

PRICE SCHEDULE

Sr. No.	Description of the work	Unit	Qty	Unit Rate (Rs.)	Amount (Rs.)
1.	Supply and laying of H.T. 11KV, 3 C X185 Sq.mm. XLPE U.G. Alu. cable as per IS standards	Mtr.	2000		
2.	Design, Supply, Installation, testing and commissioning of 11 KV / 433V, 1000 KVA, Package Outdoor compact Sub-Station	Set	1		
3.	Supply and laying of L.T. 1.1KV, 3 runs of 1 Core XLPE U.G. Alu. cable suitable for 1400A Current carrying capacity as per IS	Mtr.	300		
4.	Design, Supply, Installation, testing and commissioning of Frequency Converter for 1000KVA for 50Hz and 60Hz.	Set	1		
5.	Distribution box at the Berth for providing Shore connection.	Set	1		
6.	Earthing station for above scheme	No.	10		
TOTAL					

(In Words Rupees _____
 _____ only)

Note: The offered rates shall be inclusive of all taxes and duties, Service Tax shall be extra as applicable.

TECHNICAL SPECIFICATION

1.0 GENERAL:

Mormugao Port Trust, Goa, has proposed to install 11 / 0.433 KV substation at Berth No.10/11 in Mormugao Port Trust for providing of power supply to Ships at Berths. The said substation receives H.T. power supply from 33/11 KV substation "A" and cater to the power requirements of the berthed ships.

2.0 SCOPE OF WORKS:

The Scope of Work includes:

- i) Design, Supply, Installation, testing and commissioning of 11 kV / 433 V, 1000 KVA outdoor type package substation with Resin cast transformer, VCB, ISOLATOR, ACB, APFC, Trivector meter, Providing Charger unit, frequency convertor, other safety equipments with standard accessories etc.,
- ii) Design, Supply, Installation, testing and commissioning of LT panel with ACBs and MCCBs with all other accessories.
- iii) Providing of RCC cable trench through hard rock for laying HT/LT Cables, where ever required.
- iv) Supply and laying of H.T./ L.T. cables, end termination and Straight through joints. Provision of copper Plate Earthing and Earthing Flats, etc. However, all the materials should be supplied and executed as per relevant IS Standard and IER.
- v) Design, Supply, Installation, testing and commissioning of Distribution Box at the Berths for providing shore power connection as per IER.
- vi) The design, manufacturer supply and testing of the various equipments and accessories covered in this specification shall comply as per relevant IS standards with latest amendments.
- vii) CEA's approval.

2.1. TECHNICAL SPECIFICATIONS:-

2.1.1 OUTDOOR TYPE PACKAGE SUBSTATION

Scope of work includes design, manufacture, supply, installation, testing and commissioning of package substation suitable for marine atmosphere.

The prefabricated package substation shall be designed for compactness, fast installation, maintenance free operation and maximum safety for operator / workers.

The package substation with all accessories, fittings and auxiliary equipment in an enclosure shall consist of:

- A) HT Panel
- B) 11 / 0.433 kV Dry type Resin Cast Transformer
- C) LT Panel
- D) APFC (Microprocessor Based) Capacitor Panel
- E) Frequency Converter
- F) Battery Charger

The panels shall be manufactured as per relevant latest IEC/IS standard and the design and operational features will comply with the provision of latest version of Indian Electricity Act, Indian Electricity Rules, Factory Act and Fire Insurance Regulation.

The specification covers technical and constructional details of outdoor type Package Substation Unit which shall be capable of performing satisfactorily in open atmosphere/heavy dust atmosphere with high relative humidity. The Package Substation Unit shall be compact in size, transportable, light weight rugged and of robust construction and capable to withstand rough use in highly humid areas and suitable for use in outdoor location. It shall be installed and overall dimension shall be kept to minimum as far as practicable.

The Package Substation Unit shall be manufactured as per Manufacturers standard.

Access to the operating bay and to the transformer shall be avoided with double doors. Doors shall be provided with pad locking arrangement. Internal lighting with door operated switch shall be provided for each compartment separately and safety notices shall be provided.

All enclosures / metal frames of package substation, HV switchgear, transformer, LT switchgear and capacitor panel are to be connected to the earth system. Continuity of the earth system shall be ensured taking into account the thermal and mechanical stress caused by the current it may have to carry. Highest degree of protection to equipment and persons shall be provided. Labels for warning and operating instructions etc. shall be provided.

All equipments and material shall be designed, manufactured and tested in accordance with latest IEC Standards. The high / low voltage prefabricated package substation shall comply with and tested as per IEC 61330/62271-202

The switchgear components shall be capable of withstanding mechanical and thermal stress of short circuit without any damages or deterioration of materials.

For continuous operation of specified ratings temperature rise of various switchgear components shall be limited to permissible values stipulated in the relevant standards/codes and this specification.

Earthing arrangement shall be provided for earthing of each cable, glands, neutral bus bar, chassis & framework of the cubicle with separate earthing terminals at two ends. Earthing Strip shall be of hot dip GI of size 50mmx6mm for Body & Neutral protected against corrosion and readily accessible. The strip shall be connected to earthing terminals with Stainless Steel nut – bolts. Separate Earthing for Body and Neutral shall be provided (Two each)

The Package Substation Unit will comprise of the following:

Incoming cable entry provision

SF6 encapsulated VCB for primary control of Transformer with over current short circuit and earth leakage protection.

Double wound outdoor copper wound dry type Resin Cast transformer

HT side of transformer to HT switchgear shall be connected with 11 kV XLPE cable of size suitable for short circuit current.

Switchboard with ACBs on LT side of Transformer

Weather proof sheet steel enclosure with skid base, provision for lifting arrangement.

Measuring instruments with CTs & PTs for HT and LT side.

Frame earthing arrangement, outgoing cable termination arrangement, indicating devices etc.

LT side of transformer to LT switchgear shall be connected with each other with suitably rated copper bus bar suitable for short circuit current.

Enclosure shall be IP: 23 for transformer compartment and IP: 54 for HT and LT switchgear compartments.

To avoid entry of rodent in the transformer compartment stainless steel mesh shall be provided from inner side of louvers.

Adequate ventilation shall be provided.

Current transformers shall be of dry type.

CSS Enclosure shall be type tested for 21 KA/ 1 Sec.

A. HT Panel

HT panel shall be modular design with 1 No. SF6 encapsulated Vacuum circuit breaker as out going mounting on a common under base with suitable cable entry box arrangement for XLPE cables. Necessary control Protection and metering circuits are completely assembled, wired and enclosed in a weather and dust proof cubicle. The equipment shall be suitable for outdoor installation in highly humid area. The input to HT side of Transformer shall be through 11 KV XLPE Cable.

The HT Panel shall be the integral part of the Package Substation Unit and shall be sheet steel enclosed, dust and vermin proof, suitable for outdoor use. This shall be suitable to receive power at 11 KV, 50 Hz, 3 phase AC with all equipment fittings and accessories for efficient and trouble free operation.

- a) 11KV, 630A SF6 encapsulated VCB The self-tripping mechanism with numerical relay with IDMT, over current, earth fault and Instantaneous protection including TVM and all others panel's indications lamps.
- b) 11KV / 110 V PT of suitable VA along with HRC Fuses.
- c) 11KV CTs of suitable ratio with suitable VA burden and accuracy class 1.0 for metering, 5P10 for protection conforming to IEC 60185.
- d) Incoming cable entry box shall be provided for the required cable entry.
- e) System rated voltage 11 kV
- f) System maximum voltage 12 kV
- g) Frequency 50Hz
- h) Insulation level
 - i) 1.2/50 microsecond Impulse withstand voltage 75 kV peak
 - ii) One minute power frequency withstand voltage 28 kV rms
- j) Rated current
 - i) Continuous
 - Bus bar 630 A
 - Incoming /outgoing circuit breaker 630 A

- ii) Short time current for 3 seconds 25 kA rms
- k) Circuit breaker
- i) Quantity incomer (Isolators): One
 - ii) Rated breaking capacity 21 KA / 3 Sec. Symmetrical.
 - iii) Rated making capacity 52.5 KA
 - iv) Total breaking time 7 cycles maximum
 - v) Operating sequence As per IS/IEC
- l) Potential transformers
- i) Quantity One set for HT outgoing
 - ii) Voltage ratio $11000/\sqrt{3} : 110/\sqrt{3} : 110/\sqrt{3}$
 - iii) Reference Standard As per IS-3156
 - iv) Over voltage factor As per IS-3156
 - v) Accuracy class 1.0
 - vi) Insulation Level 75 kV Peak / 28 KV rms
 - vii) Voltage Factor 1:2
 - viii) Rated Burden 100 VA
- m) Current Transformer
- i) For Relay 5P10/15 VA (Min)
 - ii) For Metering 1 / 15VA
 - iii) Insulation Level 75 kV Peak / 28 KV rms
 - iv) Insulation Class F
 - v) Reference Standards IS:2705
 - vi) Ratio 50/1/1A

The panel shall be provided with two earthing terminal , necessary inter-connection, control wiring and shall be complete with finishing paint etc. & conform to relevant IS.

SF6 encapsulated Vacuum Circuit Breaker variable setting ranges from 50–100 %. The neutral system comprising of housing of breaker, safety shutters, isolating plugs and socket and VCB trolley with 3 Nos. vacuum interrupters with safe aligning finger type, isolating contacts suitable for vertical isolation and horizontal draw out. VCB included 3 phase, 3 limb, draw out feeder connected PT.

- (i) Type of charging : Manual as well as motorized Mechanism with 230V AC Operated motor.
- (ii) One No. Shunt trip coil : 24V DC
- (iv) One No. closing coil : 24V DC
- (v) One No. busbar chamber with 630 A copper busbar, heat shrinkable PVC sleeved / powder coated with colour code. The current density 1.5 Amps/sq mm. The busbar shall be high conductive electrolyte copper.
- (vi) 2 Nos. 230 V AC space heater with ON-OFF switch and thermostat.
- (vii) 3 Nos. epoxy cast resin CTs with 15VA burden STR of 25 KA for 1 sec. metering accuracy class 1 and protection accuracy 5P10 and having of CTR 50 /1-1 for Incomer.
- (ix) The meters shall be single digital type of approved make like load manager and it consist of Amps, Volts, KVA, KW, KWHr, KVAR, PF, Frequency and etc.
- (x) One set of breaker ON-OFF LED indicating lamp.
- (xi) One No. trip circuit healthy indicating LED indicating lamp with push button.
- (xii) One No. Spring charged LED lamp indication.
- (xiii) One No. TNC (trip neutral close) switch.
- (xiv) 1 No. ARGUS1 numerical relays consist of IDMTL + Inst 3 O/C + Inst E/F relay.
1 No. VAX – 31 Trip circuit supervision.
1 No. GAJH – 23 master trip.
- (xv) 3 sets of operating handle, spring charging handle and other required accessories shall be supplied.
- (Xvi) One No. Cable Box suitable from receiving of 3CX185 Sq.mm H.T. XLPE Cables.
- (xvii) One No. panel illumination lamp.
- (xviii) Hooter for tripping.

All necessary protection fuses for the instruments and relays shall be provided separately inside the enclosures along with power pack arrangement of suitable capacity

The incomer Isolators shall be interlocked mechanically and VCB complete with necessary interconnection with fine wiring, feruled properly, Earthing, etc. The layout drawing dimensional drawings and electrical wiring diagram and operation maintenance manuals in duplicate shall be supplied with VCB. The VCB / ISOLATOR shall be supplied in conformity with relevant ISS & IEC with up to date amendments along with manufacturer's test certificate.

HT copper busbar shall have electrolytic grade of 600 Amps rating for three phases including color code and PVC sleeving. All the HT busbar shall be supported on hylem / epoxy insulators. The Bakelite sheet of 12 mm thickness (minimum) shall be provided in side enclosures of panel and wherever it is found necessary under relevant IS specification & IER-1956 rules.

B. Transformer

One No. of specified rating, double wound dry type Resin Cast transformer complete with all fittings and accessories. The input to the Transformer for specified KV shall be by means of XLPE cable and output of the Transformer for specified KV and output of the Transformer to the LT panel shall be by means of bus arrangement. A common under base on which the above HT cubicle, Transformer and LT panel are assembled and inter connection made as mentioned above. The under base shall be provided with steel base and fitted with lifting and haulage lugs.

The equipment covered by this specification shall, unless otherwise stated to be designed, constructed and tested in accordance with latest revisions of relevant Indian standards / IEC publications.

IS 1271	-	Classification of Insulating Materials.
IS 2026	-	Power transformers (part I - V)
IS 2099	-	Bushing for alternating voltages above 1000 V
IS 2705	-	Current transformers
IS 3202	-	Code of practice for climate proofing
IS 3639	-	Power transformer fittings and accessories
IS 4257	-	Porcelain bushings for transformers
IS 11171	-	Dry type Transformer
IS 8478	-	Application guide for tap-changers
IS 10028	-	Code of practice for selection, installation and maintenance of transformers.

The transformer shall be dry type Resin Cast only and of latest design.

The transformer shall be suitable for operation at full rated power on all tapings without exceeding the applicable temperature rise.

It shall be possible to operate the transformer satisfactorily, with the loading guide specified in IS-6600. There shall be no limitations imposed by bushings, tap changers, auxiliary equipment to meet this requirement.

The transformer shall be designed to be capable of with-standing, without injury, the thermal and mechanical effects of short-circuits between phases or between phase and earth at the terminals of any winding with full voltage applied across the other winding for periods given in relevant standards. There shall be no limitations imposed by any part/component of the transformer/off load tap links to meet the short circuit level Specified.

The transformer shall be designed for minimum no-load and load losses within the economic limit and shall be able to have minimum loss at the rated load condition.

All electrical connections and contacts shall be of ample cross sections for carrying the rated current without excessive heating.

The transformer shall be capable of continuous operation at full load rating.

The core-clamping frame shall be provided with lifting eyes having ample strength to lift the complete core and winding assembly.

Off circuit tapings shall be provided on the HV windings. Tap changing is done by means of off-circuit links accessible through openings provided (manual tap changer).

The lifting lugs and rollers shall be provided. A winding temperature scanner shall be provided and shall be actuated by means of resistance temperature detectors embedded in LV windings of all three phases. It shall have alarm and trip contacts at a specified temperature.

Windings shall be of electrolytic copper conductors (circular in shape) of high conductivity and 99.9% purity.

Windings shall be designed to withstand the specified thermal and dynamic short circuit stresses.

The windings shall be duly sectionalised. Accessible joints brazed or welded and finished smooth shall connect similar sections. No corona discharge shall result on the winding upon testing the transformer for induced voltage test as specified in IS.

The end turns of the high voltage windings shall have reinforced insulation to take care of the voltage surges likely to occur during switching or any other abnormal condition.

The high voltage and low voltage winding are shall be made of copper Conductors.

Output in KVA : 1000 KVA double copper wound.

Rated No load voltage ratio	:	11KV/433 Volts
No. of phase	:	03
Rated frequency	:	50 Hz
Connections	:	Primary – Delta Secondary – Star with Neutral
Vector Group	:	DYn11
Tapings on HV Side	:	±15% in steps of 2.5%
Type of Tap changer	:	Off circuit tap links on HV side.
Cooling	:	Naturally cooled (AN)
Termination	:	HT Side - Suitable for cable LT Side - Suitable for Bus bar
Fittings	:	2 Nos. earthing terminals, rating & diagram plate, bidirectional rollers, lifting lugs, winding temperature scanner.
Temp. Rise winding over ambient temp	:	90°C
Insulation Class	:	F
Percentage Impedance	:	5%
Paint	:	Enamel (Siemens Grey)
Transformer losses	:	Minimal Losses as per IS

C. LT Panel

LT switchgear panel shall complete in all respects with all equipment fittings and accessories including internal wiring for efficient and trouble free operation as required.

Air Circuit Breakers (ACB) shall be with fault level of 50 KA for 1 Sec., copper bus bar, spring charging operating mechanism, microprocessor based overload, short circuit and earth fault

protection releases with wide setting range, LED displays, alarm display for microprocessor fault, interlocking, etc. complete as required.

The LT Panel shall be the integral part of the Package substation Unit and suitable for outdoor use. This shall be suitable to receive power at 433 V, 50 c/s, 3 phase AC and restricted earth neutral system and comprising of the followings:

Incomer

Capacity: 1 NO. 1600A, 4P, 50 KA ACB with microprocessor based over current, short circuit and earth fault release, MFM, indicating lamps and ON/OFF push buttons.

Outgoing

Outgoing cable 3 runs of 1C x 1000sq.mm LT cable shall be connected to Distribution Box at the Berth.

All outgoing feeders shall have phase indicating led lamps and ***Multifunction Meter***.

D. 300 KVAR APFC Capacitor Panel:

The capacitor panel shall be an integral part of package substation.

The Capacitors control panel shall be of automatic switching type with facilities for manual control. The panel shall be a cubical type metal clad board equipped with Microprocessor based intelligence version APFC relay with 3 phase CT sensing, Switch Fuse Units with HRC fuses (feeder Control), Heavy duty contactors and metering equipment and controlling banks of capacitor mounted in ventilated compartments with IP:54 protection with bottom lowers. The switch units, contactors, etc. shall be selected to suit Capacitor ratings. The panel shall be capable of switching ON/ switching OFF capacitor bank in stages with on delay timer. The APFC relay provided in the panel shall be three phase sensing power factor on 433V bus and there upon switch ON/switch OFF.

The panel shall be freestanding and provided with separate compartments for incoming outgoing control switches and the capacitor banks. A continuous earth bar shall be provided to which the individual capacitor banks shall be connected. All main bus bar connection shall be of Aluminium. Panel shall be painted with Epoxy primer and Epoxy paint after an accepted metal treatment process.

The switching of capacitor bank by a re-strike free breaker shall not cause first peak of transient over voltage not to exceed $2\sqrt{2}$ times the applied voltage (rms) for maximum duration of 1/2 cycle and shall be suitable for performing 5000 switching operation/year under these conditions.

LT capacitor banks shall be provided on the LT buses in proposed sub-station to improve the power factor from 0.8 to 0.98 and above lagging.

LT Capacitor banks of suitable rating shall be provided directly at incoming side of incomer breakers for LT panel to compensate the reactive load of transformers and to maintain power factor above

0.98 even when no motor is in operation. Contractor shall furnish the calculation for suitability of capacitor bank.

The rated voltage of 3 phase capacitor bank shall be 433 V (Phase to Phase) and 230 V (Phase to Ground). The capacitor offered shall be non self-heating type, super heavy duty long life MPP type conforming to IS 2834 and IS 13585.

Capacitors banks are to be built up from individual single phase units suitably interconnected and housed in a metal enclosure to form a single 3 phase bank Capacitor. Capacitors having low Loss/KVAR shall be preferred.

Capacitors shall be suitable for operation at power frequency voltage level and for power frequency plus harmonics such that current does not exceed the values specified in clause 6.2 Annex C & E of IS 13585.

Capacitor modules shall be provided with in-built fuses to isolate individual faulty units from the total bank. Capacitors are also to be provided 0.2% series Reactor to limit the fault current or inrush current during switching operations along with ON delay timer on individual feeder.

Capacitors shall be provided with directly connected discharge device suitable to reduce the residual voltage from crest value of the rated voltage to 50 volts or less within 1 min after the same is disconnected from the supply.

For enabling the metal container to carry fault current in the event of breakdown of container, this container shall be provided with a connection capable of carrying the fault current.

Relay shall be suitable for operation at low load and current sensitivity shall be equivalent to 1%.

The capacitors shall be designed of suitable rating to provide for a gradual increase in KVAR ratings in steps upto 300kVAR.

Type tests certificate for similar type & rating of capacitors in accordance with IS 13585 shall be submitted by the successful Bidder.

The routine and acceptance test shall also be performed as per the relevant standards.

E. Frequency Convertor:

The frequency convertor shall be designed with 50 Hz for Coastal Ships and 60 Hz for Foreign Ships, make: ABB/Siemens/Schneider/L&T.

F. Battery charger:

Supply, Installation, Testing and commissioning of the battery charger unit with 2 Nos. 12 V with 2 Hrs back up with suitable rating Maintenance free battery. The battery charger shall be of floor mounting and air cooled type. The input supply of the unit shall be 230V / 250V. Single-phase AC 50HZ and the output supply of the unit shall be 24V DC. Suitable for tripping / closing / Indication.

TESTS:

- (i) Type test certificate for similar type & Rating of Compact Package Substation manufactured as per IEC 61330/62271-202.
- (ii) The Routine and Field test shall be arranged by the Contractor and carried out on Compact Package Substation as per latest relevant IEC / IS Standards in presence of Third Party Inspection Agency.
- (iii) The package sub-station shall be designed to meet the similar rating of type test.

3.0 RCC CABLE TRENCH

RCC cable trench of approx. length of 500 mtrs shall be constructed on the wharf of size 0.5M X 0.5 M including all civil materials and labour for laying of HT / LT cables from the substation.

4.0 SUPPLY AND LAYING OF 11 KV 3 X185 sq. mm XLPE H.T. CABLES

The cable measurements are tentative and may vary as per site condition. This includes supply and laying of H.T. 11KV, XLPE (E) 3C x 185 sq. mm. aluminium conductor armoured cable. The cables are to be laid as per IS: 1255 and as detailed under:

- (i) The cable shall be laid in the existing trench by opening the slab covers and re-closing the same with out damaging the slab after laying of the cable.
- (ii) The cable shall be laid Earth / concrete road cutting / concrete cutting / Rail way line of size 60 cm width x 90 cm depth to lay each run of the above cable covered with RCC trough and re-closing with excavated soil and make it original level. Required RCC Troughs shall be supplied by the Contractor. For road crossing / Rail way line crossing G.I pipe shall be provided and shall be supplied by the Contractor. The size of pipe shall not be less than 10 cm in diameter for each cable. The pipe shall be laid at an angle to avoid sharp cable bends at the point of entry and exit. A spare pipe of the same size shall simultaneously be laid for future augmentation / requirement.

5.0 H.T Cable Straight through joint:

H.T. straight jointing of cable shall be done with heat shrink jointing kits of approved make. All jointing accessories and other material shall confirm to IS Specifications wherever available. On both sides of joints a loop of sufficient length of 3 to 5 Mtrs shall be kept for future requirement.

This also includes housing of straight through joint in a R.C.C. chamber of adequate size and strength duly fitted with the pipe of suitable size at an entry and exit point of chamber to facilitate easy movement of cable. The chamber shall be covered with RCC slab of suitable thickness and strength.

The cable shall be provided with suitable identification indicator mark. The work includes all labour and material required and shall be done as required by E.I.C.

5.1 End termination of H.T. cables:

This includes providing and fixing end termination to HT 11 KV 3 C x 185 sq. mm. XLPE (E) aluminium conductor armored cable with heat shrink type termination kit with all accessories and other material conforming to relevant IS specification the additional length of cable shall be provided for loop of sufficient length (3 to 5 mtrs.) for future requirement before commencing and termination work. The work includes all labour and material required and shall be done as directed by E.I.C.

The work includes end termination of cables of HV & LV cable and termination with epoxy cable jointing kits & materials, lugs of all other accessories including labour etc.

The work includes all labour and material of approved make & shall be done as directed by E.I.C. The complete work shall be carried out as per standards of CEA.

All the tests shall be carried out as per relevant IS specifications and IER 1956 before charging the Transformer

After installation of Distribution Panel testing and commissioning shall be done as directed by Engineer in charge.

6.0 SUPPLY AND LAYING OF L.T. SINGLE CORE 1000 SQ MM UNDER GROUND CABLE:

The cable measurements are tentative and may vary as per site condition. Supply and laying of Aluminium XLPE L.T. under ground cable of 1.1KV voltage grade having stranded compacted aluminium conductor with, XLPE insulation, R,Y & B colour for phases and Black colour for Neutral core, extruded PVC inner sheathed, single layer of galvanized steel wire / strip armoured, over all PVC sheathed conforming to IS 7098 Part I 1985 with latest amendments with ISI mark.

Note: i) Test certificates from the manufacturers for the cable shall be submitted along with the supply of cable.

LT cable shall be laid from the Compact substation LT panel ACB to Distribution Box for providing shore supply at berth.

The end termination for 1100V grade under ground cables shall be of crimping type lugs shall be supplied by the contractor. The crimping type lugs shall be installed by highly skilled personnel.

7.0 DISTRIBUTION BOX:

The DB shall be of sheet metal enclosure with double door provision, hinge lockable, with provision of 1400A, 433V, suitable plug and socket for providing shore connection to ship. The enclosure shall be sand blasted, treated and powder coated with marine grade paint of 100 micron thickness.

8.0 SPECIFICATION OF SAFETY EQUIPMENTS:

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

8.1 Fire Extinguishers:

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

8.2 Fire buckets:

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

8.3 First aid chart and box:

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

8.4 Instruction for restoration of persons suffering from electric shock:

Instruction in English and Tamil for providing artificial respiration as per CEA regulations shall be supplied and affixed in a frame board at convenient location in the proposed 11KV substations.

Safety posters for vigilance against electrical accidents as per CEA regulations shall also be provided by the contractor.

8.5 Rubber mat:

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

8.6 Rubber gloves:

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

8.7 Caution board:

Required number of Danger board / sticker of H.T. Voltage in three languages English / Tamil / Hindi are to be provided on the panel. The firm shall obtain necessary approval of the drawing of HT panel from Ch.P.T. before fabrication.

8.8 Letter Painting

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

9.0 EARTH PITS AND EARTHING:

The earth system shall be designed and installed so as to meet the requirement of CEA. The value of resistance of earth system should not exceed value acceptable to the Central Electricity Authority.

The earth value shall be obtained accordance with relevant standards and the earth values shall be measured after installation in the presence of Trust Engineer.

All non current carrying parts with conducting surface such as power transformer, frame works of circuit breakers and medium / low voltage switch gears, instrument transformer cases, cable glands, cable supports, any steel works of the substation buildings should be efficiently grounded for the protection of equipments and operating personnel by connecting to the earth ring bus with two distinct and separate earth leads.

The earth connection shall be made of copper of adequate size and section of the conductor conforming to IS 3043 to safely carry the maximum fault current for a short period without burning the conductor and pass on the fault current is in excess of this, additional earth connections under fault condition and at no time the potential shall exceed 10 volts between the equipment and earth. The earth system shall be mechanically robust and joints shall be capable of retaining low resistance even after many passages of fault current. The G.I. flats of size 50x 6mm shall be interconnected of earth pits.

Interconnections and joints for earth conductors shall be riveted and soldered for retaining low resistance.

Each earth bar should be connected /to the main earth through a bolted removable link. All ground connections shall be compounded and braided.

The earth electrodes shall be driven to a depth of not less than 2.7 meters below the ground level and at least 3 meters away from the building and any other earth electrodes treating the soil surrounding the electrodes with the salt, coke and charcoal in accordance with IS 3043.

The internal diameter of the cast iron earth electrode shall not be less than 100mm. The thickness of the cast iron pipe shall not be less than 13mm. The electrode shall as far as practicable be embedded below permanent moisture level and placed without overlapping the resistance area of earth electrodes. Suitable size flange shall be provided to the cast iron pipe for connecting the earth leads.

A suitable brick cemented enclosure for neutral and body earth will be as per IE Rule (i.e) 450mm x 450mm with 125mm wall thickness. The depth of the masonry work will be not less than 600mm below the ground level and with suitable cover provided by the contractor enclosing the earth electrodes and shall be able to take up the load of lorries, etc., operating in that area. The top surface of the earth pit shall be in level with the finished surface level of the surrounding area.

4Nos. earth pits with 600x600x6mm copper plate for Compact substation and HT/LT panels.

10.0 CEA APPROVAL AND TESTING AND COMMISSIONING:-

The contractor shall arrange for obtaining CEA approval and the Trust will not pay for the inspection charges. It is the responsibility of the contractor to carry out the works in accordance with the requirements of CEA. Any modification and corrections suggested by CEA on inspection shall also be complied by the contractor.

11.0 LIST OF APPROVED MAKES

S.No.	ITEM	Name of Manufacturers
1	Volt meter and Ammeter	AE / MECO / YOKINS / NIPPEN
2	Selector switches, Push buttons Emergency Switches	KAYCEE / L & T / GE / BCH / LEGRAND
3	HRC Fuses	L & T / GE / SIEMENS / ABB / INDO KOPP
4	Indicating light	AE / KAYCEE / VAISHNAV / L & T / SIEMENS
5	MCB	L & T / LEGRAND / SIEMENS / ABB / SCHNEIDER
6	Sub Distribution Board	L & T / LEGRAND / SIEMENS / SCHNEIDER / HENSEL
7	EL MCB	L & T / SCHNEIDER / LEGRAND / SIEMENS / ABB
8	FRLS PVC insulated copper conductor single/multi core stranded wires of 650/1100 volt grade	HAVELLS / FINOLEX / RPG / UNIFLEX / NICCO /RR Kables
9	Steel Conduit/PVC Conduit	BEC / AKG / NIC

S.No.	ITEM	Name of Manufacturers
10	Switches, TV & Telephone Socket outlets, Boxes	MK / CLIPSAL / LEGRAND / NORTH WEST /ANCHOR
11	Light Fixtures	PHILIPS / BAJAJ / WIPRO / CROMPTON
12	Lamps and Tubes	PHILIPS / WIPRO / BAJAJ / CROMPTON
13	Ceiling fans/Wall bracket fans / Exhaust Fans	HAVELLS / CROMPTON GREAVES / USHA / ORIENTAL
14	Cable lug & Cable Gland	DOWELLS / JHONSON / RAYCHEM
15	Terminal Blocks	WAGO & CONTROLS / PHOENIX CONTACTS / OBO BETTERMANN
16	Multi-function Meter	ABB / SIEMENS / L&T / HPL SOCOMEK/CONZERVE (ENERCON)
17	DWC HDPE Pipe	DURA LINE / CARLON / EMTELLE
18	Contactors	L&T / SCHNEIDER / SIEMENS/ABB / BCH
19	MCCB	L&T / SIEMENS / SCHNEIDER / ABB
20	VCB / SF6/ Isolator	SIEMENS / AREVA / ABB / SCHNEIDER
21	Push Buttons	SIEMENS / ABB / TELEMECANIQUE / L&T / SCHNEIDER
22	Relays	L&T / ABB / SIEMENS / SCHNEIDER/AREVA
23	Timers	L&T / SIEMENS / TELEMECANIQUE/ABB
24	Indicating Light	L&T / SIEMENS / TELEMECANIQUE / ABB / GE
25	Indicating Instruments	AE / MECO / CONZERVE / L&T
26	HT Cable	FINOLEX / RPG / UNIFLEX / TORRENT / HAVELLS / UNISTAR /NICCO
27	LT Cable (XLPE and FRLS)	UNISTAR / FINOLEX/ NICCO / HAVELLS / RPG / UNIFLEX
28	Termination Kit	BIRLA 3M / RAYCHEM /DENSON

S.No.	ITEM	Name of Manufacturers
29	CTs	L&T / AREVA / JYOTI / KAPPA / PRAGATHI
30	PTs	AREVA / KAPPA / PRAGATHI
31	HT Panels	SIEMENS / SCHNEIDER / ABB / AREVA
32	LT Panels	SIEMENS / L&T / SCHNEIDER / ABB
33	Cable Trays (FRP)	LEGRAND / ERCON / NEEDO / SUMMIP
34	ACB	SCHNEIDER / SIEMENS / ABB / L&T
35	Selector Switch	KAYCEE / L&T / SIEMENS / BCH / GE / SALZAR
36	Capacitor Banks	EPCOS / L&T / SCHNEIDER
37	Trivector Meter (Digital)	L&T / SCHNEIDER / SIEMENS / HPL SOCOMEK
38	Capacitor Panels	ABB / L&T / EPCOS / SCHNEIDER
39	Power Factor Correction Relay	EPCOS / L & T / ABB
40	Elastomeric Mat	PREMIER POLYFILM LTD / POLYELECTROSAFE / CHALLENGER
41	MS & GI Conduits Accessories	STEEL MARK / NIC
42	Transformer	ABB / SCHNEIDER / SIEMENS
43	Compact substation	ABB / SCHNEIDER / SIEMENS
44	Items not covered above	As per samples approved

12.0 DRAWING LIST

All catalogues, technical drawings, details etc., for all the proposed Compact substation, H.T. & L.T. panels with operation and maintenance manuals with spares list shall be furnished.