TECHNICAL BID

VOL – II

(ANNEXURE – A)

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TECHNICAL SPECIFICATION FOR 11KV HT SWITCHGEARS

1.0 Scope:

This Specification shall cover the basic requirements with respect to 11 KV, 26.3 kA (with highest system voltage of 12 KV) Indoor/Outdoor Nature Design, Manufacture, Factory Testing, and Packing Transport at site. 11kV Panels including metering, protection features and accessories as specified clearly in bill of materials. Related Electrical works shall be carried out as per complying the CPWD general guidelines and as well as latest norms of till date

1)	Part II	-	External	-	2013
2)	Part IV	-	DG Set	-	2013

2.0 *Service Conditions:*

2.1 11kV Panels shall be connected to the power system along with the following parameters.

1)	Nominal System Voltage	-	11 kV
2)	Corresponding highest system voltage	-	12 Kv
3)	Frequency	-	50 Hz±3%
4)	Number of phase	-	3
5)	Neutral earthing	-	Solidly Grounded
6)	System fault level (Minimum)	-	26.3kA for 3sec at 11kv

2.2 *Equipment being supplied as per the specification and also shall be suit for satisfactory operation under the following tropical conditions:-*

1)	Max. Ambient air temperature	-	50 Deg.
2)	Max. relative humidity	-	100 %
3)	Max. annual rainfall	-	1541 mm
4)	Max. Wind pressure	-	150 kg/sq.m.
5)	Max. Altitude above means sea level	-	1000 mtrs.
6)	Isoceraunic level	-	50
7)	Seismic level (Horizontal acceleration)	-	0.3 g.
8)	Climatic Condition	-	Moderately hot and *Humid tropical Climate*
9)	Reference Ambient Temperature for Temperature rise	-	50 deg C

3.0 *Standards:*

Unless otherwise anything need to be modified in this specification, Then that switchgears and associated components design criteria should comply with the following codes with latest amendments.

IS 2516	–	*Circuit Breakers.*
IS 13118/1991	–	*High Voltage A.C. Circuit Breakers.*
IS 12729/200491	-	*High-Voltage Switchgear and Control gear*
IEC 694	-	*Common clauses for switchgear*
IS 3156/1992	-	*Voltage transformers*
IS 2705/1992	-	*Current transformers.*
IS 2544/1973	-	*Porcelain Post Insulators*
8828/1996	-	*MCB*
IS 12063/1987	-	*Degree of protection provided for enclosures for electrical equipment.*

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IS 5/2005	-	*Colours for ready mixed paints and enamels.*
IS 1248/2003	-	*Indicating instruments.*
IS 13779/1999 & CBIP-88	-	*Energy meters*
IS 3231/1986 & 87	-	*Electrical Relays for Power System Protection.*
IS 4794/68 & 86	-	*Push button.*
IS 9385/1979	-	*High Voltage Fuses*
IS 55781984	-	*Marking of insulated conductor.*
11353/1985	-	*Guide for Uniform System of Marking and Identification of Conductors and Apparatus Terminals*

In the event of offered equipment confirming to standards other than the above, the salient points of comparison between the standard(s) adopted and the relevant IS shall be indicated in the technical offer. Copies of the standard adopted shall be invariably furnished with the offer.

4.0 *Technical Compliance of Electrical Equipment/Material:*

4.1 *11KV Switchgear Panels:*

4.1.1 The switch gear panel shall be Indoor type metal enclosed, rigid, free standing, floor mounted, draw out, dead front type and fabricated from standard prefabricated, cold rolled sheet steel units. Enclosure shall be of *dust & vermin proof, Complying with IS 3427 and conform to the degree of protection IP-4X.*

4.1.2 Switchgear for Indoor installation shall be Metal-clad, Drew-Out type free standing cubicle type & extensible on both sides

4.1.3 The minimum thickness of the sheet steel shall not be less than 2.5 mm. Necessary stiffeners shall be provided.

4.1.4 The VCB shall consist of three air insulated poles incorporating mechanism of interrupters. The body of interrupters shall be made of nickel chromium steel supported on insulators made out of metalised aluminum oxide. The contacts shall be of chromium copper and butt shaped.

4.1.5 Vacuum circuit breaker shall be mounted on truck or a carriage mechanism. In case of truck mechanism, the breaker shall be on a trolley while in a carriage mechanism, shall be separate door and it shall be possible to perform all operations with front door closed. The draw out carriage shall have two position for the circuit breaker viz isolated/test & service position. Busbars shall be insulated type made of high conductivity copper.

4.1.6 Monopoly designed to withstand full short circuit currents and shall be provided all along the length of the H.T. Panel Board.

4.1.7 It shall be horizontal isolation, horizontal draw out type, or vertical Isolation Horizontal draw out fully interlocked, with dust and vermin proof construction, suitable for indoor installation. The panel shall be supplied with the manufacturer's test certificates.

4.1.8 Certificates with date of manufacture and shall be complete in all respects as per details in the schedule of quantities. The steel work should have undergone a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulphuric acid and recognized phosphating process and shall be given powder coating (Electrostatic) paint of manufacturer's standard shade.

4.1.9 The switchgear constructions shall be such that the operating personnel are not endangered by breaker operation and internal explosions, and the front of the panel shall be

specially designed to withstand these. Pressure relief flaps shall be provided for safely venting out gases produced inside the high voltage compartment, busbar compartment and termination compartment. These flaps shall be vented upwards and cannot be opened from outside. These relief flaps shall be of such construction as not to permit ingress of dust/water in harmful quantities under normal working conditions. Enclosure shall be constructed with sheet steel of atleast 2.5mm thickness. It shall have a rigid, smooth, leveled, flawless finish.

4.1.10 Circuit breakers, instrument transformers, bus-bars, cable compartment etc., shall be housed in totally isolated air tight separate compartments within the cubicle. The design shall be such that failure of one equipment shall not affect the adjacent units. Suitable venting arrangement shall be provided to release the gas pressure developed due to the operation of the breaker or due to live arc of fault.

4.1.11 All relays, meters, switches and lamps shall be flush mounted on the respective cubicle door or on control cabinet built at the front of the cubicle. Each switchgear cubicle shall be provided with a thermostat controlled space heater and single phase plug point operated at 230 V AC. 50 Hz

4.1.12 The air clearance between phases and between phase to earth at the breaker unit incoming and outgoing terminals shall not be less than those indicated in the IS/IEC/British standards, corresponding to the basic insulation level of the circuit breaker as indicated in the criteria.

4.1.13 Circuit breakers, instrument transformers, bus bars, cable compartment etc. shall be housed in separate compartments within the cubicle. The design shall be such that failure of one equipment shall not affect the adjacent units.

4.1.14 Bus connection from bus compartment to breaker compartment & breaker compartment to cable compartment and bus compartment to adjacent panels shall be made with sealed resin cast bushing assembly.

4.1.15 Each cubicle shall have a front-hinged door with latches and a removable back cover. All covers and doors shall be provided with neoprene gaskets.

4.2 Circuit Breaker:

4.2.1 The switchgear panel shall be of arc proof version. Relevant Test report shall be furnished.

4.2.2 Each breaker cubicle shall be provided with ‘service’ and ‘test’ position limit switches, each having at least 6 NO & 6 NC contacts. All fixing bolts, screws, etc. appearing on the panel shall be so arranged as to present a neat appearance. The swing of the door shall not be more than 90 deg

4.2.3 Enclosure shall be so sized as to permit closing of the front access door when the breaker is pulled out to TEST position. The working zone shall be restricted within 800mm to 1800 mm from floor level.

4.2.4 All mechanical indications off breaker / LBS position, operation shall be visible from outside. Suitable transparent cover shall be provided at the front door of compact unit.

4.2.5 110V DC for operation of the Circuit Breaker and protection relays shall be taken from power pack (110V DC). This is to ensure operation of breaker in case of power supply failure being occurred (2 open and 2 close operations)

4.2.6 Circuit breakers shall be provided with spring charged, manual & electrical independent closing and shunt trip and series trip system for opening. Trip coil shall operate satisfactory range in-between 70% to 110% of rated voltage.

4.2.7 The life of the operating mechanism shall not be less than 10,000 operations.

4.2.8 The closing and tripping circuits shall be self opening on completion of their respective functions irrespective of position of the breaker ON/OFF switch.

4.2.9 In case of circuit breakers with more than one operating spring, they shall be so interlocked such that the springs are charged to the same extent and the breaker can be closed only if all the springs are charged to the required values. Further in case of multiple pole / phase breakers equal current sharing between poles shall be ensured by means of current balance schemes.
4.2.10 In order to ensure the reliability and long operating life for the mechanism, the mechanism shall be light, with a high mechanical strength and abrasion resistance to avoid high rate of wear and tear and with few components. The number of components in the breaker and operating mechanism shall be kept to a minimum and they shall be designed to be free of undue stresses during normal or short circuit operations. Further they shall ensure a high frequency of operations indicated in technical particulars. All the moving parts of the mechanism requiring inspection, maintenance and lubrication shall be easily accessible.
4.2.11 A readily identifiable mechanical emergency trip device as well as provision for manual charging of springs through the cubicle door shall be provided for each breaker.
4.2.12 A visual ON/OFF indication and SPRING CHARGED indication shall be provided positively coupled to the operating mechanism and visible from front with the cubicle door closed. Indications shall be provided for limit switches for spring charged and discharged condition. The Mechanism shall be TRIP FREE as per IEC.

4.3 Auxiliary Contacts:

4.3.1 Each circuit breaker shall have 4NO+4NC of auxiliary contacts to control circuit changes for indication, protection, interlocking, supervision, metering and others.
4.3.2 Normally open and normally closed contacts shall be interchangeable at site. Breaker auxiliary contacts available in test and service position either available in service position only which shall be clearly indicated. All auxiliary contacts shall be positively operated by the main apparatus and all contacts shall be adequate to make, carry and interrupt the currents in their circuits.
4.3.3 Emergency push button to trip the VCB shall be provided inside a weather proof box on the outer side wall of the compact Substation. An Auxiliary terminal box shall house the terminal blocks to receive the following external inputs from
a) Winding temperature indicator / alarm
b) 240V, single phase, 50Hz supply for panel and S/S illumination.
c) Separate terminal blocks shall be provided for control and power.
4.3.4 The auxiliary terminal box shall have IP55 protection on the outer side wall of compact Substation.

4.4 Rating:

4.4.1 The rating of the vacuum circuit breaker shall be as per the drawings and schedule of quantities. The rated / brea
4.4.2 king capacity of the breaker shall be from 500 MVA (26.3 KA RMS) at 11 KV. The rated making capacity shall be as per the relevant standards.

4.5 11kV Load break Switch:

4.5.1 The isolator should have HT fuse protection, Ammeter & voltmeter, potential transformers. The auxiliary contacts (2 NO & 2 NC) should be provided to transmit the signal regarding the status of isolator at remote position.
4.5.2 The potential transformer should have the suitable burden for metering & relays of breakers & other auxiliary purpose.
4.5.3 The isolator should comply with IEC publication 265-1968 & 694-1981 concerning general purpose of switch.
4.5.4 It shall not be possible to open the door with load break switching ON stage

5.0 *Busbars & Interconnections:*

All phase bus bars shall be of uniform cross section throughout the switch gear and shall be sized to carry continuous current path being specified in the Technical Data Sheet or SLD, The bus bars shall be made of electrolytic high-grade copper and shall be from rectangular bars the main buses and connections shall be of high conductivity electrolytic copper. Current density of bus bars shall not exceed 800A/sq.inch. PVC sleeves/tap of suitable thickness shall be provided on bus bars and jumpers except at the joints. The joints shall be covered with suitable shrouds. Suitable shutters shall be provided in addition and separate from interlocks, with padlocking arrangements, Bus bars shall be colour coded for easy identification and so located that the sequence R-Y-B

The bus bar chamber shall be provided with inter panel barrier with epoxy cast seal-off bushings through which the buses will pass through so as to prevent fire from one panel to another.

11kV bus support insulators and other equipment insulators shall have a minimum creepage distance of 127 mm. These insulators shall be of solid core porcelain or epoxy resin cast, with suitable petticoat design. Insulators shall have cantilever strength of not less than 1200 KgF.

All fasteners (Nuts Bolts) used for bus bar connections shall be of non magnetic stainless steel. Only Belleville type washers shall be provided for each nut bolt. If the fasteners used are not made with stainless steel then it shall be stated in commercial offer about type material being used and also confirm that the same is non-magnetic and shall most superior to stainless steel.

The bus bars along with their supporting insulators etc shall have a short time current rating of 25 KA for 3 sec.

6.0 Controls & Indications:

The circuit breaker shall be wired up for local and remote operation. Each breaker cubicle shall be equipped with following:-

- Trip / Neutral / Close switch
- Local Remote Selector
- R,Y ,B Indicating lamp
- Green Lamp - Breaker Open
- Red Lamp - Breaker Closed
- Amber - Breaker Trip

Lamps shall be of low watt LED cluster type.

7.0 Current Transformer (CT):

7.1.1 Current transformers shall be cast resin bar primary type conforming to IS 2705. All secondary connections shall be brought out to terminal blocks where star connection will be made.

7.1.2 All current transformers shall be designed to have over current factors to withstand the fault currents of the associated system as applicable to the switchboard.

7.1.3 Current transformer used for protection shall an accuracy limit factor not less than 15. Those things used for metering shall have a saturation factor of 2.

7.1.4 Current transformers shall be bar primary, cast resin type. All secondary connections shall be brought out to terminal blocks where Y or D connection will be made.

- Class PS for differential & restricted earth fault protection
- Class 5P20 for protection.

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- Class 0.5 for metering.

7.1.5 All CT secondary shall be earthed through separate switch link on terminal block. The secondary terminals of the CTS shall have the provision of shorting and disconnecting facilities by links.

7.1.6 CT terminals & their polarities shall be clearly marked.

8.0 Voltage Transformer:

8.1.1 Voltage Transformers shall be cast-resin, draw out type and shall have an accuracy class of as specified in the material schedule conforming to IS 3156. Voltage Transformer shall be mounted at rear side of the cubicle & VT's mounted on breaker carriage which is not acceptable.

8.1.2 High voltage windings of voltage transformer shall be protected by current limiting fuses. The voltage transformer and fuses shall be completely disconnected and visibly grounded in fully draw-out position.

8.1.3 Low voltage fuses, sized to prevent overload, shall be installed in all ungrounded secondary leads. Fuses shall be suitably located to permit easy replacement while the switchgear is energized.

8.1.4 Control supply 110V AC shall be derived from 11KV Bus PT for the following purpose.

- ON, OFF & Trip Indications for 11 KV VCB.
- ON, OFF & Trip Indications for 433V ACB.
- Working supply for 4 element relay meant for Transformer protection.
- Input source for 110V DC Power pack.
- PT signal to the static Energy meter

9.0 Relays:

9.1.1 The relays should be provided as per the material specification.

9.1.2 Relays shall be of draw-out or Fixed design with built-in site testing facilities. And Small auxiliary relays mounted within the cubicle.

9.1.3 Relays shall be rated for operation on 110 V secondary voltage and 5 A secondary current as shown on drawings. Number and rating of relay contacts shall suit the job requirements.

9.1.4 All relays shall be numerical type self-powered relays with RS-485 port.

9.1.5 If Relays may be from draw out design then those relays shall suit for built-in testing facilities.

9.1.6 The contractor shall furnish, install & co-ordinate all relays to suit the requirements of protection which shall broadly indicated in the material schedules and drawings.

10.0 Meters:

10.1 All meters are digital type of 96 x 96 mm accuracy class of ± 1%.

10.2 All meters shall be of Digital type with built in selector switches unless otherwise modified in the schedules.

10.3 Wherever analog meters are specified it shall be provided with suitable selector switches.

11.0 Secondary Wiring:

11.0 Control switches shall be suitable for use in AC circuits upto 440V and rating of 5A.

11.1 All incoming control and power circuits shall be fed through isolating ON/OFF rotary switch and HRC fuses with insulating base and holder. Closing circuit, tripping control circuit, lamp circuit shall be segregated and being protected by independent fuses.

11.2 All wiring shall be carried out with 1100 volts grade core wires having multistrand copper conductor. All control circuit shall be with copper conductor having a minimum cross-sectional area of 2.5 sq.mm per core and CT circuit shall be 4 sq.mm copper conductors. The wire shall be insulated with PVC.
11.3 All control wiring shall be terminated using eye type tinned copper lugs on to the stud type terminals. More than two wires shall not be terminated onto a single terminal.
11.4 All holes or tubes for wiring runs shall be bushed and shall have room for reasonable future additions. All cable runs shall clear injurious gases and heat emitted by control gear operation or shall be adequately protected from them.
11.5 Control cables when laid in HT busbar chamber, cable shall be taken through conduits. No joints or tees shall be made in wires between terminals. The wire shall be identified by numbered ferrules at each end, all in accordance with the connection diagram; equipotential terminals shall have the same ferrule numbers.
11.6 All ferrules shall be made of non-deteriorating materials. They shall be white except in case of warning ferrules, which shall be red. Ring type ferrules shall have the character engraved on it. The ferrules shall be firmly located in each wire so that they cannot move freely on the wire. Wiring across hinges shall be by flexible wires.

12.0 Inscription:

12.1 Each unit and each component shall be clearly labeled to indicate its purpose.
12.2 Nameplates at front and back of each cubicle shall be engraved on white back ground with black lettering of 10mm size.
12.3 Each component label shall include the component symbol shown on the connection or schematic diagram.
12.4 All components mounted inside the cubicle shall be provided with screwed inscription plate.
12.5 The characters to be engraved on the cubicle labels shall be furnished at later stage.

13.0 Earthing:

An earth bar adequate cross section shall be fixed preferably at the back of the switchboard. The earth bar shall be electrically continuous and shall run the full extent of each board. The earth bar shall be of same material as the busbars and shall have a minimum cross section of 300 sq.mm. Each unit shall be constructed to ensure satisfactory electrical continuity between all metal parts not intended to be alive and the earth terminals of the unit. Double earthing shall be provided from each equipment to the earth bus by suitable size of wire (or) flat.

14.0 Terminal Blocks:

14.1 Terminal blocks shall be 660V grade box-clamp type with marking strips ELMEX 10mm2 or equivalent. Terminals for C.T. Secondary leads shall have provision for shorting.
14.2 Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished.
14.3 Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

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Labels:

14.4 Labels shall be of anodized aluminum, with white engraving on block background. They shall be properly secured with fasteners.

15.0 Cable Termination:

15.1 Switchgear shall be designed for cable entry from bottom. Sufficient space shall be provided for ease of termination and connection.
15.2 Power cables shall be XLPE insulated, armored, overall PVC sheathed with stranded Aluminum conductor.
15.3 Control cables shall be PVC insulated, armoured, overall PVC sheathed with 2.5 sq mm stranded copper conductors.
15.4 All provisions and accessories shall be furnished for termination and connection of cables, including removable gland plates, cable supports, crimp type tinned copper/aluminum lugs, brass compression glands with tapered washer (For Power cables only) and terminal blocks.
15.5 The gland plates shall be minimum 3 mm thick. The gland plate and supporting arrangement for I/C power cables shall be such as to minimize flow of eddy current.
15.6 Sufficient space shall be provided between the power cable termination (end-boxes) and gland plate. Core balance C.T's, wherever specified, shall be accommodated within this space.

16.0 Earth Bus:

16.1 A Earth bus bar, rated to carry maximum fault current, shall extend full length of the switchgear.
16.2 The Earth bus bar shall be provided with two-bolt drilling with G.I. bolts and nuts at each end to terminate 50 x 6 mm CU. flat.
16.3 Each stationary unit shall be connected directly to the ground bus. The frame of each circuit breaker and draw out P.T. unit shall be grounded through heavy multiple contacts at all times except when the primary disconnecting devices are separated by a safe distance.
16.4 Wherever the schematic diagrams indicate a definite ground at the switchgear, a single wire for each circuit thus grounded shall run independently to the ground bus and connected thereto.
16.5 C.T. and P.T. secondary neutrals shall be made through removable links so that of one circuit may be removed without disturbing other.
16.6 Suitable ground terminal which can directly connect with the ground bus shall be provided in the cable chamber for grounding connection through cable screen/armoured.
16.7 All hinged doors shall be grounded using sliver plated and braided copper flexible of adequate size.

17.0 Miscellaneous:

17.1 Nameplates of approved design shall be furnished at each cubicle and at each instruments & device mounted on or inside the cubicle.
17.2 The material shall be lamicoid or approved equal, 3 mm thick with white letter on black background.
17.3 The nameplate shall be held by self-tapping screws. Nameplate size shall be minimum 20x75mm for instrument / device and 40x150mm for panels.
17.4 Caution notice on suitable metal plate shall be affixed at the back of each vertical panel.
17.5 Each cubicle shall be provided with thermostat controlled anti-condensation heaters, cubicle-illuminating lamp with door switch and 5A switched plug sockets.

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17.6 Cubicle heater, Plug/socket circuits shall have individual switch fuse units.

18.0 Space Heaters and Plug Sockets:

18.1 Each cubicle shall be provided with thermostat-controlled space heaters and 10A, 3 pin plug socket.
18.2 Cubicle heater, Plug/socket circuits shall have Individual MCB's.

19.0 Ac / Dc Power Supply:

19.1 The following power supplies will be made available at the switchgear: A.C.supply: Single Feeder with isolating switch.
19.2 Isolating MCB will be provided at the switchgear for the incoming supplies.
19.3 Bus-wires of adequate (minimum 4 sq.mm copper) capacity shall be provided to distribute the incoming supplies to different cubicles. Isolating MCB shall be provided at each cubicle for A.C. supplies.
19.4 A.C. load shall be so distributed as to present a balance loading on three-phase supply system.
19.5 1phase 230 volts AC auxiliary power supply will be made available for the 11kV Panels for Motor charging & panel auxiliary circuits.
19.6 Wherever required (specifically in RMU's & single VCB panels) suitable power pack shall be provided for tripping the CB. Power pack shall be suitable for minimum of three tripping operations. 24V DC control supply will be made available for Multi panel VCB's.

20.0 Painting:

20.1 All surfaces shall be sand blasted, pickled and grounded as required to produce a smooth, clean surface free of scale, grease and rust.
20.2 After cleaning, the surfaces shall be given a coating of red, lead primer followed by a coating of standard enamel anticorrosive undercoat.
20.3 The switchgear shall be powder coated & finish shall be as specified in the schedule of requirements.

21.0 Accessories:

21.1 **All accessories required for operation & maintenance of 11kV switchboards shall be furnished along with Package.**

22.0 Tests:

Routine Test –

22.1 The test shall include but not necessarily be limited to the following: -

- Check of conformity with wiring diagrams and plans,
- Mechanical operation tests, and checking of interlocks,
- Testing of the interchange ability of moving parts,
- High voltage dielectric tests at the power frequency.
- Low voltage dielectric tests.
- Low voltage functional checking
- Operation under simulated service condition to ensure accuracy of wiring, correctness of control scheme & proper functioning of the equipment.
- All wiring and current carrying part shall be given appropriate high Voltage test.
- Primary current and voltage shall be applied to all instrument transformers
- Routine test shall be carried out on all equipment such as circuit breakers, instrument transformers, relays, meter etc.

Any other additional tests as felt necessary by the TANGEDCO / CEA / consultants / clients the same shall be carried out by the Vendor at its own cost.

22.2 All tests shall be performed in presence of TANGEDCO / CEA consultants / client's representatives. The contractor shall give at least seven (7) days advance notice of the date when tests are to be carried out.

22.3 Certified reports of all the tests carried out at the works shall be furnished in three (3) copies for approval of the consultants.

22.4 The equipment shall be dispatched from works only after receipt of consultant's written approval of the test reports.

23.0 Drawing & Manuals:

23.1 The successful bidder shall submit the following drawings

- General arrangement drawing of panels
- Sectional drawing showing bus bar interconnections & clearances
- Typical foundation plan
- Typical breaker control schematic diagram
- Single line diagram
- Bill of materials
- Type test certificates of VCB, LBS & Accessories

24.0 Guarantee:

24.1 11kV panels shall be guaranteed for satisfactory operation for a period of 12 months from the date of commissioning. Any defects noticed during this period and the same shall be rectified at free of cost.

25.0 Handing-Over Documents:

25.1 Necessary documents & drawings shall be submitted in triplicate with the bid and in quantities, As per procedures as specified in General Conditions of contract and/or elsewhere in the specification for approval & subsequent distribution after the issue of Letter of intent.

- As fitted drawings
- Type test certificates
- Routine Test certificates of equipment & accessories
- Technical leaflets of accessories
- Installation, commissioning and maintenance instructions

26.0 Any Deviations on Technical Specification:

26.1 11kV panels shall fully conform to the technical specification & material requirements as mentioned in the tender. Further the tests shall be carried out as stipulated above.

26.2 Deviations if any with respect to site requirement and the same shall be clearly brought out in the offer being submitted by the respective vendor.

COMPLIANCE OF EQUIPMENT SPECS AT 11KV OUTDOOR RING MAIN GAIN(RMG) UNIT					
S.NO	DESCRIPTION	DATA SPECS	UNIT	RING MAIN UNIT	
				INCOMER	OUTGOING
	Desgin	Design, Manufacturing, Unloading, Leading, Positioning, Installing, Earthing, Testing and Commissioning of Outdoor type 11KV RMG panel (Combination of 2Nos Isolator & 1 VCB) will be of metal clad, free standing construction, suitable for operation with 11KV 3 Ph, 50 Hz, AC earthed system and fabricated from sheet steel, with powder coat finish painting of shade RAL 7032. The RMG panel shall contain internal components as mentioned below, complete setup with busbar interconnections,control wiring,designation labels, caution labels, sealing and pad locking facilities and wherever necessary space provision for entry of HT cables & separate control cable from the bottom through detachable gland plates as per the CEA requirements and specifications	Set	1	
A	**Switchgear**				
1	**Load Break Switch (LBS)**	11kV,TP,630A, Load Break Switch Manually operated with Mechanically interlocked earth switch, Comprising Of the following	Fixed	2	
	a	Mechanically interlocked earth switch.			
	b	2 NO + 2 NC Auxiliary Switch			
	c	Mechanical ON/OFF Indication			
2	**Circuit Breaker**	11kV, 630A, TP, 500MVA, 26.3 kA for 3Sec. Horizontal Drawout Vaccum Circuit Breaker Comprising Of	Draw-Out		1
	a	Motor/Manual spring charging mechanism - 230V AC			
	b	Closing & Tripping Coil suitable for 110V DC			
	c	6 NO + 6 NC Auxiliary Switch			
	d	Mechanical ON/OFF Indication			
	e	Mechanical Spring charge/Discharge Indication			
	f	Breaker Position Indicator			
	g	Mechancial Operating Counter			
	h	Automatic Safety Shutters			
	i	Secondary self-aligned plug in contacts			
	j	Anti-Pumping feature			
	k	Vacuum Interrupter-3Nos.			
3	**Instruments**				
	PT	11kV Epoxy Resin Cast Dual Core current Transformer			
	a	3phase 3 Limb 11kV/√3/110V/√3,3 Phase Draw out Transormer	Draw-Out		1
	b	Core - I : Cl. 0.2 with 200VA burden for Metering			
4	**CT**	11kV Epoxy Resin Cast Dual Core current Transformer	Fixed		3
	a	Core - I : Cl. 0.2S with 5VA burden for Metering			
	b	Core - II : Cl. 5P20 with 15VA burden for Protection			
5	**Relays**				
	a	Non - Directional 2O/C+1E/F Numerical relay	No		1
	b	High speed Tripping Relay	No		1
	c	Anti pumping Relay	No		1
6	**Meter**				
	a	144 sq.mm Ammeter, 100-50A/5-5A	No		1
	b	144 sqmm Voltmeter, 0-15kV	No		1
	c	Provision for Tri vector Meter	No		1
7	**Switch**	Ammeter selector switch -6 position with OFF	No	-	1
		Voltmeter selector switch - 4 position with OFF	No		1
		T/N/C - Spring return to Neutral	No		1
8	**Indicating Lamps/Push Buttons :**	R,Y,B Phase Indication Lamps	Sets		1
		Breaker ON/OFF Indicating Lamps	Set		1
		LBS ON/OFF Indication Lamps	Set	1	
		Spring charging Indication Lamp	Set		1
		Trip Circuit Healthy Indication with push button	Set		1
		Trip Indication Lamp	Set		1

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9	**Push button**	Trip circuit healthy	Set		1
		Emergency trip push button mushroom type	Set		1
10	**Power pack**	230V AC/ 110V DC with Continuous and stored energy	No		1
11	**TTB**	Link Type Test Terminal Block	No		1
12	**Miscellaneous Items:**				
	a	Space Heater, Thermostat with ON/OFF	Sets	1	1
	b	Cubicle illuminating lamp with door switch with ON/OFF	Lot	1	1
	c	Control MCB's, Fuse & Liks	Lot		1
13	**Terminal Blocks**	650V, 10A Stud type terminal blocks	Lot		1
	Busbars				
14	**Main Bus bars**	50x10mm COPPER Flats per phase			
15	**Earth Bus bar**	50x6mm Copper Flat			
	General				
16	**Enclosure**	CRCA Sheet steel - 2.5mm for load bearing members & 2mm for others			
17	**IP**	IP4X(Indoor)			
18	**Finish**	SIEMENS GREAY RAL 7032			
19	**Cable chamber**	Protected with welded mesh arrangement with Danger labels			
20	**Cable entry**	Top & Bottom			
21	**Gland plate material**	Non magnetic material preferably 3mm Aluminium Plate			

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COMPLIANCE OF EQUIPMENT SPECS AT 11KV OUTDOOR SINGLE WAY VCB PANEL (CLIENT SIDE CONTROL)				
S.NO	DESCRIPTION	DATA SPECS	UNIT	SINGLE WAY VCB
	Desgin	Design, Manufacturing, Unloading, Leading, Positioning, Installing, Earthing, Testing and Commissioning of Outdoor type 11KV Single way VCB Panel will be of metal clad, free standing construction, suitable for operation on 11KV 3 Ph, 50 Hz, AC earthed system and fabricated from sheet steel, with powder coat finish painting of shade RAL 7032. The VCB panel shall contain components as mentioned below, complete setup with busbar inter connections,control wiring,designation labels, caution labels, sealing and pad locking facilities and wherever necessary space provision for entry of HT cables & separate control cable from the bottom through detachable gland plates with all accessories	Set	1
A	Switchgear			
1	Circuit Breaker	11kV, 630A, TP, 500MVA, 26.3 kA for 3Sec. Horizontal Drawout Vaccum Circuit Breaker Comprising Of	Draw out	1
	a	Motor/Manual spring charging mechanism - 230V AC		
	b	Closing & Tripping Coil suitable for 110V DC		
	c	6 NO + 6 NC Auxiliary Switch		
	d	Mechanical ON/OFF Indication		
	e	Mechanical Spring charge/Discharge Indication		
	f	Breaker Position Indicator		
	g	Mechanical Operating Counter		
	h	Automatic Safety Shutters		
	i	Secondary self-aligned plug in contacts		
	j	Anti-Pumping feature		
	k	Vacuum Interrupter-3Nos.		
2	Instruments			
	PT	11kV Epoxy Resin Cast Dual Core current Transformer		
	a	3phase 3 Limb 11kV/√3/110V/√3,3 Phase Fixed Transformer	Nos	1
	b	Core - I : Cl. 0.5 with 50VA burden for Metering		
3	CT	11kV Epoxy Resin Cast Dual Core current Transformer	Nos	3
	a	Core - I : Cl. 0.5 with 15VA burden for Metering		
	b	Core - II : Cl. 5P20 with 15VA burden for Protection		
4	Relays			
	a	Non - Directional 2O/C+1E/F Numerical relay	No	1
	b	Multi Function Relay for-P125 & Equ.(50,51,50N,51N, 49, 95, 27 & 59)	No	
	c	High speed Tripping Relay(VAJHM-13)	No	1
	d	Auxilary Relays-VAA33	Nos	3
5	Meter			
	a	Multi Function Meter accommodated with RS 485 port.(A,V,F,PF,KW,kVA ,kVAr,kWh ,kVArh)	No	1
	b	Multi Function Meter with Demand Controller accommodated with RS 485 port.(A,V,F,PF,KW,kVA ,kVAr,kWh ,kVArh)	No	
6	Switch	T/N/C - Spring return to Neutral		1
7	Indicating Lamps/Push Buttons :	R,Y,B Phase Indication Lamps(LED Cluster Type)	Set	1
		Breaker ON/OFF Indicating Lamps	Set	1
		LBS ON/OFF Indication Lamps	Set	
		Spring charging Indication Lamp	Set	1
		Trip Circuit Healthy Indication with push button	Set	1
		Trip Indication Lamp	Set	1
8	Annunciator	12 way Alarm with in-built Push buttons for Accept,Test and Reset (Alarm for -O/C, E/F, WTA, BUH, MOLA, OLTC ,OLTC Surge Relay Trip, Trip for OTT, WTT, BUT, OLTC Surge Relay Trip)	No	1

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8	**Push button**	Trip circuit healthy	Set	1
		Emergency trip push button mushroom type	Set	1
9	**Power pack**	230V AC/ 110V DC with Continuous and stored energy		1
			No	
10	**TTB**	Link Type Test Terminal Block	No	1
11	**Miscellaneous Items:**			
	a	Space Heater, Thermostat with ON/OFF	Sets	1
	b	Cubicle illuminating lamp with door switch with ON/OFF	Lot	1
	c	Control MCB's, Fuse & Liks	Lot	1
12	**Terminal Blocks**	650V, 10A Stud type terminal blocks	Lot	1
	Busbars			
13	**Main Bus bars**	50x10mm COPPER Flats per phase		
14	**Earth Bus bar**	50x6mm Copper Flat		
	General			
15	**Enclosure**	CRCA Sheet steel - 2.5mm for load bearing members & 2mm for others		
16	**IP**	IP4X (Indoor)		
18	**Finish**	SIEMENS GREAY RAL 7032		
17	**Cable chamber**	Protected with welded mesh arrangement with Danger labels		
18	**Cable entry**	Bottom/Top		
19	**Gland plate material**	Non magnetic material preferably 3MM Aluminum Plate	Set	1

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TECHNICAL DATASHEET OF HT PANEL INSTALLATION WORKS				
SL.NO.	ITEM	UNITS	VENDOR HAS TO CONFIRM/FURNISH	
			RMG	SINGLE WAY VCB KIOSK
1.1	**General Particulars**			
1	Manufacturer's type designation			
2	Applicable technical standards			
3	Degree of Protection	IP(4X)		
4	Mini. clearance Required for Draw out in Breaker	mm		
5	Cubicle weight with Circuit Breaker	Kg		
6	Dynamic Loading	Kg		
7	Rated Voltage	Kv(11)		
8	Maximum System Voltage	kv(12)		
9	Rated Frequency	Hz(50)		
10	One minute power frequency withstand voltage	kv (rms)		
11	1.2 / 50 / usec. Impulse withstand voltage	kv(peak)		
12	safety interlocks and accessories provided as specified	Yes/No		
13	Overall dimension of each switchgear cubicle (Length X Depth X Height)Aprox.	mm(2400 x 1800 x 2100)		
2.0	**Short circuit withstand feature**			
a	Rated symmetrical breaking capacity	MVA(500)		
b	Short time (1 sec) at rated voltage	ka (rms)		
c	Dynamic rating	(rms)		
d	Continuous rating of busbars under site reference ambient temp. of 45° C	A(630)		
e	One minute dry withstand power frequency voltage	KA		
f	Impulse withstand voltage	KV		
g	Auxiliary supply for using shunt trip at power pack	V DC through(110v)		
h	Auxiliary supply for motor	VAC, Hz.		
i	Maximum temperature of busbars, droppers, connectors and contact at continuous current rating under site reference temperature	°C		
3.0	**Panel Enclosure & Busbars**			
i	**Panel Enclosure**			
1	Cable entry	Bottom/Top		
2	Thickness of sheet in mm			
	(a) cold rolled	Frame : 3		
	(b) frame enclosure	2.5		
c	Doors / Covers / Partitions	2.5		
3	Colour finish shade	2.5		
	(a) Interior			
	(b) Exterior			
ii	**Busbar Material- Main Busbar**			
1	Bare/Insulated			
2	Minimum clearance			
	(a) Phase to Phase	mm		
	(b) Phase to Earth	mm		
3	Continuous current rating under site conditions	A(630)		
4	Temperature rise over design ambient temperature for current rating as per 2.4	º C(45)		
5	One second current rating	kA		
6	Dynamic current withstand rating	kA		
7	Voltage class of supporting and through Bushings	kV		
iii	**Busbar Material- Earthing Bus Bar**			
1	Earthing Bus	ka		
2	Material			
3	Size			
4	Earthing conductor			
	(a) Material	Cu/Al		
	(b) Size	mm		
	© Bus bar insulation	PVC /Heat shrinkable		
4.0	**Circuit Breakers**			
1	Manufacture for			
2	Type Designation	kV		
3	Rated Voltage	kv(11)		
4	Rated Frequency	Hz(50)		
5	Maximum Continuous Voltage	kV(12)		
6	Rated Continuous Current	A(630)		
7	Current Rating under Site Conditions	A(630)		
8	Rated breaking capacity	MVA, ka(rms) (500)		

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9	Maximum Temperature rise	ºC(45)		
10	Rated symmetrical interrupting current	kA		
11	Making current capacity	kA		
12	One second current carrying capacity	kA		
13	Short time current withstand 4 for 1 sec. duration	MVA, KA (rms)		
14	Total break time	KA (peak)		
15	Type of operating suitable for manual	KA (rms)		
16	Minimum no. of auxiliary			
17	Withstand test voltage One minute power			
18	Frequency KV(rms) 1.2/50 u sec impulse KV (peak)			
19	Auxiliary control voltage	ka		
20	For closing coil for tripping coil 30 V DC through power pack			
21	For space heaters and lighting AC with MCB and thermostat unit			
22	Anti Pumping feature	V, Ph, Hz.		
23	Circuit breaker operation	10000		
24	Protection required panel			
25	Duty cycle of breaking capacity			
26	Total interrupting time measured from trip coil energisation	Cycle		
27	Total making time measured from closing coil energisation	Cycle		
28	Number of breaks per phase	mm		
29	Minimum clearance	mm		
a	Between poles	Per unit		
b	In air between live parts and earth	peak		
31	Switching over voltages generated by circuit breaker when switching OFF Transformers at no load	line to earth		
32	Each breaker truck provided With a 'TEST' position in addition to FULLY DRAWN OUT and IN positions	Yes/No		
33	Main contacts			
a	Type			
b	Material			
c	Silver Facing provided	Yes/No		
d	Thickness of the facing	mm		
e	Design contact pressure	Kg/mm2		
34	Arcing Contacts			
a	Type			
b	Material			
c	Silver facing provided	Yes/No		
d	Thickness of the facing	micron		
e	Design contact pressure	Kg/mm2		
35	Electrical anti pumping feature provided	Yes/No		
36	Type of closing mechanism			
37	Method of closing during power failure			
38	Closing coil consumption at rated voltage	Watts		
39	Trip coil consumption at rated voltage	Watts		
40	Number of auxiliary contacts			
41	Spring charging mechanism			
42	Spring charging Motor			
a	Rating	Watts		
b	Speed	RPM		
c	Class of insulation			
d	Time required to charge the spring from fully discharged condition	Sec.		
43.0	**Current Transformers**			
a	Type (bar/wound/any other)			
b	Standard applicable	IS(2075)		
c	Class of insulation			
d	System voltage and frequency	kV, Hz(12,50)		
e	Ratio			
f	Burden			
g	(a) for protection	va		
h	(b) for metering	va		
i	Accuracy class			
j	(a) for protection	va		
k	(b) for metering	va		
l	Short time current and duration	kA, Sec.		
m	Dynamic rating	kA (peak)		

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44.0	**Voltage Transformers**			
1	Type	(Cast Resin)		
2	Standards	IS(3156)		
3	Type of insulation			
4	Ratio	%		
5	Connections	Delta/ Star		
6	Rated output burden 1-phase	cl:		
7	Rated Accuracy	va		
8	H V Fuse rating	A		
9	H V Fuse rupturing capacity	mva		
10	L V Fuse rating	A		
11	L V Fuse rupturing capacity	mva		
12	Type of L V fuse			
45.0	**Relays & meters (Type and Make)**			
a	T.P. IDMTL relay with 2 O/C +1E/F Element type	Conventional		
b	Numerical Protection Relay for O/C, E/F, Timer and Trip Supervision	Digital		
c	D.C. fail alarm relay equivalent to VAA-33			
d	High speed tripping relay equivalent to VAJH -13			
e	Antipumping relay equivalent to VAA-11			
f	Auxiliary relay for buccholtz alarm and trip relay equivalent to VAA -33			
g	Auxiliary relay for winding temperature alarm and trip relay equivalent to VAA-33			
h	Relays draw out type			
i	Test plugs/ terminals provided			
j	Metering provided as per tender	Yes/No		
46	Impulse Voltage,Wave shape 1.2/50MS:			
a	To Earth	KV		
b	Between Poles	KV		
c	Between Open Contacts	Kv		
47	Power Frequency Test Volatage:			
a	To Earth	kv		
b	Between Poles	kv		
c	Between Poles	kv		
48	Breaking of Capacitance Load	A		
a	Closed Loop breaking Cos=0.31ND	A		
b	Rated Transformer off load breaking capacity	A		
c	Rated Line Charging breaking capacity	A		
49	Dimensions:			
a	Between open Contacts	MM		
b	Between live parts and earth mm	MM		
c	Making Time	sec.		
d	Arc Duration	M.sec		
e	Interlocked Earth switch provided	Yes/No		
50.0	**Drawings**			
a	Drawings submitted along with the Bid	Yes/No		
51.0	**Test Certificates**			
a	Type test copies furnished with the bid	Yes/No		

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LIST OF APPROVED MAKES FOR HT PANEL WORKS		
SL.NO.	ITEM	APPROVED MAKES
1	11KV VCB Panel	System Control/ Siemens/Schneider or Equivalent
2	11KV Breaker	System Control/ Siemens /Schneider or Equivalent
3	11KV LBS	System Control/ A Bond Strands /Siemens or Equivalent
4	Instrument Transformers	Cortina Electrics/Kappa/ Consolidated Electriks or Equivalent
5	Demand Controller	Enercon / Elemeasure/Quaser or Equivalent
6	Analog meters	AE/IMP/MECO or Equivalent
7	Selector Switches	Kaycee/Salzer/Kaycee or Equivalent
8	Indicating lamps / PushButtons	L& T/ Schneider/ Siemens/Tekinc or Equivalent
9	Control wires	Anchor/Finolex / RR Cable/ Polycab or Equivalent
10	Relays	Ashida/Siemens /Schneider or Equivalent
11	Alarm Annunciator	Bharni /Minilec or Equivalent
12	MCB	Siemens/ Schneider /Hager or Equivalent
13	Digital Meter	Enercon / Elmeasure/HPL or Equivalent
14	Space Heater / Thermo Stat	Sofia / Kontact or Equivalent
15	Power Pack	Barani Electronics /Sugam or Equivalent

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VOL – II

(ANNEXURE – B)

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TECHNICAL SPECIFICATION FOR 11KV/433V, 800KVA OIL COOLED TRANSFORMER WITH OLTC, RTCC & AVR CONTROLS

1.0 SCOPE

This specification covers design, engineering, manufacture, assembly, stage testing, inspection and testing at works as before delivery of 3 phase 50 Hz Core type, oil immersed self cooled Distribution Transformer conforming to (Energy Efficient level-2) of IS 1180 (Part-2) 2014 amended with respect to prevailing norms for Outdoor Use. Electrical work in general shall be carried out as per following CEIG/TNEB Specifications amended upto date.

2. 0 SERVICE CONDITIONS

2.1 Equipment has been supplied against the specification which can suit for satisfactory operation under the following tropical conditions:-

1	Max. Ambient air temperature	-	34.5 Deg.
2	Max. relative humidity	-	79 %
3	Max. annual rainfall	-	605 mm
4	Max. Wind pressure	-	26.4km/hr.
5	Max. Altitude above means sea level	-	8mtrs.
6	Seismic level (Horizontal acceleration)	-	0.3 g.
7	Climatic Condition	-	Average Temperature.
8	Reference Ambient Temperature for	-	50 deg C

3.0 STANDARDS & CODES

3.1 The equipment & its components shall confirm to design, manufacture, and testing particulars in accordance with the latest edition of the following Indian standards.

IS 2026	-	Specification for Power Transformers
IS1180	-	Outdoor distribution Transformer
IS12444	-	Specification for Copper wire rod
IS3347	-	Specification for porcelain Transformer bushing
IS335	-	Specification for Transformer Oil
IS5	-	*Specification for colors for ready mixed paints*
IS104	-	*Ready mixed paint, brushing zinc chromate, and priming*
IS2099	-	*specification for high voltage porcelain bushing*
IS649	-	*Testing for steel sheets and strips, magnetic circuits*
IS4257	-	Dimensions for clamping arrangements for bushings
IS7421	-	Specification for Low Voltage bushings
IS3347	-	Specification for Outdoor Bushings
IS5484	-	Specification for Al Wire rods
IS9335	-	Specification for Insulating Kraft Paper
IS1576	-	Specification for Insulating Press Board
IS6600	-	Guide for loading step of oil Immersed Transformers
IS6162	-	Paper covered aluminum conductor
IS6103	-	Testing of specific resistance of electrical insulating liquids
IS6792	-	Determination of electrical strength of insulating oil
IS10028	-	Installation and maintenance of transformers.
IS6262	-	Method of test for power factor and dielectric constant of electrical insulating liquids
IS2362	-	Determination of water content in oil for porcelain bushing of Transformer

CBIP Manual on Power transformers

4.0 TECHNICAL REQUIREMENTS

4.1 The 11kV/433V systems are effectively earthed at the neutral points of the star connected windings of the transformers

1)	Nominal System Voltage	-	11 kV
2)	Corresponding highest system voltage	-	12 Kv
3)	Frequency	-	50 Hz±3%
4)	Number of phase(HV/LV)	-	3
5)	Withstand voltage	-	28KV (RMS)
6)	Lightning Impulse Voltage	-	75KV (peak)
7)	Neutral earthing	-	Solidly Grounded
8)	System fault level (Minimum)	-	25kA for 3sec for 11kv
9)	Rated Power	-	800KVA
10)	Connections & Vector Group	-	Dyn11
	Primary Winding	-	Delta
	Secondary Winding	-	Star
	Vector group	-	Dyn11
11)	Service	-	Outdoor

4.2 TEMPERATURE RISE:

The temperature rise over ambient shall not exceed the limits given below.

Top oil temperature rise measured by thermometer	-	45 °C
Winding temperature rise measured by thermometer	-	50 °C
Type of Cooling	-	ONAN

4.3 Vendor shall be specify the Transformer Losses in technical data sheet

1) At 50% load losses
2) At 100% Load loss

5.0 CONSTRUCTIONAL FEATURES

5.1 Core:

The core shall be of high grade cold rolled grain oriented(CRGO steel sheet of M4) annealed steel lamination having low loss and good grain properties, coated with hot oil proof insulation, bolted together and to the frames firmly to prevent vibration or noise. All core clamping bolts shall be effectively insulated by Zinc Chromate and paper. The complete design of core must ensure permanency of the core losses with continuous working of the transformers. The value of the flux density allowed in the design and grade of lamination used shall be clearly stated in the offer

5.2 Windings

HV& LV winding shall be wound from Super Enamel covered / Double Paper covered copper conductor / foil winding for rating 800 KVA and above .Transformer shall be provided with the requisite number of windings and shall be designed to withstand the electromechanical stress exerted under short circuit conditions as per IS: 1180- 2014 .Class 'F'" insulation shall be used. Paper insulation shall be dry and uniform and free from punctures and other defects. Solid insulation shall be of best quality. Wooden supports, if used, shall be well seasoned and compatible with hot transformer oil. The test certificate of the raw materials shall be made available by the Transformer manufacturer on request during Inspection & Testing.

5.3 Terminal Boxes

Cable box for termination of high voltage PVC / XLPE cables shall be suitably dimensioned for air insulated termination. The air insulated terminal box shall be sized to permit use of all type of end termination kit including "PUSH-ON" type end *termination kit. Such cable*

box shall also have arrangements for grounding the armour of PVC / XLPE cables inside the cable box.

Terminal boxes shall be of self-supporting type & shall be adequately sized to terminate cables/ Bus ducts.

1. HV Side – Cable box for suitable to terminate 11KV, 3CX185Sq.mm. XLPE cable
2. LV Side – Bus duct flange type provision being suit for 1250A LV Al. Air Insulate Busduct.

5.4 Conservator:

The total volume of conservator shall be such as to contain 10% of total quantity of oil normally 3% quantity of the total oil will be contained in the conservator. Dimension of the conservator shall be indicated on the General Arrangement Drawing.

Oil level indicator shall be provided on the side which will be with fully covered detachable flange with single gasket and tightened with MS nut-bolt.

The inside diameter of the pipe connecting the conservator to the main tank shall be within 20 to 50 mm and it should be project into the conservator in such way that its end is approximately 20mm above the conservator so as to create a sump for collection of impurities.

The pipe from conservator tank connecting to main tank shall be of 30 mm (min.) dia and shall have a slopping flap so that the oil falling from the pipe shall not fall directly on the active job and shall fall on the side walls only.

The conservator shall be provided with the drain plug and a filling hole (30mm dia) with cover.

5.5 Heat Dissipation (Radiator)

Heat dissipation by tank walls to be excluded from top and bottom

Heat dissipation by fin type (pressed steel) radiator 1.25mm thick will be worked out on the basis of manufactures data sheet. Heat dissipation calculation sheet shall be submitted along with quote

4Nos radiator shall be provided on LV/HV side respectively. They should be fixed at right angle to the sides and diagonally. Their sizes shall be such that it covers at least 50% of the bottom yoke. Full core and complete top.

5.6 Marshalling Box

Weather proof type marshalling box shall be provided on the front side of the transformer tank and not on radiator. It shall be provided with terminals for oil temperature indicator, winding temperature indicator, magnetic oil gauge and Buchholz Relay and other control terminals as applicable. The box shall be complete with wiring up to terminal box. Whenever the control voltage is specified as D.C, the marshalling box shall be complete with D.C. Contactors and wiring. The gaskets provided shall be non deteriorating type and suitable for outdoor installation. The box shall have hinged door with locking arrangement. The marshaling box shall have removable undrilled gland plate at bottom. Inside the marshalling box, all the instruments shall be wired with 1.5sq.mm. PVC wires. Marshalling box shall be mounted at readable / approachable level.

Marshalling Box shall be provided with terminal blocks, gland plate, glands, and control wiring etc., to accommodate OTI, WTI & other accessories

5.7 Breather:

Breather joints will be screwed type. It shall have die-cast aluminum body or of Poly propylene materials and inside container for silica gel shall be of tin sheet, in case of

aluminum die cast breather. Makes of the breather shall be subject to purchaser's approval. Volume of breathers shall be suitable for 500 gm. of silica gel.

5.8 *OIL*

The transformer shall be supplied with first filling of oil. The oil shall conform to relevant Indian Standards. In case the Conservator / Radiator / Cooling tubes of the transformer are sent separately, sufficient quantity of oil shall be sent loose including 10% additional oil in non-returnable sealed drum. The transformer oil shall also conform to IS-335.

I Specific Resistance (Resistivity)
- a) at 20 º C :- 2.5 x 10 Ohm-Cm (Min)
- b) at 90 º C :- 0.2 x 10 Ohm-Cm (Min)

ii. Dielectric dissipation factor - 0.20 (Max. tan delta) at 90 º C.
iii Total acidity mg/KOH/gm - 0.05 (Max)
iv. Total sludge value (%) by weight - 0.05 (Max.)
v. The method of testing these aging characteristics is given in Appendix - C of IS 335 shall be amended up to date.
vi. Oil filled in Transformers

The transformer and all associated oil filled equipment shall be supplied along with sufficient quantity of oil, free from moisture and having uniform quality throughout for first filling of the tank, coolers and radiators along with 10% extra oil for topping up in non-returnable containers, suitable for outdoor storage. No inhibitor shall be used in the oil.

The design and material used in the construction of the transformer shall be such as to reduce the risk of the development of acidity in the oil.

5.9 Fittings & Accessories

The transformer shall be provided with standard accessories

Rating and diagram plate	-	1No
Earthing terminals with lugs.	-	2 Nos
Lifting lugs	-	6 nos. (4 nos for tank and 2 nos) or top plate of the transformer
Oil filling hole with cap (on conservator)	-	1No
Drain valve - 32mm for all T/Fs	-	1No

(Drain valve shall be covered with metallic box spot welded to tank)

Conservator with drain plug	-	1No
Thermometer pocket	-	1No
Thermometer pocket	-	1No
Silica Gel Breather	-	2Nos
Oil level gauge indicating 3 positions of	-	1No

Also being intimated the below markings;

Minimum (-) 5 deg.C.

Normal 30 deg.C

Maximum 98 deg.C.

HT bushing	-	3 nos. of HT bushing
Pulling lugs	-	4Nos
Bi-directional plain roller	-	4Nos

Air release plug	-	1No
Filter valve (32 mm dia)	-	1No
Oil temp. Indicator with Potential free Contact	-	2Nos
Winding temp. Indicator with PT Contact	-	2Nos
Bucholz relay with Potential free Contact	-	1No
On Load Tap Changer along with OSR and shut off valve.	-	1No
Magnetic oil level gauge with alarm contacts.	-	1No
Jacking pads and draw eyes		
Thermometer pockets	-	2 Nos.
Bottom drain cum filter valve	-	1 No.
Sampling valve with plug	-	1 No.
Rating and diagram plate	-	1 No
Marshaling box		
First fill of oil		
Explosion vent diaphragm with equalizer pipe and oil sight glass.	-	1No
Radiators along with stop valves and drain and air release plugs	-	1No
RTCC panel with PT, AVR and standard fittings, accessories		

6.0 Painting

Before painting or filling with oil, all UN galvanized parts shall be completely cleaned & free from rust, scale & grease and all external surfaces on castings shall be filled by metal deposition.

The interior of all transformer tank and internal structural steel work shall be thoroughly cleaned of all scale & rust by Sand-blasting or other approved method. This surface shall be painted with hot oil resisting varnish or paint.

Except for nuts, bolts and washers, all external surfaces shall receive adequate nos. of coating of weather resisting paint. All steel surfaces exposed to weather, shall be given a primary coat of Zinc chromate and at least two coats of final paint. i.e dark admiral gray paints. (IS 104 & IS: 2932)OR Powder Coating Painting as Specified by CEA.

All nuts & bolts used in the transformer for external fillings shall be galvanized or zinc passivity and painted with body paints.

7.0 OLTC, RTCC & AVR

On load tap changing gear (OLTC) shall be mounted on the transformer. The OLTC gear shall have diverter resistance or reactance and the current diverting contacts shall be housed in a separate oil chamber segregated from the main tank of the transformer. The contacts shall be accessible for inspection and shall be replaceable type.

7.1. OLTC driving mechanism shall consist of

- Suitable motor rated for 415V, 3 phase, 50 Hz AC
- Energy accumulator with springs.
- Selector wheel and arm limit switches to prevent motor over travel either direction.

- Slip clutch.

7.2. OLTC should be accommodated with following modes of control.

- Manual and Electrical mode from local switch control on the transformer itself.
- Electric mode through remote & manually.
- *Electric mode from remote automatically through voltage sensitive relay.*
- Individual / Parallel control on a master / follower.

7.3. Following technical features shall be incorporated in OLTC implementation.

- Device to ensure positive and full completion of tap change once it is initiated even if power fails.
- Interlock to cut off electrical control automatically in case manual mechanical control is initiated and vice-a-versa.
- Interlock to cut off a counter impulse for a reverse tap change, being initiated during a progressive tap change and until the mechanism comes to rest and resets circuits for a fresh operation.
- The Transformer shall be provided with On Load Tap Changer suitable for unidirectional power flow on the HV side of the transformer.
- Tapping details

a. Tap Range - +13% to -17%
b. No. of Taps - 16
c. No. of Positions - 17
d. Step Voltage - 1.25V

7.4 The tap changer shall contain the following standard accessories on it nature.

- Remote tap changing cubicle shall be provided with AVR
- RTCC shall incorporate Standard accessories like auto/ manual, local remote circuitry, digital remote tap position indicator

8.0 REMOTE TAP CHANGER CUBICLE (RTCC)

Indoor mounted remote tap changer cubicle shall consist of following:

- Control transformer with suitable isolator's and fuse protection
- Indicating lamp.
- Auto manual selector switch.
- Raise lower push buttons.
- Digital tap position indicator.
- Master follower sequence selector switch
- Out of step relay.
- Automatic voltage regulating relay (AVR) with time delay element. Lamp for tap changes in progress with suitable bell or alarm other than the one provided for annunciating faults.
- Voltmeter with HRC fuses.
- 12 Window Annunciation windows with alarm and alarm cancellation to indicate following faults:

i) Drive motor auto tripped.
ii) Tap change delayed.
iii) Lower limit reached.
iv) Upper limit reached
v) Out of step
vi) AC failure
vii) Buchholz relay alarm on OLTC

- 240V, 50 Hz, AC space heaters with switch and HRC fuses.
- Terminal blocks, internal wiring for power and control cables.
- Gasket and hinged doors with locking arrangement.
- Removable undrilled gland plate for cable entry.
- Sequence selector switch for parallel operation.

9.0 LIST OF DRAWINGS

9.1 The following drawings and manuals shall be furnished in triplicate along with Quote.

- General Arrangement Drawing (Elevations, side view & plan of the equipment)
- Core Assembly drawing.
- Internal Construction Drawing
- Rating & Diagram Plate Drawing.
- HV/LV Bushings indicating measurement of creep age distances.
- Foundation plan with equipment weight details
- Dimensional drawings.
- Construction & mounting details of marshalling box with accessories
- Control circuit schematic drawings.
- Bill of materials
- Operation and Maintenance Manual

9.2 Installation, Operation & Maintenance, Manual & Inspection Tests Certificates (Routine Tests) shall be submitted in along with the dispatch of equipment.

10.0 TESTS & TEST CERTIFICATES:
The Transformer shall be subjected to the following Routine & acceptance tests at the manufactures works. The tests are to be carried out in accordance with the details in IS 1180

10.1 Temperature rise test on the transformer

10.2 Routine tests

- Measurement of winding resistance
- voltage ratio and check of polarity and vector group
- Insulation resistances
- Load Losses
- No-Load losses and Load Current
- Induced over Voltage withstand
- impedance voltages
- Separate source voltage-withstand tests on HV and LV windings
- Bushing routine tests
- Oil leakage test
- Relief Device test
- Dielectric Routine Tests
- Galvanizing tests.
- Heat Run test - Optional

10.3 The Vendor should be Submitted the Site Analysis report with respect to below listed tests as before proceeding to commissioning work at site

- Insulation Resistance
- Ratio & Polarity Test on all taps
- Dielectric test on oil

- Open circuit test
- OLTC Operational test
- Operational test of protective devices & interlocks
- Measurement of HV & LV winding resistance on all taps

11.0 INSPECTION

All the type tests & special tests shall be conducted in completely assembled condition. All these tests shall be witnessed by the purchaser/ Consultants Engineers and the supplier has to arrange all necessary facilities to Client/Customer/Consultant for factory inspection & testing works.

12.0 REJECTION

12.1 The transformer may be rejected if

- Load or No load losses beyond the specified values
- It does not meet this guide lines
- Fails during the tests
- The guaranteed technical particulars are not met.

13.0 LIST OF APPROVED MAKES

13.1The following are the approved makes should be utilized in this tender

On load Tap Changer	-	On Load Gears/ CTR
AVR	-	Emco/PE
Bucholz relay	-	Atvus/I&C
MOLG	-	Sukrut
Oil Temperature Indicator (OTI)	-	Precimeasure/ Perfect Control
Winding Temperature Ind.(WTI)	-	Precimeasure / Perfect Control
Silica gel Breather	-	I&C, Ashish
Insulators	-	WSI/Jayshree
Valves	-	Atvus/Audco/ Leader

14.0 WARRANTY

The transformer shall be warranted for a period of 1 Year from the date of commissioning/18 Months from the date of supply.

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TECHNICAL PARTICULARS FOR 11/0.433kV,800KVA OUTDOOR TYPE OIL COOLED TRANSFORMER			
Sr.No	**Description**	**Units**	**Details/Compliance shall be furnished by the Vendor**
A	**General**		
1	Name of Manufacturer		
2	Standards		
3	Rating of Transformer	KVA	
4	Primary voltage	KV	
5	Secondary voltage	V	
6	Highest System Voltage in Kv	KV	
7	Cooling Type		
8	Transformer type (Oil/ Dry)		
9	Transformer application (Outdoor/ Indoor)		
10	Frequency	Hz	
11	Neutral earthing details		
12	Transformer Paint Shade		
13	Type of connection for H.V. Winding	Delta	
14	Type of connection for L.V. Winding	Star	
15	Vector Group	Dyn-11	
16	Maxi.temp. rise of Windings over an Ambient temp. of 50°C in °C in		
17	Maxi. Temp. rise of oil over an Ambient temp. of 50°C in °C in		
18	Overall length of the Transformer	mm	
19	Overall breadth of the Transformer	mm	
20	Overall height of the Transformer	mm	
21	Thickness of the tank plates	mm	
22	Thickness of the bottom tank plates	mm	
23	Thickness of the top tank plates	mm	
24	Degree of slope to the top plate of Transformer	deg	
25	Shape of transformer Tank		
26	Type of Tank (Corrugated/ Conventional)		
27	corrugated tank, thickness of corrugated sheet	mm	
28	Size of Transformer Base Channel	mm	
29	No. of Rollers provided to the Transformer	mm	
30	Conservator tank to the transformer with oil level indicator (showing three levels) and drain plug is provided		
31	Dimensions of conservator Tank	l & d	
32	Size of Oil filling hole with cap	mm	
33	Size of Drain valve	mm	
34	Size of filter valve		
35	Lifting lugs details		
36	No. of Earthing terminals with suitable size	swg	
37	Thermometer pocket is provided		
38	Quantity of Silica-Gel filled in breather	gm	
39	Explosion vent with diaphragm.		
40	No of radiators both on HV & LV side provided and location with arrangement & size.	qty.	
41	Thickness of the radiator	mm	
42	No of radiator fins.	qty.	
a	(A) Radiating surface of radiators	sq.mtrs.	
b	(B) Radiating surface of Tank only	sq.mtrs.	
43	Total radiating surface of transformer tank	sq.mtrs.	
B	**OLTC, RTCC & AVR**		
44	OLTC on higher voltage winding for variation of H.V voltage within range of (+) 5% to (-) 15% insteps of 1.25 % provided		
45	Weight of copper (Winding)	Kgs	
46	Weight of Transformer Tank with fittings	kgs	
47	Weight of Oil	kgs	
48	Volume of Oil	ltrs	
49	Total weight of Transformer	kgs	
50	Min. Clearances of Phase to Phase in HV Bushing	mm	
51	Min. Clearances of Phase to Earth in HV Bushing	mm	
52	Min. Clearances of Phase to Phase in LV Bushing	mm	
53	Min. Clearances of Phase to Earth in LV Bushing	mm	

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C	CORE		
54	Type of Core (Stacked/Wound)		
55	Weight of Core	kgs	
56	Core Grade		
57	Thickness of core lamination	mm	
58	Core Grade		
59	Diameter of the core	mm	
60	Gross Core Area	sq.mm	
61	Flux density at normal voltage and frequency in Tesla	tesla	
62	Material of H.V. Winding		
63	Material of L.V. Winding		
D	**Winding Details**		
64	Diameter of conductor used for HV winding	mm	
65	Total cross section area of HV Winding	sq.mm	
66	Size of strip used for LV winding conductor	mm	
67	Total cross section of Copper used in LV Winding	sq.mm	
68	No. of conductors in parallel of LV winding		
69	Current density of HV winding	Amps/sq. mm.	
70	Current density of LV winding	Amps / sq.mm.	
71	No of HV winding Turns		
72	No of LV winding Turns		
73	No of H.V. coils /phase		
74	No. of L.V. coils/phase		
75	Resistance of HV winding at 20 º C	Ohm/phase	
76	Resistance of LV winding at 20 º C	Ohm/phase	
77	% impedance value at 75º C	%	
E	**OIL**		
78	Name of manufacturer of oil		
79	Grade of Oil		
80	Quantity of total oil absorption (in Ltrs) in first filling		
81	Breakdown value of oil at the time of first filling (KV/mm) considering 2.5 mm gap	kv	
82	Total volume of conservator shall be such as to content 10% of total quantity of oil		
F	**Losses**		
83	Max. core (No load) losses at rated voltage and frequency in Watts		
84	Max. Total losses (No load loss + Load Loss) at 50 % loading in Watts at 75ºC		
85	Max. Total losses (No load loss + Load Loss) at 100 % loading in Watts at 75ºC		
86	Magnetizing current (No load) in Amps & its % of full load		
87	current & rated voltage referred to LV side		
88	Magnetizing current (No load) in amps & its % of full load current at maximum voltage		
89	(112.5% of rated voltage) referred to LV side		
G	**Clearance**		
90	Clearance between Core & L.V.	mm	
91	Clearances between L.V. & H.V.	mm	
92	Clearances between winding to body of tank	mm	
93	Clearance between HV phase to phase	mm	
94	Clearances between end insulation to Earth	mm	
95	Insulation materials provided for core		
96	Insulation materials provided for H.V. Conductor		
97	Insulation materials provided for L.V. Conductor		
98	Thickness of locking spacers between HV coils	mm	
99	Inter layer insulation provided in H.V winding to design for Top & bottom layer		
100	Inter layer insulation provided in L.V winding to design for Top & bottom layer		
101	Details of end insulation		
102	Whether wedges are Provided at 50% turns of the Coil		
103	Thickness of insulating paper	mm	

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H	**Efficiency, Regulation, and other particulars**		
104	Regulation at 0.8 P.F. lag	%	
105	Regulation at 0.8 P.F. leading	%	
106	Regulation at unity P.F..	%	
107	Reference standard of Bushing		
108	Material of HV and L.V Bushings		
109	Makes of HV and L.V Bushings		
127	Rating of HV Bushing	kv	
128	Rating of LV side Busbar		
129	Minimum Creepage Distance of HV Bushings in mm	kv	
130	Minimum Creepage Distance of LV Bushings in mm	kv	
131	Power frequency withstand voltage dry & wet for HV Bushings	kv	
129	Dry lighting impulse withstand voltage test in kV (Peak) stating the waveform adopted	kv	
130	for HV Bushing.		
131	Separate source power frequency withstand test for HV for 1minute	kv	
132	Separate source power frequency withstand test for LV for 1minute	kv	
133	Induced over voltage withstand test for 1 min.		
134	Impulse test value	kvp	
135	Efficiency at 75 º C at unity P.F & 0.8 PF at 100 % Load		
136	Efficiency at 75 º C at unity P.F & 0.8PF. at 50. % Load		

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(ANNEXURE – C)

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GENERAL SPECS & CONDITIONS FOR ELECTRICAL WORKS

1. The work under the contract shall be carried out in accordance with the schedule of item-wise works, these general specifications, drawings forming part of this tender document, general conditions and other terms of the tender.
2. The Contract works shall be carried out as per following the latest CPWD rules & regulations – Centralized one (Typical for All states in India) for Electrical & Civil Works unless otherwise specified in the nomenclature of the individual item or in the general specifications of concerned items of works.
3. For items not covered under latest CPWD specification, for (Electrical & Civil Works) and in particular specification or nomenclature of the individual item as above, the work shall be done as per latest relevant BIS codes of practice.
4. In case of non-availability of any specification in the above lines or any overlapping provisions, non- clarity on any issue, applicability of particular provision out of above, shall be decided by Engineer- in-Charge whose decision shall be final & binding on the contractor.
5. The contractor shall be responsible for executing and completing the work in accordance with the specified standards and specification which are as per requirements of IGBC-medal ratings. Execution of Electrical quality control is intended to provide a comprehensive common and consistent framework of quality control which is comprised of two main elements.
6. The contractor shall be responsible for the types of test to be carried out, frequency of testing and stage of testing as directed by Engineer-in-charge or as stipulated in Indian Standards CPWD Specifications for electrical and civil works. The cost of all these tests shall deem to be included in the item rates being quoted by the contractor.
7. In case of non-availability for any electrical items from the approved makes, In such cases electrical contractor shall proceed with equivalent brand of that particular items as per getting prior approval in advance from respective Client/Architect/Consultant by producing relevant certificates/documents/samples from the chosen equivalent brand. All test samples should be preserved, with proper identification, test log reference, test date and other applicable information. These samples must be stored at site by the contractor. In addition to tests performed on site, the contractor is responsible for specialized tests which are performed by manufacturers or third parties during the manufacturing of various materials and equipment components, to be incorporated in the works.
8. The Electrical (Interior & External) Works, Substation works & DG Set Works shall be carried out in accordance with Indian Standard Code of Practice for Electrical Wiring Installation IS: 732-1989 and IS: 2274-1963. Electrical Installation work shall also be done in conformity with National Electrical Code with respect to latest amendments. All Electrical work shall be carried out in accordance with the provision of Indian Electricity Act 1910 & Indian Electricity practice for the type of work involved. It shall also be in conformity with regulations

Part I	-	Internal Work	-	2013
Part IV	-	Substation Work	-	2013
Part VII	-	DG Set	-	2013

9. Wherever this Tender Specifications call for a higher standard of material and for workmanship than those required act by any of the above mentioned regulations

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and specifications with respect to given general specifications & conditions herewith which shall take precedence over the said regulations and standards.

10. Contractor shall do necessary co-ordination works with Govt. officials for organizing the EB point of supply inside the site premises, Getting load sanction from TANGEDCO as per site overall power demand requirement, Arranging the site inspection for all Govt legal agencies(Like CEIG,TANGEDCO,etc.,) after completing all electrical works installation at site subject to obtain their approval and shall avail the safety clearance certificate from them against installed electrical system leading to energize the electrical system for site operation.

TECHNICAL SPECIFICATION FOR ELECTRICAL WORKS

1.0 General:

The electrical Installation work shall be carried out in accordance with Indian Standard Code of Practice. It shall also be in conformity with the current Indian Electricity rules and regulations, requirements of the Local Electricity Supply Authority, Fire Insurance regulations, so far as these become applicable to the installation. Electrical work in general shall be carried out as per complying CPWD Specifications and latest rules & regulations as on present date.

General Specifications for Electrical Works.

Part -II - External Work

Wherever these specifications calls for a higher standard of material and or workmanship than those activities by any of the above mentioned regulations and specification which was mentioned here being taken as precedence over the said regulations and standards.

The details of scope of work subhead wise are given in the subsequent paras. The quantities worked out in schedule of materials which are based on particular equipment being considered during design stage. The contractor shall have to recheck the quantities based on equipment offered by him to achieve required exact parameters during execution phase at site.

System Parameters

1.1	*Utility Power - TNEB*		
	Nominal Voltage	-	*11KV*
	Highest System Voltage	-	*12KV*
	System fault Level	-	*350MVA*
	Frequency	-	*50Hz*
	Number of phase	-	*3*
1.2	*Back Up power -DG*		
	Nominal Voltage	-	*415V*
	Frequency	-	*50Hz*
	Number of phase	-	*TPN*
1.3	*Nominal Voltage*	-	*415V (3 Phase)/ 240V (1 Phase)*
1.4	*Lighting & Small Power Loads*		
	Nominal Voltage	-	*240V (1 phase)*

2.0 *Standards:*

All the supplied equipments which shall conform to the requirements of relevant Indian Standards. Further to the installation part which shall comply with the stipulated codes

described through the following Indian Standards.

IS 732	:	Electrical wiring Installation (system voltage not exceeding 650V)
IS 5216	:	Guide for safety procedure and Practice.
IS 2252	:	Code of practice for danger notice plates.
IS 5908	:	Method of measurement of electrical installation in building.
IS 1646	:	Fire safety of buildings (General) Electrical.
IS 4037	:	Heavy duty air break switches and fuses for voltage not exceeding 1000V.
IS 4237	:	General requirements of switch gear for voltage not exceeding 1000V.
IS 8623	:	Factory assembled switchgear and control gear.
IS 2147	:	Degree of protection provided by enclosure for low voltage Switch gear and control gear.
IS 3072	:	Installation and maintenance of switchgear.
IS 3106	:	Code of practice for selection, installation and maintenance of Fuses.
IS 375:	:	Marking and arrangement for switchgear bus bars, main connections and auxiliary connections.
IS 3961	:	Recommended cable ratings for cables.
IS 2667	:	Fitting for rigid steel conduits for electrical wiring.
IS 3837	:	Accessories for rigid steel conduits for electrical wiring.
IS 6946	:	Flexible non-metallic conduits for electrical installation.
IS 1913	:	General and safety equipments
IS 1777	:	Industrial luminaire with metal reflectors.
IS 7561	:	Decorative lighting outfits.
IS 3043	:	Code of practice for earthing.
IS 2309	:	Protection of building and allied structures against lighting.
IS 3854	:	Receptacles.
IS 5133	:	Junction boxes.
IS 4615	:	Switches socket outlets.
IS 4821	:	Heavy duty cable glands. All the materials shall carry ISI mark.

The Installation shall conform to the latest additions of Indian Electricity Rules and Regulations of local authorities.

3.0 L.T. Panels:

3.1 General:

Medium voltage power control centers (generally termed as switchboard panels) shall be in sheet steel clad cubicle pattern, free floor standing type, totally enclosed, compartmentalized design having multi-tier arrangement of the incomers and feeders as per details given in the schedule of quantities. The panels shall be of extensible type with provision of bus bar extensions. All panels shall conform to the requirements of the latest addition of IS and shall be suitable for 415 V, 3 phase AC supply or 230 V single phase AC supply as required.

4.0 Construction:

The panel shall be metal-enclosed, free-standing compartmentalized, modular type form 4A-Type2 suitable for indoor installation. The panel shall be dust and vermin proof, the enclosure shall provide a degree of protection of not less than IP-52. The panel shall be of uniform height not exceeding 2375 mm.

Cubical type panels shall be fabricated out of sheet steel not less than 2.0mm thick and partition shall be made of 1.6 mm thick CRCA sheet steel. Wherever necessary, such sheet

steel members shall be stiffened by angle iron frame work. General construction shall employ the principle of compartmentalization and segregation for each circuit. Unless otherwise approved, incomer and bus section panels or sections shall be separate and independent and shall not be mixed with sections required for feeders. Each section of the rear accessible type panel shall have hinged access doors at the rear. Overall height of the panel shall not exceed 2.4 meters. Operating levers, handle etc. of highest unit shall not be higher than 1.7 meters. Multi-tier mounting of feeder with permissible limit.

The general arrangement for multi-tier construction shall be such that the horizontal tiers formed present a pleasing and aesthetic look. The general arrangement shall be approved before fabrication. Cable entries for various feeders shall be either form top or bottom. Through cable alleys located in between two circuit sections, either in the rear or in the front of the panel.

Equipment to be mounted outside cubicles shall be flush mounted on cubicle door. No externally mounted equipment shall be mounted above 1.8m or below 0.3m from finished floor level. The panel shall be fabricated in suitable transport sections and assembled on rolled steel channel box frame.

All cable terminations shall be through 3 mm thick gland plates. There shall be separate gland plate for each cable entry so that there will not be dislocation of already wired circuits when new feeders are added. Cable entry plates shall therefore be sectionalized. The construction shall include necessary cable supports for clamping the cable in the cable alley or rear cable chamber.

5.0 Bus Bars:

The busbar compartment shall house the main horizontal busbars to supply power to the entire switchboard. The busbars shall be supported adequately to withstand the electromechanical and thermal forces due to short circuit currents.

The busbars shall be air insulated and made up of high conductivity, Aluminum. It shall have a fault withstand capacity as mentioned in the BOQ & SLDs. All busbars shall be fully screened by means of PVC sleeves in their own compartment running throughout the length of the panel and also suitable allowance shall be made for bus expansion. Suitable segregation shall be provided in between busbar chamber and adjoining compartments.

The busbars shall be suitable for 3 phase, 4 wire network along with PE conductor suitable to withstand fault current of system, the cross section of the neutral bus shall be 100% and 200% size of the phase busbar as referred / specified in the BOQ

The busbar shall be PVC sleeved with color strips of red, yellow, blue and black and the same shall be arranged in accordance with IS-375.

All panel's Main bus bar should be capable of either withstanding continuous rated Amps rating or to withstand the fault current for 1 minute, whichever is higher.

All the earthing busbar in the panel should be provided with same capacity for entire length of panel and the same shall be capable of either withstanding the fault current for 1 minute or half the size of neutral busbar, whichever is higher.

The busbar should be provided either based on the temperature rise limit or the current density of 0.8A/sqmm and 1A/sqmm for aluminum and copper respectively. The copper purity test will conduct at site and if anything found impure, the same will be rejected directly.

The busbar shall be properly segregated, suitably braced with insulated supports (DMC/FRP/SMC) placed at appropriate intervals to withstand the electromagnetic *stresses*

during short circuit. Minimum electrical clearances shall be maintained between phase, neutral and body as per standards.

6.0 Interconnection:

The interconnections of all the phases between the busbars and the incoming side of the switch control shall be inaccessible when the doors of the controls are opened for doing removal of fuses etc.

For each and every tapping from the busbars, separate connections shall be made. No direct tappings from the busbar shall be made for any feeder without control and protection.

The incoming and outgoing cable shall be properly identified and also identify the circuit to which it is connected to which outlet.

6.1 Incomer/ Terminations:

6.1.1 Instruments:

All voltmeters and ammeters shall be flush mounted of size with minimum 96 mm Conforming to class 1.5 of IS:1248 for accuracy. All voltmeters shall be protected with MCB.

6.1.2 Indicating Lamps:

On all the incomers of M.V. panels, ON/OFF indicating LED lamps shall be provided and shall be suitable for operation on AC supply. Phase indicating LED lamps shall be associated with necessary ON/OFF toggle switch.

6.1.3 Small wiring:

All small wiring for controls, indication etc. shall be with suitable FRLS/HFFR (halogen free fire retardant) copper conductor cables. Wiring shall be suitably protected within switch board. Runs of wires shall be neatly bunched, suitably supported and clamped. Means it shall be provided with easy identifications of the wires. Where wires are drawn through steel conduits, the works shall conform to CPWD General Specifications for Electrical works (Part I- Internal)-2013 and IS: 732 as the case may be. Identification ferrules shall be used at both ends of the wires. All control wiring meant for external connections need to be brought out at terminal block.

7.0 Earthing:

The panels shall be provided with an aluminium or copper earth bus with suitable size thickness & runs throughout the length of the switchboard. Suitable earthing eyes/bolts shall be provided with main earthing bus connectivity to the same through earth grid at the site. Sufficient number of star washers shall be provided at the joints for to achieve earth continuity between the panels and the sheet metallic parts.

8.0 Air Circuit Breakers:

8.1 General:

Air circuit Breaker shall comply with latest IEC/IS standards (IS/IEC 60447-II). All four pole Breakers shall be capable of setting Neutral Protection to N or N/2 to ensure precise neutral Protection.

Air circuit breakers shall be of 4 poles / TPN as per BOQ and shall have over load, short Circuit and Earth Fault protections wherever required as specified ratings. They shall be complete in all respects as per having the following minimum requirements.

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The Air Circuit Breakers shall be from rated Service voltage of 690V AC and Insulation Voltage of 1000V AC. The Air circuit Breaker shall be 3/4 Pole Motorized / Manual Draw out type which can capable for handling rated current up to in ambient temperature of 40 deg Celsius. The vendor shall furnish derating chart in the submittals.

The Air Circuit Breaker shall comply with latest international standards IEC60947-2.

- Should be suitable for Isolation as per standard.
- Shall have the Isolation between power circuit and Control circuit.
- Shall have Micro Processor trip-release with EMC compatibility.
- Facility to change setting in “ON” condition.
- Breaker Capacity should be from Ics value only.
- The breaker should comply with Ics=Icu=Icw (1s)
- The ACB shall have front face with Insulation Class II ie. For safety as per IEC 60947-2 allowing class II installations with breaker control from outside.
- Should have short time withstand capacity of 0.5,1 & 3 Sec.
- Should having facility of local fault identification (O/C, SC, E/F) wherever E/F is specified in the BOQ
- The Breaking capacity shall be as indicated in the BOQ.

8.2 Circuit breakers shall be provided with following accessories:

- Mechanically operated targets to show 'Open', 'Closed', 'Test' positions of the circuit breaker.
- Mechanically operated, red ‘trip’ push button, shrouded to prevent accidental operation.
- Locking facilities in the 'Test', and 'Isolated', positions. In test position the breaker will be tested without energizing the power circuits. The breaker shall remain fully housed inside the compartment in the test position.
- Minimum 6 NO and6 NC potential free auxiliary contacts, rated 10 A at 240V A.C. and 1A (inductive breaking at 230 V AC.)
- 'Red', 'green' and 'amber' indicating lamps to show 'Closed' 'Open', and ‘trip’ status. ‘Auto-trip' conditions of the circuit breaker when breaker operation is controlled by a control switch.
- Closing and trip coil shall operate satisfactorily under the following conditions of supply voltage variation :
  Closing coils - 85% to 110% of rated voltage. Trip coils - 70% to 110% of rated voltage.
- When series trip circuit breakers are specified the following releases with adjustable settings shall be provided: (Oil dash-pot type release is not acceptable):

8.3 Overload, Short circuit, under voltage releases:

- In addition to the adjustable current setting range specified in the Data, short circuit releases shall be provided with at least four adjustable time delay settings, If it is not possible to provide the specified adjustable current setting range for the short circuit releases, shunt trip circuit breakers together with necessary protective relays
- Facilities shall be provided for blocking the under-voltage release, if so required at Site.
- Each of the foregoing releases shall be provided with a single pole, double throw, and potential free alarm contact rated for 0.5A, 230V AC.

8.4 Spring Operated Mechanism:

The operating mechanism shall be manually operated spring charging stored energy type or with motor, opening and closing springs, limit switches for automatic charging and all necessary accessories. Facility for manual charging of the closing spring shall be provided. The operating mechanism shall be trip- free and non-pumping through electrically. An anti-

pumping relay to achieve electrical anti-pumping feature even if the breaker has provision for functioning anti-pumping by mechanical arrangement.

Power operated mechanism shall be provided with facilities for operation in remote panel by closing and opening operations as per breaker module designation and respective enclosed control scheme drawing.

8.5 Operating Mechanism:

The operating mechanism shall be trip-free. Failure of spring, vibrations or shocks shall not cause unintended operation of breaker or prevent intended tripping operation. Closing of breakers shall be prevented unless the spring is fully charged.

8.6 Interlocks:

The breaker shall be provided with all necessary interlocks to prevent inadvertent operations and to ensure safety for operating by personnel and also the equipment.

It shall not be possible to push in a drawn out breaker in closed condition or withdraw a breaker in closed condition. Compartment doors shall be interlocked against opening when breaker is in 'Closed' condition. It shall not be possible to operate the breaker in intermediate position while inserting or withdrawing a circuit breaker.

There shall be 3 distinct and separate positions of Test/Isolated/Service on circuit breakers on cradles which are self-lockable at each position:

8.7 Microprocessor Control Unit:

All ACBs shall have segregated by LED fault indications and microprocessor fault indication.

All ACBs shall be set for different protection settings using Rotary Dial potentiometer/ DIP Switches and navigation keys.

1. The Control unit shall be suitable to provide Overload, Short Circuit and Earth Fault protection, The Control Unit shall not be a peak sensing device and shall measure the true RMS values to make the measurement free from the influence of harmonics. It shall have thermal memory.

2. ACB shall be provided with below mentioned parameters (wherever specified)and will measure the Following:

3. Current –Phase and Neutral
4. Voltage – Phase to Phase and Phase to Neutral
5. Power- KW,KVAR,KVAH
6. Energy- KWH
7. Power Factor
8. Harmonics (If required)

The above parameters along with the status of breaker shall be displayed on front door of the panel. Also trip unit shall be shown with latest 20 trip histories which shall include *date* and time stampings. It shall be availing to upgrade the breakers with Communication feature at Site.

With RS485 -2 way communication and further upgradable to Ethernet connectivity through converters & communication on Bluetooth with a Bluetooth Module.

Total Discrimination study shall be provided for achieving total-discrimination (Based on kA) which reduces the thermal/electrodynamic stresses in the event of Short Circuit and earth fault.

9.0 MCCB Feeders:

a) GENERAL

The MCCB upto 630A shall be with current limiting category A and shall comply with the requirement of IEC 60947-2 / IS13947-2. MCCBs shall have Double Insulation between Live Power Parts and the front parts of the apparatus. No live parts shall be accessible inside the frame where accessories are fitted in the breaker to ensure safety for the operators.

b) CONSTRUCTIONS

The breaker shall be from Double Break type subject to reduce the let through energy in the event of short circuits. MCCBs shall be designed according to Eco-design complying with ISO 14062 Especially MCCB's materials shall be of halogen free type. They shall be supplied in recyclable packing & complying with European Directives. The manufacturer shall implement nonpolluting production processes that do not make use of chlorofluorocarbons, chlorinated hydrocarbons, ink for cardboard markings, etc

- Should be suitable for isolation as per standard. MCCB shall be suitable for selectivity. Such selectivity chart shall be published by the manufacturer.
- Above 630A rated MCCBs should be provided with Microprocessor based release and 630A & below the rated MCCBs should be provided with thermal magnetic release.
- Ratings above 32A up to 630A shall be TMA type of release to provide better overload and short circuit setting
- Micro-processor / electronic releases should be EMC compatibility.
- The breaking capacity shall be Ics values as per the Schedule of Quantities.
- The breaker should be comply with Ics=100% Icu
- Should have the facility to change the setting to ON condition.
- Shall have the Isolation between power circuit and Control circuit.
- Shall have with front door handles
- MCCB shall have minimum 8000 cycles electrical life upto 160A rating
- Watt-Loss of ACB/MCCBs to be provided to calculate total Power Loss occurring from each ACB/MCCBs.

The MCCB shall comprise with switching mechanism, contact system, arc extinguishing device and the tripping unit which all are to be mounted inside a moulded case. The MCCB shall be provided with field settable over load protection and S/C protection.

c) RUPTURING CAPACITY

The Moulded Case Circuit Breaker shall have a service breaking capacity (Ics) of not less than 50KA RMS at 415 volts for Main L.T. Panels. MCCB for Sub Distribution Boards shall have service breaking capacity (Ics) of not less than 36 KA RMS at 415 Volts. Short circuit with stand capacity (Service breaking capacity) specified shall be for one second.

d) TESTING

Test certificate of the MCCB as per relevant Indian Standards (IS) shall be furnished

9.1 Motor Starter Feeders:

All feeders with motor starters shall be from Type-II coordination category as per IS 13947 being provided with MCCB / MPCB + overload relay + contactor (AC3) rating as applicable for KW ratings as indicated in enclosed Single Line Diagram except for high inertia load like fans, blowers etc.

- Overload relay shall have adjustable tripping characteristics (i.e. class10, 20 & 30).
- All Motors rating < 5 kW shall be provided with Direct-On-Line starter and wherever specified.
- All Motors rating > 5 kW shall be provided with Star-delta starter.
- Sensitive Earth Fault Relay (with CBCT) shall be provided for motors 30kW & above & also for critical motors as indicated in enclosed SLDs.
- All Motors of rating <=7.5 kW shall be provided with MPCB+ Contactor + over load relay.
- All Motors of rating >7.5 kW and <= 90 KW shall be provided with MCCB+ Contactor + Overload relay.
- MCCB for motor protection shall be Icu=Ics=100%
- All Motors of rating above 90 KW shall be provided with MCCB/ACB + Motor protection Relay.
- Red, Green and Amber clustered LED indicating lamps for breaker ON, OFF, Trip suitable for control supply of 230V AC shall be considered.
- 1no. Emergency trip push button with hinged acrylic covers and reset facility.
- Motor shall have Local / remote control facility where ever indicated in SLD / BOQ.
- In local mode -Local control station for all pump-motors located in field shall have START push button and mushroom head stay put type STOP push button for start & stop operation of the motor. In remote mode – motor shall be controlled by IBMS
- In addition, loads indicated with "LOTO" shall be provided with local on load dis-connector switch of the same rating as the up-stream MCCB with 2 NO + 2 NC. Contacts
- All Motors of rating 30 kW and above shall be provided with Space heater

10.0 Miniature Circuit Breakers (MCBs):

The MCB's shall be of completely moulded design suitable for operation at 240/415 Volts 50 Hz system. The MCB's shall be a rupturing capacity of 10 KA at 0.5 p.f..

The MCB's shall be inverse time delayed thermal overload and instantaneous magnetic short circuit protection.

10.1 Cable Compartment:

The cable compartment shall have provision to terminate the user's cables. The size and type of cable shall be specified by the user at the time of enquiry. Manufacturer shall make suitable provision for the termination of these cables. If required, additional cable compartment may be used by the manufacturer to accommodate larger number of cables. However, such additional compartments shall satisfy all the requirements as those for the main structure. The instrument current transformers may also be housed in this compartment.

10.2 Contactors:

Contactor shall be of electromagnetic type rated for functioning with uninterrupted duty as defined in IS-13947-4-1 unless otherwise specified and also suitable for capacitor duty. Operating voltage is 230V AC, The main contacts shall be of silver or silver alloy. The insulation class for the coil shall be class E or better.

Each contactor shall be provided with 2 N/O and N/C aux. contacts. Contactor coil rating shall be availed with minimum pick up of 85% of rated voltage and minimum drop out of 75% rated voltage.

10.3 Push Buttons:

Push buttons shall be generally shrouded. Each push button shall be provided with 1 N/O and 1 N/C aux. contacts. "Stop" push button shall have, 'stay-put' feature. Color code shall be as per IS-6875.

10.4 Indication Lamps:

Indication lamps shall be provided in each feeder (all panels) with indication of ON, OFF & Trip.Potential free contact shall be provided with monitory ON, OFF and Trip status in all feeders for automations and each cable shall be brought out to panel for interfacing with IBMS.Fire alarm trip contacts and lamp, hooter with test button circuit shall be provided in the incomers of main panel.

10.5 Control Transformer:

Control transformer shall be double wound, dry type and Secondary output 110V AC (55V-0-55V) with centrally earthed transformer shall have good regulation (5% or less) to cope with inrush current of contactor coils with sufficient rating of ELCB with 30mA for primary and secondary.

CTs shall confirm to latest IS codes in all respects. All CTs used for medium voltage application shall be rated for 1 kV. CTs shall have rated primary current, rated burden and class of accuracy as specified in schedule of quantities/drawings. Rated secondary current shall be 5A unless otherwise stated. Minimum acceptable class for measurement shall be 0.5 to 1 and for protection class 10. CTs shall be capable of withstanding magnetic and thermal stresses due to short circuit faults. Terminals of CTs shall be paired permanently for easy identification of poles. CTs shall be provided with earthing terminals for earthing chassis, frame work and fixed part of metal casing (if any). Each CT shall be provided with rating plate indications.

10.6 Space Heaters:

Anticondensation space heaters, with thermostat suitable for 230V, 1 Ph supply along with a control MCB shall be provided in each panel.

10.7 Control Switches:

A general purpose control switch shall be provided for selection of "Auto" & "Manual". The switch shall be provided with engraving plate in the front with "Auto", Manual" & "Off" inscription. This switch shall be normally of the fixed-control bar type heavy duty unit.

10.8 Measuring Instruments:

Ammeters and Voltmeters shall be of digital type if not as analog type. They shall be industrial grade and shall have means of zero adjustment from the front without dismantling them. They shall be capable of carrying the normal full load current (via CTS) *and shall not* be damaged

by effects of rated fault current. The instruments shall have an accuracy class of 1.0 as per IS - 1248.

11.0 Earthing:

11.1 Scope:

This section covers the essential requirements of earthing system components and their installation. For details not covered in these specifications, IS Code of Practice on Earthing (IS: 3043-1987) shall be referred to.

11.2 Application:

The electrical distribution system is with earthed neutral (i.e. neutral earthed at the transformer / generator end). In addition to the neutral earthing, provision is made for earthing the metallic body of equipments and non-current carrying metallic components in the substation, as well as in the internal/ external electrical installations.

Earthing system is also required for lightning protection, computer installations etc. for function reasons.

Earthing requirements are laid down in Indian Electricity Rules, 1956 as amended from time to time, and in the Regulations of the Electricity Supply Authority concerned. These shall be complied with.

11.3 Materials:

The material of earth and earth conductor shall be as specified in BOQ.

11.3.1 Earth Electrodes:

The type of earth electrode shall be any of the following:-

a) Plate Electrodes

b) Pipe earth electrode

11.3.2 Electrode materials and dimensions:

The materials and minimum sizes of earth electrodes shall be as specified.

11.3.3 Earthing Conductor:

The earthing conductor (protective conductor from earth electrode upto the main earthing terminal/ earth bus, as the case may be) shall be of the same material as the electrode, viz. GI or copper and in the form of wire or strip as specified. The size of earthing conductor shall be as specified.

11.3.4 Hardware Items:

All hardware items used for connecting the earthing conductor with the electrode shall be of GI in the case of GI pipe and GI plate earth electrode and forged tinned brass in case of copper plate electrodes.

11.3.5 Protective (Earth Continuity /Loop Earthing) Conductor:

- The material and size of protective conductors shall be as specified.
- Unless otherwise specified, GI conductor should not be ordinarily used as protective conductor within any circuit beyond a Distribution Board downstream.

11.3.6 Location for Earth Electrodes:

Normally an earth electrode shall not be located closer than 1.5 m from any building. Care

shall be taken to see that the excavation for earth electrode does not affect the foundation of the building; in such cases electrodes may be located further away from the building, with the prior approval of the Engineering-In-Charge.

11.3.7 Installation for Electrodes:

Methods:

Pipe electrode shall be buried in the ground vertically with its top at not less than 20 cm below the ground level. The installation shall be carried out as shown in drawing.

In locations where the full length of pipe electrode is not possible to be installed due to meeting a water table, hard soil or rock, the electrode may be reduced length, provided the required earth resistance result is achieved with or without additional electrodes or any alternative method

12.0 Terminal Block:

Terminal blocks shall preferably be grouped according to circuit functions and each terminal block group shall have at least 20% spare terminals. Terminal blocks for control circuit shall be of 1100V grade with contact ratings not less than 10A and stud/clamp type. Not more than two wires shall be connected to any terminal block.

Terminal blocks for CTs and VTs shall be provided with test links and isolating facilities and CT terminals shall have short circuiting and earthling facility. All spare contacts and terminals of cubicle mounted equipment and devices shall be wired to terminal blocks.

13.0 Labels:

Labels shall be provided to describe the duty of or otherwise identify every Instrument, or other item of equipment mounted internally and externally. Switch positions shall be fully identified. Wording shall be clear, concise and unambiguous.

Each label shall be permanently secured to the panel surface below the item to which it refers. The labels shall be engraved plastic (4 mm THICK) with white letters in black background.

In addition to component labels, each cubicle door shall bear a large identification labels and the panel shall include large, prominent overall identification label.

14.0 Painting:

Care shall be taken in workmanship and selection of materials to prevent the occurrence of any form of damage or corrosion due to damp or highly humidity conditions.

The panel shall be prepared, primed, filled and painted to the highest standards. All items shall be cleaned and deburred after fabrication and welding has completed. External surfaces shall be filled and rubbed down as necessary to obtain a perfectly flat smooth surface free from blemishes and imperfections and the whole shall be Powder Coated for Siemens Grey RAL- 7032. Thickness of paint shall be not less than 75 micron range.

The panels shall be fabricated at such work shops where the following facilities are available.

a) Sand blasting
b) Pre-treatment (Seven tank process)
c) Spray booth
d) Heating oven for all sizes of panels.
e) Heat shrinking of PVC sleeves.

15.0 MCB Distribution Boards:

The distribution board shall be fabricated from 14/16SWG sheet steel, metal clad, dust & vermin proof, dead back, welded construction, double door type & suitable for wall mounting. The protection class to be a minimum of IP42 level.

The MCB DB's shall undergo suitable pre-treatment followed by powder coating off white color. Separate neutral link for each phase shall be provided.

All the internal connections shall be with either solid copper PVC insulated or copper conductor PVC insulated wires of adequate rating. And these connections shall be concealed by providing a hinged protective panel to avoid accidental contact with live points.

All outgoing equipment shall be connected direct to the bus bar on the live side. The equipment shall be mounted on a frame work for easy removal and maintenance. The sheet steel work shall undergo a rigorous rust proofing process, two coats of filler oxide primer and final powder coated paint finish.

All the circuits shall have an independent neutral insulated wire, one per circuit, and shall be numbered and marked as required by the Owner.

A sample of the completed board is to be shown and shall get approval from the Client as before commencement of supply and erection works at site.

16.0 Residual Current Circuit Breaker (RCCB):

- RCCB ratings from 25A to 125A shall comply with IS12640-1988/IEC1008.
- The short circuits withstand capacity of the RCCB without the associated short circuit/overload protection shall be 6Ka/10kA.
- The Breaking Capacity shall be 1.5kA Ratings and sensitivities shall be as specified in schedule of quantities.
- There shall be clear identification of earth fault or overload/Short circuit fault on the RCCB.
- The RCCB should be suitable for SMPS loads (i.e unaffected by the d.c pulsated components, harmonics etc, lightning, line disturbances due to other equipments) and should not give nuisance tripping.
- If RCBO is recommended for 2 Pole, it shall confirm to IEC1009 with B.C of 6kA.
- If EL + MCB is recommended for 2/4 Pole, it shall confirm to IEC1008 with B.C of 10kA.

17.0 Automatic Source Change-Over Switch (ASCS):

17.1 General:

The Automatic Source Change-over System (ASCS) shall be both mechanically and electrically interlocked to exclude any possibility of coupling together with usual and emergency sources.

To ensure continuity of service in both circuit breakers shall have two stable positions, CLOSED and OPEN. It shall be possible to manually operate each circuit breaker in the event of the absence of control voltage.

For maintenance purpose, the ASCS shall have a neutral position with both circuit breakers in at OPEN position. It shall also be possible to lock each circuit breaker in the OPEN position. Each circuit breaker of the ASCS shall be equipped with auxiliary contacts and alarm contacts (TRIPPED status indication).

The ASCS shall be provided with a micro-processor based controller. The controller shall be adopted with following features;

1. Automatic operation.
2. Forced operation of 'Mains' source.
3. Forced operation of Standby' source.
4. Stop (both 'Mains' and 'Standby' sources off). The following settable time delays shall be possible.
5. Time delay between loss of voltage in Mains and switching OFF the Mains breaker.
6. Time delay between restoration of Mains voltage and switching OFF of Standby breaker.
7. Time delay between switching OFF of mains breaker and switching ON of Standby breaker during which load shedding can be done.
8. Time delay switching OFF of Standby breaker and switching ON of Mains breaker during which shed load can be reconnected.
9. Time delay for confirmation of presence of 'Mains' source voltage before stopping the Generator set.
10. The controller shall be provided with status indication: ON, OFF, Fault-trip, Automatic mode.

17.2 Construction:

Operations of the circuit breakers shall be by individually momentarily energized motor, mounted on each breaker.

The ASCS shall include 2 circuit-breakers; 3 pole / 4 pole (draw out for ACBs type and fixed for MCCBs type), The ASCS shall have an Electrical interlock via microprocessor & mechanical interlock via base plate / flexible or rigid links for the 2 circuit-breakers to prevent both breakers to be in ON condition at same time.

17.3 Circuit breakers:

The circuit breakers shall confirm to IS 13947-1&2 /IEC60947-1&2, confirming to test sequence 1, 2 & 3. It shall confirm to Isolation standard as per annexure 7.1.2 of IEC. The breakers shall have no line load restriction & shall be suitable for operation on 3 phase 415 Volts, 50Hz supply.

17.4 Rating & Breaking Capacity:

The rating of the circuit breaker & breaking capacity shall be as per the drawings and schedule of quantities.

17.5 Protection:

The setting range shall cover the following:

- Overload - adjustable.
- Short-circuit – adjustable for ratings of 200A and above.
- Instantaneous Earth fault (if specified) - adjustable threshold with time delay.

17.6 Accessories:

Circuit Breaker shall be provided with following accessories, if specified, in schedule of quantities. Further these devices shall be field fittable from the front and common for all ratings.

- Under -voltage
- Shunt-trip
- Closing coil
- Auxiliary contact

18.0 LT Power Cables:

18.1 General:

L.T. Power Cables shall be supplied, inspected, laid, tested and commissioned in accordance with drawings, specifications, relevant Indian Standards specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drums. The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed.

18.2 Materials:

The L.T. Power cables shall be XLPE insulated PVC sheathed type aluminum conductor armoured cable conforming to IS : 7098 : 1988 (Part-I) with up to date amendments whereas control cable shall be XLPE insulated and PVC sheathed copper conductor armoured/ unarmoured cable conforming to IS:7098 (Part-I) 1988.

18.3 Installation of Cables:

Cables shall be laid directly in ground, pipes, masonry ducts, on cable tray, surface of wall/ceiling etc. as indicated on drawings and/or as per the direction of Engineer-In- Charge. Cable laying shall be carried out as per CPWD specifications.

18.4 Inspection:

All Power cables shall be inspected at site and checked for any damage during transit.

18.5 Joints in Cables:

The Contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoiding the incident as before the cables are being cut to lengths.

18.6 Laying Cables in Ground:

Cables shall be laid by skilled experienced workmen using adequate rollers to minimize stretching of the cables. The cable drums shall be placed on jacks before unwinding the cable. With great care it shall be unrolled on over wooden rollers placed in trenches at intervals not exceeding 2 meters. Cables shall be laid at depth of 0.75 meters below ground level. A cushion of sand total of 250mm shall be provided both above and below the cable, joint boxes and other accessories. Cable shall not be laid in the same trench or alongside a water main.

The cable shall be laid in excavated trench over 80mm layer of sand cushion. The relative position of the cables, laid in the same trench shall be preserved. At all changes in direction in horizontal and vertical planes, the cables shall be bent smooth with a radius of bent not less than 12 times the diameter of cables. Minimum 3 metre long loop shall be provided at both end of cable.

Distinguishing marks may be made on the cable ends for identifications of phases. Insulation tapes of appropriate voltage and in red, yellow and blue colors shall be wrapped just below

the sockets for phase identifications.

18.7 Protection of Cables:

The cables shall be protected by bricks laid on the top layer of the sand for the full length of underground cable. Where more than one cable is laid in the same trench, the bricks shall cover all the cables and shall project a minimum of approximately 80mm on either side of the cables. Cable under road crossings and any other places subject to heavy traffic shall be protected by running them through Hume Pipes with suitable size.

18.8 Excavation & Back Fill:

All excavation and back fill required for the installation of the cables shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layer not exceeding 150mm. Each layer shall be properly rammed and consolidated before laying the next layer.

The Contractor shall restore all surfaces, roadways, sidewalks, Krebs wall or the works cut by excavation to their original condition to the satisfaction of the Engineer- In-Charge.

18.9 Laying of Cable on Cable Tray of/ Surface of wall / Ceiling:

Cable shall be laid on perforated M.S. Cable tray. Cables shall be properly dressed before cable ties/clamps are fixed. Wherever cable tray is not proposed, cables shall be fixed on surface of wall or ceiling slab by suitable MS clamps/ saddles. Care shall be taken to avoid crossing of cable.

18.10 Cable on Hangers or Racks:

The Contractor shall provide and install all iron hangers racks or racks with die cast cleats with all fixings, rag bolts or girder clamps or other specialist fixing as required.

Where hangers or racks are to be fixed to wall sides, ceiling and other concrete structures, the Contractor shall be responsible for cutting away, fixing and grouting in the following tests shall be conducted on the cable as before energizing and test report are to be furnished.

1. Insulation resistance.
2. Continuity test.
3. Earth test.
4. Sheathing continuity test.
5. High voltage test.

18.11 Cables Tags:

Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. Trays tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 metres.

18.12 Testing Of Cables:

Prior to installation, burying of cables, following tests shall be carried out. Insulation test between phases, phase & neutral, phase & earth for each length of cable.

a. Before laying
b. After laying.
c. After jointing.

On completion of cable laying work, the following tests shall be conducted in the presence of

the Engineer-In-Charge.

a. Insulation Resistance Test (Sectional and overall).
b. Continuity Resistance Test.
c. Earth Test.

All tests shall be carried out in accordance with relevant Indian Standard code of practice and Indian Electricity Rules**.** The Contractor shall provide necessary instruments, equipments and labour for conducting the above tests & shall bear all expenses of conducting such tests.

19.0 Cable Tray:

The cable tray shall be fabricated out of slotted/perforated MS sheets as channel, sections, single or double bended. The channel sections shall be supplied in convenient lengths and assembled at site to the desired lengths. These may be galvanized or painted to the desired lengths. Alternatively, where specified, the cable tray may be fabricated by two angle irons of 50mm x 50mm x 6mm as two longitudinal members, with crosses bracings between them by 50mm x 5mm flats welded/bolted to the angles at 1 m spacing. 2mm thick MS perforated sheet shall be suitably welded/bolted to the base as well as on the two sides.

19.1 Typically, the dimensions, fabrication details etc.

The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8 mm dia round headed bolts, nuts, and washers. In order to maintain proper earth continuity bond, the paint on the contact surfaces between the coupler plates and the maximum permissible uniformly distributed load for various sizes of cables trays and for different supported span are as per CPWD General Specification of Electrical Work Part II -2013. The sizes shall be specified considering the same.

The width of the cable tray shall be chosen so as to accommodate all the cables in one tier, plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100mm. The overall width of one cable tray shall be limited to 800mm.Factory fabricated bends, reducers, tee/cross junctions, etc. shall be provided as per good engineering practice. Details are typically shown in figure 3 of CPWD General Specification of Electrical Work Part-II -1994. The radius of bends, junctions etc. shall not be less than the minimum permissible radius of bending to the largest size of cable shall be carried by the cable tray.

The cable tray shall be suspended from the ceiling slab with the help of 10mm dia MS rounds or 25mm x 5mm flats at specified spacing as per of CPWD General Specification of Electrical Work Part II -2013. Flat type suspenders may be used for channels up to 450mm width bolted to cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angles 50mm x 50mm x 5mm at the bottom end as specified. These shall be grouted to the ceiling slab at the other end through an effective means, as approved by the Engineer-In- Charge, to take the weight of the cable tray with the cables.

The entire tray (except in the case of galvanized type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint.

The cable tray shall be bonded to the earth terminal of the switch boards at both ends.

The cable trays shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross joints, etc, and being fixed with the same accordingly.

Cable laid on cable tray shall be clamped on the tray at suitable intervals as per CPWD specifications.

20.0 Street Light Poles and Posts:

The street light poles/pathway light poles shall be of swaged type construction conforming to IS 1239. The dimensional and other details shall be as specified in the enclosed Standard Drawings.

The street light poles shall have M.S pipes of progressively reduced dimensions and post top lanterns poles shall be of uniform cross section. The poles shall be treated with a rigorous rust inhibition process and the outside surface of the pole shall be painted with two coats of paint conforming to IS 2339. Where portion of the pole is required to be embedded in concrete and below ground, the inner circle shall be treated with two coats of bituminous paint.

The poles shall be complete with base plate of minimum size 300 x 300 mm and 10 mm thick, and as indicated in the standard drawing.

The pole below the ground level shall be grouted in 1:2:4 concrete as per standard drawing. The bottom portion of foundation shall be 800 x 800 mm. Two nos. 50 dia. G.I pipes in arc with 600 mm radius shall be embedded in concrete pedestal up to marshaling box for running of incoming and outgoing cables.

Earthing studs shall be provided on pole. Each pole shall be provided with a junction box made of 2 mm thick sheet steel mounted on supporting clamps welded to pole at +450 mm from ground level. The box shall be of weatherproof and dust tight construction with neoprene gaskets and provided with hinged front cover/door with key operated locking device. The box shall have overall dimension of 200 x 150 x 100 mm and shall be completed with the following: (However the Alternative arrangement shall be chosen through an integral type junction box as shown in drawing)

- 8 ways 30 Amp. Strip type terminals each terminal being suitable for termination of loop in and loop out of Aluminum conductor cables upto 25 Sqmm.
- 10 Amps SPN/double pole MCB.
- Internal wiring from box to lamp holder of light fitting at top by means of 2 runs of 100 V grade PVC copper conductor wire of size 4 Sqmm and one run of 2.5 Sqmm green earth wire.
- The gate lights installation shall be with 600 mm long MS pipe out of which 300 mm is embedded in compound/gate wall. The junction box shall be flush mounted in wall at +450 mm from ground level and with 19 mm dia. MS conduit interconnecting pole and junction box for running wires. The light poles shall be numbered with neat letters in paint.
- Quoted rate shall include all items/works described as above and including civil works, reducers suitable size foundation bolts as per standard drawing and any other items not specified but necessary for completion of installation.

21.0 Lightning Protection System:

This specification covers the requirements of supply, installation, testing and commissioning of lightning protection system in conformity with the requirements of IS:2309, consisting of vertical air termination the horizontal air termination's, down conductors and earth stations.

21.1 Standards:

The following standards shall fulfill:

IS 2309 — 1969 : Code of practice for the protection of buildings and allied structures against lighting.

IS 3043 — 1966 : Code of practice for earthing

IS 521 6— 1969: Safety procedures and practice in electrical work.

Indian Electricity Act 1910 and rules issued there under. British Standard Code of Practice 326 — 1965.

21.2 Air Termination's:

The air terminations shall be provided at the points shown on the drawings. The vertical air termination's shall consist of copper spikes fixed onto 25 mm dia. copper tubes of atleast 1.5 Mtrs. long grouted to the surface of the roof with base plate as approved by Consultant.

The horizontal air terminations shall consist of a rigid network of tapes fixed to the surface of the roof. All exposed metal work and roof structures forming part of the structure to be protected shall be bonded to the network by the conductors of the appropriate cross section.

21.3 Down Conductors:

Air terminations shall be connected to the earth terminations by tapes fixed onto walls of the structures with spacers. The tapes shall be securely fixed to walls by means of brass saddles and metallic fasteners. Where the down conductors are laid underground, they shall be laid at a depth of 750 mm below the ground level, buried in trench, covered with a 100 mm thick layer of sand and protected by cable protection tiles. All metallic parts of the building above the main roof level including ducts, towers , pipes gutters and other mechanical equipment's shall be bonded to the down conductors.

21.4 T-Off Conductors:

These shall be carried out if required under the advice of consultant to interconnect the various lightning arrestors of one building near the top to extend the zone of protection. These shall be of GI strip of size 40 x 6 mm as specified in Schedule of quantities and shall be fastened securely to the building surface by means of GI saddles maximum 1m apart, with GI nails/screws and shall have minimum number of joints.

21.5 General:

- The materials shall be free from rust, scale and other electrical and mechanical defects. The size, materials and quantity shall be as specified.
- Steel earthing conductors above ground shall be hot dip galvanized. If painted it shall be given two coats of approved bit mastic paint/anti-corrosive paint.
- Test links in suitable enclosures shall be installed by the contractor at no extra cost for connection between each lightning conductor down conductor and earth electrode.
- The scope of installation of lightning conductors on the roof of buildings shall include laying, anchoring, fastening and cleating of horizontal conductors, grouting of vertical rods where necessary, laying, fastening/cleating/welding of the down-comers on the walls/columns of the building and connection to the test links above ground level, and up to earth station.
- Lightning protection conductors shall not be connected to other general earthing conductors.

- The lightning protection air termination rods and/or horizontal air termination conductors shall be fixed in such a way that they remain in their installed position even during adverse weather conditions.
- The down conductors shall follow a direct path to earth. There shall not be any sharp, turns and kinks in the down conductors.
- All joints in the down conductors shall be of welded/brazed type. All metallic structures within 2 m vicinity of down conductors shall be bonded to the lightning protection system.
- Every down conductor shall be provided with a test link at about 1000 mm above ground level. The test link shall be directly connected to the earthing system/electrode.
- The lightning protection system shall not be in direct contact with the underground metallic service ducts, cables, cable conduits and metal enclosures of electrical equipment's.
- Lightning conductors shall not pass through or run inside G.I conduits.
- Wherever required, if indicated in drawings, for fuel oil and other inflammable liquid storage tanks lightning and protection shall be provided with horizontal conductors strung between tall poles covering the entire areas.

21.6 Joints Bonding:

The system shall have preferably no joints and they shall be made mechanically and electrically strong and effective. Bolted joints should only be used on test points or on bonds to as existing metal. Generally jointing/connections/installations shall be as in Earthing system.

21.7 Earth Termination's:

Suitable number of earth terminations shall be provided. The earth termination shall consist of pipe/plate earth electrode as specified elsewhere in the Earthing Specification, and generally conforming to IS: 3043. The earth terminations shall be complete in all respects

with chamber and cover, etc. as per the detailed specifications. As Before installing the lightning protection system, the contractor shall obtain approval from the Engineer with respect to the locations of air termination's and the routes for the down conductors.

21.8 Test Clamps/Links:

Test clamps/links shall be manufactured from phosphor bronze or approved equivalent with four fixing holes. Tape conductors shall be fixed to flat roof surfaces by means of suitable fixing arrangement as approved. All fixing screws shall be from brass material.

21.9 Testing:

Suitable testing links be provided at required points as per the code of practice CP 326/IS

2309. The contractor shall carry out tests on completion of the installation and submit the readings for approval.

22.0 Specification of Safety Equipments:

The following safety equipments shall be supplied in the substation as per the IER.

22.1 Fire Extinguishers:

Adequate number of portable chemical fire extinguishers of carbon tetra chloride conforming to IS 935 latest version shall be supplied and installed at the proposed 11KV substation.

22.2 Fire Buckets:

Adequate number of fire buckets with M.S. angle stands each consists of 4 Nos. of round bottom fire buckets painted with red and marked fire and filled with clear dry river sand shall be supplied and installed at convenient locations at proposed 11KV substation. The fire extinguishers and fire buckets shall be provided conspicuously marked to comply with Indian Electricity Rules 4.3 of 1956.

22.3 First aid Chart and Box:

The first aid boxes and charts equipped fully with such contents as stipulated by the CEA conspicuously marked shall be supplied and installed in the switch gear room at 11KV proposed substations.

22.4 Instruction for Restoration of Persons Suffering from Electric Shock:

Instruction in English and Tamil for providing artificial respiration as per CEA regulations shall be supplied and affixed in a frame board at convenient location in the proposed 11KV substations. Safety posters for vigilance against electrical accidents as per CEA regulations shall also be provided by the contractor.

22.5 Rubber Mat:

Suitable size of tested flexible rubber mat conforming to IS 5424 of 1994 shall be provided around the compact substation and L.T. panel.

22.6 Rubber Gloves:

Required number of rubber gloves conforming to IS 4770 of 1991 and tested to 15KV shall be supplied and provided in the proposed 11KV substations.

22.7 Caution Board:

Required number of Danger board / sticker of H.T. Voltage in three languages English / Tamil / Hindi are to be provided on the panel.

22.8 Letter Painting:

All incomer cables / all outgoing cables / P.T. & C.T. VCBs details shall be painted at the front and rear sides of the compact s s / LT panel specifying the full details and furnishing the amperage, voltage, size of the cable in the red letters on white back ground. Should be written in both L.T. & H.T. panels.

23.0 Panel board Testing:

The panel shall be completely assembled, wired, adjusted and tested for operation under simulated conditions to ensure accuracy of wiring, correctness of control scheme and proper functioning of all equipments.

23.1 Type Tests:

The Bidder shall furnish (2) sets of type test certificates for all the tests, conducted on similar/respective panel.

- Strength of materials and parts of the assembly.
- Degrees of protection provided enclosures
- Clearance Creepage distances
- Short circuit with stand strength.

- Protection against electric shock and continuity of PE circuits
- Internal electric circuits and terminals
- Terminal connections for external conductors
- Dielectric properties
- Temperature rise limit test
- Short-circuit resistance
- Electromagnetic compatibility (EMC)
- Mechanical function
- One minute power frequency voltage withstand test.
- Corrosion, insulating material, lifting.

23.2 Routine Tests: (To be witnessed by Client / Consultant)

Verification during manufacturing process:

- Degree of protection of enclosures
- Clearances and creepage distances
- Protection against electric shock and integrity of protective circuits
- Incorporation of switching devices and of components
- Internal electrical circuits and connections
- Terminals for external conductors
- Mechanical operation

24.0 Drawings and Documents:
The following drawings and documents shall be furnished by the respective panel fabricator as before staring the manufacturing works of particular panel board

General Arrangement drawing of the panel to be shown with the following specs;

- Overall Dimensions
- Terminal locations
- Total weight
- Foundation details
- Sectional view
- Bill of materials
- Single line diagram and wiring diagram.
- Technical details for ACBs, Switchgear, lamps, meters etc.
- Manufacturing schedule and test schedule.
- Calculation for sizing of busbars.

Important Note:
The bidder shall furnish a tentative drawing which has been shown about the overall dimensions of the panel, along with the bid.

SPECIFICATION FOR AUTOMATIC POWER FACTOR CORRECTION PANEL (APFCR)

1.0 Scope:
The scope of work under this section includes design, manufacture, assembly, testing at manufacturer's works, inspection, packing for transportation, delivery at site, installation, connection, testing and commissioning of Thyristor controlled Automatic Power Factor Correction Panel & Fixed capacitor panel. Panel shall include all the specified Capacitor banks, Switchgears, Control Gears, Bus bars, meters, earthing, interconnections etc as specified in the data sheets / BOQ / Schematics.

2.0 Low Voltage Capacitors:

2.1 Standards:
The capacitors shall conform to IS: IS 13340-1993, IS 13341-1992, IEC 60831-1+2 MPP capacitors for power system.

2.2 Construction:
The MPP/APP type capacitors shall be suitable for operation on 440V, 3 Phase, 3 wire, 50 Hz solidly earthed AC supply system.

The capacitor element shall comprise of aluminum foils as conducting layers (electrodes) separated by 2 layers of electrical grade hazy die-electric polypropylene film with both side roughness for better impregnation. The unit should be impregnated in the vacuum environment with Non-PCB Oil as the impregnate.

Several such elements shall be assembled into packs, connected to the terminals and enclosed in a metallic container. Each element shall be protected by fuse/PSD (Pressure Sensitive Dis-connector). In the event of a localized fault, only the faulty element shall be isolated by its fuse from the rest of the elements without any appreciable change in the performance or output of the capacitor.

The capacitor unit rating shall be of 25KVAR, 440volt, 3 phases. The air in the container and the moisture absorbed by the PP shall be removed under high vacuum, at an elevated temperature and filled by high permeability, high dielectric strength and flame resistant oil.

After evacuation and impregnation, all voids shall be completely filled with the impregnate and the container shall be hermetically sealed to prevent ingress of air, dust and moisture. The capacitor shall be suitable for a rated voltage of 440 volts and shall be of continuously operating at a maximum over-voltage of 10% above the rated voltage. The Dielectric loss (operating loss) of the material should be restricted to <0.2 watts/kvar. Total losses of the capacitor unit (including discharge resistor) should be restricted to <0.45 watts/kvar.

The rated frequency is, 50 Hz. The capacitor shall however, be suitable for continuous operation with a frequency variation of + 5% from the rated frequency. The capacitor shall be suitable for operation in temperature category 50 Deg.C. As per table 1 of IS: 13585-1994.

The capacitor shall also be capable of performing without injury an increase in current loading up to 70% of the rated current which may arise due to increase in voltage, increase in frequency, presence of non-sinusoidal voltage supply or other causes. The maximum continuous reactive output of the capacitor shall not exceed 70% over the rated reactive output.

All capacitors shall be suitably tropicalized and rated for the service conditions on site. The capacitors shall be liberally designed and manufactured from best materials for satisfactory operation under onerous service conditions without causing any permanent injury or shortening of the life.

The capacitors shall be suitable for mounting in the rack modules of panels. Due to pressure of non-sinusoidal wave capacitor should be supplied with 7% detuned reactor.

3.0 Discharge Devices:
Each capacitor bank shall be internally fitted with a low loss and continuously rated effective discharge device. It shall be designed to discharge the entire capacitor from the peak A.C voltage to a voltage not exceeding 50 volts measured at the terminals of the capacitor within a maximum period of 1 minute of disconnection from supply.

LIST OF PREFERRED MAKES		
Sl. No.	**Items Description**	**Makes or its equivalent**
1	RMG panel	System Control/Schneider/Siemens or Equivalent
2	HT Panels(Client Side Control)	System Control/Schneider/Siemens/L&T or Equivalent
3	Transformer	Voltamp/3si /Indotech or Equivalent
4	11KV XLPE Power Cables	Havells/KEI/Polycab or Equivalent
5	11KV cable termination kits	Raychem/3m/Denson or Equivalent
6	1.1kv XLPE/ PVC Cables	Havells/KEI/Polycab or Equivalent
7	Cable glands	Comet/Prabath or Equivalent
8	Cable lugs	Comet/Dowell's or Equivalent
9	ACB	Schneider-MVS/ABB-E-Max/Siemens-3WL/L& T- U Power or Equivalent
10	MCCB	Schneider-CVS / ABB-T-Max /Siemens-3VA/L&T D Sin or Equivalent
11	MCB/ELCB / RCCB	Anchor/Honywell/ ABB/Hager or Equivalent
12	Switch Fuse Unit (HRC Type)	Schneider/ABB/Siemens or Equivalent
13	Changeover Switches	HPL / Socomec / L&T or Equivalent
14	Contactors/ThermalRelay/Timers/Push Button/Indication lamps	Schneider / ABB / Siemens / L&T or Equivalent
15	MCB Distribution Boards	Legrand / Honywell / ABB / Hager or Equivalent
16	Current Transformers	Kappa / Kalpa / JP Electronics or Equivalent
17	Digital Meters	Elmeasure / Conzerve / HPL Socomec or Equivalent
18	Analog meters	AE / Rishab / IMP or Equivalent
19	Selector switches	Salzer / Kaycee or Equivalent
20	APFC Controller	Beluk / Epcos or Equivalent
21	Capacitors/ Reatcors	Schneider / Epcos / L&T or Equivalent

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22	TVSS	OBO/Cape/Liebert or Equivalent
23	Annunciator	Minilec/Bharani or Equivalent
24	Panel Fabrication shops	Tesla Controls/Mahaveer Fabs /sivasakthi Electricals or Equivalent
25	Moulded Plug & Sockets and enclosures	Legrand/L&T/Scame/ Mennekes or Equivalent
26	Outdoor W/P Boxes	Hensel/Sintex or Equivalent
27	FRLS Wires	Anchor/Polycab / Havells/Finolex or Equivalent
28	FRLS Flexible cables above 6sq.mm	Anchor / Polycab / Havells / Finolex or Equivalent
29	Cat6 / Cat 5E Cables	Legrand / Commscope / D-Link / Finolex or Equivalent
30	Coaxial cables	Commscope / Havells / Finolex or Equivalent
31	PVC Pipes & Accessories	Anchor / Avon Plast / Precision- (Medium Duty) or Equivalent
32	MS Conduits	BEC / Bharat / Gupta or Equivalent
33	Modular Switches / Sockets	Schenider / MK / Anchor-Roma/ Havells or Equivalent
34	Light Fittings	Panasonic/Philips/Wipro/Crompton Greaves or Equivalent (LED fittings)
35	Lamps	Osram / Philips or Equivalent
36	Street Light Poles	Metal Coats / Maruthum Poles / K-lite or Equivalent
37	Solar Street Light Poles	Havells / DK Solar/ K-LITE or Equivalent
38	Ceiling/Wall/Exhaust fans	Almonard / Havells / Crompton / Bajaj / Usha /Orient or Equivalent
39	Lightning Protection system	Approved by Client/Consultant or Equivalent
40	Cable trays	OBO Betterman / Profab / Pinnacle or Equivalent
41	Terminal Blocks	Connectowell / Elmex or Equivalent
42	First aid box	Thadani or Equivalent

Signature of bidder with stamp