

SECTION: 2.7

M V SWITCHGEAR

1.0 **Scope**

1.1 The scope of work shall cover the supply, installation, testing and commissioning of all power panels, incorporating circuit breakers, switch fuses, busbars, interconnections, earthing etc.

2.0 **Standards**

2.1 The following standards and rules shall be applicable:

- 1) IS:13947:1993 Switchgear & Control gear specification
- 2) IS:8623:1993 Low Voltage Switchgear and Control gear Parts 1 & 3 assemblies.
- 3) Indian Electricity Act and Rules

All codes and standards mean the latest. Where not specified otherwise the installation shall generally follow the applicable Codes of Practices of the Bureau of Indian Standards.

3.0 **Air Circuit Breakers**

3.1 Air circuit breakers shall be heavyduty air break horizontal draw out fully interlocked and meeting the requirements of Indian Standards. Breakers shall be rated for a medium voltage of 600V and rated full load amperes as indicated on drawings. Breakers shall be capable of making and breaking system short circuits specified.

3.1.1.1 Breakers shall be, motorised or manually operated as specified, complete with front-of-the-panel operating handle, isolating plugs with safety shutters, mechanical ON/OFF indicator, silver plated arcing and main contacts, arc chutes and trip free operation. Breakers shall be capable of being racked out into 'testing', 'Isolator' and 'Maintenance' position and kept locked in any position. Breakers for remote and automatic operation shall be motor operated spring charged with closing and trip coils. Breakers shall have minimum 3 NO-NC contacts. Breaker terminals shall be shrouded.

3.3 **Construction:**

- 1) ACB should be with safety shutter, Anti-pumping and rating error preventer.
- 2) Cradle: Should be service, test, isolate & maintenance positions
Racking handle should be stored in cradle.
Electrical breaker should not close during travel from service and test position and vice versa.
- 3) Inter-phase clearance should be more than 25 mm after termination of bus bar.
- 4) Neutral pole rating should be equal to phase rating unless specified otherwise
- 5) Electrical /Mechanical life: 15000 Cycles up to 2500A and 5000 cycle above 3200A.

3.4 **Release:**

- 1) All releases in ACB should be communicable microprocessor Based and having over load, short circuit and earth fault protection.
- 2) Release should be operated through magnetic fluxing device direct on trip rod.
- 3) Release should be True RMS, self powered using CT.
- 4) Release should have zone selectivity facility.

3.5 **Breaking:**

- 1) As per SLD $ICU=100\%ICS=ICW$ for 1 sec
- 2) Breaking capacity should be tested by CPRI/ERDA and reputed international authority. (Type test certificates not older than 3 year shall be provided when asked.)

4.0 **MCCB's**

4.1.1 Construction

- 1) MCCB should be current limiting type, and of trip free mechanism.
- 2) MCCB operated with rotary handle having door interlock facility.
- 3) All accessories like Shunt release, UV release, Aux & trip contacts should be site fittable.
- 4) Phase to phase barrier should be provided with MCCB.
- 5)

4.2 **Breaking:**

- 1) As per SLD $ICU=100\% ICS$.
- 2) Breaking capacity should be tested by CPRI/ERDA and reputed international authority. (Type test certificates not older than 3 year shall be provided when asked.)

4.3 **Release:**

- 1) Ratings equal and above 200Amp. should be Microprocessor based with over load ,short circuit ,earth fault protections
- 2) Ratings less then 200A should be adjustable thermal and magnetic type.

5.0 **Switch Fuse Units & Disconnectes**

- 5.1 Switch fuse units shall have quick-make, quick-break silver plated preferably double break contacts with operating mechanism suitable for rotary operation in the case of cubicle mounting. All switches shall be rated according to the equipment schedule or drawings and shall withstand the system prospective fault current let through.

Cam operated rotary switches with adequate terminal adaptors upto 25A are acceptable but for all higher rating switch fuse units shall be heavy duty type. All switch fuse unit should be AC23A.

- 5.2 Fuses shall be HRC cartridge type conforming to IS:2208 with a breaking capacity corresponding to system fault level. Fuses shall be link type with visible indication. Screw type diazed fuses are not acceptable for any ratings.

- 5.3 All disconnecting isolators shall consist of switch units quick-make, quick-break type with silver plated contacts. The switches shall preferably have double breaks. The switches shall have sheet steel enclosure, which in turn is mounted on suitable angle iron frame work. In wet locations switches shall have cast iron enclosures. Disconnects shall have a minimum breaking capacity of 5KA at 415 Volts.

6.0 **Isolators**

- 6.1 Isolators shall be fixed on wall on self-supported angle iron frame work as required and mounted as near to the motor as possible. Where several motors are installed, isolators if required shall be provided at a central location on a common frame work.

- 6.2 Painting, earthing and labels shall be provided as generally indicating for MV Switchgear and shown on drawings.

7.0 **Instrument Transformers, Meters & Relays**

- 7.1 Ammeters and voltmeters shall be electronic digital type. Meters shall conform to BS:89 and have grade 'A' accuracy.

- 7.2 Energy meters shall be electronic two element switch board mounting type suitable for unbalanced loads. In case of two incoming feeders, a summating C.T shall be provided with the meter. Meters shall conform to IS: 37.
- 7.3 The energy meters for grid supply and DG supply shall be calibrated and got certified by the respective Electricity Authority wherever required.
- 7.4 CTS shall be cast resin type and conform to IS:2705 in all respects. Rated secondary current shall be 5A unless otherwise stated. Accuracy class of metering CT's shall be 1.0 & for protection 5P20 or as specified in the datasheets.
Test links to be provided in secondary connection to facilitate testing of instruments, meters & protection device. CT burden shall be minimum of 10VA but appropriate to the instruments, relays connected or as specified in the datasheets.
- 7.5 Relays and trip devices shall be any one of the following as specified:
- i) Adjustable Thermal – Magnetic trips – direct acting
 - ii) Solid state relays with shunt tripping.
 - iii) Microprocessor controlled relays numerical type with shunt Tripping.
- All trips shall be 400/230V AC series type unless shunt tripping is specified for.
- 7.6 LED indicating lamps to be provided for phase indication & breaker position as required.
- 7.7 All wiring for relays shall be of stranded copper with colour coding and labelled with appropriate plastic tags for identification.
Minimum size of control wiring shall be 2.5 sqmm stranded copper. All control circuits to be provided with protective MCB's or fuses consistent with short circuit levels.

8.0 **Cubicle Boards**

- 8.1 All boards shall be combination of 14 SWG (Main Body) & 16 SWG (Doors & partitions) sheet steel, free standing, extensible, totally enclosed, dust tight, vermin-proof cubicle as per IP 52, flush dead front and of modular construction suitable for 3 phase 415V 4 wire 50 Hertz system TN-S neutrals grounding. All boards shall be accessible from the front or as shown on Drgs, for the maintenance of breakers, switch fuses, busbars, cable terminations, meters etc. Cables shall be capable of entering the board both from top as well as bottom as specified in drawings. All panels shall be machine pressed with punched openings for meters etc. mounted on a 75mm high base channel frame. All sheet steel shall be rust inhibited through a process of degreasing, acid pickling, phosphating etc. The panels shall be finished with powder coating of approved colour applied over a primer. Aluminium anodized Engraved labels having white letters on black background shall be provided indicating the feeder details and capacity. All panels shall be provided with danger boards on bus bar & cable chamber.

- 8.2 The boards shall accommodate air insulated bus bars, air circuit breakers, mccb's switch fuse units with HRC fuses, starters, necessary meters, relays, contactors etc. as required and arranged in suitable tiers. All breakers and switch fuses shall be suitably derated taking into account specified ambient temperature and ruling temperature inside the cubicle.
- 8.3 The switch board shall be fully compartmentalised in vertical tiers housing the feeder switches in totally enclosed independent compartments. Each compartment shall be self sufficient with switch unit, fuses, contactors, relays, indicating lamps and an inter-locked door with facility for padlocking. Each switch or MCCB or ACB shall have provision for locking in the OFF position for life safety. Each feeder must terminate in an independent labelled terminal block. Strip type terminal block accommodating several feeders together is not acceptable. Pressure clamp type terminals suitable for aluminium wires may be used upto switches of 25A and cable lugs for higher ratings. Glands shall be of heavy duty brass casting, machine finished & complete with check nut, washers etc. The lugs shall be tinned Cu /Al depending upon cable conductor & of solderless crimping type. All terminations shall be shrouded in an approved manner. The entire enclosure shall meet with IS: 13947. Feeder connections shall be of solid insulated copper/aluminium wires or strips with bimetallic clamps wherever required and if insulated, the insulation shall be able to withstand the high temp at the terminals. Internal wiring, bus bar markings etc. shall conform to IS:375/1963. Internal wiring shall have terminal ferrules.
- Main switch should be at an easily accessible height and the highest switch operating handle should not be over 1.75M from floor level. Cable glands shall form part of the switch board.
- 8.4 Space heaters of adequate capacity shall be provided inside each panel. They shall be suitable for 240V, 1ph 50 Hz supply. They shall be complete with MCB or HRC fuses, isolating switches & adjustable thermostat.
- 8.5 Each panel shall be provided with 240V 1ph 50Hz , 5A 3pin receptacle with switch located at a convenient position.
- 9.0 Bus bars shall be three phase and neutral and of copper or aluminium or aluminium alloy (E91E) as specified and shown on drawings and rated for a temperature rise of 30 deg C over the ambient temperature specified, (IS:8084-1976). Neutral bars may be of one half the size of the phase bars or as shown on drawings. The main horizontal bus bars shall be of uniform cross section and rated for the incoming switch. The vertical bus bars for the feeder columns may be rated at 75% of aggregate feeder capacity and shall be uniform in size. Bus bars and

interconnections shall be taped with PVC colour coded tape to prevent bar-to bar accidental shorts. Each bus bar shall be directly and easily accessible on removal of the front cover. Bus bars shall be totally enclosed, shrouded and supported on non-hydroscopic insulator blocks to withstand thermal and dynamic overloads during system short circuits.

Feeder connections shall be solid copper bus bars duly insulated with bimetallic dampers where required. Bus bars shall be designed for easy extension in future on either side. All feeder connections shall be rated for 25°C temperature rise over the ambient.

10.0 **Earthing**

10.1 An earthing bus shall be provided at the bottom & extended throughout the length of panel. It shall be bolted / welded to the frame of each unit & each breaker earthing bar.

10.2 Protective earthing shall be provided as shown on drawings or as follows:

Phase conductor	Protective conductor
upto 16 sqmm	equal size
16 to 35 sqmm	16 sqmm
over 35 sqmm	50% of phase conductor

In case of dissimilar materials the Protective Earth Conductor shall be suitably sized for equal conductance.

10.3 Protective earthing of each switch shall be connected to the earth bar.

10.4 All non current carrying metal work of the switchboard shall be effectively bonded to the earth bus.

11.0 **Installation**

11.1 All panels shall be supported on MS channels incorporated in the panel during the fabrication. All such supports shall have two finish coats over a prime coat after completion of the work. All panels shall be touched up for damaged painting.

11.2 All panels shall be megged phase to phase and phase to neutral using a 1000V megger with all outgoing feeders in closed position. The megger value should not be less than 2.5 megohms between phases and 1.5 megohms between phases and neutral.

- 11.3 Fabrication drawings of all panels shall be approved by the Consulting Engineers before fabrication.
- 12.0 **Testing & Inspection**
- 12.1 All switchboards shall be factory inspected before finishing and dispatch unless waived. Type test reports for all switchgear shall be furnished.
- 12.2 Certificate for all routine and type tests for circuit breakers in accordance with the IS:2516-1963 shall be furnished. In addition, all panels shall be megged phase to phase and phase to phase neutral, using a 1000V meggar with all switchgear in closed position. The meggar value should not be less than 2.5 megohms between phases and 1.5 megohms between phase and neutral.
- 12.3 All meters shall be calibrated and tested through secondary injection tests.
- 12.4 All field tests shall be witnessed by Consultants and recorded unless waived.
- 13.0 **Mode of measurement**
- 13.1 Each panel will be considered as one unit for the purpose of measurement and shall include the following:
- i) Incoming and Outgoing feeders.
 - ii) Interconnections and controls and instrument wiring with necessary protective fuses.
 - iii) Meters, Relays, Indicating lamps, CT's control fuses etc.
 - iv) Supporting structure, sheet steel enclosure
 - v) Installation, commissioning and testing
- 13.2 Isolators shall each be measured as one unit complete with:
- i) mounting frame
 - ii) switch/fuse
- 13.3 Protective earthing of the panel/Isolator from the equipment earthing system will be measured separately and paid at unit rates.
- 13.4 Outgoing and incoming feeder terminations will be paid at the unit rates separately as specified under cabling.