



TECHNICAL SPECIFICATION		SPECIFICATION NO. PROJ-ELEC/C&I-TS-MSSS-0007
		REVNO:00
PRODUCT	11KV/433V MOBILE-SKID MOUNTED SUBSTATION	DATE:24/04/2008
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11KV/433V-MOBILE SKID MOUNTED SUBSTATION

GENERAL:

The Skid mounted substation shall be of modular construction housed in a single enclosure consisting of HT control Panel with Two numbers Load break switch one incomer and one outgoing for the part of ring main supply system (Loop in & Loop out system), one number VCB and all other metering and protection, one No 11kV/415V Dry type Transformer and LT distribution Board etc. as detailed in the enclosed specification with all protections like over current, earth fault and under voltage etc.

The Substation should be suitable for outdoor application, compact and easily transportable and installation. The Substation shall have minimum maintenance requirement with no accidental access to live parts and fully comply with all statutory requirements.

The Skid mounted substation shall be fully compartmentalized. The Skid mounted substation shall be suitable for bottom cable entry.

The Skid mounted substation shall be Metal clad housing fabricated out of CRCA sheet steel of min. 3mm thick for outer enclosure and 2mm for the rest. Substation shall have suitable mechanical strength for lifting.

All sheet Metal components shall undergo rigorous seven tank process (degreasing, de-rusting, phosphating and sealing). Painting shall be of epoxy powder coating to shade RAL 7032 (Siemens Grey).

Selection of HT / LT Board and Transformer components rating shall be as per enclosed specifications.

System Requirements:

1. System HT : 11kV, 3phase, 3wire, 50Hz. 350MVA.
2. System LT : 433V, 3phase. 4wire. 50Hz. 35MVA.
3. Installation : Outdoor.
4. Transformer : 500 KVA rating
5. Busbar : Epoxy encapsulated copper busbar shall be provided. Epoxy

Seal off bushings shall be used between compartments.

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DETAILS OF EQUIPMENTS:

I. HT SWITCHGEAR

1.0 General

- i) The switch gear shall be part of compact substation and which in turn is part of ring main supply system of 11kV, 3 phase, 50HZ solidly earthed neutral system. Highest system voltage will be 12kv.
- ii) The switch gear section shall have provision for one incomer and one outgoing to be part of ring main.
- ii) Specification and other particulars of the switch gear are broadly categorized under the following heads.
 - a) Cubicle with busbars, relay, instruments, earthing device etc.
 - b) Vacuum Circuit breaker.
 - c) Load break switch (TWO Nos)
 - d) Instrument transformer (PTs, CTs)
 - e) Panel lighting

2.0

Cubicle

2.1

Construction

- i) The switch gear along with the load break switch shall be one section of the compact substation and all the components of the switch gear section shall be accessible for easy maintenance.
- ii) Sheet steel shall be of minimum 2mm thickness for partition between sections and 3mm for hinged front and bolted rear doors.
- iii) Electrical continuity between all metal parts not alive and the earth terminals of the unit shall be ensured.
- iv) Insulated partition shall be provided for Busbars, CTs, PTs, outgoing cables & circuit breaker and relay and controls. Tinned copper busbars with suitable heat shrink sleeves shall be provided. Wire mesh shall be

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provided wherever necessary to prevent inadvertent touching of busbars.

- v) Hinged doors shall be provided for accessing the switchgear section. Three point locking arrangement with single operating handle shall be provided for all hinged doors. Hinge locks, lock covers etc., shall be fabricated from anti-corrosive material. The hinges shall be sturdy and robust. The doors shall be provided with additional members for strengthening to avoid any warping (or) bending.
- vi) Cubicles will be exposed to high winds, dust and rain. Neoprene gaskets of high quality shall be used. The top cover of kiosk shall have necessary slope to avoid stagnation of rain water.
- vii) Base frame shall be of sufficient thickness and tar painted to give corrosion resistance even if water accumulation is there.
- viii) All mechanical indications of breaker / LBS position, operation shall be visible from outside. Suitable transparent cover shall be provided on the front door of compact unit.
- ix) Emergency push button shall be accessible from outside.
- x) Safety shutters to cover live part to prevent accidental contact, and explosion vents to release the gases during fault occurrences shall be provided.
- xi) Lifting lugs, base frame of adequate thickness, foundation bolts of min. 19mm dia with suitable washers shall be provided. Lifting guides shall be provided at the top to prevent touching of wire ropes with body of unit while lifting the compact substation.

2.2 Cable termination:

- i) Both incoming and outgoing cables of the compact Substation are with bottom entry. Cable terminations shall be made with the sealing kits of specified type.
- ii) Blank G.I. plates gasketed and bolted to the cubicle for glanding and terminating control and power cables shall be provided.
- iii) Double compression type brass cable glands shall be used. Tinned heavy duty copper lugs shall be supplied for all cables. Adequate space shall be provided for splicing and termination of cable. The

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cable shall be secured properly in the compact Substation with suitable support.

2.3 Relays

- i) All relays specified shall be flush mounted in dust proof cases and shall match the appearance of the instruments mounted on the same panel. Each relay shall be identified with relay number indicated in the approved control scheme.
- ii) Protective relays shall be of easy with drawable type. Trip circuits shall be automatically broken and current transformer secondary circuits shorted, when a relay is withdrawn from its case. A marking strip shall be provided in front of each terminal block and diagram plate at the back of each case to identify connections.
- iii) Relay contacts shall withstand repeated operation and shall make or break the maximum currents in their circuit without deteriorating. All spare contacts shall also be wired upto the external terminals.
- iv) Relay coils shall carry their normal currents indefinitely and such currents as can occur under fault conditions. Relay mechanism shall not be affected by vibration or external magnetic fields, which may occur in normal operation.
- v) All relays in tripping circuits shall have mechanically operated flag indicators. Indicators, mechanical or electrical, shall also be provided on other relays to identify type of fault that may have occurred. Indicators shall be capable of being reset without opening the relay case. It shall not be possible to operate the relay by hand or to alter its setting, without opening the case. All relays shall operate satisfactorily from 70 to 110% of rated voltage.

2.4 Indicating Instruments

- i) All indicating instruments shall conform to IS 1248 and integrating meters to IS 722.
- ii) Indicating instruments shall be of size 96 x 96 mm and shall conform to 1.0 accuracy class. Meters shall be suitable to PT secondary of 110V (line) and CT secondary of 5A. Scales shall be suitably provided depending on the ratio of instrument transformer. All indicating instruments shall have non-reflecting bezels, clearly divided and legibly marked scales and sharply outline pointers. They shall be provided

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with zero adjusting devices for external operation. Indicating instruments shall be taut band type.

- iii) One no. static type, class 0.5 accuracy energy meters shall be provided (as shown in the single line Diagram).

2.5 Control Circuits

- i) Control switches shall be suitable for use in AC circuits upto 440V and rating of 5A.
- ii) All incoming control and power circuits shall be fed through isolating ON/OFF rotary switch and HRC fuses with insulating base and holder. Closing circuit, tripping and control circuit, lamp circuit shall be segregated and protected by independent fuses.

2.6 Control wiring and ferrules

- i) All wiring shall be carried out with 1100 volts grade core wires having multistrand copper conductor. All control circuit shall be with copper conductor having a minimum cross-sectional area of 1.5 sq.mm per core and CT circuit shall be 2.5 sq.mm copper conductors. The wire shall be insulated with PVC.
- ii) All control wiring shall be terminated using eye type tinned copper lugs on to the stud type terminals. More than two wires shall not be terminated onto a single terminal.
- iii) All holes or tubes for wiring runs shall be bushed and shall have room for reasonable future additions. All cable runs shall clear injurious gases and heat emitted by control gear operation or shall be adequately protected from them.
- iv) Control cables when laid in HT busbar chamber, cable shall be taken through conduits. No joints or tees shall be made in wires between terminals. The wire shall be identified by numbered ferrules at each end, all in accordance with the connection diagram, equipotential terminals shall have the same ferrule numbers.
- v) All ferrules shall be made of non-deteriorating materials. They shall be white except in case of warning ferrules, which shall be red. Ring type ferrules shall have the character engraved on it. The ferrules shall be firmly located in each wire so that they cannot move freely on the wire. Wiring across hinges shall be by flexible wires.

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- vi) The colour code for control wiring shall be as enumerated below:
- a) Metering circuits – Black
 - b) Closing, tripping, protection relays and main power supply circuits – Red.
 - c) Annunciation and indication circuits – White.

2.7 Inscription

- i) Each unit and each component shall be clearly labeled to indicate its purpose.
- ii) Owner's nameplates at front and back of each cubicle shall be engraved on white back ground with black lettering of 10mm size
- iii) Each component label shall include the component symbol shown on the connection or schematic diagram.
- iv) All components mounted inside the cubicle shall be provided with screwed inscription plate.
- v) The characters to be engraved on the cubicle labels shall be furnished at later stage.

2.8 Earthing

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

2.9 Paintings

The switch gear unit cubicle shall be furnished with colour code to be indicated at the time of drawing approval conforming to IS 5-1961 latest. The sheet metal parts shall be subjected to following pre-treatment before final painting.

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- a) Degreasing
- b) Pickling for complete rust removal
- c) Phosphating
- d) Corrosion resistant primer painting. Two final coats spray painting shall be given.
- e) The cubicle shall be painted with colours as follows:-
Internal – Glossy white

2.10 Space heater

Space heater with isolating switch fuse unit shall be provided for each cubicle.

2.11 Testing & commissioning

Routine tests as per relevant IS standards to be conducted at works & site and test certificates shall be furnished. Type test certificates for identical equipment shall be provided.

2.12 Drawing

The following drawings shall be submitted for approval. Copies of approved drawings along with reproducible and soft copies in CDs shall be furnished at the time of supply of equipment. As built drawings incorporating site modifications along with reproducible and soft copies in CDs shall be furnished.

- a) Dimensional GA drawing of switchgear indicating foundation details, cable gland plate location for each cable plan and elevation of switchboard.
- b) Cross sectional drawing of cubicle busbars CTs, cable breaker LV chambers and indicating all electrical clearances between busbars and earth.
- c) Front view of the switchboard indicating arrangement of relays, controls operating heights.
- d) Control schemes of each feeder / breaker with components specification.
- e) Terminal plan and internal wiring drawings of all the cubicles

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f) Inter panel wiring drawings.

3.0 Circuit Breaker

- i) The circuit breaker shall be three pole vacuum circuit breaker with spring charged operating mechanism. Plug in isolating contacts and 4 NO+4NC auxiliary contacts all mounted on a withdrawable carriage.
- ii) The air clearance between phases and between phase to earth at the breaker incoming and outgoing terminals shall not be less than those indicated in the IS/IEC/British standards, corresponding to the basic insulation level of the circuit breaker as indicated in the criteria.
- iii) The temperature rise of the breaker contacts / terminals while carrying the rated continuously or the rated short circuit current of rated duration shall not exceed 40 deg C. Over ambient of 50 deg C. Further to minimize burning and pitting of contacts all parts exposed to the arc created by current interruption shall be protected by special arc resistance material.
- iv) The circuit breaker shall be designed such that the peak short circuit current (i.e. 2.5 times the RMS short circuit current) specified can be interrupted without causing appreciable damage to main contacts.
- v) The arc extinguishing chambers and the contact assembly shall be enclosed in an insulating tube made of FRP/tough glass/ ceramic or other suitable arc resistant material with sufficient strength to withstand the internal pressure / forces developed while clearing rated short circuit current.
- vi) Surge Arrestor shall be provided wherever necessary.
- vii) 110V DC for operation of the Circuit Breaker and protection relays shall be taken from power pack (110V DC). This is to ensure te operation of breaker in case of power supply failure. (2 open and 2 close operations).

3.1. Operating Mechanism

- i) Circuit breakers shall be provided with spring charged, manual & electrical independent closing and shunt trip and series trip for opening.

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- i) Trip coil shall operate satisfactory between 70% and 110% of rated voltage.
- ii) The closing and tripping circuits shall be self opening on completion of their respective functions irrespective of position of the breaker ON/OFF switch.
- iii) A readily identifiable mechanical emergency trip device as well as provision for manual charging of springs through the cubicle door shall be provided for each breaker.
- iv) In case of circuit breakers with more than one operating spring, they shall be so interlocked such that the springs are charged to the same extent and the breaker can be closed only if all the springs are charged to the required values. Further in case of multiple pole / phase breakers equal current sharing between poles shall be ensured by means of current balance schemes.
- v) In order to ensure the reliability and long operating life for the mechanism, the mechanism shall be light, with a high mechanical strength and abrasion resistance to avoid high rate of wear and tear and with few components. The number of components in the breaker and operating mechanism shall be kept to a minimum and they shall be designed to be free of undue stresses during normal or short circuit operations. Further they shall ensure a high frequency of operations indicated in technical particulars. All the moving parts of the mechanism requiring inspection, maintenance and lubrication shall be easily accessible.
- vi) Operation counter shall be provided on the breaker for recording number of ON/OFF operations.
- vii) A visual ON/OFF indication and SPRING CHARGED indication shall be provided positively coupled to the operating mechanism and visible from front with the cubicle door closed. Indications shall be provided for limit switches for spring charged and discharged condition. The Mechanism shall be TRIP FREE as per IEC.
- viii) The life of the operating mechanism shall not be less than 30,000 operations.
- ix) It shall not be possible to open the doors without opening the Circuit Breaker.

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3.2 Auxiliary Contacts

- i) Each circuit breaker shall have 4NO+4NC of auxiliary contacts to control circuit changes for indication, protection, interlocking, Supervision, Metering and others.
- ii) Breaker auxiliary contacts available in test and service position and those available in service position only shall be clearly indicated.
- iii) Normally open and normally closed contacts shall be interchangeable at site.
- iv) All auxiliary contacts shall be positively operated by the main apparatus and all contacts shall be adequate to make, carry and interrupt the currents in their circuits.

3.3 Emergency push button to trip the VCB shall be provided inside a weather proof box on the outer side wall of the compact Substation. An Auxiliary terminal box shall house the terminal blocks to receive the following external inputs from

- a) Winding temperature indicator / alarm
- b) 240V, single phase, 50Hz supply for panel and SI Illumination.
- c) Separate terminal blocks shall be provided for control and power.

The auxiliary terminal box shall have IP55 protection on the outside wall of compact Substation.

4.0 11kV Load break Switch

4.1 General

HT load break switches are intended to connect / disconnect from the 11kV ring main system.

4.2 Rating

The load break switch shall be fault make, load break type. The load break switch shall have rated current, fault making capacity, short time thermal rating, dynamic through fault withstand capability as specified in the design criteria without HRC fuses in the circuit.

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4.3 Type of Load Break Switch

Load break switch shall be air break type in fixed design.

4.4 Operating Mechanism

The load switch shall have quick make, quick break independent manual operating mechanism with mechanical ON/OFF indication.

4.5 Interlocks

It shall not be possible to open the door with load break switch on.

4.6 Auxiliary Contacts

4 NO + 4 NC auxiliary contacts rated to make and break 5A at 110V AC shall be provided.

5.0 Instrument Transformer

5.1 Current Transformer (CT)

- (i) Separate cores shall be used for metering and protection.
- (i) All current transformers shall be designed to have over current factors to withstand the fault currents of the associated system as applicable to the switchboard.
- (ii) Current transformer used for protection shall an accuracy limit factor not less than 15. Those used for metering shall have a saturation factor of 2.

All current transformers shall have 5 Amp. Secondaries and shall be of resin cast with bar primary.
Polarity of primary and secondaries of all the CTs shall be clearly marked.

5.2 Voltage Transformer (PT)

- (ii) Voltage transformer shall be built up of CRGO electrical steel. The voltage transformers shall be resin cast dry type. The PTs shall be 3 nos. of single – phase type of suitable ratio and burden.

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- (iii) HT side and LT side of PTs shall be protected by HRC fuses. LT terminals shall be terminated on separate power terminal block located in the same panel.
- (iv) Control supply 110V AC shall be derived from 11KV Bus PT for the following purpose.
- ON,OFF & Auto trip LED Indications for 11 KV VCB.
 - ON,OFF & Auto trip LED Indications for 0.4 KV ACB.
 - Working supply for 4 element relay meant for Transformer protection.
 - Input source for 110V DC Power pack. 110V DC for operation of the Circuit Breaker and protection relays shall be taken from power pack (110V DC). This is to ensure te operation of breaker in case of power supply failure. (2 open and 2 close operations).
 - PT signal to the static Energy meter (only in the case of 11 KV entry point kiosks) 11KV Bus PT burden shall be suitably designed to cater the above needs also.

6.0 Selector Switches:

- The rating and other features of the switches shall be suitable for the application. The number of positions and the number of contacts required for each switch shall be as indicated in the schemes enclosed.
- Selector switches shall be stay put type, provided with properly designated escutcheon plates clearly marked to show operating position.
- Terminals carrying potential above 120V shall be shrouded to prevent accidental contact with personnel.
- Ammeter selector switches shall have make before break contacts.
- The switches shall be suitable for semi-flush mounting with the front plate and operating handle projecting out. All connections to the switches shall be from the back.

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- vi) The arrangement for front mounting of these devices shall be such as to make them reasonably dust free so as not to interfere with normal operation.

7.0 Indicating Lamps:

- i) Indication lamps shall be complete with lens covers and holders.
- ii) Each lamp shall be fitted with a durable resistance integrally wired in series within the lamp. Alternatively, lamps with built in transformers are acceptable.
- iii) The lamp cover (lens) shall be translucent of red colour.
- iv) Bulbs and covers shall be interchangeable, easily replaceable from the front without the need for any special means.
- v) Terminals having potential above 120V shall be shrouded to prevent contact with personnel.

8.0 Terminals:

- i) Terminals shall be stud type of copper material.
- ii) Terminals shall be provided with transparent cover(s).
- iii) Separate terminals shall be available for each termination of loop-in and loop-out power connections.
- iv) Terminals shall be suitable for ring type copper cable lugs of size depending upon the circuit rating.

9.0 Labelling:

- i) Labels to identify all the main assemblies, sub-assemblies and components of the Kiosk shall be provided.
- ii) Name and rating plate/markings shall be provided as required by relevant standard applicable to each component/assembly to be identified
- iii) Labels shall be of two colour, three layer plastic material with matt or semi matt finish or of the anodized Aluminium sheet.
- iv) All labels other than "danger" or "warning" labels shall have black lettering on a white background. Danger label shall be as per applicable standard and shall not be fixed on to removable parts.

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v) All labels shall be securely fixed on to the equipment by means of self-tapping screws or other approved means.

vi) Stick-on type labels of good quality and permanent mounting shall be acceptable for internally mounted components only.

10.0 Surface Treatment:

- i) All metal parts and the surfaces (exterior & interior) of equipment, unless stated otherwise in case of reflectors, shall be degreased by dipping in hot alkaline solution and rubbed with wire brush to remove oil & scale from them & then rinsed in water. Alternatively, they may be shot/sand blasted.
- ii) Parts shall be pickled by dipping in hydrochloric acid tank to remove the rust from the surfaces formed during storage of sheets & then rinsed to remove traces of the acid. The cleaning and pre treatment of all metal parts shall be as per applicable standards.
- iii) All parts shall then be subjected to a coat of red oxide primer paint.
- iv) All inside and outside surfaces of panel shall be spray painted with synthetic enamel of the shade.
- v) The surfaces to be painted shall then be prepared by phosphatizing to protect them from further rusting & to create a good bond with the paint. The pretreatment shall conform to the applicable standard.
- vi) Paint thickness shall be as per applicable standard.
- vii) Electrostatic or powder painting shall be acceptable subject to purchaser's approval.
- viii) Wherever possible, finished parts shall be coated with peelable compound by spraying method to protect the finished product from scratches, grease, dirty and oily spots during handling and transportation.

11.0 Additional Requirements:

1. 1 No emergency trip push button (mechanical).
2. Mimic: A single line diagram showing the direction of power flow shall be drawn on the front of load break switch. The mechanical operation of switch shall

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automatically indicate ON/OFF status of both main switch as well as the earth switch in the mimic diagram.

3. 1 set of epoxy encapsulated copper busbar interconnection arrangement for transformer.
4. Fluorescent lamps for sufficient illumination shall be provided and for that power supply shall be provided from LT side of Substation.
5. DC Fluorescent lamps for emergency lighting shall be provided.

12.0 TECHNICAL REQUIREMENTS:

1.0 11 KV SWITCHGEAR SECTION

- i) Thickness of sheet steel :
- a) Partitions between panels : 2mm sheet steel
- b) Front and rear hinged doors and top covers sides and bottom : 3mm sheet steel
- ii) Rated voltage : 3 Phase, 12 KV, 50 Hz
- iii) Continuous rated current at 50 deg C : 1000 A
- iv) Short circuit withstand Capability to switchboard Including busbars :
- a) Short time rating : 18.4 KA (RMS) for 3 secs.
- b) Dynamic rating : 47 KA peak
- v) Busbars :
- a) Materials of busbars & rating : Copper, 1000 A for phase, Size of dropper Shall be same as main bus bars.
- b) Temperature rise of busbars at rated current over 50 deg C ambient : 40 deg C

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- c) Busbar chamber partition : Cast resin bushings to be provided
- d) Busbar joints : 1. Cadmium plated bolts and tinned surfaces.
2. Flexible connection if required
- e) Insulation : 1.1 KV PVC sleeved
- f) Phase identification : Colour tapes
- g) Support insulators : Non-hygroscopic, non-tracking, resin cast insulators.
- vi) Insulation level
- a) Impulse withstand value : 75 KV (P)
- b) 1 min. PF withstand value : 28 KV (RMS)
- vii) Auxiliary connections : Silver plated, 16A plug and socket
- viii) Safety shutters : Automatically operated shutters
- ix) Accessories with each cubicle
- a) HT section illumination lamp with Switch : To be provided
- b) Space heater : 230V, AC, 50 Hz heater with control switch
- c) 3 Pin power socket with switch : to be provided
- d) Base channel : Base channel of minimum 100 x 50 mm with cross bracings and 19mm foundation bolts.
- e) Name plates, inscription plates for components, switches feeder identification : As specified

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