



BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS HVDC ENGINEERING & SYSTEMS

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	TYPE OF DOC.	TECHNICAL SPECIFICATION				SIGN			
	TITLE LT Switchgear					NAME	MSP	SKS	AG
						DATE	07.08.19	07.08.19	07.08.19
						GROUP	TBEM	W.O. No	88009
	Customer	UTTAR PRADESH TRANSMISSION CORPORATION LTD (UPPTCL)							
	PROJECT	400/220/132 kV GIS SUBSTATION AT SHAMLI, U.P.							
	LOA NO.	1311/ESD-8/126/III/400 kV SHAMLI dtd 14.11.2018							
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SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS & QUANTITIES

1.0 SCOPE

This technical specification covers the requirements of design, manufacture, assembly, testing and inspection at works, packing, loading at works and transport to *site*, supervision of erection-testing & commissioning of metal enclosed , indoor floor mounted, compartmentalised double front construction and free standing type LT Switchgear (AC & DC distribution boards) as per specification complete in all respects and including all fittings and accessories required for efficient and trouble-free operation.

The scope shall encompass and include all the activities listed above.

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.

The equipment is required for the following project:

Name of customer: Uttar Pradesh Transmission Corporation Ltd (UPPTCL)

Name of Projects: 400/220/132 kV GIS Substation at Shamli, U.P.

The fitment and equipments offered shall be of approved make of UPPTCL or its subsequent approval from UPPTCL shall be bidder's responsibility with no commercial implications to BHEL. If any of the make offered by the bidder is not acceptable to M/s UPPTCL, the bidder has to supply alternate UPPTCL approved make, meeting the specification, with no commercial implications to BHEL.

1.1 **CODES & STANDARDS:**

The equipment and accessories covered under this specification shall be designed, manufactured and tested in accordance with latest editions of standard listed in Section-2 and other relevant standards.

The specification comprise of following sections:

Section-1: Scope, Specific Technical Requirements and Quantities

Section-2: UPPTCL Equipment Specification

Section-3: Project Details & General Specification

Section-4: Guaranteed Technical particulars (GTP)

Section-5: Checklist

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

Note: The term 'Owner' appearing in this specification shall refer to UPPTCL, the term 'Purchaser' shall refer to BHEL and the term 'Contractor' shall refer to the successful Bidder.

1.1 SPECIFIC TECHNICAL REQUIREMENTS:

Please refer enclosed SLD for LT AC & DC system (Doc no: TB-0-406-316-011 rev.00)

Refer Section-2 for other technical requirements.

Refer Section - 3 for Project Details and General Specifications.

1.2 Bill of Quantities:

- a) Bidder must quote prices for addition/deletion item for each type of complete module (Type of modules defined in Section-2), which may be required to account for any changes (addition/deletion) in the Single line diagram during detailed engineering stage.
- b) For details of the components/fitments in the module, refer Section-2 & Single Line diagram.
- c) Rated capacity, type & fault ratings of boards shall be as per SLD.
- d) The types of modules as required in the LT AC/DC Boards is as below:
 - (i) Module Type AE : Refer clause 6.26.4 of Section 2
 - (ii) Module Type M1 : Refer clause 6.26.5 of Section 2
 - (iii) Module Type E : Refer clause 6.26.6 of Section 2
 - (iv) Module Type G - 1 : Refer clause 6.26.7 of Section 2
 - (v) Module Type G - 2 : Refer clause 6.26.8 of Section 2
 - (vi) Module Type H & H (BC) : Refer clause 6.26.9 of Section 2
 - (vii) Module Type S : Refer clause 6.26.10 of Section 2
 - (viii) Module Type X : Refer clause 6.26.11 of Section 2
 - (ix) Module Type DC : Refer clause 6.26.12 of Section 2
 - (x) Module Type DG - 1 : Refer clause 6.26.13 of Section 2
 - (xi) Module Type H1 : Refer clause 6.26.14 of Section 2
 - (xii) Module Type EL : Refer clause 6.26.15 of Section 2

1.3 TYPE TESTS

- 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 07.09.2013. 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.

In the event that equipment furnished includes important modifications of, or significant departure from, the designs of equipment on which type test report has been furnished or if there is evidence that the equipment does not comply with the requirements of the Specifications, type test procedure was not properly followed as laid down in standards, the bidder shall conduct the type test without any cost implication to the Employer.

In case equipments of same design and rating are supplied under this contract from different works, they shall be type tested separately.

Acceptance of the type test reports shall be at the discretion of the employer. All type tests performed after the date of award of the contract shall be witnessed by the Employer unless authority to proceed with the tests in his absence is received from the employer in writing.

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 year) 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.

Annexure-1: Bill of Quantities**A) Bill of quantities for main items**

Sl. No	Item Description	Units	Qty
a.	3-phase, 4-wire, 1250A, 25kA for 1 sec , 415 V Main Switchboard-1A	Set	1
b.	3-phase, 4-wire, 800A, 20kA for 1 sec , 415V AC Distribution Board-2A	Set	1
c.	3-phase, 4-wire, 500A, 415V Main Lighting DB-3A (including 2 no. 150kVA, 415/415V Lighting Transformer)	Set	1
d.	3-phase, 4-wire, 500A, 415V Emergency Lighting DB-5A (including 1 no. 150kVA, 415/415V Lighting Transformer)	Set	1
f.	220V, 400A, 20kA (DC) for 1 sec, 220V DCDB-1D	Set	1
g.	220V, 400A, 20kA (DC) for 1 sec, 220V DCDB-2D	Set	1
g.	48V, 400A, 20kA (DC) for 1 sec, 48V DCDB-3D	Set	1
h.	48V, 400A, 20kA (DC) for 1 sec, 48V DCDB-4D	Set	1

B) Bill of quantities for mandatory spares

Sl. No	Item Description	Units	Qty
	L.T. Switchgear		
i)	Relays (1 no. of each type and rating)	Set	1
ii)	CTs and PTs (1 no. of each type and rating)	Set	1
iii)	Switches/ Push buttons and Meters (1 no. of each type)	Set	1
iv)	TPN Switches/ MCB (1 no. of each type and rating)	Set	1
v)	MCCB (1 no. of each type and rating)	Set	1
vi)	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 no. of each type and rating)	Set	1
f)	Arcing contacts (Fixed/Moving) (1 no. 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 no. of each type and rating)	Set	1
k)	Limit Switches (1 no. of each type and rating)	Set	1
l)	Jaw contacts (1 no. of each type and rating)	Set	1
m)	Busbar insulators	Nos	5
n)	Interphase barrier	Nos	2
o)	Busbar strip 1mm (Aluminium)	Mtr	5

C) Bill of quantities for Services:

Sl. No	Item Description	Units	Qty
i)	Supervision of Erection Testing & Commissioning.	Lot	1

D) Unit Rate items:

Sl. No	Item Description	Units	Qty
i)	Module Type AE-1250A	No.	1
ii)	Module Type AE-800A	No.	1
iii)	Module Type AE-630A	No.	1
iv)	Module Type E-500A	No.	1
v)	Module Type E-400A	No.	1
vi)	Module Type E-200A	No.	1
vii)	Module Type E-100A	No.	1
viii)	Module Type E-63A	No.	1
ix)	Module Type X-32A	No.	1
x)	Module Type X-40A	No.	1
xi)	Multi Function meter (MFM)	No.	1

NOTE:

- 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).
- Quoting for unit prices is mandatory and shall be considered for evaluation.
- 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.
- It will be the bidders responsibility to organise deputation of OEM of protection relays and devices for configuration & setting at site (multiple visits may be required as per site readiness, which shall be informed by site as and when required). Equipment required for testing of protection relays is in Bidders scope. The prices of this activity shall be deemed to be included in prices for services.

ANNEXURE-B: TECHNICAL REQUIREMENT

SR. No.	Description	Supporting Documents to be attached							Reference of Docs. attached																
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. 07.09.2018. 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. 07.09.2018. #: 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>Sl. No.</th><th>Items Supplied to</th><th>Order ref.</th><th>Items</th><th>Qty</th><th>Order fully executed</th><th>Status if order under execution</th><th>Remarks if any</th></tr><tr><td colspan="8"></td></tr></table> 4. Type test certificates 5. Dispatch instructions/ Material receipt at site/ lorry receipt details etc. 6. Factory License and certificate							Sl. No.	Items Supplied to	Order ref.	Items	Qty	Order fully executed	Status if order under execution	Remarks if any									
Sl. No.	Items Supplied to	Order ref.	Items	Qty	Order fully executed	Status if order under execution	Remarks if any																		

SECTION-2

LT SWITCH GEAR
(AC & DC DISTRIBUTION BOARDS)

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

CONTENTS

Clause No.	Particulars
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4.0	Interchangeability
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6.1	Constructional Details of Switch Board and Distribution Boards
6.2	Derating of Equipments
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6.11	Indicating Instruments
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6.19	Space Heater
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6.25	Special Tools and Tackles
6.26	Equipment to be Furnished
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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 :-

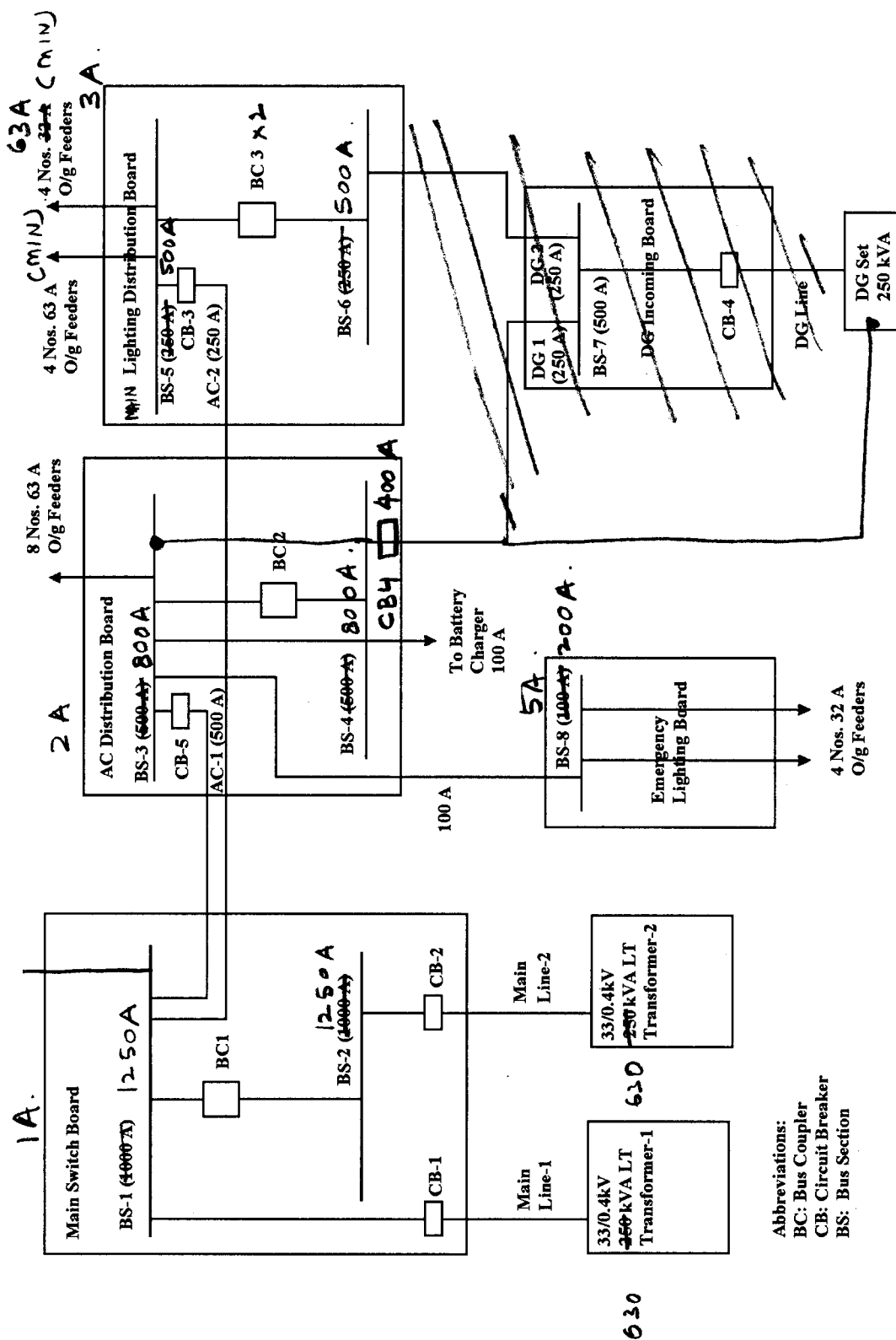
- i) Under normal conditions i.e. when supply is available in both the incomers, incomers I&II of 415 V Main switchboard, ACDB shall be in closed condition and Bus couplers and DG set breaker shall be in open condition.
- ii) In case of failure of either of the sources, the incomer of that source shall 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.

LT PANELS AC DISTRIBUTION ARRANGEMENT

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.

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
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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 Buchholz Alarm & trip
- vii) LT transformer-II Buchholz 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

GENERAL TECHNICAL REQUIREMENTS OF SPECIFICATIONS (GTR)

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GENERAL TECHNICAL REQUIREMENTS OF SPECIFICATIONS (GTR)

1.0 GENERAL

This section stipulates the General Technical Requirements (GTR) under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under respective equipment sections and are not exclusive. However in case of conflict between the requirement specified in this section and requirements specified under respective equipment sections, the requirements specified under respective sections shall hold good.

Every effort will be made to supply all equipment as per the technical details furnished in the specification. However, due to the standard manufacturing practice of various equipment suppliers and depending on the selected vendor, there may be slight variations from indicated values at the contract stage. Such variations should not affect the quality and performance of the equipment.

It is not the intent to specify completely in technical specifications of equipments/ materials all details of the design and construction of equipment. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation. The Purchaser will interpret the meaning of drawing and specification and shall have the power to reject any work or material which in his judgement is not in accordance therewith. The equipment offered shall be complete with all components necessary for its effective and trouble free operation. Such components shall be deemed to be within the scope of Bidder's supply, irrespective of whether these are specifically brought out in this specification and/or commercial order or not.

2.0 COMPLETENESS OF EQUIPMENTS

2.1 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.

2.2 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.

3.0 STANDARDS

3.1 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.

3.2 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.

3.3 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.

3.4 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.

3.5 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.

3.6 REFERENCE OF STANDARDS

Reference	Abbreviation	Name and Address
IEC/ CISPR	International Electro technical Commission	Bureau Central de la Commission, Electro Technique International, 1 Rue de verembe Geneva, Switzerland
IS	Indian Standards,	Bureau of Indian Standard, Manak Bhavan, 9, Bahadur Shah Zafar Marg, New Delhi-110 002, INDIA

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

4.0 PROJECT DATA

i.	Location	UTTAR PRADESH
ii.	Altitude	not exceeding 1000 Meters
iii.	Climatic Conditions	
(a)	Design maximum ambient Air Temperature	50 ⁰ C
(b)	Minimum ambient air temperature in shade	0 ⁰ C
(c)	Relative Humidity	100%Max.
(d)	Wind Load	195 Kg./ Sq.m.
(e)	Seismic Level	0.3 g
(f)	Isoceraunic Level	50days/ year
(g)	Average annual rain fall	1200 mm
(h)	Hot and humid tropical Climate conducive to rust and fungus growth	

5.0 SYSTEM PARTICULARS

(i)	Rated System voltage	420 kV, 245kV, 145kV, 36kV
(ii)	System frequency	50 Hz, This may vary by $\pm$ 5%
(iii)	Number of phases	Three
(iv)	Neutral	Effectively Earthed
(v)	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	2wire ungrounded DC supplies
(i)	400 kV S/S	: 220V DC (ii)
	220/132kV S/S	: 110V DC (iii)
	Communication equipment	: 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

6.0 SYSTEM PARAMETERS

The following system parameters shall prevail:

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	31.5 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	1000 microvolt	1000 microvolt	500 microvolt	-
10.	Minimum total creepage	25mm/ kV (10500 mm)	25mm/ kV (6125 mm)	25mm /kV (3625 mm)	25mm/kV (1300 mm)
11.	Min. clearances				
	i. Phase to phase	4000mm (for Conductor- conductor) 4200mm (for rod - Conductor)	2100 mm	1300 mm	320 mm
	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	Effectively Earthed	Effectively Earthed	Effectively Earthed

Major technical parameters of bushings/ hollow column/ support insulators are given below:

Sl. No	Parameters	400 kV System	220 kV System	132 kV System	33 kV System
(a)	Max. System voltage Um (kV)	420	245	145	36
(b)	Impulse withstand voltage (dry & wet) (kVp)	± 1425	± 1050	± 650	±170
(c)	Switching surge withstand voltage (dry & wet) (kVp)	1050	-	-	-
(d)	Power frequency withstand voltage (dry and wet) (kV rms)	650	460	275	75
(e)	Total creepage distance(min) (mm)	10500	6125	3625	900

Insulator shall also meet requirement of IEC- 815 for 420kV, 245kV, 145kV and 36kV systems, as applicable having alternate long and short sheds.

7.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT

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

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.

The Bidder shall design the various forces which the terminal connectors of the equipment are required to withstand.

All outdoor EHV equipments except marshalling kiosks shall be suitable for hot line washing.

To facilitate erection of equipment, all items to be assembled at site shall be "match marked".

8.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

8.1 Each equipment shall be supplied with necessary terminals and connectors as required by the design for the particular installation. The terminal connector shall be suitable for the conductor used for particular installation, which are as under as per UPPTCL's practice:

8.2 Where copper to aluminum connections are required, bimetallic 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 part which are not current carrying or subjected to stress. The design details of the joint shall be furnished to the Purchaser by the Bidder.

- 8.3** Low voltage connectors, grounding connectors and accessories for grounding all equipment are also included in the scope of work.
- 8.4** No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanized. Copper alloy liner of minimum 2 mm thickness shall be used with aluminum body for Bimetallic clamps.
- 8.5** All casting shall be free from blow holes, surface blisters cracks and cavities. Sharp edges and corners shall be blurred and rounded off.
- 8.6** 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.
- 8.7** The clamps/ connectors 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 specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on hardware.
- 8.8** All current carrying parts shall be designed and manufactured to have minimum contact resistant.
- 8.9** Clamps and connectors shall be designed to be corona controlled. Corona extinction voltage for 420kV, 220kV and 132kV class clamps shall not be less than 320, 156 and 105kV (rms) respectively and R.I.V. level shall not be more than specified 1000, 1000 and 500 micro volts for 420kV, 220kV and 132kV system at the test voltage specified.

9.0 SUPPORT STRUCTURES

- 9.1** 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.
- 9.2** All equipment support structures shall be supplied alongwith brackets, angles, stools etc. for attaching the operating mechanism, control cabinets and marshalling box (wherever applicable) etc.
- 9.3** The support structures should be hot dip galvanised with minimum 610 gram/sq.m net of zinc.

10.0 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 purchaser. The decision of Purchaser shall be final. The scheme shall include.

Finishing colour of Indoor equipment.

Finishing colour of Outdoor equipment.

Finish colour of all cubicles.

Finishing colour of various auxiliary system equipment including piping

Finishing colour of various building items.

All steel structures, plates etc. shall be painted with non-corrosive paint with a suitable primer. It may be noted that normally all electrical equipments in switchyard are painted with shade 631 of IS-5. The indoor cubicles, GIS enclosures and other miscellaneous items, the colour scheme shall be approved by the Purchaser during detailed engineering.

11.0 MATERIAL/ WORKMANSHIP

11.1 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 fulfill their required function. In general screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the 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.

11.2 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.

12.0 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 centered 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.

13.0 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.

14.0 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.

15.0 DEGREE OF PROTECTION

The enclosures of the Control Cabinets, junction boxes and Marshalling Boxes, panels etc. to be installed shall be provided with 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 :13947 (Part-I)/ IEC-60947 (Part-I)/ IS 12063 / IEC-60529. Type test report for degree of protection test, on each type of the box shall be submitted for approval.

16.0 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.

17.0 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.

18.0 PACKAGING AND PROTECTION

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. The Bidder shall also submit packing details/associated drawing for any equipment/material, to facilitate the Purchaser to repack any equipment/material at a later date. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Bidder.

All coated surfaces shall be protected against abrasion, impact, discolouration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protectin device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

19.0 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.

20.0 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 electro-galvanized. 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.

21.0 PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotation and/of moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

22.0 TOOLS AND TACKLES

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

23.0 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

- 23.1** 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.
- 23.2** 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.
- 23.3** 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.
- 23.4** 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.
- 23.5** 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.

23.6 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.

23.7 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.

23.8 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.

23.9 All control switches shall be of rotary type. Toggle piano switches shall not be accepted.

23.10 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.

23.11 The bay marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/ wiring by pasting the same on the inside of the door.

23.12 a) The following routine tests alongwith the routine tests as per IS: 5039 shall also be conducted.

Check for wiring
Visual and dimension check

b) 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.

23.13 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.

24.0 TERMINAL BLOCKS AND WIRING

- 24.1** 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.
- 24.2** 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. 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 6.6 which shall be free of halogens, fluorocarbons etc.
- 24.3** Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.
- 24.4** 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.
- 24.5** The conducting part in contact with cable shall preferably be tinned or silver plated, however Nickel plated copper or zinc plated steel shall also be acceptable.
- 24.6** The terminal blocks shall be of extensible design.
- 24.7** The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.
- 24.8** 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.
- 24.9** 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 |
- 24.10** The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live.

- 24.11** 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.
- 24.12** 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.
- 24.13** 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.
- 24.14** All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The 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.

25.0 LAMPS AND SOCKETS

25.1 Lamps

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

25.2 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.

25.3 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.

25.4 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.

26.0 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS

26.1 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 silicon rubber insulator, conforming to IEC-61462.

26.2 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.

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

26.4 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.

26.5 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.

26.6 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.

26.7 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.

26.8 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.

27.0 MOTORS

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

27.1 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.

27.2 Operational Features

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

27.3 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, 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.

27.4 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.

27.5 TESTING AND COMMISSIONING

The Bidder shall conduct following tests alongwith list of instruments and calibration certificates to the Purchaser. If any additional test is required the same shall be conducted without any extra cost to the Purchaser.

- (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.

28.0 TECHNICAL REQUIREMENT OF EQUIPMENTS

28.1 Circuit Breakers (Applicable for 400kV, 220kV & 132 kV)

- 28.1.(i) The manufacturer(s) whose SF6 Circuit Breaker are offered should have designed, manufactured tested as per IEC/IS or equivalent standard supplied the same for the specified system voltage and **40kA/ 50kA fault level or above class** which are in satisfactory operation for at least 2 (two) years as on the date of bid opening

Or

- 28.1.(ii)(a) The manufacturer(s) whose SF6 Circuit Breaker are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no 28.1.(i) given above.

And

- 28.1.(ii)(b) Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

And

- 28.1.(ii)(c) Furnishes a confirmation letter from the parent company or collaborator along with the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder

28.2 Isolators (Applicable for 400kV, 220kV & 132kV)

- 28.2.(i) The manufacturer whose isolator are offered, should have designed, manufactured & tested as per IS/IEC or equivalent standard and supplied the isolator for the specified system voltage and **40kA/ 50kA fault level or above class** and should be in satisfactory operation for at least 2 (two) years as on the date of bid opening

Or

- 28.2.(ii)(a) The manufacturer(s) whose Isolator are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a

parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no 28.2.(i) given above.

And

- 28.2.(ii)(b) Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

And

- 28.2.(ii)(c) Furnishes a confirmation letter from the parent company or collaborator along with the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder

28.3 Instrument Transformers (Applicable for 400kV, 220kV & 132kV)

- 28.3.(i) The manufacturer whose instrument transformers are offered, should have designed, manufactured & tested as per IS/IEC or equivalent standard and supplied the same for the specified system voltage for CT & VT and 40kA/ 50kA fault level or above class. These equipment should be in satisfactory operation for at least 2 (two) years as on the date of bid opening

Or

- 28.3.(ii)(a) The manufacturer(s) whose Instrument Transformer are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no 28.3.(i) given above.

And

- 28.3.(ii)(b) Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

And

- 28.3.(ii)(c) Furnishes a confirmation letter from the parent company or collaborator alongwith the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder

28.4 Surge Arresters (Applicable for 400kV, 220kV & 132kV)

- (a) The manufacturer whose Surge Arresters are offered should have designed, manufactured and tested as per IEC/IS or equivalent standard and supplied the Surge Arrester for the specified energy capability with rated system voltage and which are in satisfactory operation for at least 2 (two) years as on the date of bid opening.

Or

- (b) The manufacturer(s) whose Surge Arrestors are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no (a) given above.

And

Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to

guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

And

Furnishes a confirmation letter from the parent company or collaborator alongwith the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder.

28.5 220 kV Grade XLPE Power Cables

The cable shall be from the manufacturer who must have designed, manufactured, type tested and supplied in a single contract at least 15 (fifteen) km of single core, 220kV or higher grade XLPE insulated cable which must be in operation for at least 2 (two) years as on the date of bid opening.

28.6 132 kV Grade XLPE Power Cables

The cable shall be from the manufacturer who must have designed, manufactured, type tested and supplied in a single contract at least 15 (fifteen) km of single core, 132kV or higher grade XLPE insulated cable which must be in operation for at least 2 (two) years as on the date of bid opening.

28.7 33 kV Grade XLPE Power Cables

The cable shall be from the manufacturer who must have designed, manufactured, type tested and supplied in a single contract at least 15 (fifteen) km of single core, 33kV or higher grade XLPE insulated cable which must be in operation for at least 2 (two) years as on the date of bid opening.

28.8 1.1 kV Grade Power & Control Cables

28.8.1 Applicable for PVC Control Cable

The manufacturers, whose PVC control cables are offered, should have designed, manufactured, tested and supplied in a single contract at least 100 kms of 1.1 kV grade PVC insulated control cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 27C x 2.5 Sq.mm or higher size as on the date of bid opening.

28.8.2 Applicable for PVC Power Cable

The manufacturer, whose PVC Power Cables are offered, should have designed, manufactured, tested and supplied in a single contract atleast 100 kms of 1.1 kV or higher grade PVC insulated power cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 1C x 150 Sq. mm or higher size as on the date of bid opening.

28.8.3 Applicable for XLPE Power Cables

The Manufacturer, whose XLPE Power cables are offered, should have designed, manufactured,

tested and supplied in a single contract atleast 25 kms of 1.1 kV or higher grade XLPE insulated power cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 1C x 630 Sq. mm or higher size as on the date of bid opening.

28.9 LT Switchgear

28.9.1 The Manufacturer whose LT Switchgear are offered, should be a manufacturer of LT Switchboards of the type and rating being offered. He should have designe 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 (ie Moulded Case Circuit Breakers) modules of the type offered which should be in successful operation as on date of bid opening.

28.9.2 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.

28.10 Battery and Battery Charger

28.10.1 Requirements for Battery Manufacturers

The manufacturer whose Batteries are offered should have designed, manufactured and supplied DC Batteries of the type specified and being offered, having a capacity of at least 600 AH and these shall be operating satisfactorily for two years in power sector and/or industrial installations as on date of bid opening.

28.10.2 Requirements for Battery Charger Manufacturers

The manufacturer, whose Battery Chargers are offered, should have designed, manufactured and supplied Battery Chargers generally of the type offered, with static automatic voltage regulators and having a continuous output of at least ten (10) kW and these should be in successful as on the date of bid opening.

28.11 LT Transformers

The manufacturer, whose transformers are offered should have designed, manufactured, type tested including short circuit test as per IEC/IS or equivalent standards and supplied transformers of at least 33 kV class of 800 kVA or higher. The transformer should have been in successful operation for at least 2 years as on the date of bid opening.

28.12 Fire Fighting System

The bidder or his sub-vendor should have designed, supplied, tested, erected and commissioned at least one number fire protection system of the each type described in (i), (ii), (iii) and (iv) below in installations such as power plants, substations, refineries, fertilizer plants or other industrial or commercial installations. Such systems must have been designed to the recommendations of Tariff Advisory Committee of India or any other international reputed

authority like (FOC, London or NFPA, USA etc.) executed during last ten (10) years and should have been in successful operation for at least 2 (two) years as on the date of bid opening.

- i) Nitrogen Injection Fire Prevention cum Extinguishing System
- ii) Portable Fire Extinguishers
- iii) GI Buckets – 9.0 liters capacity and Steel stand for Buckets
- iv) Fire Detection and Alarm System

In case bidder himself do not meet the requirement of design, he can engage a consultant(s) who must have designed the above system, which must be in successful operation for at least two years as on the date of bid opening.

28.13 Control and Relay Panels (400 kV, 220 kV, 132 kV & 33 kV)

The manufacturer whose Control, Relay & Protection System (Control & protection Intelligent Electronic Devices (IEDs)), and Sub-station Automation System (If applicable) are offered should have designed, manufactured, tested, installed and commissioned Control, Relay & Protection system along with Sub-station Automation System which must be in satisfactory operation on specified voltage level or above for atleast 2 (two) years on the date of bid opening.

AND

The Manufacturer or their joint venture or subsidiary company must have established repair, testing and integration (for at least 4 bays) facilities for Control, Relay & Protection System and Sub-station Automation System in India.

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1.0 General

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

2.0 Test Levels

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

3.0 Test Methods for RIV

3.1 RIV tests shall be made according to measuring circuit as per International Special-Committee on Radio Interference (CISPR) Publication 16-1(1993) Part -1. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 MHz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107-1964, except otherwise noted herein.

3.3 In measurement of, RIV, temporary additional external corona shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, and 110% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 400kV, 220kV, 132kV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.

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

4.0 Test Methods for Visible Corona

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised

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

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

- 4.1 The test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.
- 4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Purchaser's inspector, after determining the best camera locations by trial energisation of test object at a voltage which results in corona.
- 4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.
- 4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Purchaser's inspector if, in his opinion, it will not prejudice other test.

5.0 Test Records

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

- a) Background noise before and after test.
- b) Detailed procedure of application of test voltage.
- c) Measurements of RIV levels expressed in micro volts at each level.

- d) Results and observations with regard to location and type of interference sources detected at each step.
- e) Test voltage shall be recorded when measured RIV passes through 100 microvolts in each direction.
- f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

ANNEXURE – B

SEISMIC WITHSTAND TEST PROCEDURE

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

The Bidder shall arrange to transport the structure from his Contractor's premises/UPPTCL sites for the purpose of seismic withstand test only.

The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the Purchaser. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the Purchaser.

LIST OF SPECIFICATIONS

GENERAL STANDARDS AND CODES

India Electricity Rules

Indian Electricity Act

Indian Electricity (Supply) Act

Indian Factories Act

IS-5,	-	Colors for Ready Mixed Paints and Enamels.
IS-335,	-	New Insulating Oils.
IS-617,	-	Aluminium and Aluminium Alloy Ingots and Castings for General Engineering Purposes
IS-1448 (P1 to P 145)	-	Methods of Test for Petroleum and its Products.
IS-2071 (P1 to P3)	-	Methods of High Voltage Testing.
IS-12063	-	Classification of degrees of protection provided by enclosures of electrical equipment.
IS-2165 P1:1997 P2:1983	-	Insulation Coordination.
IS-3043	-	Code of Practice for Earthing
IS-6103	-	Method of Test for Specific Resistance (Resistivity) of Electrical Insulating Liquids
IS-6104	-	Method of Test for Interfacial Tension of Oil against Water by the Ring Method
IS-6262	-	Method of test for Power factor & Dielectric Constant of Electrical Insulating Liquids.
IS-6792	-	Method for determination of electric strength of insulating oils.
IS-5578	-	Guide for marking of insulated conductors.
IS-11353	-	Guide for uniform system of marking & identification of conductors & apparatus terminals.
IS-8263	-	Methods for Radio Interference Test on High voltage Insulators.
IS-9224 (Part 1,2&4)	-	Low Voltage Fuses
IEC-60060 (Part 1 to P4)	-	High Voltage Test Techniques
IEC 60068	-	Environmental Test

IEC-60117	-	Graphical Symbols
IEC-60156,	-	Method for the Determination of the Electrical Strength of Insulation Oils.
IEC-60270,	-	Partial Discharge Measurements.
IEC-60376	-	Specification and Acceptance of New Sulphur Hexafluoride
IEC-60437	-	Radio Interference Test on High Voltage Insulators.
IEC-60507	-	Artificial Pollution Tests on High Voltage Insulators to be used on AC Systems.
IEC-62271-1	-	Common Specification for High Voltage Switchgear & Controlgear Standards.
IEC-60815	-	Guide for the Selection of Insulators in respect of Polluted Conditions.
IEC-60865 (P1 & P2)	-	Short Circuit Current - Calculation of effects.
ANSI-C.1/NFPA.70	-	National Electrical Code
ANSI-C37.90A	-	Guide for Surge Withstand Capability (SWC) Tests
ANSI-C63.21,	-	Specification for Electromagnetic Noise and
C63.3	-	Field Strength Instrumentation 10 KHz to 1 GHz
C36.4ANSI-C68.1	-	Techniques for Dielectric Tests
ANSI-C76.1/IEEE21	-	Standard General Requirements and Test Procedure for Outdoor Apparatus Bushings.
ANSI-SI-4	-	Specification for Sound Level Meters
ANSI-Y32-2/C337.2	-	Drawing Symbols
ANSI-Z55.11	-	Gray Finishes for Industrial Apparatus and Equipment No. 61 Light Gray
NEMA-107T	-	Methods of Measurements of RIV of High Voltage Apparatus
NEMA-ICS-II	-	General Standards for Industrial Control and Systems Part ICSI-109
CISPR-1	-	Specification for CISPR Radio Interference Measuring Apparatus for the frequency range 0.15 MHz to 30 MHz
CSA-Z299.1-1978h	-	Quality Assurance Program Requirements
CSA-Z299.2-1979h	-	Quality Control Program Requirements
CSA-Z299.3-1979h	-	Quality Verification Program Requirements

CSA-Z299.4-1979h - Inspection Program Requirements

TRANSFORMERS AND REACTORS

IS:10028 (Part 2 & 3)	-	Code of practice for selection, installation & maintenance of Transformers (P1:1993), (P2:1991), (P3:1991)
IS-2026 (P1 to P4)	-	Power Transformers
IS-3347 (part 1 to Part 8)	-	Dimensions for Porcelain transformer Bushings for use in lightly polluted atmospheres.
IS-3639	-	Fittings and Accessories for Power Transformers
IS-6600	-	Guide for Loading of Oil immersed Transformers.
IEC-60076 (Part 1 to 5)	-	Power Transformers
IEC-60214	-	On-Load Tap-Changers.
IEC-60289	-	Reactors.
IEC- 60354	-	Loading Guide for Oil - Immersed power transformers
IEC-60076-10	-	Determination of Transformer and Reactor Sound Levels
ANSI-C571280	-	General requirements for Distribution, Power and Regulating Transformers
ANSI-C571290	-	Test Code for Distribution, Power and Regulation Transformers
ANSI-C5716	-	Terminology & Test Code for Current Limiting Reactors
ANSI-C5721	-	Requirements, Terminology and Test Code for Shunt Reactors Rated Over 500 KVA
ANSI-C5792	-	Guide for Loading Oil-Immersed Power Transformers upto and including 100 MVA with 55 deg C or 65 deg C Winding Rise
ANSI-CG,1EEE-4	-	Standard Techniques for High Voltage Testing

CIRCUIT BREAKERS

IEC-62271-100	-	High-voltage switchgear and controlgear - Part 100: Alternating current circuit-breakers
IEC-62271-101	-	High-voltage switchgear and controlgear - Part 101:

Synthetic testing

- | | | |
|---------------|---|---|
| IEC-62155 | - | Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1000 V |
| IEC-62271-110 | - | High-voltage switchgear and controlgear - Part 110: Inductive load switching |
| IEC-62271-109 | - | High-voltage switchgear and controlgear - Part 110: Inductive load switching |

CURRENT TRANSFORMERS, VOLTAGE TRANSFORMERS AND COUPLING

CAPACITOR VOLTAGE TRANSFORMERS

- | | | |
|---------------------|---|--|
| IS-2705- (P1 to P4) | - | Current Transformers. |
| IS:3156- (P1 to P4) | - | Voltage Transformers. |
| IS-4379 | - | Identification of the Contents of Industrial Gas Cylinders |
| IEC-60044-1 | - | Current transformers. |
| IEC-60044-2 | - | Inductive Voltage Transformers. |
| IEC-60044-4 | - | Instrument Transformes : Measurement of Partial Discharges |
| IEC-60044-5 | - | Instrument transformers - Part 5: Capacitor voltage transformers |
| IEC-60358 | - | Coupling capacitors and capacitor dividers. |
| IEC-60481 | - | Coupling Devices for power Line Carrier Systems. |
| ANSI-C5713 | - | Requirements for Instrument transformers |
| ANSIC92.2 | - | Power Line Coupling voltage Transformers |
| ANSI-C93.1 | - | Requirements for Power Line Carrier Coupling Capacitors |
| BUSHING | | |
| IS-2099 | - | Bushings for Alternating Voltages above 1000V |
| IEC-60137 | - | Insulated Bushings for Alternating Voltages above 1000V |

SURGE ARRESTERS

- | | | |
|-----------------|---|---|
| IS-3070 (PART2) | - | Lightning arresters for alternating current systems |
|-----------------|---|---|

		: Metal oxide lightning arrestors without gaps.
IEC-60099-4	-	Metal oxide surge arrestors without gaps
IEC-60099-5	-	Selection and application recommendation
ANSI-C62.1	-	IEEE Standards for S A for AC Power Circuits
NEMA-LA 1	-	Surge Arresters

CUBICLES AND PANELS & OTHER RELATED EQUIPMENTS

IS-722, IS-1248, IS-3231, 3231 (P-3)	-	Electrical relays for power system protection
IS:5039	-	Distributed pillars for Voltages not Exceeding 1000 Volts.
IEC-60068.2.2	-	Basic environmental testing procedures Part 2: Test B: Dry heat
IEC-60529	-	Degree of Protection provided by enclosures.
IEC-60947-4-1	-	Low voltage switchgear and control gear.
IEC-61095	-	Electromechanical Contactors for household and similar purposes.
IEC-60439 (P1 & 2)	-	Low Voltage Switchgear and control gear assemblies
ANSI-C37.20	-	Switchgear Assemblies, including metal enclosed bus.
ANSI-C37.50	-	Test Procedures for Low Voltage Alternating Current Power Circuit Breakers
ANSI-C39	-	Electric Measuring instrument
ANSI-C83	-	Components for Electric Equipment
IS: 8623: (Part I to 3)	-	Specification for Switchgear & Control Assemblies.
NEMA-AB	-	Moulded Case Circuit and Systems
NEMA-CS	-	Industrial Controls and Systems
NEMA-PB-1	-	Panel Boards
NEMA-SG-5	-	Low voltage Power Circuit breakers
NEMA-SG-3	-	Power Switchgear Assemblies
NEMA-SG-6	-	Power switching Equipment
NEMA-5E-3	-	Motor Control Centers
1248 (P1 to P9)	-	Direct acting indicating analogue electrical

measuring instruments & their accessories.

Disconnecting Switches

IEC-62271-102	-	High-voltage switchgear and controlgear - Part 102: Alternating current disconnectors and earthing switches
IEC-60129	-	Alternating Current Disconnectors (Isolators) and Earthing switches
IEC-1129	-	Alternating Current Earthing Switches Induced Current switching
IEC-60265 (Part 1 & 2)	-	High Voltage switches
ANSI-C37.32	-	Schedule of preferred Ratings, Manufacturing Specifications and Application Guide for high voltage Air Switches, Bus supports and switch accessories
ANSI-C37.34	-	Test Code for high voltage air switches
NEMA-SG6	-	Power switching equipment

PLCC and Line Traps

IS-8792	-	Line traps for AC power system.
IS-8793	-	Methods of tests for line traps.
IS-8997	-	Coupling devices for PLC systems.
IS-8998	-	Methods of test for coupling devices for PLC systems.
IEC-60353	-	Line traps for A.C. power systems.
IEC-60481	-	Coupling Devices for power line carrier systems.
IEC-60495	-	Single sideboard power line carrier terminals
IEC-60683	-	Planning of (single Side-Band) power line carrier systems.
CIGRE	-	Teleprotection report by Committee 34 & 35.
CIGRE	-	Guide on power line carrier 1979.
CCIR	-	International Radio Consultative Committee
CCITT	-	International Telegraph & Telephone Consultative Committee

EIA - Electric Industries Association

Protection and Control Equipment

IEC-60051 : (P1 to P9)	-	Recommendations for Direct Acting indicating analogue electrical measuring instruments and their accessories.
IEC-60255 (Part 1 to 23)	-	Electrical relays.
IEC-60297 (P1 to P4)	-	Dimensions of mechanical structures of the 482.6mm (19 inches) series.
IEC-60359	-	Expression of the performance of electrical & electronic measuring equipment.
IEC-60387	-	Symbols for Alternating-Current Electricity meters.
IEC-60447	-	Man machine interface (MMI) - Actuating principles.
IEC-60521	-	Class 0.5, 1 and 2 alternating current watt hour metres
IEC-60547	-	Modular plug-in Unit and standard 19-inch rack mounting unit based on NIM Standard (for electronic nuclear instruments)
ANSI-81	-	Screw threads
ANSI-B18	-	Bolts and Nuts
ANSI-C37.1	-	Relays, Station Controls etc.
ANSI-C37.2	-	Manual and automatic station control, supervisory and associated telemetering equipment
ANSI-C37.2	-	Relays and relay systems associated with electric power apparatus
ANSI-C39.1	-	Requirements for electrical analog indicating Instruments

MOTORS

IS-325	-	Three phase induction motors.
IS-4691	-	Degree of protection provided by enclosure for rotating electrical machinery.
IEC-60034 (P1 to P19:)	-	Rotating electrical machines

IEC-Document 2 - Three phase induction motors
(Central Office) NEMA-MGI Motors and Generators

Electronic Equipment and Components

MIL-21B, MIL-833 & MIL-2750

IEC-60068 (P1 to P5)	-	Environmental testing
IEC-60326 (P1 to P2)	-	Printed boards Material and workmanship standards
IS-1363 (P1 to P3)	-	Hexagon headbolts, screws and nuts of product grade C.
IS-1364 (P1 to P5)	-	Hexagon head bolts, screws and nuts of products grades A and B.
IS-3138	-	Hexagonal Bolts and Nuts (M42 to M150)
ISO-898	-	Fasteners: Bolts, screws and studs
ASTM	-	Specification and tests for materials

Clamps & Connectors

IS-5561	-	Electric power connectors.
NEMA-CC1	-	Electric Power connectors for sub station
NEMA-CC 3	-	Connectors for Use between aluminium or aluminum-Copper Overhead Conductors

Bus Hardware and Insulators

IS: 2121	-	Fittings for Aluminum and steel cored Al conductors for overhead power lines.
IS-731	-	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000 V.
IS-2486 (P1 to P4)	-	Insulator fittings for overhead power lines with a nominal voltage greater than 1000 V.
IEC-60120	-	Dimensions of Ball and Socket Couplings of string insulator units.
IEC-60137	-	Insulated bushings for alternating voltages above 1000 V.
IEC-60168	-	Tests on indoor and outdoor post insulators of ceramic material or glass for Systems with Nominal Voltages Greater than 1000 V.

IEC-62155	-	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V
IEC-60233	-	Tests on Hollow Insulators for use in electrical equipment.
IEC-60273	-	Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V.
IEC-61462	-	Pressurized and un-pressurized insulator for use in electrical equipment with rated voltage greater than 1000V – Definitions, Test methods, acceptance criteria and design recommendations
IEC-60305	-	Insulators for overhead lines with nominal voltage above 1000V-ceramic or glass insulator units for a.c. systems Characteristics of String Insulator Units of the cap and pintype.
IEC-60372 (1984)	-	Locking devices for ball and socket couplings of string insulator units : dimensions and tests.
IEC-60383 (P1 and P2)	-	Insulators for overhead lines with a nominal voltage above 1000 V.
IEC-60433	-	Characteristics of string insulator units of the long rod type.
IEC-60471	-	Dimensions of Clevis and tongue couplings of string insulator units.
ANSI-C29	-	Wet process procelain insulators
ANSI-C29.1	-	Test methods for electrical power insulators
ANSI-C92.2	-	For insulators, wet-process porcelain and toughened glass suspension type
ANSI-C29.8	-	For wet-process porcelain insulators apparatus, post-type
ANSI-G.8	-	Iron and steel hardware
CISPR-7B	-	Recommendations of the CISPR, tolerances of form and of Position, Part 1
ASTM A-153	-	Zinc Coating (Hot-Dip) on iron and steel hardware

Strain and Rigid Bus-Conductor

IS-2678	-	Dimensions & tolerances for Wrought Aluminum and Aluminum Alloys drawn round tube.
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IS-5082	-	Wrought Aluminum and Aluminum Alloy Bars. Rods, Tubes and Sections for Electrical purposes.
ASTM-B 230-82	-	Aluminum 1350 H19 Wire for electrical purposes
ASTM-B 231-81	-	Concentric - lay - stranded, aluminum 1350 conductors
ASTM-B 221	-	Aluminum - Alloy extruded bar, rod, wire, shape
ASTM-B 236-83	-	Aluminum bars for electrical purpose (Bus-bars)
ASTM-B 317-83	-	Aluminum-Alloy extruded bar, rod, pipe and structural shapes for electrical purposes (Bus Conductors)

Batteries and Batteries Charger

Battery

IS:1651	-	Stationary Cells and Batteries, Lead-Acid Type (with Tubular Positive Plates)
IS:1652	-	Stationary Cells and Batteries, Lead-Acid Type (with Plante Positive Plates)
IS:1146	-	Rubber and Plastic Containers for Lead-Acid Storage Batteries
IS:6071	-	Synthetic Separators for Lead-Acid Batteries
IS:266	-	Specification for Sulphuric Acid
IS:1069	-	Specification for Water for Storage Batteries
IS:3116	-	Specification for Sealing Compound for Lead-Acid Batteries
IS:1248	-	Indicating Instruments
IS:10918	-	Vented type nickel Cadmium Batteries
IEC:60896-21&22	-	Lead Acid Batteries Valve Regulated types – Methods of Tests & Requirements
IEC: 60623	-	Vented type nickel Cadmium Batteries
IEC:60622	-	Secondary Cells & Batteries – Sealed Ni-Cd rechargeable single cell
IEC:60623	-	Secondary Cells & Batteries – Vented Ni-Cd rechargeable single cell
IEC:60896-11	-	Stationary Lead Acid Batteries – Vented Type – General requirements & method of tests
IEEE-485	-	Recommended practices for sizing of Lead Acid

Batteries

IEEE-1115	-	Sizing of Ni-Cd Batteries
IEEE-1187	-	Recommended practices for design & installation of VRLA Batteries
IEEE-1188	-	Recommended practices for design & installation of VRLA Batteries
IEEE-1189	-	Guide for selection of VRLA Batteries

Battery Charger

IS:3895	-	Mono-crystalline Semiconductor Rectifier Cells and Stacks
IS:4540	-	Mono-crystalline Semiconductor Rectifier Assemblies and Equipment.
IS:6619	-	Safety Code for Semiconductor Rectifier Equipment
IS:2026	-	Power Transformers
IS:2959	-	AC Contactors for Voltages not Exceeding 1000 Volts
IS:1248	-	Indicating Instruments
IS:2208	-	HRC Fuses
IS:13947 (Part-3)	-	Air break switches, air break disconnectors & fuse combination units for voltage not exceeding 1000V AC or 1200V DC
IS:2147	-	Degree of protection provided by enclosures for low voltage switchgear and controlgear.
IS:6005	-	Code of practice for phosphating of Iron and Steel
IS:3231	-	Electrical relays for power system protection
IS:3842	-	Electrical relay for AC Systems
IS:5	-	Colours for ready mix paint
IEEE-484	-	Recommended Design for installation design and installation of large lead storage batteries for generating stations and substations.
IEEE-485	-	Sizing large lead storage batteries for generating stations and substations

Wires and Cables

ASTMD-2863	-	Measuring the minimum oxygen concentration to support candle like combustion of plastics (oxygen index)
IS-694	-	PVC insulated cables for working voltages upto and including 1100 Volts.
IS-1255	-	Code of practice for installation and maintenance of power cables, upto and including 33 kV rating
IS-1554 (P1 and P2)	-	PVC insulated (heavy duty) electric cables (part 1) for working voltage upto and including 1100 V.
	-	Part (2) for working voltage from 3.3 kV upto and including 11kV.
IS:1753	-	Aluminium conductor for insulated cables
IS:2982	-	Copper Conductor in insulated cables.
IS-3961 (P1 to P5)	-	Recommended current ratings for cables.
IS-3975	-	Mild steel wires, formed wires and tapes for armouring of cables.
IS-5831	-	PVC insulating and sheath of electric cables.
IS-6380	-	Elastometric insulating and sheath of electric cables.
IS-7098	-	Cross linked polyethylene insulated PVC sheathed cables for working voltage upto and including 1100 volts.
IS-7098	-	Cross-linked polyethyle insulated PVC sheathed cables for working voltage from 3.3kV upto and including 33 kV.
IS-8130	-	Conductors for insulated electrical cables and flexible cords.
IS-1753	-	Aluminum Conductors for insulated cables.
IS-10418	-	Specification for drums for electric cables.
IEC-60096 (part 0 to p4)	-	Radio Frequency cables.
IEC-60183	-	Guide to the Selection of High Voltage Cables.
IEC-60189 (P1 to P7)	-	Low frequency cables and wires with PVC insulation and PVC sheath.
IEC-60227 (P1 to P7)	-	Polyvinyl Chloride insulated cables of rated voltages up to and including 450/750V.
IEC-60228	-	Conductors of insulated cables
IEC-60230	-	Impulse tests on cables and their accessories.

IEC-60287 (P1 to P3)	-	Calculation of the continuous current rating of cables (100% load factor).
IEC-60304	-	Standard colours for insulation for low-frequency cables and wires.
IEC-60331	-	Fire resisting characteristics of Electric cables.
IEC-60332 (P1 to P3)	-	Tests on electric cables under fire conditions.
IEC-60502	-	Extruded solid dielectric insulated power cables for rated voltages from 1 kV upto to 30 kV
IEC-754 (P1 and P2)	-	Tests on gases evolved during combustion of electric cables.

Air Conditioning and Ventilation

IS-659	-	Safety code for air conditioning
IS-660	-	Safety code for Mechanical Refrigeration
ARI:520	-	Standard for Positive Displacement Refrigeration Compressor and Condensing Units
IS:4503	-	Shell and tube type heat exchanger
ASHRAE-24	-	Method of testing for rating of liquid coolers
ANSI-B-31.5	-	Refrigeration Piping
IS:2062	-	Steel for general structural purposes
IS:655	-	Specification for Metal Air Dust
IS:277	-	Specification for Galvanised Steel Sheets
IS-737	-	Specification for Wrought Aluminium and Aluminium Sheet & Strip
IS-1079	-	Hot rolled cast steel sheet & strip
IS-3588	-	Specification for Electrical Axial Flow Fans
IS-2312	-	Propeller Type AC Ventilation Fans
BS-848	-	Methods of Performance Test for Fans
BS-6540 Part-I	-	Air Filters used in Air Conditioning and General Ventilation
BS-3928	-	Sodium Flame Test for Air Filters (Other than for Air Supply to I.C. Engines and Compressors)
US-PED-2098	-	Method of cold DOP & hot DOP test
MIL-STD-282	-	DOP smoke penetration method
ASHRAE-52	-	Air cleaning device used in general ventilation for

		removing particle matter
IS:3069	-	Glossary of Terms, Symbols and Units Relating to Thermal Insulation Materials.
IS:4671	-	Expanded Polystyrene for Thermal Insulation Purposes
IS:8183	-	Bonded Mineral Wool
IS:3346	-	Evaluation of Thermal Conductivity properties by means of guarded hot plate method
ASTM-C-591-69	-	Standard specification for rigid preformed cellular urethane thermal insulation
IS:4894	-	Centrifugal Fans
BS:848 Fans	-	Method of Performance Test for Centrifugal Fans
IS:325	-	Induction motors, three-phase
IS:4722	-	Rotating electrical machines
IS:1231	-	Three phase foot mounted Induction motors, dimensions of
IS:2233	-	Designations of types of construction and mounting arrangements of rotating electrical machines
IS:2254	-	Vertical shaft motors for pumps, dimensions of
IS:7816	-	Guide for testing insulation resistance of rotating machines
IS:4029	-	Guide for testing three phase induction motors
IS:4729	-	Rotating electrical machines, vibration of, Measurement and evaluation of
IS:4691	-	Degree of protection provided by enclosures for rotating electrical machinery
IS:7572	-	Guide for testing single-phase a.c. motors
IS:2148	-	Flame proof enclosure for electrical apparatus
BS:4999 (Part-51)	-	Noise levels

Galvanizing

IS-209	-	Zinc Ingot
IS-2629	-	Recommended Practice for Hot-Dip galvanizing

on iron and steel.

IS-2633	-	Methods for testing uniformity of coating of zinc coated articles.
ASTM-A-123	-	Specification for zinc (Hot Galvanizing) Coatings, on products Fabricated from rolled, pressed and forged steel shapes, plates, bars and strips.
ASTM-A-121-77	-	Zinc-coated (Galvanized) steel barbed wire

Painting

IS-6005	-	Code of practice for phosphating of iron and steel.
ANSI-Z551	-	Gray finishes for industrial apparatus and equipment
SSPEC	-	Steel structure painting council

Fire Protection System

Fire protection manual issued by tariff advisory committee (TAC) of India

HORIZONTAL CENTRIFUGAL PUMPS

IS:1520	-	Horizontal centrifugal pumps for clear, cold and fresh water
IS:9137	-	Code for acceptance test for centrifugal & axial pumps
IS:5120	-	Technical requirement - Rotodynamic special purpose pumps
API-610	-	Centrifugal pumps for general services
	-	Hydraulic Institutes Standards
BS:599	-	Methods of testing pumps
PTC-8.2	-	Power Test Codes - Centrifugal pumps

DIESEL ENGINES

IS:10000	-	Methods of tests for internal combustion engines
IS:10002	-	Specification for performance requirements for

		constant speed compression ignition engines for general purposes (above 20 kW)
BS:5514	-	The performance of reciprocating compression ignition (Diesel) engines, utilising liquid fuel only, for general purposes
ISO:3046	-	Reciprocating internal combustion engines performance
IS:554	-	Dimensions for pipe threads where pressure tight joints are required on threads
ASME Power Test Code	-	Internal combustion engine PTC-17
	-	Codes of Diesel Engine Manufacturer's Association, USA

PIPING VALVES & SPECIALITIES

IS:636	-	Non percolating flexible fire fighting delivery hose
IS:638	-	Sheet rubber jointing and rubber inserting jointing
IS:778	-	Gun metal gate, globe and check valves for general purpose
IS:780	-	Sluice valves for water works purposes (50 to 300 mm)
IS:901	-	Couplings, double male and double female instantaneous pattern for fire fighting
IS:902	-	Suction hose couplings for fire fighting purposes
IS:903	-	Fire hose delivery couplings branch pipe nozzles and nozzle spanner
IS:1538	-	Cast iron fittings for pressure pipes for water, gas and sewage
IS:1903	-	Ball valve (horizontal plunger type) including floats for water supply purposes
IS:2062	-	SP for weldable structural steel
IS:2379	-	Colour Code for the identification of pipelines
IS:2643	-	Dimensions of pipe threads for fastening purposes
IS:2685	-	Code of Practice for selection, installation and maintenance of sluice valves
IS:2906	-	Sluice valves for water-works purposes (350 to 1200 mm size)

IS:3582	-	Basket strainers for fire fighting purposes (cylindrical type)
IS:3589	-	Electrically welded steel pipes for water, gas and sewage (150 to 2000 mm nominal diameter)
IS:4038	-	Foot valves for water works purposes
IS:4927	-	Unlined flax canvas hose for fire fighting
IS:5290	-	Landing valves (internal hydrant)
IS:5312	-	Swing check type reflex (non-return) valves
(Part-I)		
IS:5306	-	Code of practice for fire extinguishing installations and equipment on premises
Part-I	-	Hydrant systems, hose reels and foam inlets
Part-II	-	Sprinkler systems
BS:5150	-	Specification for cast iron gate valves

MOTORS & ANNUNCIATION PANELS

IS:325	-	Three phase induction motors
IS:900	-	Code of practice for installation and maintenance of induction motors
IS:996	-	Single phase small AC and universal electric motors
IS:1231	-	Dimensions of three phase foot mounted induction motors
IS:2148	-	Flame proof enclosure of electrical apparatus
IS:2223	-	Dimensions of flange mounted AC induction motors
IS:2253	-	Designations for types of construction and mounting arrangements of rotating electrical machines
IS:2254	-	Dimensions of vertical shaft motors for pumps
IS:3202	-	Code of practice for climate proofing of electrical equipment
IS:4029	-	Guide for testing three phase induction motors
IS:4691	-	Degree of protection provided by enclosure for rotating electrical machinery
IS:4722	-	Rotating electrical machines

IS:4729	-	Measurement and evaluation of vibration of rotating electrical machines
IS:5572	-	Classification of hazardous areas for electrical (Part-I) installations (Areas having gases and vapours)
IS:6362	-	Designation of methods of cooling for rotating electrical machines
IS:6381	-	Construction and testing of electrical apparatus with type of protection 'e'
IS:7816	-	Guide for testing insulation for rotating machine
IS:4064	-	Air break switches
IEC DOCUMENT 2 (Control Office) 432	-	Three Phase Induction Motor
VDE 0530 Part I/66	-	Three Phase Induction Motor
IS:9224 (Part-II)	-	HRC Fuses
IS:6875	-	Push Button and Control Switches
IS:694	-	PVC Insulated cables
IS:1248	-	Indicating instruments
IS:375	-	Auxiliary wiring & busbar markings
IS:2147	-	Degree of protection
IS:5	-	Colour Relay and timers
IS:2959	-	Contactors

PG Test Procedures

NFPA-13	-	Standard for the installation of sprinkler system
NFPA-15	-	Standard for water spray fixed system for the fire protection
NFPA-12A	-	Standard for Halong 1301 Fire Extinguishing System
NFPA-72E	-	Standard on Automatic Fire Detectors
Fire Protection Manual by TAC (Latest Edition)		
NFPA-12	-	Standard on Carbon dioxide extinguisher systems
IS:3034	-	Fire of industrial building:
Electrical generating and distributing stations code of practice		

IS:2878	-	CO2 (Carbon dioxide) Type Extinguisher
IS:2171	-	DC (Dry Chemical Powder) type
IS:940	-	Pressurised Water Type

D.G. SET

IS:10002	-	Specification for performance requirements for constant speed compression ignition (diesel engine) for general purposes
IS:10000	-	Method of tests for internal combustion engines
IS:4722	-	Rotating electrical machines-specification
IS:12063	-	Degree of protection provided by enclosures
IS:12065	-	Permissible limit of noise levels for rotating electrical machines.
	-	Indian Explosive Act 1932

Steel Structures

IS-228 (1992)	-	Method of Chemical Analysis of pig iron, cast iron and plain carbon and low alloy steels.
IS-802 (P1 to 3:)	-	Code of practice for use of structural steel in overhead transmission line towers.
IS-806	-	Code of practice for use of steel tubes in general building construction
IS-808	-	Dimensions for hot rolled steel beam, column channel and angle sections.
IS-814	-	Covered electrodes for manual arc welding of carbon of carbon manganese steel.
IS-816	-	Code of Practice for use of metal arc welding for general construction in Mild steel
IS-817	-	Code of practice for training and testing of metal arc welders. Part 1 : Manual Metal arc welding.
IS-875 (P1 to P4)	-	Code of practice for design loads (other than earthquake) for buildings and structures.
IS-1161	-	Steel tubes for structural purposes.
IS-1182	-	Recommended practice for radiographic examination of fusion welded butt joints in steel

		plates.
IS-1363 (P1 to P3)	-	Hexagonal head bolts, screws & nuts of products grade C.
IS-1364	-	Hexagon headbolts, screws and nuts of product grades A and B.
IS-1367 (P1 to P18)	-	Technical supply condition for threaded steel fasteners.
IS-1599	-	Methods for bend test.
IS-1608	-	Method for tensile testing of steel products.
IS-1893	-	Criteria for earthquake resistant design of structures.
IS-1978	-	Line Pipe.
IS-2062	-	Steel for general structural purposes.
IS-2595	-	Code of practice for Radiographic testing.
IS-3063	-	Single coil rectangular section spring washers for bolts, nuts and screws.
IS-3664	-	Code of practice for ultrasonic pulse echo testing by contact and immersion methods.
IS-7205	-	Safety code for erection of structural steel work.
IS-9595	-	Recommendations for metal arc welding of carbon and carbon manganese steels.
ANSI-B18.2.1	-	Inch series square and Hexagonal bolts and screws
ANSI-B18.2.2	-	Square and hexagonal nuts
ANSI-G8.14	-	Round head bolts
ASTM-A6	-	Specification for General Requirements for rolled steel plates, shapes, sheet piling and bars of structural use
ASTM-A36	-	Specifications of structural steel
ASTM-A47	-	Specification for malleable iron castings
ASTM-A143	-	Practice for safeguarding against embilement of Hot Galvanized structural steel products and procedure for detaching embrilement
ASTM-A242	-	Specification for high strength low alloy structural steel
ASTM-A283	-	Specification for low and intermediate tensile strength carbon steel plates of structural quality
ASTM-A394	-	Specification for Galvanized steel transmission

		tower bolts and nuts
ASTM-441	-	Specification for High strength low alloy structural manganese vanadium steel.
ASTM-A572	-	Specification for High strength low alloy columbium-Vanadium steel of structural quality
AWS D1-0	-	Code for welding in building construction welding inspection
AWS D1-1	-	Structural welding code
AISC	-	American institute of steel construction
NEMA-CG1	-	Manufactured graphite electrodes

Piping and Pressure Vessels

IS-1239 (Part 1 and 2) steel	-	Mild steel tubes, tubulars and other wrought fittings
IS-3589	-	Seamless Electrically welded steel pipes for water, gas and sewage.
IS-6392	-	Steel pipe flanges
ASME	-	Boiler and pressure vessel code
ASTM-A120	-	Specification for pipe steel, black and hot dipped, zinc-coated (Galvanized) welded and seamless steel pipe for ordinary use
ASTM-A53	-	Specification for pipe, steel, black, and hotdipped, zinc coated welded and seamless
ASTM-A106	-	Seamless carbon steel pipe for high temperature service
ASTM-A284	-	Low and intermediate tensile strength carbonsilicon steel plates for machine parts and general construction.
ASTM-A234	-	Pipe fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures
ASTM-S181	-	Specification for forgings, carbon steel for general purpose piping
ASTM-A105	-	Forgings, carbon steel for piping components
ASTM-A307	-	Carbon steel externally threaded standard fasteners
ASTM-A193	-	Alloy steel and stainless steel bolting materials for

		high temperature service
ASTM-A345	-	Flat rolled electrical steel for magnetic applications
ASTM-A197	-	Cupola malleable iron
ANSI-B2.1	-	Pipe threads (Except dry seal)
ANSI-B16.1	-	Cast iron pipe flanges and flanged fitting. Class 25, 125, 250 and 800
ANSI-B16.1	-	Malleable iron threaded fittings, class 150 and 300
ANSI-B16.5	-	Pipe flanges and flanged fittings, steel nickel alloy and other special alloys
ANSI-B16.9	-	Factory-made wrought steel butt welding fittings
ANSI-B16.11	-	Forged steel fittings, socket-welding and threaded
ANSI-B16.14	-	Ferrous pipe plug, bushings and locknuts with pipe threads
ANSI-B16.25	-	Butt welding ends
ANSI-B18.1.1	-	Fire hose couplings screw thread.
ANSI-B18.2.1	-	Inch series square and hexagonal bolts and screws
ANSI-B18.2.2	-	Square and hexagonal nuts
ANSI-B18.21.1	-	Lock washers
ANSI-B18.21.2	-	Plain washers
ANSI-B31.1	-	Power piping
ANSI-B36.10	-	Welded and seamless wrought steel pipe
ANSI-B36.9	-	Stainless steel pipe

Other Civil Works Standards

IS-269	-	33 grade ordinary portland cement.
IS-2721	-	Galvanized steel chain link fence fabric
IS-278	-	Galvanized steel barbed wire for fencing.
IS-383	-	Coarse and fine aggregates from natural sources for concrete.
IS-432 (P1 and P2)	-	Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement.
IS-456	-	Code of practice for plain and reinforced concrete.

IS-516	-	Method of test for strength of concrete.
IS-800	-	Code of practice for general construction in steel.
IS-806	-	Steel tubes for structural purposes.
IS-1172	-	Basic requirements for water supply, drainage and sanitation.
IS-1199	-	Methods of sampling and analysis of concrete.
IS-1566	-	Hard-drawn steel wire fabric for concrete reinforcement.
IS-1742	-	Code of Practice for Building drainage.
IS-1785	-	Plain hard-drawn steel wire for prestressed concrete.
IS-1786	-	High strength deformed Steel Bars and wires for concrete reinforcement.
IS-1811	-	Methods of sampling Foundry sands.
IS-1893	-	Criteria for earthquake resistant design of structures.
IS-2062	-	Steel for general structural purposes.
IS-2064	-	Selection, installation and maintenance of sanitary appliances-code of practices.
IS-2065	-	Code of practice for water supply in buildings.
IS-2090	-	High tension steel bars used in prestressed concrete.
IS-2140	-	Standard Galvanized steel wire for fencing.
IS-2470 (P1 & P2)	-	Code of practice for installation of septic tanks.
IS-2514	-	Concrete vibrating tables.
IS-2645	-	Integral cement waterproofing compounds.
IS-3025 (Part 1 to Part 48)	-	Methods of sampling and test (Physical and chemical) for water and waste water.
IS-4091	-	Code of practice for design and construction of foundations for transmission line towers and poles.
IS-4111 (Part 1 to P5)	-	Code of practice for ancillary structures in sewerage system.
IS-4990	-	Plywood for concrete shuttering work.
IS-5600	-	Sewage and drainage pumps.

National Buiding Code of India 1970

USBR E12	-	Earth Manual by United States Department of the interior Bureau of Reclamation
ASTM-A392-81	-	Zinc/Coated steel chain link fence fabric
ASTM-D1557-80	-	test for moisture-density relation of soils using 10-lb (4.5 kg) rame land 18-in. (457 mm) Drop.
ASTM-D1586	-	Penetration Test and Split-Barrel
(1967)	-	Sampling of Soils
ASTM-D2049-69	-	Test Method for Relative Density of Cohesionless Soils
ASTM-D2435	-	Test method for Unconsolidated, (1982) Undrained Strengths of Cohesive Soils in Triaxial Compression.
BS-5075	-	Specification for accelerating Part I Admixtures, Retarding Admixtures and Water Reducing Admixtures.
CPWD	-	Latest CPWD specifications

ACSR MOOSE CONDUCTOR

IS:6745	Methods for Determination of BS:443-1969 Mass of zinc coating on zinc coated Iron and Steel Articles
IS:8263	Methods for Radio Interference
IEC:437-1973	Test on High Voltage Insulators NEMA:107-1964 CISPR
IS:209	Zinc Ingot BS:3436-1961
IS:398	Aluminum Conductors for IEC:209-1966
Part - V	Overhead Transmission Purposes
BS:215(Part-II)	Aluminium Conductors galvanized IEC:209-1966 steel reinforced extra high
BS:215(Part-II)	voltage (400 kV and above)
IS:1778	Reels and Drums forBS:1559-1949 Bare Conductors
IS:1521	Method for Tensile Testing ISO/R89-1959of steel wire

IS:2629	Recommended practice for Hot dip Galvanising on Iron and Steel.
IS:2633	Method for Testing Uniformity of coating of zinc Coated Articles.
IS:4826	Hot dip galvanised coatings on round steel wires ASTM-A-472-729

GALVANISED STEEL EARTHWIRE

IS:1521	Method for Tensile Testing ISO/R:89-1959 of Steel Wire
IS:1778	Reels and Drums for Bare Conductors
IS:2629	Recommended practice for Hot Dip Galvanising on Iron and Steel.
IS:2633 Coated	Methods for testing Uniformity of Coating of Zinc Articles.
IS:4826	Hot dip Galvanised Coatings ASTM:A 475-72a on Round Steel Wires BS:443-1969
IS:6745	Method for Determination BS:443-1969 of mass of Zinc Coating on Zinc coated Iron and Steel Articles.
IS:209	Zinc ingot BS:3463-1961
IS:398 (Pt. I to P5:1992)	Aluminum Conductors for BS:215 (Part-II) overhead transmission purposes.

Lighting Fixtures and Accessories

IS:1913	General and safety requirements for electric lighting fittings.
IS:3528	Water proof electric lighting fittings.
IS:4012	Dust proof electric lighting fittings.
IS:4013	Dust tight proof electric lighting fittings.
IS:10322	Industrial lighting fittings with metal reflectors.
IS:10322	Industrial lighting fittings with plastic reflectors.
IS:2206 mines	Well glass lighting fittings for use under ground in

	(non-flameproof type).
IS:10322	Specification for flood light.
IS:10322	Specification for decorative lighting outfits.
IS:10322	Luminaries for street lighting
IS:2418	Tubular fluorescent lamps
IS:9900	High pressure mercury vapour lamps.
IS:1258	Specification for Bayonet lamp fluorescent lamp.
IS:3323	Bi-pin lamp holder tubular fluorescent lamps.
IS:1534	Ballasts for use in fluorescent lighting fittings. (Part-I)
IS:1569	Capacitors for use in fluorescent lighting fittings.
IS:2215	Starters for fluorescent lamps.
IS:3324	Holders for starters for tubular fluorescent lamps
IS:418	GLS lamps
IS:3553	Water tight electric fittings
IS:2713	Tubular steel poles
IS:280	MS wire for general engg. Purposes

Conduits, Accessories and Junction Boxes

IS:9537	Rigid steel conduits for electrical wiring
IS:3480	Flexible steel conduits for electrical wiring
IS:2667	Fittings for rigid steel conduits for electrical wiring
IS:3837	Accessories for rigid steel conduits for electrical wiring
IS:4649	Adaptors for flexible steel conduits.
IS:5133	Steel and Cast Iron Boxes
IS:2629	Hot dip galvanising of Iron & Steel.

Lighting Panels

IS:13947	LV Switchgear and Control gear(Part 1 to 5)
IS:8828	Circuit breakers for over current protection for house hold
	and similar installations.
IS:5	Ready mix paints

IS:2551	Danger notice plates
IS:2705	Current transformers
IS:9224 (7)IS:5082 and	HRC Cartridge fuse links for voltage above 650V(Part-2) Wrought aluminium and Al. alloys, bars, rods, tubes sections for electrical purposes.
(8)IS:8623 Gear	Factory built Assemblies of Switchgear and Control for voltages upto and including 1000V AC and 1200V DC.
(9)IS:1248	Direct Acting electrical indicating instruments

Electrical Installation

IS:1293 3	pin plug
IS:371	Two to three ceiling roses
IS:3854	Switches for domestic and similar purposes
IS:5216	Guide for safety procedures and practices in electrical work.
IS:732 (system	Code of practice for electrical wiring installation voltage not exceeding 650 Volts.)
IS:3043	Code of practice for earthing.
IS:3646	Code of practice of interior illumination part II & III.
IS:1944	Code of practice for lighting of public through fares.
IS:5571 hazardous	Guide for selection of electrical equipment for areas.
IS:800	Code of practice for use of structural steel in general building construction.
IS:2633 coated	Methods of Testing uniformity of coating on zinc articles.
IS:6005	Code of practice for phosphating iron and steel.
	INDIAN ELECTRICITY ACT
	INDIAN ELECTRICITY RULES

LT SWITCHGEAR

IS:8623 (Part-I) gear	Specification for low voltage switchgear and control assemblies
IS:13947 (Part-I) gear,	Specification for low voltage switchgear and control Part 1 General Rules
IS:13947 (part-2) gear,	Specification for low voltage switchgear and control Part 2 circuit breakers.
IS:13947 (part-3) gear.	Specification for low voltage switchgear and control Part 3 Switches, Disconnectors, Switch-disconnectors and fuse combination units
IS:13947 (part-4) gear.	Specification for low voltage switchgear and control Part 4 Contactors and motors starters.
IS:13947 (part-5) gear.	Specification for low voltage switchgear and control Part 5 Control-circuit devices and switching elements
IS:13947 (part-6) gear.	Specification for low voltage switchgear and control Part 6 Multiple function switching devices.
IS:13947 (part-7) gear.	Specification for low voltage switchgear and control Part 7 Ancillary equipments
IS:12063	Degree of protection provided by enclosures
IS:2705	Current Transformers
IS:3156	Voltage Transformers
IS:3231	Electrical relays for power system protection
IS:1248	Electrical indicating instruments
IS:722	AC Electricity meters
IS:5578	Guide for Marking of insulated conductors of apparatus terminals
IS:13703 (part 1) or	Low voltage fuses for voltage not exceeding 1000V AC 1500V DC Part 1 General Requirements
IS:13703 (part 2) or	Low voltage fuses for voltage not exceeding 1000V AC 1500V DC Part 2 Fuses for use of authorized persons

IS:6005	Code of practice of phosphating iron and steel
IS:5082	Wrought Aluminum and Aluminum alloys for electrical purposes
IS:2633	Hot dip galvanising

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 ($\pm$) %			
	b) Supply frequency variation ($\pm$) %			
	c) Drop off Voltage %			
4.7	Rated (thermal) current			
4.8	Rated Duty			
4.9	Rated Utilization Category as per IS 2459 (IS 13947)			

Technical Specification
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			

Technical Specification
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			

Technical Specification
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			

Technical Specification
AC & DC BOARD

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

TB-406-316-025
REV.00

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 07.09.2018	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 07.09.2018	Documentary proof attached	Yes	
3	Offered equipment should have given three years proven trouble free operational service in tropical climate.	Documentary proof attached	Yes	

PROJECT : 400/220/132 kV UPPTCL GIS SS at SHAMLI (U.P.)
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Technical Specification of LT SWITCHGEAR
Section-1: Scope, Specific Technical Requirements & Quantities

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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 07.09.2013 . If type test reports are	Yes	

PROJECT : 400/220/132 kV UPPTCL GIS SS at SHAMLI (U.P.)
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Technical Specification of LT SWITCHGEAR
Section-1: Scope, Specific Technical Requirements & Quantities

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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