



कलकत्ता पत्तन न्यास
KOLKATA PORT TRUST
हल्दिया गोदी परिसर
HALDIA DOCK COMPLEX
AN ISO-9001:2015 ORGANISATION



Plant & Equipment (P&E) Division
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No.: DM (P&E)/TSEM/1008/BUDGET_ENQ/ EXTN/02

September 22, 2018

Subject:

Enquiry for obtaining budgetary quotations for the work “Replacing / refurbishing of 11kV/0.433V Substations & 11kV HT Overhead Lines & allied equipment in the Township of Haldia Dock Complex–Kolkata Port Trust”.

Haldia Dock Complex (HDC), Kolkata Port Trust (KoPT) intends to **Replacing / refurbishing of 11kV/0.433V Substations & 11kV HT Overhead Lines & allied equipment in the Township.**

A technical estimate, in this regard, is enclosed herewith for ready reference please.

Budgetary offers, alongwith comments / suggestions (if felt necessary), are invited from experienced / reputed firms, for the subject work, within September 30, 2018.

डी.मल्लिक / D. Mallik

उप प्रबंधक (पी एंड ई) / Dy. Manager (P&E)

कृते महाप्रबंधक (अभियांत्रिकी) / for General Manager (Engg.)

हल्दिया गोदी परिसर / Haldia Dock Complex

कलकत्ता पत्तन न्यास / Kolkata Port Trust

September 22, 2018

REPLACING / REFURBISHING OF 11KV/0.433V SUBSTATIONS & 11KV HT OVERHEAD LINES & ALLIED EQUIPMENTS IN THE TOWNSHIP OF HALDIA DOCK COMPLEX–KOLKATA PORT TRUST

TECHNICAL SPECIFICATION

6.1 GENERAL

- 6.1.1 The works will be executed to comply with the General Specifications for Electrical works and conforming to the Indian Electricity Act & rules, BIS and direction of the Engineer.
- 6.1.2 The items of work shall be executed as per detailed technical specifications and scheme. In case of contradiction between schedule of work with its Additional Specification and the General Specification, the former shall prevail.
- 6.1.3 The work will be executed as per general arrangement drawing and detailed fabrication drawings duly approved by the Engineer. The various items of equipment will be ordered only after the drawings are approved and quantities in detail of various items are ascertained as per actual requirements. Therefore the actual quantities / measurement may vary from the stipulated quantities, which are only estimate.
- 6.1.4 The schematic diagram / dimensional drawings of the various electrical cubical panels shall be got approved from the Engineer before fabrication and shall comply with specifications and Indian Electricity Rules. The panels shall conform to IS: 8623/1993.
- 6.1.5 All panels/DB shall be suitable for 45°C ambient temperature.
- 6.1.6 The MCB shall be of the same make as that of MCB DB's. Contractor shall obtain approval of the Engineer before procurement of MCB DB's. All DB's shall be double door type confirming to minimum IP-54 degree of protection.
- 6.1.7 Miniature Circuit Breaker shall comply with IS: 8828-1996 / IEC 898. Miniature Circuit Breakers shall be quick make and break type for 230 V / 415 V A.C., 50Hz application with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10 kA at 415 V A.C. The MCB shall be DIN mounted. The MCB shall be current limiting type (Class – 3).
- 6.1.8 MCB shall be as per their tripping characteristics curves defined by the manufacturer. The MCB shall have the minimum power loss (watts) per pole defined as per the IS / IEC and the manufacturer shall publish the values.

- 6.1.9 All the MCCBs shall have microprocessor based trip unit for reliable protection and accurate measurement. The rated Service breaking capacity (kA rms) shall be 100% of Ultimate breaking capacity (kA rms). All MCCBs shall be of current limiting type with features as per relevant IS codes and specification. There has to be total discrimination between the incoming and outgoing MCCBs and MCBs, as required, at the MDBs and DBs level.
- 6.1.10 MCCBs shall be used with rotary handle and terminal spreaders and all terminals shall be shrouded to avoid direct contact.
- 6.1.11 All measuring CTs, unless otherwise specified shall be cast resin CTs with class 0.5 accuracy. All digital measuring meters shall be with class 0.5 accuracy unless specified otherwise.
- 6.1.12 All measuring and indicating instruments shall be protected through MCBs (of 0.5 A rating) and isolating switches.
- 6.1.13 The switchgear housing shall be heat resistant and having high impact strength. The terminal shall be protected against finger contact to IP20 degree of protection.
- 6.1.14 Mechanical Castle key interlock shall be provided among the incomer MCCBs, wherever, as applicable, two different incomer sources are provided in the panel , as per the directions of the Engineer. The same is deemed included in the scope of work.
- 6.1.15 All model of modular accessories required for the work shall be got approved from the Engineer among the approved makes. The base plate shall be preferably in sheet steel or otherwise in unbreakable polycarbonate. The cover plates shall be screw less type in shade approved by the Engineer. The GI box shall be of the same make as the modular accessories.
- 6.1.16 General arrangement drawing of the switchboard, LT / HT switchgear shall be got approved by the Engineer before commencement of manufacturing.
- 6.1.17 Ratings, sizes and quantities shall be checked and considered for satisfactory operation of electrical system complete in all respect.
- 6.1.18 Breaker shall have LCD display to show the metering and protection parameters.
- 6.1.19 All materials for the work shall be supplied from approved list of manufacturer and any item, not covered in approved list, shall be supplied after getting approval from the Engineer or his authorized representative.
- 6.1.20 The Contractor shall supply the cable in single length based on the manufacturer drum standard. If straight through joints are required, approval of competent authority may be taken. Subjected

that the Contractor provides (Raychem make) straight through joints free of cost. Also the joint shall be located, by making a pit (civil work) for free maintenance and future identification.

- 6.1.21 It is important that every equipment is tested fully before dispatch.
- 6.1.22 Inspection / acceptance, in no way shall absolve the Contractor from supplying material as per standards / codes and warranty or other obligations under the contract.
- 6.1.23 Test certificates both type test and routine tests, wherever required, shall be furnished along with supply for all Electrical / Mechanical items.
- 6.1.24 Any materials brought for work which is not matching with specification will be rejected and the rejected materials shall be removed from site on the same day.
- 6.1.25 All electrical works shall be tested by the Contractor in the presence of HDC,KOPT / TPI AGENCY and to the entire satisfaction, as per IE Rules.
- 6.1.26 The Contractor shall arrange the testing / measuring equipment by own cost to carry out pre-commissioning test of all equipment at site as per IER.
- 6.1.27 Conduits, Switchboards, Sockets to be provided on walls shall be open type unless specifically approved by the Engineer.
- 6.1.28 Conduits on ceiling in existing system may be provided on surface and in new construction shall be open type.
- 6.1.29 Conduit layout as per switching arrangement shall be prepared by Contractor and got approved from the Engineer before slab casting. At all expansion joints in the building suitable arrangement shall be ensured during conduiting.
- 6.1.30 Contractor shall have a valid Electrical Contract Licence with HT installation issued by appropriate authorities from State / Central Govt.
- 6.1.31 The Contractor / agency will engage suitable qualified / experienced & licensed engineering supervisor for the work and suitable skilled personnel with required license for doing the erection work. Required special tools are to be used during the execution of the work.
- 6.1.32 The contractor shall ensure that the staff employed by him for execution of the electrical work, possess the valid electrical license issued by competent authority. Consequences arising due to the default of the contractor in not complying with the above condition shall be the entire responsibility of the contractor.

- 6.1.33 The firm shall deploy only licensed personnel as required under IE Rules, for execution of the electrical works. The firm shall be liable to submit the list of such personnel along with the attested copy of the licenses at the time of execution.
- 6.1.34 The work will be performed as per the day to day instruction and approval of the Engineer or his representative. All materials / equipment will be used after taking approval of the Engineer or his representative.
- 6.1.35 Equipment will be duly inspected in the manufacturer's works / premises by the representative of HDC, KoPT or Third Party Inspection Agency before dispatch to the site, in line with the approved Quality Assurance Plan (QAP).
- 6.1.36 The work will be executed as per the programme of completion of the project. The delivery & erection schedule of various materials / equipment will be as per approval of the Engineer.
- 6.1.37 All concealed work and earthing shall be done in presence of the Engineer or his authorized representative.
- 6.1.38 The Contractor holds responsibility for the entire job as per relevant specifications. If any item is left out within the schedule of work but if it is considered essential for the completion of the job, the contractor has to carry out the items as extra substituted item.
- 6.1.39 The Contractor shall have to make arrangements, at his own risk and cost, for transportation of materials from the point of issue of stores to site of work, if any.
- 6.1.40 Contractor shall have to check the site order Book for any instructions of Engineer or his authorized representative and sign the site order book. He shall be bound to ensure compliance with the instructions recorded there in.
- 6.1.41 All fees payable to concerned authorities and other local bodies if any shall be paid by the contractors.
- 6.1.42 Contractor shall obtain permit / approval from concerned authorities before commencement of work. All documents / drawings, required for such permit / approval, shall be prepared by the Contractor.
- 6.1.43 In connection with aforesaid work, transportation and handling of all materials should be done by the Contractor at their own risk, cost and arrangement.
- 6.1.44 The Contractor should arrange, at their own cost, all necessary tools, tackles, lifting machineries, scaffolding, temporary lighting, different vehicular transport etc., required for the execution of total work.

6.1.45 Any part or whole of the system which requires approval of the Central Electricity Authority, or any other statutory body, should be arranged by the Contractor at his cost. It is the responsibility of the Contractor to submit the system drawings with all details to the Electrical Inspectorate and obtain their approval.

6.1.46 Data / documents to be furnished by the Contractor :

a) Five Set of copies of installation, operation and maintenance manuals, descriptive bulletins etc, shall be furnished prior to / at the time of despatch of all materials. Manuals shall include the following aspects:

i) Outline dimension drawing showing relevant cross sectional views, earthing details and constructional features including foundation drawing.

ii) Rated voltage, current, duty cycle and all other technical information which may be necessary for correct operation of the switchgear.

iii) Storage details for prolonged duration.

iv) Unpacking.

v) Handling at site.

vi) Erection.

vii) Pre-commissioning test.

viii) Operating procedure.

ix) Maintenance procedures.

x) Precaution to be taken during operation and maintenance work.

b) Test Certificates:

The contractor supply all the LT Panels, from the Manufacturers, who are having type test certificate issued by CPRI / ERDA. Also, the contractor shall furnish the type test certificate issued by CPRI / ERDA to the manufacturers of similar rating during approval of above equipments.

c) On completion of work, the Contractor shall submit all drawings, manuals and test certificates, etc. for all equipment / materials ordered and as specified by the Engineer , which includes “As Built Drawing” for the for the entire system and cable route drawings (with GPS locations, at 30 m interval).

6.2 **SCOPE OF WORK**

6.2.1 The scope of work includes supply, installation, testing and commissioning of HT / LT Switch Gears, Transformers, HT / LT Cables with end termination, DC system with maintenance free Battery, earthing system with copper / GI flat, APFC panel, control cable and removal dismantle transit and storage site etc.. The subject work shall be carried out as per IER with relevant IS / BIS standard and also fulfil the requirement of CEA. The successful Contractor shall submit the manufacturer's drawing based on the technical specification and relevant standard for approval from the Engineer for all the above items before commencement of manufacturer / fabrication and supply. Also, HDC engaged the TPI agency for carrying out the stage / final inspection at manufacturer's works / site based on the QAP which is approval by Engineer / TPI agency. The scope also includes that the Contractor shall arrange Central Electricity Authority (CEA) for certification for complete electrical installation and HDC will assist.

6.2.2 Substation-wise breakup of Transformers & HT Vacuum Circuit Breakers are tabulated below :

TABLE – I

Sub stations	Transformers	Details of Circuit breakers			
		Incoming	Bus coupler	Outgoing	Total no of panels
SS - 3	2 X 1000 kVA	2	1	10	13
SS - 2	2 X 1000 kVA	2	1	3	6
SS - 1	2 X 500 kVA	2	1	3	6
Anchorage Camp sub station	2 X 500 kVA	1	0	3	4
Jawahar Tower sub station (proposed)	2 X 500 kVA	2	1	3	6
TOTAL	1000 kVA – 4 nos. 500 kVA – 6 nos.	9	4	22	35

6.2.3 The scope of LT cubicle Distribution Panel for the subject work are tabulated below, based on sub station-wise requirement:

TABLE – II

Sub stations	Details of Circuit breakers								Total
	Incoming		Bus coupler		Outgoing			ACB	
	ACB		ACB		MCCB				
	1000 A	1600 A	1000 A	1600 A	400 A	250 A	100 A		
Sub Station - 3	-	2	-	1	10	6	8	1	28
Sub Station - 2	-	2	-	1	10	6	8	1	28
Sub Station - 1	2	-	1	-	8	6	4	1	22
Anchorage Camp Sub Station	2	-	1	-	8	6	4	1	22
Jawahar Tower Sub Station (proposed)	2	-	1	-	8	6	4	2	23

6.3 **DETAILED TECHNICAL DATA**

6.3.1 **HT 11kV 630A, 26.3kA Vacuum Circuit Breaker (VCB) panel.**

The HT Panel should be SCADA compatible of latest model, with basic insulation level (BIL) 95kV /38 kV and should have correspondingly phase-phase and phase-neutral clearances. Panel manufactured by OEM (original equipment manufacturer) only is acceptable. Panel offered from channel partner or franchise of OEM is not acceptable.

- The switchgear shall be metal clad, floor mounted, vertical isolation & horizontally drawout type. Enclosure shall be conform to the Degree of protection IP-52 as per IEC 60529. The design shall be such that failure of one panel shall not affect the adjacent units. The switchgear panel shall be arc proof version and as per DIN VDE 0670 part 601, IEC 694/IEC -298.

- b) The incoming & outgoing cable shall be terminated through CBCT of suitable size and also suitable provision shall be made in the HT panel board for extension on either side for future expansions.
- c) Structural framework with foundation / fixing bolts, etc. at the bottom: slotted for mounting of panels directly on concrete / steel channel base.
- d) Envelope shall be of CRCA sheet of thickness 2 mm and cable Gland plate of 3 mm thick, removable type and split in the middle.
- e) **Painting:** Surface cleaning by seven tank process & emulsion cleaning, pickling with dilute acid, washing and rinsing by water, phosphating and oven drying, one coat of zinc chromate primer, putty application, two coats of synthetic enamel.
- f) Panel doors and removable covers shall be provided with Neoprene/ EPDM - gaskets all around the edges. All doors shall have padlocking arrangements.
- g) Each cubicle shall be separated from adjacent one by sheet steel barrier and bus sealing arrangement. Bus connection from Main busbar compartment to Individual breaker compartment and cable compartment and adjacent feeders/ panels shall be through resin cast bushing assembly.
- h) Bus Cubicle doors should not get open unless associated switching devices are in OFF-position. Mechanical & Electrical indications of switching devices: Mechanical indication of Spring Charged/ Discharged and Breaker ON / OFF shall be provided. Electrical indication for Service (when withdrawn, power and auxiliary circuits connected)/ Test position (when withdrawn, only auxiliary circuits connected).
- i) Mechanical & electrical safety interlock shall be provided to prevent the circuit breaker from being raked in or out of the service position when the breaker is closed.
- j) Special tool box shall provide for operation and Maintenance: Complete set [(one set) including multimeter (ENERCON make) , insulation tester (meggar make) & earth tester (meggar make)].

EARTHING:

- a) There shall be a continuous tinned copper earth bus of size 50x6 mm running at the bottom of the panel. Earth bus shall be robust and shall be capable of carrying full short circuit current for 1 second. Doors, covers and all non-current carrying metallic parts shall be earthed through flexible copper wires. This also includes instrument casing and cable armour which are also connected to the earth bus. Earth bus must be tested for 26.3 KA for 1 sec.
- b) Separate earthing track shall be provided for bus earthing and cable earthing for each set of panel.
- c) The earthing track shall be so designed that it is impossible to earth a live bus. It shall be provided with capacitive voltage divider and complete with audio visual annunciation.
- d) In addition to scrapping earth in auxiliary plug and socket proper arrangement should be made so that during engagement of the breaker in service condition earthing contacts is made first before isolating power contacts are engaged.
- e) Bonding of all non-current carrying metal parts effectively and directly to the earth bus.

BUS BARS:

- a) Suitable size uniform cross-section bus bar made of Tinned Copper to carry the current indicated in the BOQ to be provided. Colour coded heat shrinkable sleeves (R, Y, B Colour) of 11KV or higher grade only acceptable. Busbars, links etc shall be with Epoxy-cast resin shrouds only.
- b) Continuous current rating of the Switchgear shall be based on the name plate rating of the connected equipment with 20% margin, rounded off to the next higher standard rating. The current density shall be 1 Ampere per square mm.
- c) Safety shutters, phase barriers, busbar seal-off bushing plate, insulators shall be non-flammable high tracking fibre glass/ epoxy insulation system.

CIRCUIT BREAKER:

- a) Circuit breaker shall be triple pole, electrically operated, horizontally drawout type.
- b) Circuit breakers of identical rating shall be physically and electrically interchangeable. Circuit breaker shall have manual spring charge as well as motor charging facility with Mechanical & Electrical anti -pumping features and shunt trip. Motor wound mechanism spring charging shall take place automatically after each breaker closing operation. The motor shall be suitable for operation with voltage variation from 85% to 110% of rated voltage.
- c) Circuit breaker shall have SERVICE, TEST AND ISOLATED positions with indication for each position.
- d) Mechanical safety interlock to be provided to prevent breaker from being racked IN or OUT of the service position when the breaker is closed.
- e) It will not be possible to rack in or rack out, withdrawal the truck when the front high voltage door is open. However, a suitable defeat interlock mechanism is provided for emergency purpose.
- f) It will not be possible to RACKIN the withdrawable truck from test to service position when the low voltage control plug is not in position and locked on the truck itself.
- g) It will not be possible to close the door if the low voltage control plug is not engaged.
- h) Manual trip device to be provided on the front door and indicators with shrouds will be visible from door even when breaker is closed.
- i) The trip coil shall be operated satisfactorily at voltage between 70% and 110% of rated control voltage.
- j) Earthing facility to be provided to each circuit breaker cubicle.
- k) All panel shall be provided with two nos. heater with thermostat.

CURRENT AND POTENTIAL TRANSFORMER:

- a) Current transformers shall be double core wound/bar primary for higher rating or wound primary for lower rating. Maximum VA burden shall be of 15 VA and shall be rated for full short circuit current for 1 second. In case of numerical relays 10VA

burden shall be sufficient. CT shall be of a minimum accuracy of class 0.5/5P10 and CT Secondary rating shall be 1A unless otherwise specified.

- b) Potential transformer shall be 3phase 3 limb type with 50 VA burden per phase of class 0.5/3P accuracy. P.T shall be mounted in a separate withdrawal truck in a separate CUBICLE.

AUXILIARY POWER AND CONTROL SUPPLY:

Control voltage shall be:-

- i) For Closing and tripping coil: : 24V DC
- ii) For Indication circuit: 24V DC
- iii) For Motor, Panel illumination, 6 Pin 16A socket, etc: 230V AC

Separate battery and battery charger to be provided for closing and tripping circuit.

PROTECTIVE RELAY AND INSTRUMENTS :

- a) Numerical multifunction relays shall be provided for all feeders. Numerical relay shall have trip circuit supervision.
- b) All protective relays shall be of draw -out type, suitable for flush mounting and fitted with dust tight covers. All relays shall have built -in testing facilities. Small auxiliary relays may be of non-draw-out type and mounted within the cubicle. Relays shall have lock-out facility with manual reset. Each feeder shall be complete with necessary auxiliary relays, timers, etc., to meet the circuit requirement.
- c) Under voltage relays shall be provided in the bus PT circuit.
- d) Relays shall be rated for operation on 110V PT secondary voltage and 1A CT secondary current. The switchgear shall be provided with DC fail relay and DC fail indication lamp for each DC control supply incomer. DC isolation switch for each feeder shall be provided with backup HRC fuse.

- e) Breaker auxiliary contacts used for interlocking purposes shall be multiplied using electrically latched relay.

- f) Outgoing transformer feeders shall have the following minimum protection relays.
 - i. Numerical protection relay having Short circuit protection (50) on all the three phases, IDMT Over current protection (51) on all the three phases, Instantaneous earth fault protection (50 N).
 - ii. Instantaneous earth fault protection through CBCT (50 N).
 - iii. Backup earth fault protection connected to Transformer neutral CT (51N).
 - iv. Latched Lock out relay (86).
 - v. Trip circuit supervision relay
 - vi. REF protection relay (For 2MVA & above)

- g) Self-reset auxiliary relays with hand reset flag indicator shall be provided for contact multiplication of the following: -
 - i) Transformer winding temperature indicator alarm and trip contacts.
 - ii) Surge diverters / surge arresters of suitable voltage rating shall be provided in RYB phases of all Incoming VCBs.

- h) Provision for additional Port for SCADA.

- i) Incomer and Tie feeders shall have the minimum following protection relays:-
 - i) Numerical protection relay having IDMT Back up over current protection (51) on all the three phases, IDMT Back up Earth fault protection (51N) and Definite time delayed Back up earth fault protection residually connected (50 N).
 - Latched Lock out relay (86).
 - Trip circuit supervision relay.
 - ii) All the relays shall be microprocessor based numerical type.

- iii) All CT-PT wired to be brought upto terminal blocks.
- iv) For control supply distribution, panel to panel separate set of terminal blocks shall be provided.
- v) Auxiliary relays shall be provided for Transformer faults.

WIRING:

- a) Cables: Stranded Copper FRLS PVC insulated, 1100 V, 2.5sq.mm for Control circuits and minimum 1.5 sq.mm for other circuits. The colour coding shall be: -
 - AC SYSTEM : BLACK
 - DC SYSTEM : GREY
 - EARTHING : GREEN & YELLOW
 - CT & PT : R, Y, B
- b) Fuse and links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches and other devices shall be wired upto terminal blocks.
- c) Wires shall run through PVC channels with covers. Separate PVC channels shall be provided for power and control wires.
- d) Grommets shall be provided for the cutouts or openings. Inter panel wiring at shipping sections
- e) Shall be through terminal blocks placed suitably at intersection points.

TERMINATIONS:

- a) Terminal block shall be 1100 V grade. Not more than two wires should be terminated in one terminal. If required multi connection strip to be used. Spare 20 % of active terminals to be provided. All control wire shall be terminated with ring type insulated lug only.
- b) Voltage Terminal block: Disconnecting type, with plug for portable instrument
- c) Current terminal block; short circuiting type, with plug for portable instrument

LABELLING:

- a) Destination: Each Switchgear, each panel, each cubicle, each component; components mounted on doors, panels and removable covers, are double labelled: internally (with the functional diagram code), and externally (with the functional text for the operator)
- b) Material: Black synthetic strip, engraved
- c) Fixing: Snapped or screwed or riveted; gluing or similar is not allowed.
- d) Additional safety: Danger-board and other mandatory and usual warnings, on front and on back of each Switchgear.

TESTS:

Factory Acceptance Tests (FAT) are carried out according to contractual standards, for each Switchgear, with all the panels of the same Switchgear assembled together.

- a) Preliminary, at manufacturer -premises before delivery:-
 - i) **Visual:** general compliance with the contractual documents and with good execution:
 - Mechanical operation of doors shutters, switching devices.
 - Ratio and Polarity of measuring transformers.
 - ii) **IR** of Main and Auxiliary circuits.
 - iii) Pick-up and drop-off test of auxiliary relays.
 - iv) Functional test of control circuits.
 - v) Simulation and operation of protection relays at set points.
 - vi) High voltage test for panels and any other test required.
 - vii) TYPE TEST CERTIFICATE for Bus bars and circuit breaker from CPRI or Government recognized test laboratory. Copy of certificates shall be produced at the time of FAT.
- b) Acceptance, on site repeating above tests except high voltage and polarity test.

- c) The contractor has to submit the HT panel drawings showing plan, Front Elevation, Section and Internal mounting arrangements, Door interlocks & Schematic wiring Diagram etc. , for approval before fabrication of the panel.

Technical data of 11 kV VCB panel.

SL. NO.	DESCRIPTION
1.	SWITCHGEAR: 11KV, 630A, 26.3KA for 3 sec. Vertical isolation & Horizontal Draw out type 4 panel VCB with motorised spring charge Motor: 230V AC, closing and tripping coils rated: 110V DC, Auxiliary contacts: 6 No + 6NC (additional for Customer use)
2.	ENCLOSURE: Indoor, Fully compartmentalized sheet steel enclosure CRCA 2 mm thick for enclosure and 3 mm thick for gland plate, floor mounting type with automatic safety shutters independent pressure discharge flaps along with tinned copper 630A rated Busbar, Foundation Bolts etc with provision for terminating 1 No. 3 core x 185 sq.mm XLPE 11 KV armoured UG cables using heat shrinkable type end termination kits.
3.	CURRENT TRANSFORMER: Double core Epoxy cast resin CT; Ratio: 200-100A/1-1A Core 1: 0.5/ 15VA class Core 2: 5P10/15VA class
4.	CURRENT TRANSFORMER: Double core Epoxy cast resin CT; Ratio: 100-50A/1-1A Core 1: 0.5/ 15VA class Core 2: 5P10/15VA class
5.	POTENTIAL TRANSFORMER: Single phase Epoxy cast resin PT; Ratio: 11Kv/rt3/110V/rt3 Core 1: 0.5/ 100VA

6.	MEASURING INSTRUMENTS:
	Digital type multi-function meter. CL of Accuracy:0.5S Measuring parameter: A, V, KW, KVA, KWH, KVAH, PF, F. Two output signals of 4-20mA and communication port (RS 485) for all the parameters for monitoring from remote location/PLC with suitable software.
	Digital Ammeter 96 sq.mm with ASS with four position type having make before break contacts to prevent open circuit of CTsecondary
	Digital Voltmeter 96 sq.mm with VSS
	Digital PF meter 96 sq.mm
7.	12 window annunciation panel
8.	LED(Metal body)indicating lamp: CLOSE, OPEN, AUTO TRIP, SC, TCH
	LED R, Y, B indication lamps
9.	PROTECTION RELAY MICRO PROCESOR BASED NEMERICAL AND COMMUNICABLE
	WITH RS 485 COMMUNICATION PORT, 110 AC secondary voltage and 1A secondary current.
	IDMT & INSTANTANEOUS O/C RELAY
	IDMT & INSTANTANEOUS E/F RELAY
	PT FUSE FAILURE RELAY
	TRIP CIRCUIT SUPERVISION RELAY
	UNDER VOLTAGE RELAY WITH TIMER
	OVER VOLTAGE RELAY

	ANTI PUMPING RELAY
	MASTER TRIP RELAY WITH HAND RESET CONTACT (2 NO+ 2 NC)
	LOCKOUT RELAY
	AUXILIARY RELAY BUCKHOLZ ALARM INDICATION AND TRIP
	AUX RELAY FOR WINDING & OIL TEMP. ALARM INDICATION & TRIP

6.3.2 **Transformers**

INTRODUCTION

This specification covers the requirements of 11/0.433 KV Distribution transformers complete with all accessories as per IS: 2026, IS: 1180 section II and amended latest.

DESIGN

- a) The oil filled transformers shall be suitable for capable of operating continuously at its rated output without exceeding the temperature limits specified.
- b) The transformers shall be suitable for connection to the system having short circuit level and short circuit duration as specified. The transformers shall be capable of withstanding without injury, the thermal & magnetic stresses caused by faults on any of the winding / through faults. Calculation shall be submitted along with the offer to prove that thermal as well as mechanical withstand capacity of the transformer is as per Indian Standards in the event of short circuit to the specified duration. Transformers shall be designed to withstand the thermal and dynamic stresses due to short circuit at the terminals for 5 seconds duration with respect to fault level specified.
- c) The impedance of the transformer shall not be less than as stated in Indian Standard at a reference temperature of 75° C.
- d) The transformers shall be capable of delivering the rated output at any particular tap without exceeding the specified temperature limits under the following operating conditions.
 - Voltage variation of $\pm 10\%$ of rated voltage of that particular tap.
 - Frequency variation of +3% to -5% of rated frequency.

- Combined voltage and frequency variation of 10% (absolute sum).
- e) The transformers shall be free from annoying hum and vibration when it is in operation, even at 110% rated voltage as per IS.
 - f) The noise level at rated voltage and frequency shall be as per NEMA-TR1 standard.
 - g) The transformers shall be suitable for over fluxing (due to combined effect of voltage & frequency) up to 10% on any tapping without injurious heating at full load condition. The maximum flux density in any part of core and yoke under such condition shall not exceed 1.9 Tesla.

CONSTRUCTION:

❖ Windings

- a) Transformers shall be constructed as specified in design requirements as per IS 2026 and IS 1180. Winding shall comprise of high conductivity **copper conductors** completely impregnated under vacuum in fully insulated of very good electrical and mechanical quality and shall be suitable for the highest system voltage.
- b) Winding shall be concentrically wound on the core, and shall be braced to withstand shocks, which may occur through rough handling during transport, switching and other transient condition during service, and also to reduce to a minimum the damage arising from stresses due to an internal fault.

❖ Core

- a) Cores shall be built from best quality, low loss, cold-rolled, grain oriented electrical steel laminations conforming to relevant Indian Standard. All core sheets shall be to reduce the core loss to a minimum. The flux density in core shall not exceed 1.6 Tesla under over voltage conditions and to this effect calculations shall be submitted. Maximum current density shall not exceed 2.5A per sq.mm.
- b) All joints shall be interleaved and the core shall be securely clamped so as to ensure that the noise level and the vibration are maintained at a minimum. All clamps shall be adequately insulated. The complete core shall be coated with special resin as a protection against corrosion.

❖ Temperature Indicators

For measuring hot spot temperature in the winding, 150 mm dia dial type winding temperature indicator (WTI) & oil temperature indicator (OTI) with adjustable potential free alarm and trip contacts, maximum reading pointer and resetting device shall be provided. Temperature sensing element shall be complete with image coil, bushing CT etc. Accuracy class of WTI & OTI shall be $\pm 2^{\circ}\text{C}$ or better.

❖ Bushings

- All bushings shall be homogenous, non-porous porcelain type, uniformly glazed and free from blisters, burns and other defects complete with suitable terminal connectors of adequate capacity. Bushings located inside cable boxes / busduct flanges can be epoxy-moulded types.
- Bushing CTs shall be provided as per system requirement. Secondary leads of CTs shall be wired upto-marshalling box. The arrangement shall be such that the CT can

be removed from the transformer without removing the tank cover. Current transformers shall be oil filled/cast resin type with Class E or better insulation.

❖ **Terminal Arrangement**

Type of terminal connection shall be by Cables on both HV & LV side: -

- a) The cable box shall be suitable for the working pressure of cable with which it is associated and shall have adequate clearances for the specified voltage and cable termination kits.
- b) For cable termination, terminals of transformer shall be brought out through side wall mounted bushings to a detachable cable box with disconnect link. The cable box shall be self-supporting, weather proof, air filled type complete with all hardware such as undrilled gland plates, etc.
- c) The design of the box shall be such as to preclude the access of water to the box. An adequate space shall be provided within the box so that the cable cores may be formed into the lugs without undue bending or stress on the lugs, and adequate clearance shall be preserved between live metal and frame such that the electrical pressure tests specified in Indian Standard are satisfied.
- d) Flexible links shall be provided between transformer terminals and cable lugs.
- e) Cable box shall have IP 65 degree of protection.

❖ **Marshalling Box**

- a) Marshalling box shall be sheet steel enclosed with IP 65 degree of protection alarm & trip contacts

of all the fittings & accessories and secondary leads of CTs shall be wired up to marshalling box. Cable gland plate shall be of removable type.

- b) The marshalling box shall have isolating switch & MCB for incoming power supply. Cubicle illumination lamp with door switch and space heater with thermostat and ON/OFF switch shall be provided.
- c) The marshalling box shall have 10% additional set of control terminals.

❖ **Grounding**

- a) Two grounding pads, located on the opposite sides shall be provided for connection of station ground mat / overall earthing for each transformer. Grounding pads shall have clean buffed surface with tapped holes. M10 GI bolts, nuts and spring washers.
- b) Two ground terminals each shall be provided on marshalling box & cable box.
- c) For neutral connection, two ground copper conductors of specified size shall be provided, supported on pin insulators (provided on tank) from neutral bushing to the bottom of the tank for connection to station ground.

❖ **Off Load Tap Changer**

- a) Off Load tap changers shall be provided on HV winding with +/- 10% range of taps in steps of 2.5%. The tap changing shall be effected by an external 3 phase gang operated tap change switch. The operating handle shall be padlocked at any position.
- b) The mechanism shall be provided with a mechanical tap position indicator, mechanical stop to prevent over cranking of mechanism etc. A warning plate indicating 'For de-energised operation only' shall be fitted.

❖ **Wiring and Terminal Blocks**

- a) All control cabinets, marshalling boxes, etc. shall be fully wired at the factory to ensure proper functioning of the control, protection and interlock schemes. All spare contacts of switches, relays and other devices shall be wired up to the terminal block.
- b) Wiring shall be done with flexible 1.1KV grade HR PVC cables with stranded copper conductor of minimum size 2.5 sq.mm. Wiring shall be identified at both ends with ferrules bearing wire numbers as per approved drawings. Wire termination shall be made with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.
- c) Terminal blocks shall be of 1.1KV grade suitable for terminating required cable size. Terminals for CT secondary shall have provision for shorting. Not more than two wires shall be connected to any terminal. 20% spare terminals shall be provided.
- d) All devices and terminal blocks within the panel shall have identification numbers as per schematic diagram.

❖ **Nameplate**

- Each transformer shall be provided with a nameplate of weather-resistance material fitted in a visible position showing all the 'information and additional information' as per IS 2026-I.

❖ **Fittings & Accessories (Whichever is Applicable)**

Each transformer shall be supplied with the following as a minimum: -

- a) 1 no. Silica gel breather with oil seal & charge.

- b) 1 no. Conventional diaphragm type pressure relief device.
- c) 1 no. Double float Buchholz relay with isolating valves, test cock & sampling valve.
- d) 1 no. Thermometer pocket with mercury in glass thermometer
- e) 1 no. Winding temperature indicator
- f) 1 no. oil temperature indicator
- g) 2 set of Radiator banks with isolating valve & drain valves.
- h) 1 no. Air release devices.
- i) 4 nos. hauling lugs
- j) 4 nos. Jacking Pads
- k) 4 nos. Rollers /flanged wheels
- l) 4 nos. Cover lifting eyes
- m) 2 nos. Grounding pads for transformer tank, cover and radiator banks, cable box and marshalling box.

- n) 2 nos. Stainless steel Rating and diagram plate (English).
- o) 1 no. Stainless steel winding diagram & name plate
- p) 1 no. Marshalling box
- q) 1 no. Cable box
- r) 3 nos. HV Bushings with terminal connectors
- s) 3 nos. LV Bushings with terminal connectors
- t) 2 nos. LV Neutral Bushings with terminal connectors
- u) Platform mounting channel
- v) 1 set LV Neutral Bushing CTs
- w) 2 nos. Inspection covers.
- x) 2 nos. supports for HV cable box.
- y) 1 Lot Interconnecting cables.
- z) Nuts and Bolts as per SS316

TESTING AND INSPECTION

- Transformer and all its fittings should have been type tested and proven type. Type test certificates shall be furnished for Purchaser's review. Transformer and all its fittings shall be subjected to routine tests as per applicable Indian Standard. In addition, any special test required shall also be performed. Test reports shall be submitted for approval.
- Generally, the Transformer shall have total efficiency not less than 98% at full load condition. Transformer shall be fitted with diagram and rating plates. The diagram plate shall show the winding connections and tapings in tabulated form.
- Salient parameters of the transformers are as follows:-
 - a) Nominal system voltage (HV / LV) 11/0.433KV
 - b) Vector group Dyn11
 - c) Temp rise in winding by resistance method 60°C over 45°C ambient
 - d) Parallel operation of transformer .
 - e) Short circuit withstand duration 2 seconds
 - f) 11kV System fault level 26.3 kA for 3 sec
 - g) 415V System fault level 50 kA for 1 sec

- Transformer shall be factory tested as per the requirements laid down in IS 2026 / IS 1180 / other relevant standards for transformer. The original test certificate shall be furnished for each transformer. The type test must have been conducted on a transformer of same design during the last five years at the time of bidding. All the testing equipments shall be duly calibrated and should be certified by the OEM.
- STAGE INSPECTION: Stage inspections shall be witness by HDC, KoPT / Thirty Party Inspection Agency appointed by HDC, KoPT. However, the decision of inspection / witness is at the discretion of Engineer or EIC. **Stage inspection at the time of assembly and also final inspection will be witnessed by HDC, KoPT / Thirty Party Inspection Agency.**

INSTALLATION:

IS : 10028, Code of Practice of installation, maintenance of transformer shall be followed by the Contractor.

COMMISSIONING AND TESTING

The following pre-commissioning tests shall be carried out before commissioning on Site:-

- A) Visual inspection for broken parts, cracks, leaks & oil level, top up, if oil level is low.
- B) Three samples of oil shall be taken from the bottom of the tank and tested to withstand a voltage of 40 kV for 60 seconds against a 4 mm gap as described in Appendix of IS: 335/1993.
- C) The insulation resistance between a) HV and LV b) Winding and earth shall be tested with a 1000V DC Megger and the values should correspond to the factory results.

- All transformer mountings and accessories such as breather, gauges, and thermometer should thoroughly be checked and adjusted. All such checks and adjustment shall be recorded. After satisfactory testing as above, the transformer shall be energized on no load and maintained no-load for a period of 8 hours. Thereafter, the full load shall be built-up progressively over a period of another 8 hours. Transformers shall be mounted on a U channel of suitable size embedded in concrete/ size stone masonry plinth. After Installation, the rollers shall be locked by wedges or any other means to prevent accidental movement of transformer.
- Transformer neutral, core and tanks shall be earthed as specified.
- After completion of work, the contractor should furnish the Test Certificate for the following to the Engineer or Engineer-in-charge before servicing the installation.
 - a. Insulation Resistance of the whole installation.
 - b. Resistance of earthing stations.
- TOLERANCES: No positive tolerance shall be allowed on the maximum losses as specified in the BOQ for both 50% and 100% loading values.

TRANSFORMER FOUNDATION

- EXCAVATION in all types of soil for transformer foundation.
- Providing 150 mm thick 1:4:8 cement concrete bed using 40 mm graded aggregate including curing, etc., complete as directed by the Engineer or his representative.
- Construction of size stone masonry with 1:8 cement mortar including curing etc. as directed by Engineer or his representative.
- Rendering 10mm thick 1:6 cement plaster on fair faces of the above stone masonry including curing as directed by Engineer or his representative.
- Providing coping slab over the stone masonry platform 100mm thick 1:2:4 cement

concrete using 20mm graded aggregate including curing as directed by Engineer or his representative.

- Providing suitable U channel embedded in the platform of the Transformer of size 3 m X 3 m X 0.3 m

TRANSFORMER YARD FENCING

- Supply, fabricating & grouting in the soil 75x75x6mm thick M.S angle iron post of not less than 6.8 Kg/mtr., 3mtrs long (600mm below ground level & 2.4 Mtrs. above ground level) for fixing the GI chain link type fencing panels including excavation and providing 1:4:8 cement concrete foundation of size 200mm x 200mm x 800mm for grouting the post and painting the post with 2 coats of aluminum paint over a coat of aluminum primer complete in all respect and as directed by OIC/EIC.
- Supply & fabrication of heavy duty GI chain link type fencing panels of size 2000mm width and 2400mm height and fixing the same to the angle iron post indicated above by employing necessary bolts, nuts etc. The chain link mesh fencing panel shall be fabricated out of 40x40x6mm angle iron frame work all round and covering this panel with chain link mesh fencing made up of 8 SWG galvanized steel wire of not less than 4 Kg/m² conforming to IS 2721 and cross support of 50X6 mm size MS flat, including painting the MS frame work of fencing panel with 2 coats of aluminum paint over a coat of aluminum primer, preparation of surface etc. Complete in all respect and as directed by OIC/EIC.
- Supply, fabrication and fixing 1500mm wide 2400mm height M.S angle iron hinged & lockable gate fabricated out of 50x50x6mm thick M.S angle covered with GI chain link type fencing as per item 10(b) with pad lock arrangement including painting the MS frame work of fencing panel with 2 coats of aluminum paint over a coat of aluminum primer complete in all respects. **(2 Gates per substation)**

- Supply, mixing and placing 1:3:6 cement concrete 100mm thick using 40mm graded aggregate in suitable piles, consolidating form work including a base of 75mm thick brick soling including consolidating by ramming etc. after levelling the yard and 1 mtr. all around the fencing as per site requirement complete and finishing the top by belting as directed.
- Supply and spreading crusher made 40mm aggregate stone jelly to a thickness of 100mm in the yard including levelling as directed.

6.3.3 **LT Cubicle Switch Board**

INTRODUCTION:-

This specification covers the requirements of 415 V indoor type floor mounting cubicle main switch board complete with all accessories.

LT MAIN PANEL:

- All the LT Panels shall be metal clad, totally enclosed, rigid, floor / pedestal mounted, extensible type (both sides) air -insulation, cubicle type suitable for operation on three Phase 415, 50 Hz. with neutral and short circuit level of 50KA.
- The LT Panels shall be designed to withstand heaviest weather conditions at site, with ambient temperature of upto 55 °C, 90% humidity and dusty weather. Should confirm to Latest Indian standard.

STRUCTURE:

- The LT Panel shall be metal clad enclosed, indoor type, **single front**, extensible type, fully compartmentalized and be fabricated out of high quality CRCA sheet, floor/pedestal mounting

type. All shipping sections should have side sheet on both the sides. **CRC A sheet steel thickness for different members shall be as below:-**

- o Frames & Mounting plate and Gland plate : 3.0 mm
 - o Body and Doors : 2.5 mm
 - o Partitions : 3.0 mm
- The LT Panel shall be totally enclosed, completely dust and vermin proof and degree of protection being not less than IP-52. Hinges provided in the panel shall be of Stainless steel only. Gaskets between all adjacent units and beneath, all covers shall be provided to render the joints dust proof. All doors and covers shall be fully gasketed with EPDM and / or rubber strips and shall be lockable.
- Base channel of MS 75 mm x 40 mm x 5 mm thick shall be provided at the bottom.
- LT Panel shall be in multi-tier formation. The size of the LT Panel shall be designed in such a way that the internal space is sufficient for hot air movement and for ease of maintenance. Minimum height of compartment should be 400 mm. If necessary openings shall be provided for natural ventilation, but the said openings shall be screened with fine weld mesh.
- Knockout holes of appropriate size and number as per the Incoming/outgoing cable size to be provided in Gland plate during fabrication itself. Gland plate shall be removable type.
- Removable type plate should be provided at the top of the panel on both left and right end for easy joining of Busbars of two shipping sections. The LT Panel shall be designed to facilitate easy inspection, maintenance and repair. The LT Panel shall be sufficiently rugged in design and shall support the equipment without distortion under normal and short circuit condition; they shall be suitably braced for short circuit duty.
- Panel shall have main horizontal and riser busbars housed in a separate compartment, segregated from all other compartments with sheet steel barriers.
- Power/control terminals in the cable alleys for each module & also the busbar chamber shall be covered with hinged & bolted type Hylum shrouds respectively to prevent accidental contact when

the door/cover is withdrawn. In each feeder module, the phase barrier of Hylum sheet shall be provided between the adjacent phases. Proper ventilation louvers along with wire mesh should be provided for the busbar chamber for heat dissipation. Removable type plates with louvers to be provided below the busbars at the rear end of the panel. Bus - bars should not be left open or visible from bottom.

- All the feeder modules & the cable alleys are provided with hinged type doors and cam lock with key lock chromium plated, whereas all the busbar chambers are provided with bolted type doors.
- All the hardware used in the construction of the switchboard shall be chromium/zinc plated passivated type with spring washers to avoid loosening of the fixed parts and corrosion resistive.
- Separate compartment for housing meters to be provided for Incomers, bus coupler and ACB feeders.
- Multifunction meter of ACB feeder shall be provided with RS 485 port to communicate with PLC/SCADA.
- Cable alley and Rear side of ACB should be provided with LED lamp with switch, 16 A socket.

PAINTING:

- All sheet steel work used in the construction of the switchboards shall be pre-treated with 7-tank chemical process with cleaning of scale, grease, rust and foreign matter and chemical de-rusting, sand blasting, degreasing, pickling in acid bath and phosphating as per IS: 6005 before powder coating. Primer coating with two coats of highly corrosion resistant zinc chromate primer shall be done before applying the final paint finish. The final finishing of synthetic enamel/epoxy paint of RAL-7032 shall be matt finish and powder coated.
- STAGE INSPECTION TO BE CALLED BEFORE POWDER COATING. 7 TANK TREATMENT AND POWDER COATING WILL BE WITNESSED BY HDC, KoPT. ONLY AFTER CLEARANCE ASSEMBLY OF BUSBAR/COMPONENTS TO BE STARTED.

BUSBARS:

- The busbars shall be of high conductivity, electrolytic Aluminium (E91 -E) suitable for carrying the rated and short circuit current without overheating. Sizing of Aluminium busbar shall be of current density: $1 \text{ sq.mm} = 0.8\text{A}$. Busbars in vertical alleys shall be rated to carry 100% of the rated current of all feeders connected to vertical busbars. Neutral busbar shall be minimum 50% of Phase busbar.
- Busbar supports shall be SMC/ resin cast to withstand thermal and dynamic short circuit loads
- The busbar shall have uniform cross section throughout the length. The busbar and interconnection shall be insulated with heat shrinkable PVC sleeves and be colour coded in red, Yellow, Blue and Black to identify the three phases and neutral of the system. The busbar shall be supported on unbreakable, non- hygroscopic SMC insulated supports/ FRP supports/ suitable supports at sufficiently close interval to prevent busbar sag and shall effectively withstand electromagnetic stresses in the event of short circuit capacity of 50 kA
 - o Between phases : 27 mm min
 - o Between phases and neutral: 25 mm min.
 - o Between phases and earth: 25 mm min.
- Extra holes should be provided in incoming and outgoing busbars for accommodating minimum two additional cable in future.
- Only Zinc passivated or Cadmium plated **HIGH TENSILE STEEL BOLTS, nuts and washers** to be used for all Busbar joints.

ELECTRICAL POWER & CONTROL WIRING CONNECTION:

- Terminal for both incoming and outgoing cable shall be suitable for 1.1KV grade, Aluminium/copper conductor PVC insulated and sheathed, armored cable and shall be suitable for connections of solderless sockets for the cable size as per standard practice.
- Both control and power wiring shall be brought out in cable alley for ease of external connections, operation and maintenance. Both control and power terminals shall properly be shrouded. 10% spare terminal shall be provided on each terminal block. Sufficient terminals shall be provided on each terminal block so that not more than one outgoing wire connected per terminal.
- Terminal strip for power and control shall preferably be separated from each other by suitable barriers of enclosures.
- All wiring shall be done with ISI marked FRLS insulated flexible copper wires. The insulation grade for wire shall be 1.1KV. Control wiring shall be enclosed in PVC channels/ rails only. Each wire shall be identified with PVC ferrules on both the ends.
- CT wiring shall be with minimum 2.5 sq.mm ISI marked FRLS insulated flexible copper wire. 20% extra/spare terminal to be provided on each terminal block.

EARTHING:

- Hot dip Galvanized busbar of 50 x 10 mm shall be provided in the LT Panel for the entire length of panel. The frame work of the LT Panel shall be connected to this earth busbar. Provisions shall be made for connection from earth busbar to the main earthing bar coming from the earth pit on both sides of the LT Panel.
- The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The armour shall be properly connected with earthing clamp and the clamp shall be ultimately bounded with the earth bar.

LABELS:

- Engraved PVC labels shall be provided on all incoming and outgoing feeders. Single line circuit diagram showing the arrangements of circuit inside the panel board shall be pasted on inside of the panel door and covered with transparent laminated plastic sheet.

NAME PLATE:

- A name plate with panel designation in bold letter shall be fixed at top in the center of panel. A separate name plate giving feeder details shall be provided for each feeder module door. Inside the feeder compartment, the electrical component, equipments, accessories like switchgear, contactor, lamp, relays etc. shall suitably be identified by providing stickers.

MOULDED CASE CIRCUIT BREAKER:

- All MCCB shall be 50 kA, 4 pole. The MCCB shall be air break type and having quick make quick break with trip free operating mechanism. Operating handle of the MCCB shall be in front and clearly indicate ON / OFF / TRIP positions. The electrical contact of the circuit breaker shall be of high conducting non deteriorating silver alloy contacts.
- The MCCB shall be provided with 50 kA Microprocessor release with inbuilt overload, short circuit and earth fault protection. $I_{cs} = 100\% I_{cu}$.
- Model of MCCB shall be as below:-

- o ABB: Tmax

- o SCHNEIDER: NSX Micrologic 6A

- o Siemens: Sentron 3VA

AIR CIRCUIT BREAKER:

- The ACB shall meet with IS-13947/IEC 60947-2 with all latest amendment/ IS: 2516 part I, II and III. Each pole of the ACB's shall be equipped with microprocessor based tripping device for over current, earth fault and short circuit protection. The ACB's shall be equipped with Shunt trip and under voltage trip coils. Disconnecting devices of approved type shall be provided to facilitate the removal of the circuit breakers from the housing for test and maintenance purpose.
- All ACB's shall be 50 kA, 4 pole, with microprocessor release with O/L, S/ C and E/F feature. ACB's shall be with RS 485 communication port on MODBUS for connecting to PLC/SCADA.
- The breaker plates shall have an ON-OFF indicators, spring charge indicators, provision to padlock manual handle and provision to lock drawout mechanism. Electrically operated breaker shall have provision for emergency manual closing by inserting a tool through the fuse plate. A control isolating switch shall be provided on the fuse plate to isolate the supply to the charging motor. Model of ACB shall be as below:-

- o ABB: Emax

- o SCHNEIDER: NWseries

- o Siemens: 3 WL

LOAD MANAGER:

The load manager should be having facility to read voltage, current, harmonics power parameters. It should contain real time clock. The meter should be field programmable

and to generate high / low profile for all power parameters with date & time, also able to store previous period integrated data. The meter should have RS 485 port for networking purpose. All the programming should be password protected.

CURRENT TRANSFORMER:

Where ammeter is called for, CT's shall be provided for current measuring as per requirement. Each phase shall be provided with separate CT of class-1 accuracy and suitable VA burden for operation of associated metering and controls. Current transformer shall be in accordance with IS: 2705 -1964 as amended up to date.

PUSH BUTTON:

The push button unit shall comprise of the contact element, a fixing holder, and push button actuator. The push button shall be momentary contact type. The contacts shall be of silver alloy and rated at 10 Amps. Continuous current rating. The actuator shall be of stranded type and colour as per its usage for ON, OFF and Trip.

INDICATING LAMP:

- Indicating Lamp shall be of LED type and shall be supplied complete with translucent covers to diffuse the lamp light.
- Colour shade for the indicating lamps shall be as below:
 - o ON indicating lamp : Red
 - o OFF indicating lamp : Green
 - o TRIP indicating lamp : Amber

- o PHASE indicating lamp: Red, Yellow, Blue.

TEST:

- The factory acceptance test (FAT) shall be arranged by the contractor before dispatching the panel
- The following drawings shall be submitted before procurement for approval from the client.
 - o General arrangement and Fabrication details.
 - o Power wiring diagram of the panel.
 - o Control wiring diagram of panel.
 - o Material list with make, model and technical leaflet.

Technical data

Sl. No.	PARTICULARS
A)	INCOMER
1	INCOMER-1
	ACB, 4P, EDO, MP Based protection relay with O/L, S/C and E/F protection with RS 485 for SCADA/PLC communication. Under voltage coil, shunt trip coil etc. as per detailed specification
	Digital MFM with A, V, F, KW, KWH, KVA, KVAH, PF, MD etc.

Sl. No.	PARTICULARS
	with RS 485 for SCADA/PLC
	Digital Ammeter with selector Switch
	Resin cast CT, Cl:1, 10 VA (Rating as per SLD)
	Resin cast CT, Cl:1, 10 VA for APFC panel (Rating as per SLD)
	Digital Voltmeter with selector Switch
	LOCAL/REMOTE(SCADA) SWITCH
	AUTO/MANUAL SWITCH
	TNC SWITCH
	EMERGENCY TRIP/OFF PB
	ON PB
	ON, OFF, TRIP, PHASE LED INDICATING LAMPS
	TPN, 50KA, MCCB, MP based with O/L, SC AND E/F (FOR FIXED CAPACITOR FEEDER FOR TFR-1)
2	INCOMER-2
	ACB, 4P, EDO, MP Based protection relay with O/L, S/C and E/F protection with RS 485 for SCADA/PLC communication. Undervoltage coil, shunt trip coil etc. as per detailed specification

Sl. No.	PARTICULARS
	Digital MFM with A, V, F, KW, KWH, KVA, KVAH, PF, MD etc. with RS 485 for SCADA/PLC
	Digital Ammeter with selector
	Switch
	Resin cast CT, Cl:1, 10 VA (Rating as per SLD)
	Resin cast CT, Cl:1, 10 VA for APFC panel (Rating as per SLD)
	Digital Voltmeter with selector Switch
	LOCAL/REMOTE(SCADA) SWITCH
	AUTO/MANUAL SWITCH
	TNC SWITCH
	EMERGENCY TRIP/OFF PB
	ON PB
	ON, OFF, TRIP, PHASE LED INDICATING LAMPS
	TPN, 50KA, MCCB, MP based with O/L, SCAND E/F (FOR FIXED CAPACITOR FEEDER FOR TFR-2)
3	BUS COUPLER
	ACB, 4P, EDO without release with RS 485 for SCADA/PLC communication. Undervoltage coil, shunt trip coil etc as per detailed specification
	LOCAL/REMOTE(SCADA) SWITCH
	AUTO/MANUAL SWITCH

Sl. No.	PARTICULARS
	TNC SWITCH
	EMERGENCY TRIP/OFF PB
	ON PB
	ON, OFF, TRIP
	Selector switch for selective I/C -1 or Incomer-2 for control supply
	SUMMATION CT 5+5/5A FOR APFC PANEL
B	OUTGOING FEEDER
4	ACB FEEDER:
	800A, ACB, 3P, 50KA, EDO, MP Based protection relay with O/L, S/C and E/F protection shunt trip coil etc as per detailed specification.
	Digital Ammeter with selector Switch
	Resin cast CT, Cl:1, 10 VA 800A/5A
	ON & TRIP LED indicating lamp
5	MCCB FEEDER:
	400A, MCCB, 3P, 50KA, MP Based protection relay with O/L, S/C and E/F with extended Rotary operating handle, terminal spreader with phase separator and auxiliary contact for ON and Trip indication

Sl. No.	PARTICULARS
	250A, MCCB, 3P, 50KA, MP Based protection relay with O/L, S/C and E/F with extended Rotary operating handle, terminal spreader with phase separator and auxiliary contact for ON and Trip indication
	100A, MCCB, 3P, 50KA, MP Based protection relay with O/L, S/C and E/F with extended Rotary operating handle, terminal spreader with phase separator and auxiliary contact for ON and Trip indication
	Digital ammeter with selector switch (only for 400A MCCB)
	Resin cast CT, Cl:1, 10 VA (Rating as per SLD)
	ON & TRIP LED indicating lamp

NOTE: Electrical and Mechanical Interlocking to be provided between Incomer - 1, Incomer - 2 and Bus coupler such that any Two Circuit Breaker Only Are “ON” at a time.

TECHNICAL DATA SHEET FOR LT PANEL

Sl. No.	PARTICULAR	DETAILS
1.0	SITE CONDITION	
1.1	Type / Make	Indoor / As per tender
1.2	Mounting	Floor
1.3	Ambient Temperature	50° C
1.4	Atmosphere	Corrosive, Humid and Dusty

Sl. No.	PARTICULAR	DETAILS
2.0	OPERATIVE CONDITION	
2.1	Voltage	415 V $\pm$ 10%
2.2	No. of phase	3
2.3	System	3 phase, 4 wire
2.4	Frequency	50 Hz, +5% / -5%
2.5	Fault Current	50kA
2.6	Neutral Grounding	Solid
3.0	CONTROL SYSTEM	
3.1	Voltage	
3.2	For Indication	230 V A.C.
3.3	For Metering	230 V A.C.
3.4	For Protection	230 V A.C.
3.5	Control Wiring	1.5/2.5 mm ² FRLS Cu. Wire
2.0	CONSTRUCTION	SINGLE FRONT, EXTENSIBLE FROM BOTH SIDES
2.1	Door and PARTITION	2.0 mm thick CRCA sheet
2.2	Protection Class	IP-52
2.3	Mounting plate	3.0mm thick CRCA sheet with Hinges
2.4	Gland plate	3.0mm thick CRCA sheet with Hinges

Sl. No.	PARTICULAR	DETAILS
2.5	Removable type top cutout for each section	Removable type cutouts in the top plate on both side of the section for easy jointing of busbars of adjacent section to be provided.
2.6	Base channel	75 x 40 mm C Channel
2.7	Hardware	High tensile, corrosive resistant
2.7	Minimum height of the compartment	400mm
2.8	Pocket For Drg at door	To be provided
2.9	Panel Internal Lighting	Auto NO contact/switch with Panel door and CFL 18 W for Panel Internal Lighting
3.0	PAINTING	
3.1	Sheet should be 7 tank processed, Oven Baked at 310 °C with powder coating.	Required
3.2	Shade : Exterior & Interior	Siemens Gray
3.3	Shade: Mounting plate:	white
4.0	BUSBAR	
4.1	Material	high conductivity, electrolytic aluminium (E91-E)
4.2	Current density	1 sq/mm = 0.8A
4.3	Rating of Main busbar	As per SLD
4.4	Rating of neutral busbar	Minimum 50% of phase busbar

Sl. No.	PARTICULAR	DETAILS
4.5	Rating of Vertical busbar	100% of the rated current of all feeders connected to vertical busbars
4.6	Earth Bus bar Material	Hot dip galvanized strip. (Average thickness of galvanizing : 100 Micron
4.7	Size of earth busbar	50 x 10mm (throughout)
4.8	Busbar support insulator	DMC/SMC
4.9	Hardware	High tensile bolts
5.0	CABLE ENTRY	Bottom

6.3.4 **110 V DC System**

INTRODUCTION

This specification covers the requirements of 110V DC Batteries, Chargers and DC distribution boards.

DESIGN

- The function of the 110V DC Power Supply System is to provide the normal source of power to the 110V DC loads, such as Control Supply to Switchgears / Panels.

- The 110VDC Power Supply System shall also be capable of constantly supplying emergency loads for a period of 1 hour when AC supply to Charger fails.
- The duty cycle imposed on the battery shall include the following: -
 - a) Continuous loads (indicating lights, continuously energized coils, Control Panels, Relays)
 - b) Momentary loads (switchgear operation (Trip coil/Closing coil), which exist for a period of less than 1 min period)
- The 110 VDC Power Supply System shall be operated as an ungrounded system; that is, the negative terminal or ground reference terminal is not connected to the station ground grid. A DC ground monitoring system on the DC systems shall be provided and any DC ground fault shall be alarmed.
- Batteries shall be sized in accordance with IEEE-485. The battery shall be sized with a 10% design margin and an ageing factor of 1.25
- 110V DC Power Supply System consists of 100%, 110V batteries, 100% 110V battery chargers and DC Distribution Boards.
- End Cell Voltage of **Lead Acid Plate battery is 1.85 V / Cell.**
- During Normal operating condition, batteries shall be supplied from the battery charger. The charger supplied power from LT cubicle switchboard. The battery charger shall supply the 110V DC loads and, at the same time, shall continuously float charge fully charged batteries. The charger shall have dedicated incoming AC supply from LT cubicle switchboard.
- During Emergency operation the battery shall supply the DC load when there is a loss of all auxiliary AC power supplies and/or a loss of power from the battery charger. Battery shall normally be permanently connected to the load in parallel with a charger and shall supply the load during emergency condition

when AC supply is lost.

- The Charger shall be float cum boost type Charger suitable for float charging the batteries and supply load simultaneously. Charger shall boost charge fully discharged batteries in 12 hours. Design margin of minimum 20% shall be considered in charger sizing for either mode of operation.
- Charger protections such as DC-O/V & U/V, AC U/V, E/F, S/C protection etc. shall be considered.

CONSTRUCTION OF BATTERY

- Lead Acid maintenance free Plate type batteries shall be float charged at 2.15 to 2.20 Volts per cell and chargers shall also be capable of boost charging the associated DC battery up to 2.7 Volts per cell at the desired rate. Batteries shall be rated for 10 hour discharge rate (C10) as per manufacturer data.
- Containers shall be made of suitable glass fibre reinforced plastics or Polypropylene. Containers shall be robust, heat resistance, leak proof, non -absorbent, acid/alkaline resistant, non-bulging type and free from flaws such as wrinkles, cracks, blisters, pin holes, etc.
- Batteries shall have thick plates designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuations of load. The separators shall maintain the electrical insulation between the plates and shall allow the electrolyte to flow freely. Separators should be suitable for continuous immersion in the electrolyte without distortion. The positive and negative terminals shall be clearly marked.
- Each cell shall be separately supported on porcelain insulators fixed on to the racks with adequate clearance between adjacent cells. Breathers/Vent plugs etc. shall be provided for each cell. It shall be anti-splash type and having more than one exit hole to allow the gases to escape freely but prevent the acid spray from the battery.
- Lead coated copper inter-cell connectors shall be used for connecting up adjacent cells and rows. Bolts, nuts and washers shall be effectively lead coated to prevent corrosion. All the terminals and cells, interconnections shall be fully insulated or have insulation shrouds/covers.

- End take off connections from positive and negative poles of batteries shall be made by single core cables having stranded copper conductors and PVC/XLPE insulation. Necessary supports and lugs for termination of these cables on batteries shall also be supplied. All connectors and lugs shall be capable of continuously carrying the 60 minute discharge current of the respective batteries and through fault short circuit current which the battery can produce and withstand for the period declared. Anti-corrosive gel shall be applied at the Battery terminals.
- **Wooden racks shall be provided for batteries for multi-tier installation.** These racks shall be made of good quality first class seasoned teak wood. They shall be free standing type mounted on porcelain insulators. Numbering tags, resistant to acid for each cell shall be attached on to the necessary racks. The bottom tier of the stand shall not be less than 150 mm above the floor.
- **The following accessories shall be provided with each set of battery and charger.**
 - a) Cell testing voltmeter 3-0-3 volts : 2 Nos per Battery
 - b) Spanners : 2 sets per Battery
 - c) Wall mounted teak wood rack for above items : 2 Nos per Battery
 - d) The following maintenance spares shall be provided as a minimum
 - Inter cell connectors : 10 Nos.
 - Inter row connectors : 2 Nos.
 - Battery stand insulators : 2 Nos.
 - Cell insulators : 2 Nos.

- Nuts, bolts & washers : 10 pieces each
- Vent plugs : 10 Nos.
- Spare dry cell : 4 Nos.

e) Fuse box for each battery shall be provided in the battery room and shall comprise the following:

- DP Fuse Switch unit
- HRC Fuses with striker pin & aux contact for remote alarm
- FRP enclosure.

f) Discharge resistor made of punched stainless steel grid enclosed in sheet steel enclosure shall be provided for discharge testing of Battery.

CONSTRUCTION OF BATTERY CHARGER

- During float charging, the charger shall feed the respective DC Distribution board and as well as float charge its own batteries and shall maintain a DC voltage that shall pass the minimum current through the cells to keep them charged without overcharging. In case of mains failure to charger or charger failure, battery shall supply the full load. While boost charging of respective battery, DCDB shall be isolated from the Charger and shall be fed from other Charger.
- Battery charger should meet the Trickle requirement of bank and boost requirement of bank.
- During boost charging, the battery charger shall operate on constant current mode (when

automatic regulator is in service). It shall be possible to adjust the boost charging current continuously over a range of 50 to 100 % of the rated output current for boost charging mode. During boost charging the Boost charger shall recharge the completely discharged battery to full capacity in 10 hours.

- When on automatic control mode during float charging, the charger output voltage shall remain within $\pm 1\%$ of the set value for AC input voltage variation of $\pm 10\%$, frequency variation of $\pm 3\%$, a combined voltage and frequency (absolute sum) variation of 10 % and a continuous DC load variation from zero to full load. Uniform and stepless adjustments of voltage setting (in both manual and automatic modes) shall be provided on the front of the charger panel covering the entire float charging output range specified. Battery chargers shall have a selector switch for selecting the battery charging mode i.e. whether float or boost charging.
- All battery chargers shall be provided with facilities such as automatic voltage regulator (AVR) for both automatic and manual control of output voltage and current.
- The chargers shall be of self-regulating, natural air cooled, static type provided with suitable double wound transformer, full wave thyristor type rectifiers, filter circuits, DC & AC Switchgear. Chargers shall be metal enclosed, fixed type, suitable for indoor mounting on floor. Panel frame shall be fabricated using cold rolled sheet steel of thickness not less than 2.0 mm. The frames shall be enclosed by cold rolled sheet steel of thickness not less than 2.0 mm. Suitable synthetic rubber gaskets shall be provided to achieve a degree of protection of IP54.
- Rectifier transformer shall be continuously rated, dry type, class F insulation, epoxy resin impregnated, A.N. cooling and with adequate number of taps. The rating of rectifier transformers shall correspond to the rating of the associated rectifier assembly.
- All the charger panels shall be provided with an illuminating LED lamp, a 6 Amp socket and space heaters with thermostat. Toggle switches and MCB's shall be provided separately for each of the above fittings. Space heaters "ON" indication to be provided. Two separate grounding pads shall be provided.
- Locking facilities shall be for locking float / boost selector switch in the float position only.

- Digital type Window annunciator shall be provided for alarm annunciation with acknowledge, test and rest push buttons and a buzzer for the following conditions:-
 - a) SCR fuse fail
 - b) Battery / DC system under voltage
 - c) DC system overvoltage
 - d) DC over load
 - e) Output fuse blown
 - f) AC supply fail
 - g) AC under voltage
 - h) Battery earth fault
 - i) Filter fuse failure
 - j) Battery on Float /Boost
 - k) Charger fail/Battery on discharge
 - l) Any other annunciation, as required

- Remote alarm contacts for hooking up to PLC shall be provided. For each charger, current & voltage transducer shall be provided for remote monitoring of DC voltage and Current at PLC.
- Protection features, indications, meters and alarms shall be provided for each charger. Protection features shall include the following as minimum.
 - a) Overload Protection
 - b) Phase failure protection
 - c) Voltage unbalance protection
 - d) Fuse failure protections for SCR and filter circuit
- Suitable potential free contacts for remote indication of above abnormal conditions shall be provided. However, the requirements / design shall be firmed up during the detailed engineering stage.

DC DISTRIBUTION BOARD (DCDB)

The DC Control and distribution board shall be equipped with MCBs.

The equipment shall be capable of carrying, making and breaking the maximum possible fault current and details of the make -up of this shall be provided. Curves of battery current plotted against time under short circuit conditions shall be supplied.

Outgoing distribution cables shall be connected directly to the relevant MCB.

Cabling and wiring terminations shall be shrouded to avoid accidental short circuit or earthing of the battery. PVC insulation shall be used for fuse wiring connections.

Suitable means shall be provided such that when the charger is operating in float charge mode and when switching to boost charge mode the voltage at the outgoing distribution terminals shall be automatically limited to within the tolerances as specified elsewhere in this Section. This shall be achieved by the insertion of voltage dropping diodes into the input circuit and the diodes shall have a rating of at least twice the board's standing load. A minimum of three diode strings (stages) shall be provided which shall be inserted into the input circuit of DCDB in stages to provide the range of voltage control in DCDB within limits as specified elsewhere in this section. It is preferred that during float mode the diode assembly shall not be included in the circuitry.

Suitable alarm relays shall be provided to monitor at the distribution board both high and low battery voltages to pre-set values. The relays shall be fitted with variable time delays adjustable between 0-30 seconds. The relays shall indicate the fault condition locally and shall have two sets of voltage free contacts for indication to SCADA and the RCP.

TESTING AND INSPECTION

Battery & Charger and all its components should have been type tested and proven type. Type test certificates shall be furnished during inspection for review. Battery & Charger shall be subjected to routine tests as per applicable Indian Standard. In addition, any special test required shall also be performed.

6.3.5 HT & LT Cables

HT CABLES

HT Cables shall be XLPE insulated, screened, PVC inner sheathed (extruded), armoured, FRLS PVC outer sheathed, compacted aluminium conductor conforming to IS: 7098

Part-II. 11KV (E) cables shall be suitable for earthed system. The conductor screen and insulation screen shall both be of extruded semi-conducting compound and shall be applied along with the XLPE insulation in a single operation of tripple extrusion process. The metallic screen of each core shall consist of copper tape with minimum overlap of 20% copper screen which shall be capable of carrying the system earth fault current for 2 seconds. Outer sheath shall be FRLS PVC.

LT CABLES

LT Cables shall be XLPE insulated PVC inner sheathed (extruded), armoured, FRLS PVC outer sheathed, compacted aluminium conductor conforming to IS: 7098 Part -I. 1.1 kV grade cables.

CABLE IDENTIFICATION SYSTEM

- Cable Identification shall be provided at every 5 meters interval incorporating the following marking shall also be embossed over outer sheath.
 - a) Cable size and voltage grade.
 - b) Word 'FRLS' at every 5 metre.
 - c) Sequential marking of length of the cable in meters at every one metre.
- The embossing shall be progressive, automatic, in line and marking shall be legible and indelible.

CABLE DRUMS

Cables (both HT & LT) shall be supplied in returnable steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with waterproof layer. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/rubber caps, secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection.

TESTING AND INSPECTION

Cables offered shall be of type tested and proven type. Type test certificates for test conducted earlier on similar rating shall be furnished. Routine tests, Acceptance tests and all special tests for FRLS properties shall be carried out for all the cables as per applicable standards. The sample shall be drawn at the rate of one per type and size for every lot offered for inspection.

SPECIAL TESTS

- The following tests as applicable to FRLS sheathed cables shall be conducted as type tests on each size of each lot:-
 - Oxygen index test
 - Temperature index test
 - Acid gas generation during fire
 - Smoke generation test under fire
 - Swedish chimney test for class F3 as per SS : 4220 14 : 75
 - Under fire conditions for bunched cables as per IEEE std. 383 / 74

6.3.6 CABLE LAYING

HT / LT CABLES LAYING INSIDE SUBSTATION IN THE TRENCHES

- The UG cables shall be laid by grouting 75 x 75 x 8 mm. L angles inside the substation trenches.
- Cables should not be laid directly in the trench floor. Cables trenches should be provided with strong & effective covers with water & fireproof sealing arrangement at trench entry & exit points.
- Cables of different voltages shall be laid in separate racks. Minimum distance of 250 mm shall be maintained along the routes between various types of cables. In case of horizontal formation, the highest voltage cables shall be laid in the top most position in the tray stack followed by other grades as follows in the descending order.

o 11 kV Power cables (Top Tier)

o 1.1kV Power cables (Below HT Tier)

HT/ LT CABLE LAYING OUTSIDE THE SUBSTATIONS

The HT/LT cables shall be laid as per IS: 1255. The UG cable shall be laid by excavating the earth by 1.2m depth for HT cable and covered with standard size bricks on sides and PCC slab on top. The LT cables shall be laid by excavating the earth by 0.75m depth and covered with standard size bricks on sides and top. For HT & LT cable laying, a sand bed cushion of 100 mm shall be made at the bottom of the cables. HT cable route markers shall be provided once in 30 Mtrs. distance on HT cable route.

HT/LT CABLE LAYINGS ACROSS THE ROADS

HT & LT cable laying across the roads shall be by under craving as follows:-

Mechanized Horizontal directional drilling (HDD) of all types of soil under the existing road/gate way for laying the 2 runs of 3C X 185 Sq.mm HT UG cable through **3 runs of 110mm dia HDPE pipe (one spare)** across the road including making good to the damaged soil/concrete road/asphalted road to match to the existing finish as per site requirement including providing nylon pull rope for laying the cable complete in all respects and as directed by Engineer or his representative. Necessary clearances if any from statutory authorities for crossing the road has to be taken by the contractor itself. Incidental charges if any has to be borne by the contractor itself. Scope of works include construction of chambers at cable entry and exist point.

END TERMINATION

Heat shrinkable type end termination kits for HT 11KV 3C x 185 sq.mm aluminum, XLPE armoured cable.

6.3.7 Automatic Power Factor Correction Control Panels (APFC) with Capacitors

- 150 KVAR 415 V Automatic Power Factor Control Panels shall comprise of MCCB / Switch Fuse, 1.1KV MCCB, Air Break Contactor, PF Meter, Automatic PF Correction Relay with Capacitor Banks of suitable rating. Contractor shall perform their own calculations to verify the size and submit the same to HDC, KoPT for verification. Number of steps shall be based on 10 KVAR power step minimum. The capacitor banks ratings shall be finally selected to provide a power factor of 0.98 lag on the bus. Zero step shall also be provided.
- Harmonic Filters for Automatic Power Factor correction shall be provided. The Harmonic Filters shall be designed in such a way that the THD shall be less than 8%. Capacitor duty contactors to be installed for capacitor banks.
- Capacitor bank shall be double layer construction (film + foil) gas impregnated type.

6.3.8 Control Cables

Supply, laying and connecting 12 Core, 2.5 sqmm copper conductor PVC insulated 1.1KV grade Armoured control cables for inter connection with VCB panels to transformer for control cabling including glands and both end termination using suitable copper lugs with suitable marking ferrules complete as directed by the Engineer or EIC.

6.3.9 Earthing System

COPPER PLATE EARTHING: (TRANSFORMER NEUTRAL)

- Providing earth station using 600 x 600 x 3.15 mm thick Copper / GI (Hot dip galvanised) plate electrode (copper for transformer neutral and GI for body earthing of all equipments) buried in the earth pit of minimum size 900 x 550 x 2500 mm depth below the ground level with top edge of the plate not less than 1.5M below the ground level including necessary excavation. The plate electrode shall be covered with uniformly spread alternate layers of charcoal and salt up to a thickness of 150 mm all around the plate. 25 mm dia 2500 mm long medium GI pipe to be rigidly clamped with the plate electrode using suitable clamps, bolts, nuts etc. and a GI funnel with wire mesh covering to be provided at the top of the GI pipe. Two runs of 2500 mm long 50 x 6mm thick

Copper strip as specified in BOQ to be welded and clamped rigidly with the plate electrode on either side of the GI water pipe using suitable bolts, nuts etc. and the same to be welded and clamped with 2 X 50 X 6 mm (600 sq.mm) thick 200 mm long Copper strip kept horizontally at the top end for providing electrical continuity. Cement concrete base of minimum size 750 x 750 x 100 mm thick shall be provided using 1:2:6 CC after necessary excavation, refilling of soil, consolidating, ramming, leveling of soil etc. and providing cement concrete chamber of inside dimension 600 x 600 x 450 mm with a wall thickness of 120 mm using 1:2:6 CC above the base concrete including providing 50mm thick RCC cover. All bolts, nuts, check nuts, washers etc. after fixing shall be covered with bitumen. All details required and not mentioned above shall be conforming to **IS 3043-1987** complete in all respects and as directed.

CEMENT CONCRETE AND BACK FILLING etc.

All materials whether to be consumed in the work or used temporarily shall conform to relevant IS specification, unless stated otherwise, and shall be of the best approved quality.

Cement to be used in the work under the contract shall generally conform to IS: 269 / 455-1989.

For M20 concrete (1:1.5:3) the aggregate will be in the ranges from 12mm to 20mm. size and for M20 concrete (1:1.5:3) these will be from 25mm to 40mm size.

EARTHING BELOW GROUND

- The main Earthing Grid shall be buried below ground unless required otherwise. For crossing any trench or under-ground pipe minimum earth coverage of 500 mm. shall be provided over the earthing conductor.
- Where the earthing conductor passes through reinforcement or steel plate it shall be bonded to the same.

- All building steels and columns shall be bonded directly to the earthing grid.
- The riser/pigtails from earthing grid shall project 600 mm. above grade/concrete level unless shown otherwise.
- All earthing conductor connections shall be made by electric arc welding or by nuts and bolts using plain washers and spring washers.
- All arc welding shall be carried out with low hydrogen content electrode.
- All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it. No artificial cooling should be adopted to cool welded joints.
- The welding required for earthing shall serve the following three purposes sufficient mechanical strength between the jointing materials.
- Earthing shall be mechanically robust and all joints shall be capable of retaining low resistance even after passages of many fault current.
- All the connections are to be made carefully and properly. Improper/poor connections are to be remade at the cost of Contractor.
- Welded areas of risers/pigtail shall be thickly coated with bitumen compound to prevent corrosion.
- Earthing pits/conductors shall be laid in field to avoid fouling with concrete foundations and in consultation with the Employer at site.
- Trenches shall be filled up with 'Free of Stones' earth after laying earth conductor. After filling up of trenches the earth shall be rammed carefully.

- The successful Contractor shall submit detailed working drawings of earthing grid for approval by HDC, KoPT prior to construction of the grounding system.
- The rate quoted shall be inclusive of cost of all materials, labour required for excavation, backfilling, welding, cutting, bending, placing of GI strips etc. complete as per specification.
- All tests as per relevant standards shall be conducted to certify the effectiveness and other requirements of the earthing grid.
- Depth of laying of earth conductor for earth grid, ring and inter-connections shall generally be min. 500 mm from ground level and 300 mm below all foundations.
- Erection of earth pits shall include making of masonry enclosure and supply of chemical and other materials.

EARTHING ABOVE GROUND

- The successful Contractor shall lay the above ground earthing conductors inside the buildings and on various structures for connection to various equipment/ drives etc. These earthing conductors may be installed within the cable trays in the form of runway conductors. The connection to equipment shall be tapped from these runway conductors at suitable locations. One runway conductor shall be provided for each side of cable trench/tray.
- The neutral points of all earthed system of different voltages, all equipment frame works, other non-current carrying metallic structures and equipments shall be earthed by a minimum of two separate and distinct connections.
- Armour of all power and control cables shall be earthed at both ends through gland earth ring provided with the cable glands.
- All cable trays and supporting structure are to be earthed. All cable tray sections shall be bonded

with each other for continuity.

- All earth leads and riser connections shall be as short as possible.
- Metal pipes and conduits through which cables run shall be effectively bonded and earthed.
- Neutral connection shall not be used for equipment earthing.
- All connections to earth conductors shall be welded/bolted type. Earthing connections to all equipment shall be bolted type.
- All joints in earthing conductor shall be welded type. All joints shall be welded with an overlap of 65 mm. Joints shall be thoroughly cleaned before welding. Welding is to be done around joint completely. All joints shall be given two coats of anti-corrosive paint (Red Oxide) to a thickness of 3-5 micron, followed by a coat of bitumen paint. Joints shall be thoroughly cleaned before applying paints.
- All nuts, bolts washers etc. shall be cadmium plated or zinc passivated. Generally, earthing studs and terminals shall be provided on all equipment. In such cases, where it is not provided the Contractor shall have to drill and tap the equipment for deriving earth terminals.
- Connections of earthing conductors to the main earthing loops or to equipment shall generally be made by means of cable lugs in case of round conductors, solid or stranded and directly in case of strips. Devices like spring washers and lock washers must be used to ensure that the connections are vibration proof.
- Laying of earthing conductor shall include fabrication and fixing of clamps, cleats and supply fixing device i.e. nuts, bolts, washers as also civil work such as preparation of floor surface and finishing them to the finished floor level after installation of earthing strips.
- Minimum Electrode size shall be as per the latest amendments of IS: 3043. Earth electrodes / plates for body earth transformer neutral earthing and lightning earth pits shall be selected as per the latest amendments / requirements of IS : 3043.

- In all cases the pipes shall be driven such that their zones of earthing do not overlap. Each earth electrode shall be connected to its associated earth tape through a linked connection. The link shall be installed as close to the earth electrode as possible. Each earth electrode shall be enclosed together with the link in a reinforced concrete hand-hole with cast iron cover, which shall be set flush with the ground.

6.3.10 Removal / Dismantle of existing HT/ LT switchgears & transformers

- All substation equipments viz. Transformers, HT/LT Panel, Battery Charges, Lighting system, Existing fencing and Gates etc.
- All Over Head line conductors, MS 2 pole and 4 pole structures of OH line and their foundations including all OH line components shall be removed, transported and disposed at the places as directed by the Engineer or Engineer in Charge.
- The removal of Equipments / Components shall be preplanned by program such that the power supply shall not be disturbed or shall be minimized power outage by discussing with the Engineer or Engineer in charge before starting of each part of the work.
- Mobilizing equipments viz. Cranes, Trucks and Tools & Tackles, Welding / Cutting Sets and Compressors shall be the responsibility of the contractor.

6.3.11 Safety Equipments For Substations

Fire sand buckets with stand, fire extinguishers of CO₂ gas and dry chemical powder, first aid chart for electric shock, first aid kit and 11 kV hand gloves in adequate quantity and as per CEA norms in

all substations.

6.3.12 Preparation of Drawing

Preparation of complete drawing for substation equipments and HT overhead line system etc. Submission of drawings getting approval from CEA / Local Authority, Arranging inspections and getting approval for the system.

6.3.13 Testing And Inspection at Manufacturer's Site

Equipment offered shall be of type tested and proven type. Type test certificates for test conducted earlier on similar rating shall be furnished. Routine tests shall be carried out for all the equipment as per applicable standards.

6.3.14 Testing And Commissioning Of The Complete Electrical System

The HT/LT installations including HT overhead line and its allied equipments shall be tested for pre commissioning for the system as per IEC / IS.

• **VENDOR LIST(LIST OF APPROVED MAKES) Sl. No.**

Equipment/ Componen PreferredMakes

- | | | |
|----|--------------------------|---|
| 1. | HT Switchgear | Schneider / Siemens / ABB |
| 2. | LT Switchgear | Schneider / Siemens / ABB |
| 3. | Distribution Boards | Siemens / Schneider / ABB / Indo
Asian / Milestones / Pyrotech / L&T |
| 4. | Lighting Panels | Siemens / L& T / Schneider / GE
Power Controls / Havells / Indo
Asian / MDS |
| 5. | Distribution Transformer | Areva / Emco / BHEL / Voltamp /
Bharat Bijlee |
| 6. | HT< Power cables | Universal / NICCO / CCI /
Fort Gloster/Gem |
| 7. | Copper Wires PVC FRLS | Skytone / Echo Cables / Batra Henlay |

/ National / Finolex / Polycab

- | | | |
|-----|--|---|
| 8. | Cable Glands/Lugs | Jainsons / Dowells / Gripwell / SMF |
| | | |
| 10. | LTCapacitorBank | L&T / Siemens / Epcos / Mehar /
ABB / Crompton / Asian / Universal
/ Madhav |
| | | |
| 11. | AutomaticPowerFactor
Correction Control Relay | Beluk / Epcos |

12.	Battery	Exide / Amco / Amara Raja / Chloride / Standard
13.	BatteryChargerwithDCDB	Chhabi Electricals / Caldye / Mastek / DB Electronics / Hirel Hitachi
14	FRLSPVCwires	Finolex / Kundan / Polycab / Havells
15.	MCCB	Siemens / L&T / ABB / Schneider
16	MCB/ELCB/RCB/MPCB	Siemens / L & T / MDS / Schneider / Havells
17	Fuse/Link	Siemens / L&T / Alstom / Schneider / C&S / Areva
18	Contactors	Siemens / L&T / ABB / Schneider
19	Indicating Lamps / Push buttons	Siemens / Schneider / Teknic / Kaycee / L&T / Essen / Vaishnav / BCH / C&S

22.	Push button stations	Siemens / Schneider / Teknic / Rishabh/L&T/BCH/ControlGroup
21.	Meters(digital) MFM	Schneider (Conzerv) / L&T / Secure
22.	Voltmeter / Ammeter / PF Meter / Frequency Meter/ KWH Meter	AEI/ IMP / MECO / INDCOIL / conzerve / L&T / Rishab / Siemens / Industrial Meters
23.	Selector Switch	L&T / Siemens / Schneider / Kaycee / Salzer / C&S
24	Auxiliary Contactors/Relays	L&T / Siemens/ BCH

25.	Overload Relays (Hand Reset Type)	L&T / Siemens / BCH / Telemachanique
26	Protective/Auxiliary Relays	Alstom / Schneider / Siemens / ABB / Telemachanique / L&T
27	Time Delay Relays	BCH / Siemens / L&T / English Electric
28	Power Contactor with 2NO+2NC	L&T / Siemens / Telemachanique
29	Timer	Siemens / L&T / BCH / Schneider
30	Terminal Blocks	Elmex / Connect Well
31.	Current Transformer/ Potential Transformer	AE / Kappa / L&T / Siemens / Pragati / C&S / Jyoti
32.	Cable Termination Kits & Straight Through Joints	Raychem / M-Seal (3M) / Denson

STANDARDS AND REGULATIONS:

- The design and manufacture of the electrical equipment shall conform as a minimum to applicable codes, regulations and standards published by the following bodies:
 - BIS : Bureau of Indian Standards
 - IER : Indian Electricity Rules
 - BSI : British Standard Institution
 - ISO : International Organization for Standardization
 - IEC : International Electro-Technical Commission
 - IEEE : Institute of Electrical & Electronics Engineers
 - NFPA : National Fire Protection Association
 - NEC : National Electrical Code
- Following is the list of some of the directly applicable Standards particular to the equipment. Any other relevant Indian Standard, not covered shall also be applicable.

IS:375

Marking and arrangement of
Switchgear Bus

IS:13118	Specification for high voltage alternating current circuit breaker
IS:12729	Switchgear and Control gear for voltages exceeding 1000V - General Requirements
IS:2705	Current transformers
IS:3156	Voltage Transformers
IS:335	New Insulating oils
IS:2026,IS 1180Sec-2	Power transformers
IS:3639	Fittings and accessories for Power transformers
IS:4257	Dimensions of clamping arrangement for porcelain transformer bushings
IS:10028	Code of Practice for selection, installation and maintenance of transformer
IS:3427	A.C. Metal enclosed switchgear and control gear for rated voltages above 1kV and upto and including 52kV
IS:8623	Specification for low voltage switchgear and control gear assemblies of switchgear & control gear for voltages not exceeding 1000V AC.
IS:13703	Low Voltage fuses
IS:13947	Low Voltage switchgear and control gear

IS:1651	Stationary cells and batteries, Lead Acid Type (with tubular positive plates)–Specification
IS:266	Specification for Sulphuric acid
IS:3895	Mono crystalline Semi-conductor rectifier cells and stacks
IS:4540	Mono –crystalline Semi-conductor rectifier assemblies and equipment
IEEE:484	Recommended Design for Installation design and installation of large lead storage batteries for generating stations and substations.
IEEE:485	Sizing large lead storage batteries for generating stations and substations.
IS:1554	PVC insulated (heavy duty) electric cables for working voltages up to and including 1100 volts.
IS:7098-I	Cross linked polyethylene insulated PVC sheathed cables for working voltages up to and including 1100 volts.
IS:7098-II	Cross linked polyethylene insulated PVC sheathed cables for working voltages from 3.3 kV up to and including 33 kV.

PRICE SCHEDULE

[To be filled up and uploaded, duly signed & stamped]

PART: A

Sl. No.	Description of the work	Unit	Qty	Applicable GST %		
				SGST	CGST	IGST
1.	Supply & Installation of HT 11KV 630A, 26.3KA Vacuum Circuit Breaker (VCB) panel, as per the details given in TABLE – I of “Technical Specification”					
	a) Supply					
	i) For SS – 3 sub stations	SET	1			
	ii) For SS – 2 sub stations	SET	1			
	iii) For SS – 1 sub station	SET	1			
	iv) For Anchorage Camp sub station	SET	1			
	v) For Jawahar Tower sub station	SET	1			
	b) Installation, Testing & Commissioning					
	i) For SS – 3 sub station	SET	1			
	ii) For SS – 2 sub station	SET	1			
	iii) For SS – 1 sub station	SET	1			
	iv) For Anchorage Camp sub station	SET	1			
	v) For Jawahar Tower sub station	SET	1			

Sl. No.	Description of the work	Unit	Qty	Applicable GST %		
				SGST	CGST	IGST
2.	Supply & Installation of 11 kV/0.433 kV oil filled, floor mounted outdoor type Distribution Transformers with Off-load tap changer, as per the details given in TABLE – I of “Technical Specification”					
	a) Supply					
	i) 1000 kVA Transformer	No.	4			
	ii) 500 kVA Transformer	No.	6			
	b) Installation, Testing & Commissioning including Transformer foundation 3 m X 3 m X 0.5 m					
	i) 1000 kVA Transformer	No.	4			
	ii) 500 kVA Transformer	No.	6			
3.	Supply & Laying of HT 11 KV (E) Grade 3C x 185 sq. mm aluminum conductor, armoured XLPE UG cable as per IS : 7098 Part – II and as per Technical Specification.					
	a) Supply	Mtr.	8000			
	b) Laying, Testing & Commissioning	Mtr.	8000			
4.	Supply & Installation of HT 11KV (E) 3C x 185 sq. mm Heat shrinkable type end termination kits suitable for aluminum, XLPE armoured UG cable.					
	a) Supply	No.	20			
	b) End termination, Testing & Commissioning	No.	20			
5.	Supply & Installation of the following LT cubicle Distribution Panel with rated Busbar, floor mounted & with all accessories as per the details given in TABLE – II of “Technical Specification”					

Sl. No.	Description of the work	Unit	Qty	Applicable GST %		
				SGST	CGST	IGST
	a) Supply					
	i) 3000 A, LT Distribution Panel	Set	2			
	ii) 1600 A, LT Distribution Panel	Set	3			
	b) Installation, testing & Commissioning					
	i) 3000 A, LT Distribution Panel	Set	2			
	ii) 1600 A, LT Distribution Panel	Set	3			
6.	Supply & Installation of 110 volts. DC system of 120 AH complete with maintenance free batteries of 1-hour backup for substations as per Technical Specification.					
	a) Supply	Set	5			
	b) Installation, Testing & Commissioning	Set	5			
7.	Supply & Laying of LT XLPE Aluminum conductor UG armoured cable of 1.1 kV. Grade as per IS: 7098 Part – I and as per Technical Specification.					
	a) Supply	Mtr.	1400			
	i) 1C x 630 sq.mm flexible cable	Mtr.	1400			
	ii) 3.5C x 400sq.mm	Mtr.	100			
	iii) 3.5C x 240 sq.mm	Mtr.	100			
	iv) 3.5C x 120 sq.mm	Mtr.	250			
	v) 3.5C x 25 sq.mm	Mtr.	500			
	b) Laying, Testing and Commissioning of					
	i) 1C x 630 sq.mm flexible cable	Mtr.	1400			
	ii) 3.5C x 400 sq.mm	Mtr.	100			
	iii) 3.5C x 240sq.mm	Mtr.	100			
	iv) 3.5C x 120sq.mm	Mtr.	250			

Sl. No.	Description of the work	Unit	Qty	Applicable GST %		
				SGST	CGST	IGST
	v) 3.5C x 25 sq.mm	Mtr.	500			
8.	Supply & Installation of LT 1.1 KV Straight through joint kits Heat shrinkable type for XLPE, aluminum armoured UG cable as per Technical specification.					
	i) 3.5C x 400 sq.mm	No.	10			
	ii) 3.5C x 240 sq.mm	No.	10			
	iii) 3.5C x 120 sq.mm	No.	10			
	iv) 3.5C x 25 sq.mm	No.	10			
9.	Providing 1.1 KV cable end termination for XLPE, aluminum armoured UG cable as per Technical specification.					
	i) 3.5C x 400 sq.mm	No.	10			
	ii) 3.5C x 240 sq.mm	No.	10			
	iii) 3.5C x 120 sq.mm	No.	10			
	iv) 3.5C x 25 sq.mm	No.	10			
10.	Providing earthing system of Galvanized Iron plate with Copper plate in accordance with BIS 3043 or latest amendment as per Technical specification.					
	a) Supply	No.	20			
	b) Installation, Testing & Commissioning	No.	20			
11.	Supply and Installation of 50 x 6 mm copper flats for transformer neutral as per Technical specification.					
	a) Supply	Mtr.	500			
	b) Installation, Testing & Commissioning	Mtr.	500			

Sl. No.	Description of the work	Unit	Qty	Applicable GST %		
				SGST	CGST	IGST
12.	Supply and Installation of Hot Dip Galvanized (100 micron) flats of size 50 X 6 mm for HT/LT switchboards, transformers overhead line poles, DP etc. with assorted sizes as per Technical specification.					
	a) Supply	Mtr.	1000			
	b) Installation, Testing & Commissioning	Mtr.	1000			
13.	Automatic power factor correction panel (APFC) with 150KVAR capacitors and all accessories as per Technical Specifications.					
	a) Supply	Nos.	10			
	b) Installation, Testing & Commissioning	Nos.	10			
14.	Supply and Installation of Control cables 2.5 sq.mm 12 C, Copper armoured with colour codings as per Technical Specifications.					
	a) Supply	Mtr.	500			
	b) Installation, Testing & Commissioning	Mtr.	500			
15.	Supply & installation of safety equipments like HT/LT rubber mats, CO ₂ fire extinguishers, First Aid boxes, etc. as per CEA norms, for all substations.	Set	5			
16.	Removal / dismantle, Loading / Unloading, Transporting & Disposal of all substation equipments viz. Transformers, HT/LT panels Battery chargers and Lighting system etc. as per Technical Specifications.	LS	LS			

PRICE SCHEDULE

[To be filled up and uploaded, duly signed & stamped]

REPLACING / REFURBISHING OF 11KV/0.433V SUBSTATIONS & 11KV HT OVERHEAD LINES & ALLIED EQUIPMENTS IN THE TOWNSHIP OF HALDIA DOCK COMPLEX-KOLKATA PORT TRUST

Sl. No.	Description of the work	Unit	Qty	Applicable GST %		
				SGST	CGST	IGST
1.	Supply & Installation of HT 11KV 630A, 26.3KA Vacuum Circuit Breaker (VCB) panel, as per the details given in TABLE – I of “Technical Specification”					
	a) Supply					
	i) For SS – 3 sub stations	SET	1			
	ii) For SS – 2 sub stations	SET	1			
	iii) For SS – 1 sub station	SET	1			
	iv) For Anchorage Camp sub station	SET	1			
	v) For Jawahar Tower sub station	SET	1			
	b) Installation, Testing & Commissioning					
	i) For SS – 3 sub station	SET	1			
	ii) For SS – 2 sub station	SET	1			
	iii) For SS – 1 sub station	SET	1			
	iv) For Anchorage Camp sub station	SET	1			
	v) For Jawahar Tower sub station	SET	1			

Sl. No.	Description of the work	Unit	Qty	Applicable GST %		
				SGST	CGST	IGST
2.	Supply & Installation of 11 kV/0.433 kV oil filled, floor mounted outdoor type Distribution Transformers with Off-load tap changer, as per the details given in TABLE – I of “Technical Specification”					
	a) Supply					
	i) 1000 kVA Transformer	No.	4			
	ii) 500 kVA Transformer	No.	6			
	b) Installation, Testing & Commissioning including Transformer foundation 3 m X 3 m X 0.5 m					
	i) 1000 kVA Transformer	No.	4			
	ii) 500 kVA Transformer	No.	6			
3.	Supply & Laying of HT 11 KV (E) Grade 3C x 185 sq. mm aluminum conductor, armoured XLPE UG cable as per IS : 7098 Part – II and as per Technical Specification.					
	a) Supply	Mtr.	8000			
	b) Laying, Testing & Commissioning	Mtr.	8000			
4.	Supply & Installation of HT 11KV (E) 3C x 185 sq. mm Heat shrinkable type end termination kits suitable for aluminum, XLPE armoured UG cable.					
	a) Supply	No.	20			
	b) End termination, Testing & Commissioning	No.	20			
5.	Supply & Installation of the following LT cubicle Distribution Panel with rated Busbar, floor mounted & with all accessories as per the details given in TABLE – II of “Technical Specification”					

Sl. No.	Description of the work	Unit	Qty	Applicable GST %		
				SGST	CGST	IGST
	a) Supply					
	i) 3000 A, LT Distribution Panel	Set	2			
	ii) 1600 A, LT Distribution Panel	Set	3			
	b) Installation, testing & Commissioning					
	i) 3000 A, LT Distribution Panel	Set	2			
	ii) 1600 A, LT Distribution Panel	Set	3			
6.	Supply & Installation of 110 volts. DC system of 120 AH complete with maintenance free batteries of 1-hour backup for substations as per Technical Specification.					
	a) Supply	Set	5			
	b) Installation, Testing & Commissioning	Set	5			
7.	Supply & Laying of LT XLPE Aluminum conductor UG armoured cable of 1.1 kV. Grade as per IS: 7098 Part – I and as per Technical Specification.					
	a) Supply	Mtr.	1400			
	i) 1C x 630 sq.mm flexible cable	Mtr.	1400			
	ii) 3.5C x400sq.mm	Mtr.	100			
	iii) 3.5C x 240 sq.mm	Mtr.	100			
	iv) 3.5C x 120 sq.mm	Mtr.	250			
	v) 3.5C x 25 sq.mm	Mtr.	500			
	b) Laying, Testing and Commissioning of					
	i) 1C x 630 sq.mm flexible cable	Mtr.	1400			
	ii) 3.5C x400 sq.mm	Mtr.	100			
	iii) 3.5C x 240sq.mm	Mtr.	100			
	iv) 3.5C x 120sq.mm	Mtr.	250			

Sl. No.	Description of the work	Unit	Qty	Applicable GST %		
				SGST	CGST	IGST
	v) 3.5C x 25 sq.mm	Mtr.	500			
8.	Supply & Installation of LT 1.1 KV Straight through joint kits Heat shrinkable type for XLPE, aluminum armoured UG cable as per Technical specification.					
	i) 3.5C x 400 sq.mm	No.	10			
	ii) 3.5C x 240 sq.mm	No.	10			
	iii) 3.5C x 120 sq.mm	No.	10			
	iv) 3.5C x 25 sq.mm	No.	10			
9.	Providing 1.1 KV cable end termination for XLPE, aluminum armoured UG cable as per Technical specification.					
	i) 3.5C x 400 sq.mm	No.	10			
	ii) 3.5C x 240 sq.mm	No.	10			
	iii) 3.5C x 120 sq.mm	No.	10			
	iv) 3.5C x 25 sq.mm	No.	10			
10.	Providing earthing system of Galvanized Iron plate with Copper plate in accordance with BIS 3043 or latest amendment as per Technical specification.					
	a) Supply	No.	20			
	b) Installation, Testing & Commissioning	No.	20			
11.	Supply and Installation of 50 x 6 mm copper flats for transformer neutral as per Technical specification.					
	a) Supply	Mtr.	500			
	b) Installation, Testing & Commissioning	Mtr.	500			

Sl. No.	Description of the work	Unit	Qty	Applicable GST %		
				SGST	CGST	IGST
12.	Supply and Installation of Hot Dip Galvanized (100 micron) flats of size 50 X 6 mm for HT/LT switchboards, transformers overhead line poles, DP etc. with assorted sizes as per Technical specification.					
	a) Supply	Mtr.	1000			
	b) Installation, Testing & Commissioning	Mtr.	1000			
13.	Automatic power factor correction panel (APFC) with 150KVAR capacitors and all accessories as per Technical Specifications.					
	a) Supply	Nos.	10			
	b) Installation, Testing & Commissioning	Nos.	10			
14.	Supply and Installation of Control cables 2.5 sq.mm 12 C, Copper armoured with colour codings as per Technical Specifications.					
	a) Supply	Mtr.	500			
	b) Installation, Testing & Commissioning	Mtr.	500			
15.	Supply & installation of safety equipments like HT/LT rubber mats, CO ₂ fire extinguishers, First Aid boxes, etc. as per CEA norms, for all substations.	Set	5			
16.	Removal / dismantle, Loading / Unloading, Transporting & Disposal of all substation equipments viz. Transformers, HT/LT panels Battery chargers and Lighting system etc. as per Technical Specifications.	LS	LS			