Technical Requirements and Fabrication Procedure of Three Phase Distribution Board

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Abstract:

The Distribution Board, refers to an equipment which consists of bus bars, and possible switches, fuse links and Automatic protective equipment, bypass equipment, for connecting, controlling and protecting a number of branch circuits fed from one main circuit of a wiring installation in a building or premises for easy and safe handling of incoming power supply. These are, also used to protect the electrical distribution system in turn, connected electrical equipment from being damaged due to various faults like short circuit, over load, earth leakage, etc. In this paper providing the detailed components required for distribution board and fabrication procedure of distribution board.

Keywords: *Distribution Board, Fabrication.*

1. INTRODUCTION

The Conductor system by means of which electrical energy is conveyed from bulk power source or sources to the consumers is known as distribution system, which may be divided into two systems known as high voltage (primary) distribution and low voltage (secondary distribution) [1]. From generating stations, the Electrical Power is usually transmitted to various Sub- stations, through extra high tension transmission lines at voltages from 33 to 220 kV and at these Sub-stations this voltage is stepped down to 11 or 6.6 or 3.3 kV and power at this voltage is conveyed to different sub-stations for distribution and to the bulk supply consumer.

Similarly at distribution Sub-stations the voltage is stepped down to 400 volts. From these Sub-stations various low voltage (400 volts between phases and 230 volt between phase and neutral) distributed and radiated out to feed the consumer. This system of distribution of power is known as low voltage or secondary distribution system. The distribution system is classified in many ways i.e. according to current A. C. or D. C. distribution, or according to the character of service i.e. it may be: (i) General light and power, (ii) Industrial Power, (iii) Railway (iv) Street lights etc. and according to number of wire, i.e.: (i) two wire, (ii) three wire and (iii) four wire etc. But now a days AC distribution system almost universally employed [2].

2.GENERAL TECHNICAL REQUIREMENTS

2.1 Constructional Features

The board shall be sheet steel enclosed, indoor, floor mounted modular, self supporting type made up of the requisite vertical sections. It shall be dust & vermin proof with a degree of protection of IP-52. It shall be possible to extend the board on both sides by addition of vertical sections after removing the end covers. A metal sill frame made of M.S. channel of 100 x 50 mm ISMC shall be provided as base frame, properly drilled for mounting the board. Necessary hardware shall also be provided for the same. It shall be provided with cable entry at bottom with 3 mm removable gland plate. The board shall be of uniform height of not more than 2450 mm and it shall be of single front execution. It shall be provided with busbars running at top along the length of the board in separate sheet steel enclosure. The board shall be provided with gasket all round including removable covers & doors [3].

All the operating devices shall be provided only on the front of the board. The height of the top most operating handle shall not be more than 1800 mm and that of the bottom most operating handle shall not be less than 300mm. The board shall be divided into distinct sections comprising of a) metal enclosed busbar compartment running

horizontally b) Individual feeder modules arranged in multitier formation. c) Enclosed vertical busbars serving all modules. d) Vertical cable alley covering entire height. Metal sheet shall be provided between two adjacent vertical sections running to full height of the board. All equipment associated with a single circuit shall be housed in a separate module compartment.

The compartment shall be sheet steel enclosed on all sides and rear. A plate cover with a slot to permit wiring connections shall be provided on the side corresponding to the cable alley. The front of the compartment shall be provided with hinged door. Only the handles of switches, push buttons knobs and cut-outs for lamps & meters shall be arranged on front of the respective compartment to permit operation without opening the door. All cut-outs shall be gasketed for dust proofing.

Cable alley shall be provided with suitable hinged door. Vertical bus bar compartments shall be provided with adequate shrouding & bolted covers. Rear of the board shall be provided with removable panels. All doors shall be provided with concealed type hinges and captive screws. All identical equipment and corresponding parts of similar ratings shall be fully interchangeable.

2.2 Sheet Metal Work

The board frame shall be fabricated using pressed & shaped CRCA sheet steel of minimum 2.5mm thickness. The Board shall be enclosed by sheet steel of minimum 2.0 mm thickness smoothly finished & levelled. Doors & covers shall be made of 1.6 mm thick sheet steel. Adequate stiffeners shall be provided wherever necessary. All panel edges and door edges shall be reinforced against distortion. Cut outs shall be true in shape and devoid of sharp edges. The complete structure shall be rigid, self-supporting free from vibration, twists & bends.

Figure1.Sheet Metal for distribution board

2.3Painting

All sheet steel work shall be phosphate in accordance with the following procedure. Oil, grease, dirt and swan shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying. After phosphating, through rinsing shall be carried out with clean water, followed by final rinsing with dilute dichromate solution and over drying. The panel then powder coated with an approved colour shade as per IS. The final finished thickness of paint film on steel shall not be less than 50 microns, and shall not be more than 80 microns. Finished painted appearance of equipment shall present an aesthetically, pleasing appearance, free from dents and uneven surfaces.

2.4Main Bus & Taps

The board shall be provided with three phase and neutral busbars. Busbars shall be of uniform cross section throughout the length of the board and up to the incoming terminals of feeder circuit breaker/switch. The busbars shall be made of high conductivity aluminium alloy of E91E grade. Busbars shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents. Busbar supports shall be made of hilum sheets, glass reinforced moulded plastic material or cast resin. Separate supports shall be provided for each phase of the busbars. If a common support is provided for all three phase, antitracking barriers shall be incorporated. Busbar joints shall be complete with high tensile steel bolt and washers and nuts. Busbars shall be thoroughly cleaned at the joint locations and a suitable contact

grease shall be applied just before making a joint[4].

2.5 Mounted case Circuit Breakers

Wherever specified moulded case Circuit Breakers shall be provided for circuit protection. They shall be suitable for over load and short circuit protection of the feeders. The circuit breaker shall have switching mechanism, contact system, arc extinguishing device and a tripping unit contained in a compact moulded case and cover. The insulating case and cover shall be made of high strength, heat resistant, flame retardant material.

The MCCB shall be provided with a quick make- quick break type of switching mechanism which a definite speed of travel of moving contacts is ensured. The MCCB shall employ a maintenance free contact system designed to minimize the let through energies while handing abnormal currents. An indicator showing ON, OFF and TRIPPED positions shall be provided.

Figure2: Mounted case Circuit Breakers

2.6 Air Break Switches

Air break switches shall be of the heavy duty, group operated load-break, fault-make type, complying with the requirements of applicable standards. 4.6.2 The switches shall be capable of withstanding the thermal stresses caused by overloads, and short circuit currents of values associated with protective relays settings and the let through current of the associated fuse.

The switches shall be capable of withstanding the mechanism stress caused by the peak short circuit current of value equal to the cut-off current of the associated fuse. Whenever solid links are used for the connections between switches and fuses, such links shall be fitted with insulated sleeves. All live parts of the switch shall be shrouded. Switch operating handles shall be suitable for padlocking in `OFF' position.

Figure 3. Air Break Switch

2.7 Current Transformers

Current transformers shall be dry type. Current transformers shall have a short time withstand rating equal to the short time withstand rating of the associated board for one second. Rated burden shall be as specified in the single line diagram. All current transformers shall be earthed through a separate earth link on the terminal block to permit easy measurement of the current transformers insulation resistance.

Figure4.Current Transformer

2.8 Indicating Instruments and Meters

Electrical indicating instruments shall be of minimum 144 sq.mm. size for incoming feeder and 96 mm size for out going suitable for flush mounting. Indicating instruments shall have provision for zero adjustment outside the cover. Instrument dials shall be parallax free with black numerals on a white dial.

2.9 Control & Selector Switches

The control & selector switches shall be adequately rated for the purpose intended and shall be rotary type. They shall be provided with scutcheon plates clearly marked to show the position. The selector switches shall be maintained contact stay put type. Further switches in ammeter circuit shall have make before break type contact & shall be provided with oval handles.

2.10 Push Buttons

The push buttons shall be of momentary contact push to actuate type rated to carry 10A at 240V A.C. It shall be fitted with self-reset, 2 No. & 2 NC contacts. It shall be provided with integrate plate marked with its function. Start, open, close, push buttons shall be green in colour & stop push button shall be red in colour. All other push buttons shall be black.

3.Internal Wiring

Wiring inside the board shall be carried out with 1100/650V grade. PVC insulated, stranded conductor wires. Minimum size of conductor for power circuits shall be 4 sq.mm. copper or stranded wires. Control circuits shall be wired with copper conductor of at least 2.5 sq.mm. for CT circuits & 1.5 sq.mm. for other circuits, the number and size of strands shall be 7 of 0.67 mm and 0.5 mm diameter respectively.

Engraved identification ferrules, marked to correspond with the wiring diagrams shall be fitted to each wire. Ferrules shall be of yellow colour with black lettering. Spare auxiliary contacts of all equipment forming part of the board shall be wired up to the terminal blocks. Wiring shall be terminated on preferably stud type terminal blocks such that the wires are connected by cable-lugs with nuts & washers/lock nuts.

3.1Terminal blocks

Terminal blocks (both for power and control circuits) shall be of reputed make specially for CT and PT circuits. It shall comprise finely threaded pairs of brass studs of at least 6 mm diameter, links between each pair of studs, washers, nuts and lock nuts. The studs, shall be accurately locked within the mounting base to prevent their turning. Insulated barriers shall be provided between adjacent terminals. Terminal blocks shall be adequately rated to carry the current of the associated circuit Minimum rating of the terminal block shall be 10A.

Terminals shall be numbered for identification, Engraved white-on-black labels shall be provided on the terminal blocks, describing the function of the circuit. Where duplication of a terminal block is necessary, it shall be achieved by solid bonding links. Terminal blocks for CT secondary lead wires shall be provided with shorting and disconnecting/earthing facilities.

4.Earthing

Each Board, shall be provided with an earth busbar running along the entire length of the board. Material and size of the earth busbar shall be as specified. At either end of the earth bus, one clamp type terminal with nuts, bolts and earthing conductor shall be provided for bolting Purchaser's earthing conductor. In case the earth bus is provided near top of the Board, one down comer at either end shall be provided for connection to the Owner's earthing conductor.

Earth busbars shall be supported at suitable intervals. Positive connection between all the frames of equipment mounted in the switchboard and earth busbar shall be provided by using insulated copper wires/bare busbars of cross section equal to that of the busbar. All instrument and relay cases shall be connected to the earth busbar using 1100/650V grade, 2.5 sq.mm. stranded copper earthing conductor.

5. Process of Making Distribution Board

The distribution boards are sheet metal fabricated enclosures open, semi-closed or totally enclosed type which provide and control, electric power to distribution systems. Provision for indicating the parameters like voltage, current frequency per unit will be reflected on the face of the board. Regulation of the power supply is available through switches and MCB's and fault protection through the use of different relays[5].

The sheet metal enclosure for the control panel is designed and fabricated in the unit. The components and accessories are bought out from the market and fitted as designed in the board[6]. The circuit as per the design is laid out and the board is tested for proper functioning as per relevant standards. In brief the manufacturing process consists of: i) Establishing the requirement and accordingly designing circuit diagram. ii) Fabricating the Distribution Board - Marking, cutting, and bending of sheet, welding and Grinding and holing. iii) Fixing the joint clips iv) Fixing the frame of buttons v) Wiring according to circuit diagram vi) Fitting and connecting components/ accessories vii) Testing as per relevant specifications/ standards.

Figure5: Three Phase Distribution Board components

Figure6: Three Phase Distribution Board

CONCLUSION

Electrical engineer must aware of the components required for three phase distribution board and fabrication procedure of the distribution board. Assembled all the components of three distribution board and installed in college.

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