) Short Time Current
Rating (for CTs Associated
with circuit breakers)
- | | |
|---------------------|--------------|
| I. Current | 20 kA (RMS) |
| II. Duration | One second |
| III. Dynamic Rating | 45 kA (Peak) |
| IV. One minute | 2.5 kV (rms) |
- Power frequency
Withstand test
Voltage

6.27.8 Voltage Transformer

- | | |
|---|---------------------------------|
| a) Type | Cast Resin |
| b) Rated Voltage | |
| Primary | 415/ $\sqrt{3}$ V |
| Secondary | 110/ $\sqrt{3}$ V |
| c) Method of connection | |
| Primary | Star |
| Secondary | Star |
| d) Rated Voltage Factor | 1.1 continuous, 1.5 for seconds |
| e) Class of insulation | E or better |
| f) One minute power
frequency withstand
voltage | 2.5 KV (RMS) |
| g) Accuracy class | 0.5, not less than 20 VA |

6.27.9 **Relay**

- a) One minute power frequency withstand test 2 kV (rms)

6.28 **AUTOMATIC CONTROL OF OUTDOOR LIGHTING**

- 6.28.1 EL-type module of 415 V **MAIN LIGHTING DISTRIBUTION BOARD** and **EMERGENCY LIGHTING DISTRIBUTION BOARD** shall be controlled by timer and contactor module to facilitate its operation automatically.

6.29 **AUTOMATIC SUPPLY CHANGEOVER**

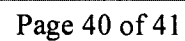
Automatic changeover between Incomer I, Income II and DG set is to be carried out during the failure of supply in one/or both the incomers. After the restoration of the supply, system shall be restored to normal condition automatically. The requirement of changeover under various conditions are as below :-

- i) Under normal conditions i.e. when supply is available in both the incomers, incomers I&II of 415 V Main switchboard, ACDB shall be in closed condition and Bus couplers and DG set breaker shall be in open condition.
- ii) In case of failure of either of the sources, the incomer of that source shall trip and Bus coupler shall get closed. On restoration of supply, normal conditions described above are to be established automatically.
- iii) In case of failure of supply in both the sources, both incomers, incomers of ACDBs and ACDB Bus coupler shall trip and DG Set breaker switched on.

On restoration of one or both sources, DG Set breaker shall trip, DG set stopped and conditions described in paragraph (i)/(ii) shall be restored.

To avoid unnecessary operation of switchgear for momentary disturbances all changeovers from one state to another shall be intimated after a time delay, after the conditions warranting such change has been detected.

ANNEXURE-1



ANNEXURE-2

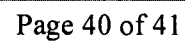
CONTINGENCY / EMERGENCY SITUATION SWITCHING ARRANGEMENTS:

S.No.	Contingency/ Situation									Remark
FAILURE of Main Supplies		CBI	CB2	CB3	CB4	CB5	BCI	BC2	BC3	
1.	Normal Condition	C	C	C	O	C	O	O	O	Supply from Main Line-I
2.	Main Line-I Fails	O	C	C	O	C	C	O	O	Supply from Main Line- II
3.	Main-I & Main -II Lines Fail	O	O	O	C	O	O	C	C	Supply from DG Set
RESTORATION										
1.	Main-I Restored when supply is on DG Set	C	C	C	O	C	O	O	O	Supply restored on Main Line- I
2.	Main- II Restored when supply is on DG Set	O	C	C	O	C	C	O	O	Supply restored on Main Line- II
3.	Both Main-I & Main-II Restored	C	C	C	O	C	O	O	O	Normal Condition Supply on Main Line-I

C: Close **O:** Open

Note: The switching arrangements in various situations have been given for the bidder's reference only. A scheme shall be so designed to have switching sequences are achieved automatically as per the condition/ situation. The final arrangement shall however be decided and approved by the Purchaser during detailed engineering.

ANNEXURE-1



Lighting Transformer:

1.	Lighting transformers shall be supplied in separate and distinct panel completely assembled for incoming cable connection from bottom and outgoing connection through bus bar with adjacent associated lighting distribution board. Lighting transformers shall have provision of base channel with rollers for taking in and out from the panel in case of maintenance after disconnecting incoming and outgoing connections. Provision of single phase fans at least two (2) numbers of suitable ratings shall be made in the panel for ventilation. These fans shall run in sequential mode at suitable time interval to be controlled by thermostat and timer. The offered design of panel should be such that in no case, temperature rise of lighting transformers shall exceed the permissible limits for the class of insulation of lighting transformer.																				
2.	<i>Lighting transformers shall be of 150/50 KVA rating (in case of substations where highest voltage is 400 kV, 415/415 V, 3 phase, 50 Hz Dry type natural air cooled type. The technical parameters of these lighting transformers are as follows:</i> Technical Parameters of Lighting Transformer <table> <tr> <td>Type of transformer:</td><td>Dry type natural air cooled</td></tr> <tr> <td>Rating:</td><td>150/50 KVA</td></tr> <tr> <td>Voltage ratio:</td><td>415/415 volts</td></tr> <tr> <td>No. of phases:</td><td>Three</td></tr> <tr> <td>Frequency:</td><td>50 Hz</td></tr> <tr> <td>Winding connection:</td><td>Dyn-1</td></tr> <tr> <td>Class of insulation:</td><td>'B' class</td></tr> <tr> <td>Impedance:</td><td>4% $\pm$ 10%</td></tr> <tr> <td>No. of taps & steps:</td><td>5, $\pm$ 5% in steps of 2.5%</td></tr> <tr> <td>Ref. standard:</td><td>IS:2026</td></tr> </table>	Type of transformer:	Dry type natural air cooled	Rating:	150/50 KVA	Voltage ratio:	415/415 volts	No. of phases:	Three	Frequency:	50 Hz	Winding connection:	Dyn-1	Class of insulation:	'B' class	Impedance:	4% $\pm$ 10%	No. of taps & steps:	5, $\pm$ 5% in steps of 2.5%	Ref. standard:	IS:2026
Type of transformer:	Dry type natural air cooled																				
Rating:	150/50 KVA																				
Voltage ratio:	415/415 volts																				
No. of phases:	Three																				
Frequency:	50 Hz																				
Winding connection:	Dyn-1																				
Class of insulation:	'B' class																				
Impedance:	4% $\pm$ 10%																				
No. of taps & steps:	5, $\pm$ 5% in steps of 2.5%																				
Ref. standard:	IS:2026																				
3.	Panels with lighting transformers shall have IP 31 degree of protection in accordance with IS 13947 (Part-1). Door frame of panels, meters, relays, Breaker cut-outs shall be provided with neoprene rubber gaskets generally conforming to Type-II, Class 2A as per IS: 11149.																				
4.	Type test reports of Lighting Transformer shall be as per IS: 2026																				

Inputs required for Substation Automation Purpose:**1. ANALOGUE INPUTS:**

LT System shall have provision of following analogue inputs for owner's substation automation(SAS) purpose. These analogue inputs shall be generated by distinct transducers to be provided in respective modules.

These inputs shall be wired up to respective terminal blocks.

- i) Voltage R-Y, Y-B, B-R of Main Switch Board section-I
- ii) Voltage R-Y, Y-B, B-R of Main Switch Board section-II
- iii) Current from LT transformer-I
- iv) Current from LT transformer-II
- v) Voltage of 220V DCDB-I
- vi) Voltage of 220V DCDB-II
- vii) Current from 220V Battery set-I
- viii) Current from 220V Battery set-II
- ix) Voltage of 48V DCDB-I
- x) Voltage of 48V DCDB-II
- xi) Current from 48V Battery set-I
- xii) Current from 48V Battery set-II

2. DIGITAL (Potential Free) INPUTS:

LT System shall have provision of following digital inputs for owner's substation automation purpose. These digital inputs shall be made available in the form of potential free contacts to be provided in respective modules.

These potential free contacts shall be wired up to respective terminal blocks.

- i) Main (MSB) Incomer-I breaker On/Off
- ii) Main (MSB) Incomer-II breaker On/Off
- iii) Main(MSB) 415V Bus-I/II U/V
- iv) Main (MSB) bus coupler breaker on/off
- v) DG set breaker on/off
- vi) LT transformer-I Bunchholz Alarm & trip
- vii) LT transformer-II Buchloz Alarm & trip
- viii) LT transformer-I WTI Alarm & trip
- ix) LT transformer-II WTI Alarm & trip
- x) LT transformer-I OTI Alarm & trip
- xi) LT transformer-II OTI Alarm & trip
- xii) 220 V DC-I earth fault
- xiii) 220V DC-II earth fault

Note:

1. Multi-Function Panel Meter (MFM) is with RS-485 communication port with Modbus protocol and LED display.
2. Mapping address/looping to SAS BCU is in the scope of Vendor.
3. RS-485 cable is in the scope of Vendor.

SECTION-3

PROJECT DETAILS & GENERAL SPECIFICATION

SITE INFORMATION

	Particular	Details
a)	Owner	UPPTCL
b)	Customer	UPPTCL
c)	Project Title	400/220/132 kV GIS at Rasra, Ballia
d)	Location	Uttar Pradesh
e)	Transport Facilities	Nearest rail head - Ballia
SITE CONDITIONS		
a)	Max. ambient air temp.	50°C
b)	Min. ambient air temp.	0°C
c)	Max. design ambient emp.	50°C
d)	Design reference temp.	50°C
e)	Average Humidity	Max. 100%
f)	Special corrosion conditions	No
g)	Solar Radiation	
h)	Atmospheric UV radiation	High
i)	Altitude above sea level	Less than 1000meter
j)	Pollution Severity	High Pollution level
k)	Seismic Zone	As per the seismic zone defined in the relevant BIS / IEC-62271-300 but not less than 0.3g horizontal
WIND DATA		
	Wind load	195kg/sqm
	Average No. of thunderstorm days per annum	As per IS

1. GENERAL

This Chapter covers Technical Requirements and requirements of auxiliary items.

- 1.1** Equipments furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories specified &/or normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the Technical Specifications.

Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the substation unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost All similar standard components/ parts of similar standard equipment provided, shall be inter-changeable with one another.

- 1.2** The Bidder shall supply type tested (including special test as per technical specification) equipments and materials. The test reports/details shall be furnished by the Bidder in the bid.

In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to non-compliance with the requirement stipulated in the Technical Specification and/or IEC/ IS, same, shall be carried out without any additional cost implication to the Purchaser. The Purchaser reserves the right to get any or all type tests conducted/ repeated.

The reports for all type tests and additional type tests as per technical specification furnished by the Bidder shall be of the tests conducted within last 05(five) years prior to the date of bid opening. The type tests conducted should have either been conducted in accredited laboratory (accredited based on ISO/ IEC Guide 25/ 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by UPPTCL or representative authorized by UPPTCL or Utility or representative of accredited test lab or reputed consultant.

2. SYSTEM PARTICULARS

	Rated System voltage	420 kV, 245kV, 145kV, 36kV
	System frequency	50 Hz, This may vary by $\pm 5\%$
	Number of phases	Three
	Neutral	Effectively Earthed
	Auxiliary power supply:-	
	Auxiliary electrical equipment shall be suitable for operation on the following supply system:	
(a)	Power device (Like drive motors)	400V, 3Phase, 4Wire 50Hz Effectively earthed AC system.
(b)	Lighting fixtures, space heaters, fractional Horse Power motors and control devices.	250V, 2wire, 50Hz, AC supply with one point grounded.
(c)	DC alarm, Control and Protective Devices from sub station batteries as under	2 wire ungrounded DC supplies (i) 400 kV S/S : 220V DC (ii) 220/132kV S/S : 110V DC (iii) Communication : 48 V DC The above supply voltage is subject to variation as follows: All devices must be suitable for a continuous operation over the entire range of voltage variations : (i) AC Voltage may vary by $\pm 10\%$. Frequency by $\pm 5\%$ Combined Voltage & frequency by $\pm 10\%$. (ii) DC a) 220 V may vary between 187 & 242 V b) 110 V may vary between 93 & 121 V c) 48 V may vary between 41 & 53 V

3. System parameters

Sl. No.	Description of Parameters	400 kV System	220 kV System	132 kV System	33 kV System
1	Nominal system voltage	4000kV	220kV	132kV	33kV
2	Maximum operating voltage of the system(rms)	420kV	245kV	145kV	36kV
3	Rated frequency	50Hz	50Hz	50Hz	50Hz
4	No. of phase	3	3	3	3
5	Rated short time current	50 kA for 3 Sec.	40 kA for 3 SEC	40 kA for 3 SEC	25 kA for 3 SEC
6	Dry and wet one minute power frequency withstand voltage	680 kV	460 kV	275 kV	95 kV
7	Dry and wet impulse withstand voltage positive and negative	1550 kVp	1050 kVp	650 kVp	250 kVp
8	Corona extinction voltage	320 kV	156 kV	105 kV	-
9	Max. Radio interference voltage for frequency between 0.5 MHz and 2 MHz at 508 kV rms for 765kV, 320kV rms for 400kV system and 156kV rms for 220kV system & 92kV rms for 132kV system system & 92kV rms for 132kV system	1000 microvolt	1000 microvolt	500 microvolt	-
10	Minimum total creepage	25mm/kV	25mm/kV	25mm/kV	25mm/kV
		(10500 mm)	(6125 mm)	(3625 mm)	(1300 mm)
11	Min. clearances				
	i. Phase to phase	4000mm (for Conductor - conductor)	2100 mm	1300 mm	320 mm
		4200mm (for rod - Conductor)			
	ii. Phase to earth	3500 mm	2100 mm	1300 mm	320 mm
	iii) Sectional clearances	6500 mm	5000 mm	4000 mm	3000 mm
12.	System neutral earthing	Effectively Earthed			

4. SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

- 4.1** All equipments shall perform satisfactorily under various electrical, electromechanical and meteorological conditions of the installation site.

-
- 4.2** All equipment shall be able to withstand all external and internal mechanical thermal and electromechanical forces due to various factors like wind load temperature variation, ice & snow (wherever applicable) short circuit etc for the equipment.
- 4.3** The Bidder shall design the various forces which the terminal connectors of the equipment are required to withstand.
- 4.4** All outdoor EHV equipments except marshalling kiosks shall be suitable for hot line washing.
- 4.5** To facilitate erection of equipment, all items to be assembled at site shall be "matchmarked".

5. SUPPORT STRUCTURES (If in the scope of Bidder)

The base design of all the equipments, to be installed on auxiliary structures, shall conform to the standard auxiliary structure designs presently being used in UPPTCL at 400/220/132/33kV Substations.

All equipment support structures shall be supplied along with brackets, angles, stools etc. for attaching the operating mechanism, control cabinets and marshalling box (wherever applicable) etc. The support structures should be hot dip galvanised with minimum 610 gram/sq.m net of zinc.

6. STANDARDS

- 6.1** **Except** as modified by this Bid specification, all material and equipment shall conform to the requirement of the latest editions of relevant ISS/ IEC and other applicable standards. The equipments/ works shall be designed, engineered, manufactured, built, tested and commissioned shall be carried out in accordance with the Acts, Rules, Laws and Regulations in force in India.
- 6.2** In addition to meeting the specific requirements called for in the respective sections of the Technical Specification, the equipment shall also conform to the general requirement of the relevant standards which shall form an integral part of the specification. When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.
- 6.3** In the event of the Bidder offering equipment conforming to standards other than ISS/IES standards, which ensure equivalent or better performance than that specified in the standards, the salient point of comparison between the standards adopted and relevant ISS/ IEC standards shall be indicated clearly in the proposal, along with English language version of such standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to Purchaser's approval.
- 6.4** The standards mentioned in the respective equipment specifications are not mutually exclusive or complete in themselves. The equipment &/or work shall also conform to any other applicable standard, even if not specifically mentioned in these specifications.

-
- 6.5** Should the Bidder wish to depart from the provisions of the specifications, either on accounts of manufacturing practices or for any other reason, he shall clearly mention the departure and submit complete justification supported by information, drawings etc. as will enable to assess the suitability of equipment(s) offered. In the event of the Bidder's specifications, drawings, forms and tables etc. being found to disagree with the requirement of the Bid specifications at any stage, Bid specifications shall be binding, unless the departures have been duly approved in writing by the purchaser.

6.6 R E F E R E N C E O F S T A N D A R S

Reference	Abbreviation	Name and Address
BS	British Standards,	British Standards Institution, 101, Pentonville Road, N-19-ND UK
ISO	International Organization For Standardization,	Danish Board of Standardization Danish Standardising Sraat, Aurehoegvej-12, DK-2900, Heelstrup, DENMARK
NEMA	National Electric Manufacture Associate	115, East 44th Street, New York NY 10017 U.S.A
BS	British Standards,	British Standards Institution, 101, Pentonville Road, N-19-ND UK
ISO	International Organization For Standardization,	Danish Board of Standardization Danish Standardising Sraat, Aurehoegvej-12, DK-2900, Heelstrup, DENMARK
NEMA	National Electric Manufacture Associate	115, East 44th Street, New York NY 10017 U.S.A

7. ENGINEERING DATA AND DRAWINGS

7.1 SUBMISSION AND APPROVAL OF DRAWINGS/ DOCUMENTS

- 7.1.1** The Bidder shall follow a well-defined coding system for proper and quick identification of all systems/ sub-systems/ equipments/ assemblies/ sub-assemblies/ accessories/ other plant material/ spare parts/ special tools and plants and drawings for the execution of the plant and later for its operation and maintenance.

Copies of coding documents defining the above shall be supplied along with drawings to understand the system.

- 7.1.2 All drawings submitted by the Bidder shall be in sufficient details to indicate the type, size arrangement, weight of each component, details for packing and shipment, the external connections, fixing arrangements, dimensions required for installation arrangement, dimensions required for installation and interconnections with other equipment and other information specifically, as called for in the drawing schedules. All the equipments tapping points etc. shall be numbered according to pre-determined scheme/ system which shall be subject to approval of Purchaser.
- 7.1.3 Each drawing shall be clearly marked with the name of the Purchaser, unit designation, UPPTCL's Contract No. and the name of the project. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawings shall be in English. All the dimensions should be in metric units.
- 7.1.4 If any dimension figures on a drawing or a plan differs from those obtained by scaling the drawing or plan, the dimensions as mentioned in figures on the drawing or plan shall be taken as correct.

7.2 Submission and distribution of drawings/ documents

All the drawings which do not require approval shall be submitted along with reproducible in required number and those requiring approval shall be initially submitted for comments/ approval before submitting along with reproducible as per "Document Distribution Schedule".

7.3 APPROVAL OF DRAWINGS

- 7.3.1 The Purchaser shall return to the Bidder one set of drawings, plans and technical data requiring approval after marking them with their comments/ corrections, if any, either (a) marked 'Approved' or (b) marked 'Approved subject to incorporation of comments' or (c) marked 'Not Approved' with comments requiring resubmission of drawings etc. in 14 days or (d) marked 'Approval not required', where drawing is for information only. In case of (a) no further revision of drawings will be required. In case of (b) Bidder can proceed with the work but will resubmit the drawings incorporating the corrections as per comments only within fourteen (14) days. In case of (c) Bidder can proceed with the work only after resubmitting the drawings within fourteen (14) days and getting approval under (a) or (b) categories above. In case of (d) the Bidder drawing is deemed to have been received only for information purpose.
- 7.3.2 The Purchaser shall have the right to ask the Bidder to make any change in the design/ drawing which may be necessary to make equipment conform to the provisions and intent of the contract, without any extra cost to the Purchaser.

The drawings submitted shall be re-viewed by the Purchaser and shall be modified by the Bidder as required. The Bidder shall incorporate such modifications and/or corrections and submit the final drawings for approval/ reference.

7.3.3 No deviation from the approved drawings shall be permitted without the written approval of the Engineer.

7.3.4 The review of drawings/ data by the Purchaser will cover only general conformance of the data of the specifications and document, interfaces with the equipment provided under the specifications, external connections and the dimensions which might effect substation layout.

This review by the Purchaser may not indicate thorough review of all dimensions, quantities and details of the equipment, wiring, materials, any devices or items indicated or the accuracy of the information submitted. This review and/ or approval by the purchaser shall not be considered by the Bidder, as limiting any of his responsibilities specified under these specifications and documents.

Approval/ comments conveyed as above shall neither relieve the Bidder of his contractual obligations and his responsibilities for correctness of dimensions, material of construction, quantities, design details, assembly fits, performance particulars, guarantees and conformity of the supplies with the specifications, schemes, systems and statutory laws, nor does it limit the Purchasers right under the contract.

7.3.5 Should any minor revision be made after 'approval', at the time of erection/ commissioning the Bidder shall redistribute prints and reproducible, clearly certifying the changes incorporated in the drawing and marking it in a block. Every revision shall be marked by a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.

7.3.6 The Bidder shall be responsible for and shall pay for any alterations of the work due to any discrepancies, errors and omissions in the drawings or other particulars supplied by him, whether such drawings or particulars have been approved by Engineer or not.

No extension of delivery periods shall be granted on this account.

7.3.7 As- build drawings

Drawings of all equipments as detailed in technical specifications of respective equipments necessarily including schematic drawings and terminal block drawings wherever applicable whether mentioned in respective technical specifications or not.

8. NAME PLATE, MARKING OF PARTS, LABELS

8.1 All equipment shall have metal name plates fixed in suitable position with full particulars engraved legibly thereon and not painted.

8.2 Each main and auxiliary item of plant is to have permanently attached to it in a conspicuous position, a rating plate of non corrosive material upon which is to be engraved identifying manufacturer's name, equipment type or serial number, rating together with details of the loading/ operating conditions under which the item or plant in question has been designed to operate and such diagram plates as may be required by the Engineer.

8.3 Each item of plant is to be provided with a name plate or label designating the service of the particular equipment. These inscriptions are to be approved by the Engineer or as

detailed in the appropriate sections of the technical specifications.

- 8.4** Such name plates or labels are to be white non hygroscopic material with engraved block lettering or, alternatively, in the case of indoor equipments of transparent plastic material with suitably colored lettering engraved on the back
- 8.5** Each bay module in GIS room will have a clear marking showing the name of bay, identification, name and rating plate marking for each individual equipment like circuit breaker, disconnectors grounding switches, current transformer, voltage transformers and bushings etc. as per relevant IEC to facilitate identification during routine operation/ maintenance.
- 8.6** All such name plates, instruction plates, lubrication charts etc. shall be bilingual with Hindi inscription first followed by English. Provisions shall be made to fit in name plates, lubrication/ connection diagram plates etc.
- 8.7** In order to facilitate identification, the parts of the equipment shall be suitably marked.

9. INSTRUCTION MANUALS

- 9.1** The Bidder shall submit to the Engineer 'Descriptive Manuals', i.e. system design concept, detailed catalogues of equipment and typical equipment instructions for this project, for all major systems and equipment, covered under this contract along with dispatch of equipment.
These initial copies of descriptive manuals shall be in sufficient details, bringing out detailed internal construction, characteristics, performance parameters, principles of operation, maintenance requirements, replacement and renewals needed, erection and overhauling procedure, testing and operation procedure etc. for various equipment.
- 9.2** The integrated instruction manuals, fully defining the interfaces between various systems and complete in all respects shall be submitted by the Bidder one month before scheduled date of commissioning. The instruction manuals shall contain full details of designation and drawings of all the equipment furnished, the erection procedure, testing procedure, operation and maintenance procedure of the equipment, single line diagrams, and schematics. After the commissioning and initial operation of the plant, modifications/ additions/ changes, wherever required shall be incorporated in the instruction manuals and drawings shall be submitted by the Bidder to the Purchaser.
- 9.3** The manuals shall be specific to the equipment supplied and not of general nature.

10. DOCUMENTS AND ERECTION DRAWINGS

The Bidder shall submit within a reasonable time but at least four (4) weeks before dispatch of equipment (as per distribution schedule) the following drawings/ documents and instruction manuals etc. to the consignee and the Engineer.

- I. List of item-wise equipment as proposed to be dispatched by the Bidder.
- II. Erection drawings along with reproducible prints of each drawings.
- III. Instruction books for proper handling/ checking of material on receipt at site/storage,
- IV. erection and assembly of all equipment and necessary instruction for checking and
- V. recording proper assembly of the plant.
- VI. Instruction sheets for proper balancing, alignment, adjustment, checking and calibrations

-
- VII. as may be necessary.
 - VIII. Descriptive literature and drawings to illustrate the working principals, methods of
 - IX. assembly and dismantling of plants and equipment.
 - X. Testing/commissioning format for recording data during erection/testing/
 - XI. commissioning and trial run. These formats/data sheets shall clearly indicate the results
 - XII. obtained during shop tests and permissible deviations.

11. QUALITY CONTROL PROGRAMME

To ensure that the equipment construction work and the services covered under this job are in accordance with the specifications and conform to the high standard of workmanship. It is obligatory on the part of the Bidder to adopt a suitable quality control program. Such a program shall include suitable hold point for check for major equipments during manufacture at supplier's work, during erection at site and during the construction stage such that material checks for attaining proper strength and dimensional checks for attaining close tolerances required for equipment installation can be obtained.

In order to attain the above objectives, the Bidder shall draw out a plan listing all quality control checks in detail, including all hold points at which the quality checks shall be applied, also specifically mentioning those hold points where the Purchaser shall also participate in the quality check to assure him of the quality of the products supplied. Such a program shall be outlined by the Bidder for the acceptance by the Purchaser. The Bidder shall furnish detailed information regarding his quality control program and its strict implementation. Following information shall be included in the proposal along with others regarding quality control program:

- I. The quality control organizations and the proposal of its implementation.
- II. The system for controlling drawings and documents for correctness.
- III. The system of quality control for raw materials, process control and maintaining
- IV. tolerances during manufacturing, assembly and fabrication.
- V. Quality control during purchase of components, sub-systems and assemblies.
- VI. Methods for ensuring selection of proper vendors/ sub-vendors.
- VII. Inspection of testing at shop after assembly.
- VIII. Control of accuracy during calibration of measuring and testing equipments.
- IX. Preservation and quality control during the transit.
- X. Procedure for inspection before erection and quality control during erection.
- XI. System for storage and delivery.

Bidder shall be wholly responsible for the quality control and quality assurance for the manufacture, supply, erection, testing and commissioning etc.

During inspection, destructive testing and non destructive test evaluation shall be done wherever applicable, in presence of Purchaser's representative in accordance with established norms. Directions of Purchaser shall be rigorously followed.

12. INSPECTION

&

TESTING

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- 12.1** The Purchaser reserves the right to inspect any machinery and material to ensure that approved Q.A.P. is being strictly implemented by the Bidder or his Sub Bidder/ Supplier under this contract and to reject any item found defective in workmanship or design or otherwise unsuitable for the use and purpose intended or which is not in accordance with the intent of this contract. The Bidder should on demand by the Purchaser, rectify or replace such defective or unsuitable equipment, or the Purchaser may at the Bidder's expense, rectify or replace such defective or unsuitable equipment whether before or after supply.
- 12.2** That Bidder shall, for purpose of clause 15 of the annexed conditions of contract Form-A inform to the Purchaser places of manufacture, testing and inspection of various equipment offered by him. Unless specifically provided otherwise, all tests shall be carried out at the Bidder's work or for bought out items at sub-vendors works before dispatch.
- 12.3** The Bidder shall advise the Purchaser at least 4 weeks in advance as to when the equipment will be ready for stage/ final inspection at the Bidder's works or at his Sub-Bidder's works.

PENAL CHARGES

In case the equipment is not available for inspection at the time of arrival of inspection officers,
the Bidder shall pay to UPPTCL towards futile journey a sum decided by Chief Engineer (765 KV DU), UPPTCL and demanded by "Engineer of Contract". This amount shall be paid within 10 days from the date of demand. Further action for inspection of the material shall be taken only after the said amount is deposited.

- 12.4** During inspection, the Purchaser's Inspecting Engineers at all times have access to all part of shops where the equipment is being manufactured and also shall be provided with all reasonable inspection facilities by the Bidder and/ or sub-Bidders. Even without scheduled inspection, the Engineer and/or his duly authorized representative shall have at all reasonable times access to the Bidder's premises, works or site and shall have the power to inspect and examine the materials and workmanship of the works during it's manufacture or erection.
- 12.5** All plants equipment/ parts, sub assemblies/ assemblies shall comply with the requirement of type tests and shall be subjected to the routine/ acceptance tests specified in the set of standards adopted and to such other tests as are stipulated in the respective technical specifications.

The Purchaser reserves to himself the right of having at his own expense any inspection or special test of a reasonable nature at Bidder's premises or at site, in addition to those prescribed in applicable standards and the enclosed technical specifications.

- 12.6** The Engineer shall either depute his representative to witness the tests as applicable and

inspect the material or shall waive the inspection. In case of waiver the Bidder or his sub-Bidder shall carryout the all applicable tests in absence of Purchaser's representative. In both the cases i.e. either inspection or waiver the test certificates shall be submitted to Engineer of Contract for approval and issue of dispatch authorization. In case of inspection the test certificates must bear signatures of the Purchaser's inspecting officer.

The Engineer of Contract, within 10 days of receipt of test certificates, shall issue approval/ dispatch authorization, if test certificates are found satisfactory.

In case test certificates are not found satisfactory the Engineer of Contract, within 10 days of receipt of test certificates, shall communicate his objections and actions required to be taken in writing to the Bidder. The Bidder shall take remedial action and shall re-submit the test certificates or re-offer the material for inspection as asked for by the Engineer. Subsequent actions shall follow as in case of fresh offer for inspection. No extension of delivery/ completion period shall be granted on this account.

12.7 REJECTON

Purchaser reserves the right to reject any equipment if during the tests at works or site, the test value achieved do not comply with the respective standard/ specifications and exceeds that tolerable limits. Rejection of any equipment will not be held as a valid reason for delay in timely completion of the work.

12.8 No equipment to be furnished or used in connection with this contract shall be dispatched, until factory inspection and acceptance test have been carried out satisfactorily and dispatch authorization issued by Engineer of Contract. Such factory inspection of the equipment or approval of acceptance tests shall not however, relieve the Bidder from full responsibility for supplying equipment conforming to the requirements of this contract, nor prejudice any claim, right or privilege which the Purchaser may have because of the use of defective or unsatisfactory equipment. Should Purchaser waive the right to inspect any equipment, such waiver shall not relieve the Bidder in any way from his obligations under this contract. The inspection/waiver by Engineer and/ or approval of test certificates shall in no way limit the liabilities and responsibilities of the Bidder in respect of the agreed quality assurance program, and the desired performance of the equipment.

12.9 In all cases where the contract provides for tests whether at the premises or works of the Bidder or of any Sub-Bidder, the Bidder shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably required to carry out effectively, such tests on the equipment in accordance with the contract and shall give facilities to the Engineer or to his authorized representative to accomplish inspection. All the expenses incurred for testing including material consumed in testing shall be to the Bidder's account.

12.10 Purchaser will not entertain any request for waiver of inspection on the ground that subvendors are not agreeing for the Purchaser's inspection. It is the responsibility of the Bidder to ensure that all the requirements of the Purchaser as envisaged in the

technical specifications are incorporated.

- 12.11** The Bidder is required to record the following certificates on the invoices and challans of each and every consignment:

"Certified that material being dispatched against the above invoices and challan has been inspected and tested by the representative of Engineer of the contract on (date) and all the test results were satisfactory, as per approved test certificate enclosed."

Or

Certified that inspection of material being dispatched against the above invoice and challan has been waived off by Engineer of Contract vide letter No.....Dt..... (Copy enclosed) and all the acceptance and routine tests as per relevant standards and those provided in Contract, have been conducted and all the test results were found satisfactory as per test certificates enclosed."

- 12.12** In case the inspection or testing of the material is to be carried out outside India, all the expenditure including boarding and lodging etc. of the inspecting officer/ officers shall be borne by the contractor and information regarding inspection has to given at least 8 weeks in advance.

13. PACKING

- 13.1** All equipment 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.
While packing all the materials, the limitations from the point of view of availability of transportation facilities in India should be taken into account. The Bidder shall be responsible for any loss or damage during transportation, handling and storage.
- 13.2** The Bidder shall include and provide for security protection and packing the plant so as to avoid loss or damage during transport by any mode.
- 13.3** All packing shall allow for easy removal and checking at site. Wherever necessary, proper arrangement for attaching slings for lifting shall be provided. All packages shall be clearly marked for with signs showing 'UP' and 'DOWN' side of boxes, and handling and unpacking instructions as considered necessary. Special precautions shall be taken to prevent rusting of steel and iron parts during transit and storage. Gas seals or other methods proposed to be adopted for protection against moisture during transit shall be to the satisfaction of the engineer.
- 13.4** The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbols i.e. FRAGILE, HANDLE WITH CARE, USE NO HOOKS etc.
- 13.5** Each package delivered under the contract shall be marked by the Bidder at his expense and such marking must be distinct (all previous irrelevant marking being carefully obliterated). Such marking shall show the description and quantity of contents, the name of consignee and address, the gross and net weights of the package, the name of Bidder with a distinctive number of mark sufficient for purpose of identification.

All markings shall be carried out with such materials as to ensure quickness of drying, fastness and legibility.

- 13.6** Each Package shall contain a note quoting specifically the name of the Bidder, the number and date of contract or order and the name of office placing the contract, nomenclature of the stores and include a schedule of parts for each complete equipment giving the parts number with reference to the General Arrangement/ Assembly drawing and the quantity of each part, drawing number and tag numbers.
- 13.7** All equipment/ material shall be suitably packed for transport, carriage at site and outdoor storage during transit. The Bidder shall be responsible for any damage to the equipment during transit. The contents of each package shall bear marking that can be readily identified from the package list and packing shall provide complete protection from moisture, termites and mechanical shocks etc.
- 13.8** Any material found short inside the packing cases shall be supplied by the Bidder without any extra cost.
- 13.9** Notwithstanding anything stated in this clause the Bidder shall be entirely responsible for any loss, damage or depreciation to the stores.

14. DESPATCH OF EQUIPMENT

- 14.1** Detailed dispatch instructions will be intimated to the Bidder. All materials shall be dispatched by road.
- 14.2** The Bidder shall intimate, at least thirty (30) days in advance to the consignee as well as the concerned Superintending Engineer at site, the probable date when the equipment will be ready for dispatch from the works. Notification of delivery or dispatch in regard to each and every consignment shall be made to the Purchaser immediately after dispatch or delivery. The supplier shall further supply to the consignee a priced invoice and packing account of all stores delivered or dispatched by him. All packages, containers, bundles and loose materials forming parts of each and every consignment shall be described fully in the packing account, and full details of the contents of packages and quantity of material shall be given to enable the consignee to check the stores on arrival at destination.
- 14.3** A list in duplicate containing details of equipment for verification at site shall also be placed inside each package and shall correspond with the advice note. One additional copy of each of the package lists shall also be sent to the consignee.

15. TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

The Bidder shall supply type tested (including special test as per technical specification) equipments and materials. The test reports/details shall be furnished by the Bidder in the bid.

In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to non-compliance with the

requirement stipulated in the Technical Specification and/or IEC/ IS, same, shall be carried out without any additional cost implication to the Purchaser. The Purchaser reserves the right to get any or all type tests conducted/ repeated.

The reports for all type tests and additional type tests as per technical specification furnished by the Bidder shall be of the tests conducted within last 10(five) years prior to the date of bid opening. The type tests conducted should have either been conducted in accredited laboratory (accredited based on ISO/ IEC Guide 25/ 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by UPPTCL or representative authorized by UPPTCL or Utility or representative of accredited test lab or reputed consultant.

15.1 Pre-commissioning Tests

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

15.2 Commissioning Tests

- 15.2.1 The available instrumentation and control equipment will to be used during such tests and the Purchaser will calibrate, all such measuring equipment and devices as far as practicable.
- 15.2.2 Any special equipment, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.
- 15.2.3 The specific tests requirement on equipment have been brought out in the respective chapters of the technical specification.
- 15.2.4 The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning the equipment and the switchyard. However necessary fee shall be reimbursed by POWERGRID on production of requisite documents.

16. MATERIAL WORKMANSHIP

16.1 General Requirement

Where the specification does not contain references 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 purpose 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. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately

positioned and restrained to fulfil their required function. In general screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the 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 also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be considered as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, 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 manufacturer's limits.

Suitable guards shall be provided for the protection of personnel on all exposed rotating and/ or moving machine parts and shall be designed for easy installation and removal for maintenance purposes. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

The Bidder 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 Bidder 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 Bidder has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help Purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

A cast iron or welded steel base plate shall be provided for all rotating equipment which are 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 design with pads for anchoring the units and shall have a raised up all around and shall have threaded in air connections, of so required.

16.2 Provisions For Exposure to Hot and Humid climate

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

16.3 Space Heaters

The heaters shall be suitable for continuous operation at 240V AC supply. On-off switch and fuse shall be provided for the heater.

One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of coiled resistance wire centred in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conduction and electrical insulation properties, or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built into an envelope of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in glaze. The surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulator wire or other component in the compartments.

16.4 FUNGI STATIC VARNISH

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

16.5 Ventilation opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with

shutter type blinds and suitable provision shall be made so as to avoid any communication of air/ dust with any part in the enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc.

16.6 Degree of Protection

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

- a) Installed out door: IP- 55

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

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

16.7 RATING PLATES, NAME PLATES AND LABELS

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

All such nameplates, instructions plates, rating plates CB, CT, VT, SA, Isolators and Relay & Protection panels equipments shall be bilingual with Hindi inscription first followed by English.

Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

16.8 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

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

17. Surface finish

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly 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 painting 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 otherwise 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.

All external painting shall be as per shade No. 631 of IS: 5.

18. HOT DIP GALVANISING

All ferrous parts including all sizes of nuts, bolts, plain and spring washers, support channels, structures, shall be hot dip galvanized conforming to latest version of IS: 2629 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electrogalvanized.

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 6 mm. For items lower than 6mm thickness, requirement of coating shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq. m minimum.

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

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

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

19. PAINTING

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

19.2 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.

19.3 After application of the primer, two coats of finishing synthetic enamel paint shall be

applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.

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

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

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

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

19.6 COLOUR SCHEME AND CODES FOR PIPE SERVICE

The Bidder shall propose a colour scheme for the those equipments/ items for which the colour scheme has not been specified in the specification. For the approval of _____ The decision of _____ shall be final. The scheme shall include

- | | | |
|----|---|--|
| a) | For connecting ACSR/ AAC conductor | Aluminum alloy casting conforming to designation A6 of IS:617 and shall be tested for all tests as per IS:617 |
| b) | For connecting equipment terminals made of copper or ACSR conductor | Bimetallic connectors made from aluminum alloy casting conforming to designation A6 IS: 617 with 4mm thick cast copper lines and shall be tested as per IS:617 |
| c) | For connecting G.I.Shield wire | Malleable iron casting. |
| d) | Bolts, nuts and plain washers. | Hot dip galvanising mild steel |
| e) | Spring washers for items 'a' to 'c' | Electrogalvanised-suitable for at least 3 service conditions as per IS:3063 & IS:1573 |
| f) | Misc. | Mild steel. |

20.

21. CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

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

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

- 21.2** Necessary clamps and connectors shall be supplied for all equipment and connections. The requirement regarding external corona and RIV as specified for any equipment shall include its terminal fittings. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of work.
- 21.3** Where copper to aluminum connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress.
- 21.4** Low voltage connectors, grounding connectors and accessories for grounding allequipment as specified in each particular case, are also included in the scope of Work.
- 21.5** No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminum body or 2 mm thick bi-metallic strips shall be provided for Bi-metallic clamps.
- 21.6** All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
- 21.7** Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through (fixed/sliding) type connection of 4" IPS AL. tube as required. In both the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.
- 21.8** Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/connector is designed with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on the hardware.
- 21.9** All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- 21.10** Clamps and connectors shall be designed to be corona controlled.
- 21.11 Tests**
- Clamps and connectors should be type tested as per IS:5561 and shall also be subjected to routine tests as per IS:5561. Following type test reports shall be submitted for approval as per clause 9.2 above except for sl. no.(ii) & (iii) for which type test once conducted shall be applicable (i.e. the requirement of test conducted within last ten years shall not be applicable).
- I. Temperature rise test (maximum temperature rise allowed is 35°C over 50°C ambient)
 - II. Short time current test
 - III. Corona (dry) and RIV (dry) test (for 220 KV and above voltage level clamps)
 - IV. Resistance test and tensile test

22. CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

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- 22.1** All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS- 5039/ IS-8623, IEC-60439, as applicable, and the clauses given below.
- 22.2** Control cabinets, junction boxes, marshalling boxes and terminal boxes shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminum enclosed box, the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.
- 22.3** Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements. A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes/ Control cabinets to prevent ingress of rain water.
- 22.4** Cabinet/boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of the gasket shall be such that it does not get damaged/cracked during the operation of the equipment.
- 22.5** All doors, removable covers and plates shall be provided gasket all around with suitably profiled EPDM/Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan, IS:11149 and IS:3400. The quality of gasket shall be such that it does not get damaged/cracked during 10(ten) years of operation of the equipment or its major overhaul whichever is earlier.
- All gasketed surfaces shall be smooth straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters, the screen shall be fine wire mesh made of brass.
- 22.6** All boxes/ cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting at least 150 mm above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. Gland plate shall have provision for some future glands to be provided later, if required.
- 22.7** A 240V, single phase, 50 Hz, 15 amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.
- 22.8** For illumination, a 20 Watts fluorescent tube or 15 watts CFL/LED bulb shall be provided. The switching of the fittings shall be controlled by the door switch.

For junction boxes of smaller sizes such as lighting junction box, manual operated earth

switch mechanism box etc., plug socket, heater and illumination is not required to be provided.

- 22.9** All control switches shall be of rotary type. Toggle piano switches shall not be accepted.
- 22.10** Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire/ strip shall be terminated on to the earthing pad and secured by the use of self etching washer. Earthing of hinged door shall be done by using a separate earth wire.
- 22.11** The bay marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/ feruling by pasting the same on the inside of the door.
- 22.12** The following routine tests alongwith the routine tests as per IS: 5039 shall also be conducted:
Check for wiring
Visual and dimension check

The enclosure of bay marshalling kiosk, junction box, terminal box shall be type tested for IP-55 as per IS: 13947. After IP-55 test, 2.5 kVrms for 1 (one) minute, insulation resistance and functional test should be conducted.

22.13 Auxiliary Switches

All the auxiliary switches shall be fully type tested as per relevant IS.

The following type test reports on auxiliary switches shall be submitted:

- a) Electrical endurance test - A minimum of 2000 operation for 2A D. C. with a time constant greater than or equal to 20 millisecond with a subsequent examination of mV drop/visual defects/temperature rise test.
- b) Mechanical endurance test. A minimum of 1,00,000 operations with a subsequent checking of contact pressure test/visual examination.
- c) Heat run test on contacts.
- d) IR/HV test etc.

23. TERMINAL BLOCKS AND WIRING

- 23.1** Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All interphase and external connections to equipment or to control cubicles will be made through terminal blocks.
- 23.2** Terminal blocks shall be 1100 V grade and have continuous rating to carry the maximum expected current on the terminals. These shall be of moulded piece, complete with insulated/barriers stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals.

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- 23.3** But preferably the terminal blocks shall be non-disconnecting stud type of Elmex type CATM4, phoenix cage clamp type or equivalent. The insulating material of terminal block shall be nylon which shall be free of halogens, fluorocarbons etc.
- 23.4** Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.
- 23.5** The terminals shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.
- 23.6** The conducting part in contact with cable shall preferably be tinned or silver plated, however Nickel plated copper or zinc plated steel shall also be acceptable.
- 23.7** The terminal blocks shall be of extensible design.
- 23.8** The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.
- 23.9** The terminal blocks shall be fully enclosed with removable covers of transparent, non-deterioration type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.
- 23.10** Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.
- a) All circuits except CT circuits - Minimum of 2 nos. of 2.5 sq. mm copper flexible
 - b) All CT circuits - Minimum of 4 nos. of 2.5 sq.mm copper flexible
- 23.11** The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live.
- 23.12** At least 20% spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminal rows.
- 23.13** There shall be minimum clearance of 250 mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm.
- 23.14** The Bidder shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets.
- 23.15** All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The Bidder shall also provide necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

24. LAMPS & SOCKETS

24.1 Lamps

All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

24.2 Sockets

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

24.3 Hand Lamp

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

24.4 Switches and Fuses

Each panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breaker/ switchfuse units. Selection of the main and Sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

All fuses shall be of HRC cartridge type conforming to IS-9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints to the fuse rating and voltage. All control switches shall be of rotary type. Toggle piano switches shall not be accepted.

25. Bushings, Hollow Column Insulators, Support Insulators:

25.1 Bushings shall be manufactured and tested in accordance with IS:2099 & IEC-60137 while hollow column insulators shall be manufactured and tested in accordance with IEC-62155/IS:5621. The support insulators shall be manufactured and tested as per IS:2544/IEC-60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable. The bidder may also offer composite hollow insulators, conforming to IEC-61462.

25.2 Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

25.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.

25.4 Support insulators/bushings/hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

25.5 When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to

conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.

25.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

25.7 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by machining. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.

25.8 Tests

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

26. MOTORS

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

26.1 Enclosures

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

26.2 Operational Features

- a) Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point and the motor shall not be over loaded at any operating point of driven equipment that will rise in service.

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- b) Motor shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system having the particulars as given in Clause 15.0 of this Section.

26.3 Starting Requirements:

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

26.4 Running Requirements:

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

26.5 TESTING AND COMMISSIONING

An indicative list of tests is given below. Contractor shall perform any

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

(a) Insulation resistance.

(b) Phase sequence and proper direction of rotation.

(c) Any motor operating incorrectly shall be checked to determine the cause and the conditions corrected.

SECTION IV

GUARANTEED TECHNICAL PARTICULARS FOR AC-DC DISTRIBUTION BOARDS

For each type and rating of board proposed, the bidder shall provide the following information.

S.No.	PARTICULAR	Unit	AC BOARD	DC BOARD
1.00	GENERAL			
	a) Manufacturer's Designation			
	b) Type Designation			
1.1	Rated Voltage			
1.2	a) Symmetrical Short Circuit withstand current at rated voltage of switchgear/ MCC cubicle			
	b) Peak short circuit withstand current			
	c) Rated current at 50°C			
1.3	Degree of protection as per IS 13947 (IS 13947)			
	a) Breaker / MCC Cubicle			
	b) Busbar Chamber			
1.4	Cubicle sheet metal details			
	a) Cold rolled/ hot rolled			
	b) Thickness, structural & load bearing members			
	c) Thickness front and rear			
	d) Thickness, sides and top			
	e) Thickness of gland plates			
1.5	Painting shade and thickness of as per IS 5			
	a) External Surface			
	b) Internal Surface			
1.6	Minimum clearance in air (busbars)			
2.0	POWER BUSBARS & INSULATORS			
2.1	Material & applicable standards			
2.2	Bare/ painted/ epoxy/ insulated/ sleeved			
2.3	Bus joints silver faced			
2.4	Minimum Clearance			
	a) Phase to Phase			
	b) Phase to Earth			
2.5	Continuous Current Rating			
	a) at 40 deg C ambient			

Technical Specification
AC & DC BOARD

	b) at 50 deg C ambient			
2.6	Temperature rise over design ambient temperature of 50 deg C for continuous current rating (deg. C)			
2.7	Cross sectional area per phase for different ratings			
	a) Horizontal Busbars			
	b) Vertical Busbars			
2.8	Material of the Support Insulators			
2.9	Tracking Index of Insulators			
2.10	One Second Current rating			
3.0	AIR BREAK SWITCHES			
3.1	Make			
3.2	Type			
3.3	Applicable Standards			
3.4	Rated current at design ambient temperature			
3.5	Design Ambient temperature in deg C			
3.6	Derating factor for use under site ambient conditions			
3.7	Rated breaking current			
3.8	Maximum through fault withstand current			
3.9	Maximum size of fuse recommended			
3.10	Temp. rise of contacts when carrying continuous rated current			
3.11	Door interlock as specified has been provided			
3.12	No. of auxiliary contacts and its rating			
4.0	CONTACTOR			
4.1	Make			
4.2	Type and applicable standards			
4.3	No. of poles			
4.4	No. and configuration of auxiliary contacts			
4.5	Rated Voltage of coils			
4.6	Limits of operation			
	a) Supply Voltage Variation (±) %			
	b) Supply frequency variation (±) %			
	c) Drop off Voltage %			
4.7	Rated (thermal) current			
4.8	Rated Duty			
4.9	Rated Utilization Category as per IS 2459 (IS 13947)			

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AC & DC BOARD

4.10	Rated breaking capacity			
4.11	Rated making capacity			
4.12	Coil winding insulation			
4.13	Rated making capacity			
4.14	Max. Recommended back up HRC fuse size			
4.15	Coil VA burden			
5.0	AUXILIARY CONTACTOR			
5.1	Make			
5.2	Type			
5.3	Coil Burden (VA)			
5.4	Operating Time (ms)			
5.5	No. of contacts			
	a) Normally Open			
	b) Normally Closed			
5.6	Contact rating			
6.0	FUSES (FOR EACH TYPE & RATING)			
6.1	Make			
6.2	Type			
6.3	Applicable Standards			
6.4	Rated Voltage			
6.5	Prospective Breaking Current			
6.6	Peak cut-off current			
6.7	Whether mounted on an insulated carrier			
7.0	SPACE HEATER			
7.1	Make			
7.2	Type Designation			
7.3	Rated Voltage			
7.4	Heater Output (W)			
7.5	Thermostat - Type , Make and Setting range (°C)			
8.0	WIRING & TERMINAL BLOCKS			
8.1	Voltage grade of wires			
8.2	Insulation of wires			
8.3	Minimum size of conductor for			
	a) Power Wiring (sq. mm)			
	b) Control wiring (sq. mm)			
8.4	Type of control wiring terminal blocks on			

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AC & DC BOARD

	a) fixed portion and draw-out portion of draw-out MCC modules			
	b) switchgear panels			
	c) for CTs			
8.5	Make & type of terminal blocks			
8.6	Minimum current rating of terminal blocks			
8.7	Suitable for 2x2.5 sq. mm cable termination on each side			
9.0	MCB/ MCCB/			
9.1	Maker's name & country of manufacture			
9.2	Applicable standards			
9.3 a)	Nominal voltage class			
b)	Rated maximum voltage			
9.4	Number of poles			
9.5	Rated normal current			
a)	Under normal conditions			
b)	Under site conditions			
9.6	Rated frequency			
9.7	Rated short circuit breaking current			
a)	RMS value of a. c. component			
b)	Duration of short circuit			
c)	Rated short circuit making current			
9.8	Rated operating sequence			
9.9 a)	Opening time at 100% rated breaking current			
b)	Arcing time at 100% rated breaking current			
c)	Closing time			
9.10	Maximum rise of temperature over ambient for current rating under item 5 (b) above.			
9.11	No of auxiliary contacts provided for owner's use			
9.12	Number of breaks in series per pole			
9.13	Type of main contact			
9.14	Type of arcing contacts / or arc control device			
9.15	Material of contacts			
a)	Main			
b)	Arcing			
c)	If silver plated, thickness of coating			
9.16	Insulation level of breaker One minute power frequency withstand voltage			

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AC & DC BOARD

9.17	Clearances			
a)	Between phases			
b)	Between live part and earth			
c)	Centre to centre distance between phases			
d)	Safety boundaries during the breaking operation			
9.18	Whether circuit breaker is fixed trip or free			
9.19	Method of closing			
a)	Normal			
b)	Emergency			
9.20	Type of closing mechanism			
9.21a	Normal voltage of closing coil			
b)	Pick up range			
9.22a	Auxiliary power at normal voltage of closing mechanism			
b)	Power at 85% of normal voltage			
9.23	Type of tripping mechanism			
9.24	Normal voltage of tripping coil			
9.25a	Power at normal voltage for tripping coils			
b)	Power at 85% of normal voltage for tripping coils			
10.0	INSTRUMENTS			
10.1	Make			
10.2	Type			
10.3	Dial Size			
11.0	INSTRUMENT TRANSFORMERS			
11.1	Make			
11.2	Type			
11.3	Rated Voltage			
11.4	Ratio			
11.5	Accuracy and Limit factor			
11.6	Rated Burden			
12.0	RELAYS			
12.1	Make			
12.2	Type			
12.3	Rated Voltage			
12.4	Accuracy and Limit factor			
12.5	Rated Burden			
12.6	1 min power frequency withstand voltage			

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12.7	Power supply required			
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PROJECT : 400/220/132 kV UPPTCL GIS SS at Rasra, Ballia (U.P.)
CUSTOMER : UP POWER TRANSMISSION CORPORATION LTD. (UPPTCL)
Technical Specification of LT SWITCHGEAR
Section-1: Scope, Specific Technical Requirements & Quantities

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SECTION-5 **CHECKLIST**

FURNISH 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.

b) The evaluation of bidder against technical requirement criteria specified under Annexure-A of Section –I of technical specification shall be based on the documentary proof submitted by bidder along with the offer.

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

BHEL ENQUIRY NO.:

BIDDER OFFER REFERENCE:

EQUIPMENT: LT AC / DC Boards

S.No.	Qualifying criteria (Annexure-A of Section-I)	Documentary proof required	Yes/No	Remarks
1	The Manufacturer whose LT Switchgear are offered, should be a manufacturer of LT Switchboards of the type and rating being offered. He should have designed manufactured, tested and supplied at least 50 nos. draw out circuit breaker panels, out of which at least 5 nos. should have been with relay and protection schemes with current transformer. He should have also manufactured at least 50 nos. MCC panels comprising of MCCBs (i.e. Moulded Case Circuit Breakers) modules of the type offered which should be in successful operation as on date of bid opening i.e 17.04.2018	Documentary proof attached	Yes	
2	The Switchgear items (such as circuit breakers, fuse switch units, contactors etc.), may be of his own make or shall be procured from reputed manufacturers and of proven design. At least one hundred circuit breakers of the make and type being offered shall be operating satisfactory as on date of bid opening i.e 17.04.2018	Documentary proof attached	Yes	
3	Offered equipment should have given three years proven trouble free operational service in tropical climate.	Documentary proof attached	Yes	

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S. No.	Parameters	Data	Yes/No	Remarks
1.	Applicable Standards	IS 8623, IS 13947 PART-II , IEC 60255, IS 2026	Yes	
2.	Type of Boards	Metal enclosed, indoor floor mounted , compartmentalized double front construction and free standing	Yes	
3	Module type	All modules shall be fixed type except air circuit breaker module ,which shall be draw out type	Yes	
4	Ingress Protection requirement	Shall be as per clause 6.1.5 of Section 2	Yes	
5	Lightning Transformer	Shall meet requirements mentioned in Annexure-2	Yes	
6	Special tools & tackles	List of special tools and tackles (which are proprietary in nature) is attached	Yes	
6	Offered Boards	Bidder has quoted for the AC/DC distribution boards in line with the specification	Yes	
7	Addition / deletion	Bidder has quoted addition /deletion prices for each and every type of complete module (as mentioned in BOQ. Annex-1)	Yes	
8	Automatic Control of Outdoor lighting	In line with clause 6.28 of Section 2 , EL-Type module of 415V MLDB and ELDB shall be controlled by timer and contactor module to facilitate its operation automatically	Yes	
9	Automatic changeover	Automatic changeover as per clause 6.29 of Section 2 shall be met.	Yes	
10	Analogue Input for SAS interface	Shall meet requirements mentioned in Annexure-2	Yes	
11	Digital Input for SAS interface	Shall meet requirements mentioned in Annexure-2	Yes	
12.	Cubicle Colour finish	a) Interior: Glossy White b) Exterior: Smoke grey shade No. 692 of IS:5	Yes	
13.	Type test reports	Type test reports furnished shall be in line with clause 6.22 of Section-2	Yes	
14.	Type test	The type test reports submitted shall be of tests conducted after 17.04.2013 . If type test reports are	Yes	

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		not acceptable to UPPTCL /BHEL then above tests shall be conducted by the bidder free of cost		
15	Conformation to the Minimum indicative requirement of Analog signals, Potential Free contacts & Command signals. Refer Signal Chart mentioned in SLD drawing.	This should be available at respective equipment for remote indication & control from Auxiliary BCU located in S/s control room.		
16.	Quotation for items	Bidder has also quoted for Unit Rate items and Mandatory spare items mentioned in BOQ.	Yes	
17.	Supervision of ETC	Bidder has quoted for Supervision of Erection Testing & Commissioning of LT Switchboards.	Yes	
18	Control Wiring	2.5sqmm., 1100V grade, PVC insulated stranded Cu cable	Yes	
19	Supply of unit rate items, if not quoted	If any of the unit rate items is not quoted, but is required due to damages, theft, replacement, change in feeder rating etc. or any other reason during execution, the required quantity shall be supplied free of cost within guarantee period.	Yes	

ANNEXURE - C
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
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Any deviation not specifically brought out in this section shall not be admissible for any commercial implication at later stage. Except to the technical deviations listed in this schedule, bidder's offer shall be considered in full compliance to the tender specifications irrespective of any such deviation indicated / taken elsewhere in the submitted offer.

Date:

Tenderer's Stamp & Signature