SECTION- B 2.10

ENCLOSED SWITCHES & CIRCUIT BREAKERS

2.10.1 PREMABLE

This Section includes individually mounted enclosed switches and circuit breakers used for the following:

a) Service disconnecting means i.e. Isolator unit after residential & common meter
b) Motor and equipment disconnecting means.
c) Lift equipment disconnecting means

2.10.2 SUMMARY

A. The equipment shall comply with the technical specification and guaranteed technical particulars specified herein. Any deviations to the specification shall be indicated clearly clause by clause
B. The complete system shall comply to requirements.
C. Codes and Standards: The LV enclosed switch shall be designed, manufactured and tested in accordance with the latest applicable sections of the IEC/BS/IS codes. Since IS Standards are originated from IEC standards, technical requirements listed in the latest IEC standards supersedes IS standards requirements which do not cover them.

IEC 60051	Direct acting indicating analogue electrical measuring instruments and their accessories.
IEC 60073	Coding principles for indicator lights and push buttons.
IEC 60189	PVC insulated cables for switchgear and control wiring.
IEC 60255	Electrical relays.
IEC 60258	Direct acting recording electrical measuring instruments and their accessories.
IEC 60269	Low-voltage fuses.
IEC 60417 DB	Graphical symbols for use on equipment.
IEC 60439	Low voltage switchgear and control gear assemblies.
IEC 60445	Basic and safety principles for man-machine interface marking and identification. Identification of equipment terminals and of termination's of certain designated conductors. Including general rules for an alphanumeric system.
IEC 62052	Electricity metering equipment (AC)
IEC 60529	Degrees of protection provided by enclosures. (IP Code)
IEC 60715	Dimensions of low voltage switchgear and control gear. Standardised mounting on rails for mechanical support of electrical devices in switchgear and control gear installations.
IEC60947	Low Voltage switchgear and control gear
IEC TR 61641	Enclosed LV Switchgear and Control gear assemblies – guide for testing under conditions of arcing due to internal fault.
IEC 60439-1	Low Voltage Switchboard
IEC 60831	Capacitor switching contactors
IS/IEC 60947 : PART 3	Lowpvoltage switchgear and controlgear : Part 3 Switches, disconnectors, switch-disconnectors and fuse combination units
IS/IEC 60947 : Part 4 : Sec 1	Low-Voltage Switchgear and Controlgear - Part 4 : Contractors and Motor-Starters - Section 1 : Electromechanical Contactors and Motors-Starters
IS/IEC 60947 : PART 4 : Sec 3	Low voltage switchgear and controlgear : Part 4 AC semiconductor controllers and contactors for non-motor loads
IS/IEC 60947 : Part 5 : Sec 1	Low-Voltage Switchgear and Controlgear - Part 5 : Control Circuit Devices and Switching Elements - Section 1 : Electromechanical Control Circuit Devices
IS/IEC 60947 : Part 4 : Sec 2	Low-Voltage Switchgear and Controlgear : Part 4 - Contractors and Motor-Starters Section 2 ac Semiconductor Motor Controllers and Starters
IS 5082	Material for data for aluminium bus bars
IS 13703	Low voltage fuses.
IS 1248	Electrical indicating instruments.
IS 13010	AC Watthour Meters, Class 0.5, 1 and 2
IS 3231	Electrical relays for power system protection.

IS 13947 : Part 5 : Sec 2	Part 5 : Control Circuit Devices and Switching Elements - Section 2 : Proximity Switches
IS 694	PVC insulated cables for working voltages upto and including 1100V.
IS 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals.
IS 5578	Guide for marking of insulated conductors.
IS 3618	Phosphate treatment of Iron and steel for protection against corrosion.
IS 6005	Code of practice of phosphating of Iron and steel.
IS 5	Colours for ready mixed paints and enamels.
IS/IEC 60947 : Part 1	Degree of protection provided by enclosures for switchgear and Control.

2.10.3 SUBMITTALS

A. Technical Data: Submit data for approval, including catalog, detailed literature, manufacturer's name, catalogue number, rating, specification, overall dimensions and special features, as applicable for each type of switch, circuit breaker, accessory, and component indicated.

B. Shop and Construction Drawings: Submit Drawings for approval including according to the Specifications, but not limited to, the following:

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

    a. Enclosure types and details.
    b. Current and voltage ratings.
    c. Short-circuit current rating.
    d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer installed and field installed wiring.

C. Field Test Reports: Submit written test reports and include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Samples: Submit samples of each type of equipment for approval, unless otherwise agreed in writing by the Engineer.

E. Maintenance Data: For enclosed switches and circuit breakers and for components to include in maintenance manuals. In addition to requirements "Closeout Procedures," include the following:

F. Routine maintenance requirements for components.

G. Manufacturer's written instructions for testing and adjusting switches and circuit breakers.

H. Time-current curves, including selectable ranges for each type of circuit breaker.

2.10.4 QUALITY ASSUARANCE

A. Comply with related Standards, specified hereinafter. All circuit breakers are to be of the latest version of the manufacturers.

B. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

2.10.5 MANUFACTURERS

A. Approved Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to those listed in Section G..

2.10.6 CONSTRUCTION

2.10.6.1 TECHNICAL DATA

A. Ratings: Nominal System Voltage: 415 V, 3Phaes 4 wire, 50 Hz. Or 230 V, 1Phase 2 wire, 50Hz as indicated in the drawing.
B. The electrical arrangement of the switchgear, protection, control, etc. shall be as per the standards.
C. All components of the switchboard shall be rated for the electrical system characteristics shown on the one-line diagram(s). The rating of equipment/component shall take full account of all heat sources and other derating factors.
D. The switchgear shall be suitable for operation with system voltage and frequency variations as stated on the one-line diagram(s).
E. Wherever possible rated voltages and lightning impulse withstand voltages shall be selected from the IS / IEC standards.
F. Receptacle Switches: Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product.
    1. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

2.10.6.2 CONSTRUCTION REQUIREMENTS

A. Enclosed Switches and Circuit Breakers cubicles shall be metal enclosed, floor mounted / Wall mounted.
B. The structure, including doors shall be suitable of withstanding the stresses due to seismic conditions as specified in aforementioned site conditions.
C. Structures, including doors and panels, shall be capable of withstanding the internal pressure created by faults within the structure (equal to the maximum fault-current rating for a specified duration) without danger to the operating personnel. The minimum standard required is detailed in IEC and IS. Type test certificate(s) shall be provided with the quotation.
D. Switchgear shall generally be self-ventilating.
E. All circuit breaker / switch shall have provision for padlocking. Padlocking facility for multiple locks shall be provided in the Off / Test / Isolated position.
F. Enclosure shall be designed and constructed to facilitate inspection, cleaning, repair and maintenance and to ensure absolute safety during operation, inspection and maintenance.
G. Similar parts and components shall be interchangeable.
H. Unless otherwise stated on the one-line diagram, switchgear intended for indoor installation shall have minimum protection of IP 41 and outdoor installation shall have minimum protection of IP 55 in accordance with IEC or IS.
I. All hardware shall be corrosion resistant. All joints and connections of the panel members shall be Zinc passivated or Cadmium plated, high quality steel bolts, nuts and washers secured against loosening.
J. Finish: Manufacturer's standard gray finish over rust-inhibiting primer on phosphatizing-treated metal surfaces.

2.10.6.3 CABLE TERMINATION

A. Cable terminating facilities and terminals shall be suitable for the specified cable type and conductor size. Consideration and provision shall be taken by the vendor on the equipment design for the use of cables with aluminium / copper conductors as mentioned on single Line Diagram / Switchgear schedule.

B. Terminal blocks shall be arranged and positioned to afford ready access for carrying out external cable termination, testing, inspection and maintenance. There shall be ample clear space allowed between the terminals and the gland-plate for the spreading and termination of external conductors.
C. Terminal blocks shall be mounted in a single deck arrangement. Terminal blocks for the connection of external control wiring shall be of the clamp type with a facility to connect two wires on each side of the terminal. A minimum of 20% spare terminals shall be provided.
D. All external wiring shall be on one side of the terminal block only.
E. All terminal blocks shall be shrouded or provided with transparent covers. Pinch screw type terminals are not acceptable.
F. Terminals for different voltages shall be separated by partitions.
G. Terminal boxes (where specified) shall be suitable for dry type terminations unless otherwise specified.
H. A terminal box or chamber with undrilled gland plate or entry panel of sufficient dimensions to terminate the specified cables shall be provided. Direction of cable entry shall be as stated on the one-line diagram(s).
I. Positioning of cable terminations shall avoid obstruction of other cable terminations, removable covers, etc. and provide for easy access for terminating cables.
J. There shall be sufficient clear space allowed between the terminal block and the cable entry for the spreading and termination of external conductors. Should this not be possible using the standard design in relation to specified cable size then the seller shall incorporate an extended cable glanding box within its design.
K. Termination of single core cables shall be through a non-magnetic gland plate and provision made for bonding and earthing any armour and/or concentric ground conductors.
L. Adequate support arrangement shall be provided for each cable to avoid undue strain on the cable terminations.

2.10.7 EXECUTION

2.10.7.1 EXAMINATION

A. Examine elements and surfaces to receive switchgear for compliance with requirements for installation tolerances, required clearances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

2.10.7.2 INSTALLATION

A. Install enclosed switches as indicated, in accordance with manufacturer's written instructions, and with recognized industry practices; complying with applicable requirements of applicable standards or codes approved.
B. Install enclosed switches only after the room has been fully completed, including all painting and made dust tight and vacuum cleaner.
C. Installation to be certified by manufacturer/authorized representative.
D. Enclosed switch wall fixing: Ensure that wall/surface provided for installation of equipment are constructed in accordance with the switchgear load, approved Shop and Construction Drawings and equipment manufacturers' drawings and that holes for fixing bolts and provisions for passage of cables etc. are provided as required.
E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from main distribution board units and components.

F. Built-In Items: Ensure that equipment supports, fixings and the like, and sleeves for passage of feeders and cables which are to be built into concrete foundations, bases, cable trenches or building structure are provided as and when required and that they are properly installed.
G. Equipment: Install on concrete bases etc., and assemble completely plumb and level, before grouting in holding-down bolts. Installation to be inspected and certified as fit for "energization" by manufacturer/authorized representative.
H. Supports and Terminations: Install all incoming and outgoing cable supports, cable ends and termination fittings required for power and control cables.
I. Relays: Set in accordance with manufacturer's instructions and in accordance with an approved scheme.
J. Make Good, damage painted surfaces, clean and apply rust-inhibiting prime coat and 2 finishing coats of approved enamel upon delivery of equipment to site, or as required by the Engineer.

K. Operating Instructions: Frame and mount the printed basic operating instructions for main distribution boards, including control and key interlocking sequences and emergency procedures. Fabricate frame of metal and cover instructions with clear acrylic plastic. Mount in front of main distribution boards.
L. Install clear copy of certified and stamped “As-Built” drawings inside the Panel
M. Install panel key on stainless steel chain fixed securely alongside board.
N. Correction of errors generated during busbars installation: Ensure that these errors, such as excessive busbar drilling, do not affect the electrical properties and current carrying capacities of the busbars. The Engineer reserves the right to reject such unsatisfactory installations.
O. An approved type 1.20m wide non-slip rubber floor mat in accordance with IEC 61111 and rated to 1.0kV shall be fitted along the full length of each main LV. switchboard supplied. This material shall suitable for heavy duty electrical safety matting and shall be fully tested and certified for electrical insulation properties to IEC 61111; 2009 and shall be continuously marked with 5kV Proof Test, 10kV Withstand Voltage and 1000V Working. Each matt to IEC 61111 Class 0 - 6mm Thick.

2.10.7.3 CONNECTIONS

A. Tighten bus joints, electrical connectors, and terminals according to manufacturer's published torque-tightening values.

2.10.8 FIELD QUALITY CONTROL

A. Equipment: Inspect equipment upon delivery to Site and report any damage to the Engineer.
B. Switchgear: Inspect and check switchgear for completeness, component ratings, types, sizes, and wiring connections. Check phasing of busbars, contacts and clearances.
C. Prior to energization of circuitry, check all accessible connections to manufacturer’s torque tightening specification.
D. Tests: After installation and before hand-over, carry out all visual and mechanical inspection and electrical tests required by the governing codes and any other tests the Engineer may require to check compliance of installation with the Specification, including, but not limited to, the following. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest. All testing to be witnessed/certified by manufacturer as acceptable results.
    1. Insulation resistance tests for each main distribution board bus, component, connecting supply, feeder, and control circuit.
    2. Continuity tests of each circuit.
    3. Operational tests.
E. Test Procedure: Conform to the following:
    1. Protective Device and Relay Settings: Verify that settings given on the Drawings are appropriate for final system configuration and parameters based on system study. Where discrepancies are found, recommend final settings for approval before making final adjustments.
    2. Submit short circuit and coordinated relay settings with calculations based on IEC from the medium voltage incomer to the final load.
    3. Load shedding program to be developed by identifying the nonessential loads for generator or turbine loading.
F. Main and Control Circuits: Using 1000 V megger (2000 Megohm range), check insulation resistance between phases, between phases and earth/enclosure and between neutral and earth.
G. Primary Injection Tests: Provide portable test equipment to test time-delay characteristics of circuit breakers by simulating an overload or fault condition. Measure and record all test results and ambient conditions and compare with manufacturer’s data.
H. Instantaneous Trip Elements: Test by high current primary injection, using high-current primary injection test-sets and reports all readings.
I. Routine tests on site are to be carried out on every main distribution board in accordance with the Standard specified (IEC or BS) for FBAs assembled from standardized components outside the works of the manufacturer. Routine tests are also to be carried out on every FBA, delivered to site, if requested by the Engineer.
J. Manufacturer/authorized representative shall install and certify “equipment ready for energization”
K. All test record certificates shall be clear, having a distinctive test certificate number, signed and certified by authorized testing agency, contractor and Engineer.
L. Conduct site test with Oscilloscope after loading of the MDB to demonstrate that harmonic filters function properly as specified.

M. Inspections and Tests for Power Factor Correction Capacitors: Inspect and test component features, functions, operations, and protective devices according to manufacturer's instructions and International Electrical Testing Association.
N. Re-test: Correct deficiencies identified by tests and observations and retest until specified requirements are met

2.10.8.1 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

2.10.8.2 DEMONSTRATION

A. General: Manufacturer's factory-authorized service representative to train the Employer's personnel in the operation of the Unit.
B. Equipment: Check operation of each unit with Owner's personnel present and before Substantial Completion. Determine that operational systems and devices are functioning properly.
C. Instruction: Instruct the Employer's personnel in proper use, maintenance, adjustment, and repair of each system.

END OF SECTION-B2.10