Fabrication and Assembly of Segmented Flame Proof Fully Protected Novel Power Distribution Board

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Abstract- *The distribution wiring, both power and lightning in the commercial and industrial sectors are not being wired up, taking into consideration of the safety norms. The electricians look only at the functional aspects and complete the wiring work. This is definitely has to be addressed to create an awareness. In this project, we have designed a special distribution board and segmented the three phase input supply to take single phase output introducing adequate protections. The whole internal wiring of this novel distribution board is carried out using FRLS (fire retardant low smoke wires).*

Keywords— Distribution board, Domestic Wiring, CABLES, Circuit brakers.

I. INTRODUCTION

Regarding the environment conditions and the appropriate wiring/cable systems, and enclosure for equipment, IS: 732/1989 should be referred. The sub-switch board and DBs should preferably be located close to the loads, the sub-switch boards and all other boards should have spare switches/ways for future expansion. The sub-switch board and DBs should not be locked at an elevated position which will result in convenience for routine operation and maintenance. The sub-switch boards/distribution fuse boards should be provided with adequate means of control either by switch or isolators on the incoming side, near the board. However ,such control can be dispensed with if the board are erected within about 3 meters (10)from the switchboard feeding it and in the same room. Each out going circuit from the sub-switch board should be provided with a switch fuse or fuse switch only. The current causing effective operation of the protective device (fuse or breakers) should not exceed 1.45 times the current carrying capacity of the down-stream cable.(vide cl 5.3.3.2 of IS:732/1989) . Molded case circuit breaker can be employed in sub-switchboards subject to appropriate fault level. Generally same type of controls are to be employed for all the outgoing feeders. Care should be taken for proper cable termination at the MCCB and the incoming terminal shrouded. The various clearances of the sub-switch board should be as per paragraph-6 in chapter –IV. Large capacity of the loads may have to be fed directly from the sub-switch boards. Loads requiring less than 63 Amps and located close by can be grouped and arranged to be fed by fuse distribution board instead of sub-switch board ,depending up on the convenience and suitability. MCB boards when employed in power distribution should conform to the requirements mentioned in chapter-VII subject to appropriate fault level. When MCB's are used for motor circuits, these should be suitable to with stand the starting current as well as fault currents. T-joints and looping of conductors should never be adopted .Standard distribution arrangement should be adopted. supply to the motors should not be taped from open wires should not be run in trenches and cable racks from switch boards/DBs to motor or equipment's and should be enclosed in conduits The distribution board should conform to relevant standards. The distribution board be minimum of 4 ways and maximum of 12 ways and should not be of odd number. The fuse distribution board should be limited to maximum of 63 Amps per way and each way should be of same current rating. However, rating of fuse employed in the fuse distribution board, can be different to suit the load. Rewirable fuses should not be used in DBs designed for HRC fuses. One power distribution fuse board should not feed another distribution fuse board. All the bus bars and interconnections should be provided with insulating barriers to prevent accidental contact at the time of renew of fuses. No live terminal or buses are exposed when the door is open. The DBs should be erected at a convenient heights so the top row of the fuses are accessible without the aid of stool, platform etc. and easily approachable. Dummy fuse carriers should be fitted in the spare ways to keep the live terminal inaccessible. All loose wiring inside the DB should as far as possible be avoided and such wiring, if sufficient space is not available to connect all these cables to the top or bottom of the DB, an adopter box of adequate size should be employed. The outgoing and incoming cables should only be connected at the bottom or at the top of the DB and not at the sides, rear and front. If sufficient space is not available to connect all these cables to the top or bottom of the DB, an adopter box of adequate size should be employed. Circuits from the distribution fuse board should be the final sub circuit. The unused knockout holes in the DB should be the closed permanently.

II. LIGHTENING LOAD

Lightning should be separated from power. The lightning supply may be as far as possible taken as a separated feeder from the main M.V switch Board. If any building is away from the main building and taking supply from the main lightning board is difficult, the lightning supply for that building may be taken from the main power board of that particular building for feeding the lightning loads in that particular section/hall department. In all the above cases, the lightning supply should be distributed to various section/hall/departments/office etc. in the premises through separate lightning sub-switch boards/MCB/DBs/Distribution fuse boards. The lightning boards should be located as near as possible to the centre of the load they are intended to feed. The lighting boards (sub-switch board, DBs, MCB) should be at an accessible height and in an easily approachable location. The board should not be located in toilets, locating them below staircase should be avoided where there is no ample head room clearance. If only three single phase circuits are required for lightning, they may be taken directly from TPN switch fuse with three DPIC switch fuses of adequate rating immediately after the TPN switch fuse. In such cases, the neutral leads should not be bunched but taken separately from the neutral link itself. The lightning final sub-circuits should be taken from single phase distribution, fuse board or MCB DBs controlled by double pole switch on the incoming side. If lightning final sub-circuit is taken directly from the TP&N MCB DB or TP &N distribution fuse board, the incoming supply to the said three phase board should be controlled by TPN isolator and suitable double pole control should be provided for each final sub-circuit to facilitate isolation of both phase & neutral. Fuse should never be provided in the neutral. Link alone should be provided in the neutral of the D.P. switch fuse control for lightning and the neutral marked. The load on each phase should as far as possible be equality distributed at all three phase distribution board. In industrial premises, the MCBs and fuse boards/lighting control switch, D.P. switches and SPT switches should not be mounted on wooden boards. The M.C.B DBs and distribution fuse boar should conform to relevant standards: (IS: 13032/1991)All unused knock-out holes in MCB DBs/ distribution fuse boards should be covered by non-inflammable material. MCB DBs/distribution fuse boards should be identified and circuit lists provided.

The following should be taken care of in case of MCB DBs.

a) The live incoming terminals of the incoming isolator at the MCB DB should be suitably shrouded by means of PVC sleeves to avoid accidental contact.
b) The supply to individual MCBs should not be effected by way of looping, using short bit of wires, bus bars of adequate length should be provided for phase and neutral.
c) MCB should be well supported to the frame work.
d) The live bus bars and tapping should be covered by insulating materials to avoid accidental contact.
e) All live outgoing terminals of each MCB unit should be shrouded.
f) The MCBs should be of correct rating for load connected.
g) Each outgoing circuits should be connected to a separate MCB unit.
h) The tandum rods in DP/TP/four pole should be of adequate mechanical strength.
i) Each MCB units should be identified with reference to the circuit controlled by it on MCB unit itself.
j) Each MCB should have adequate breaking capacity at the point of application.
k) The MCB DBs should have homogeneous arrangement i.e of same rating and type of MCB's.

The MCB's themselves should conform to IS: 8828 – 1978- miniature circuit breakers for voltages not exceeding 1000v.

The following should be taken care of in the case of distribution fuse board:

a) The live bus bars should be suitably covered by insulating sheet to prevent accidental contact.
b) Correct rating of fuse should be provided.
c) The opening between the incoming switch control and distribution fuse board should be covered by suitable insulating sheets.
d) Dummy fuse carriers should be provided for the spare ways in the distribution fuse board so as to cover the exposed live parts.

TABLE 1: Minimum clearances provided in the switch boards.

Note: for main M.V panels, 0.6 KV clearances may be adopted.

System voltage in KV	phase to phase clearance(mm)	Phase to earthed metal clearance(mm)
0.416	19	16
0.6	25	19
3.3	51	35
6.6	77	60
11	127	77
22	242	140
33	356	223

There must be separate neutral lead for each sub-circuit right from the neutral bus. The earth wire should never be used as neutral. The earth and neutral should be maintained separate. Circuit of atleast different phase may be taken in separate conduit. Different circuit of same phase may be taken in same conduit provided the number of wires drawn into the conduit is within the permissible limit. Where three phase and four wire circuit is taken for connecting alternate light, single conduit can be used, provided the wires are of appropriate voltage grading. Both the incoming and outgoing supply wires to and from the lightning boards should not be enclosed in one and the same conduit. The PVC conduit should be of rigid type and adequate mechanical strength conforming to IS 2509. The metal and PVC conduit should be supported by using the clamps.

III. GENERAL REQUIREMENT OF DISTRIBUTION BOARD

Having classified different switchgear products according to their application we now proceed to study their requirements. In order to simply we will first study the general requirements of switchgear and then see how they different form product. The following is the criteria of general requirements of low tension switchgear.

A. Current carrying capacity of an Equipment:

Each low tension switchgear equipment has certain capability the current continuously. This is termed as the thermal current of device. when carrying the thermal current for 8hrs. the temperature rise of the equipment is not to exceed the specific

limits. The products used for continuously duty are also used on intermittent duty and short time duty. In the intermittent and short time duty carry current higher than Ith. In any case

$$\int i^2 \times dt = I^2 th \times Ʈ$$

where I represents the function of the current and T is the period of time

B. Operational current and voltage:

These are the operational values useful to a user in actual operating conditions. Operational currents are specified for a given operational voltage and their values will changes in case operational voltage changes. The ultimate making and breaking capacity of a low tension switchgear device is given in terms of its operational current for a given operational voltage usually termed as making and breaking capacities in normal operations current of a conductors is 16 amperes at 415 volts then it has ultimate making and breaking capacity of about 160 amperes at – say 415 volts ,for AC3 duty, its normal making current in actual operation will be 96 amperes and breaking current will be 16 amperes at 415 volts. The electrical life will be specified for this normal duty. Similarly for different switchgear products depending upon their utilization such limits will be specified in terms of this operational current.

IV.PROPOSED MODEL OF DISTRIBUTION BOARD

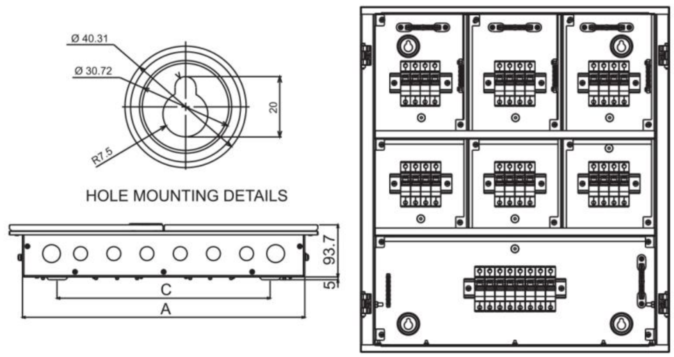

Figure:1 (Model of Proposed DB)

The Figure1 was the outer schematic of the proposed Distribution board in which all sort of mechanical isolation between two segments has been established successfully. The below figure shows actual image of the model.

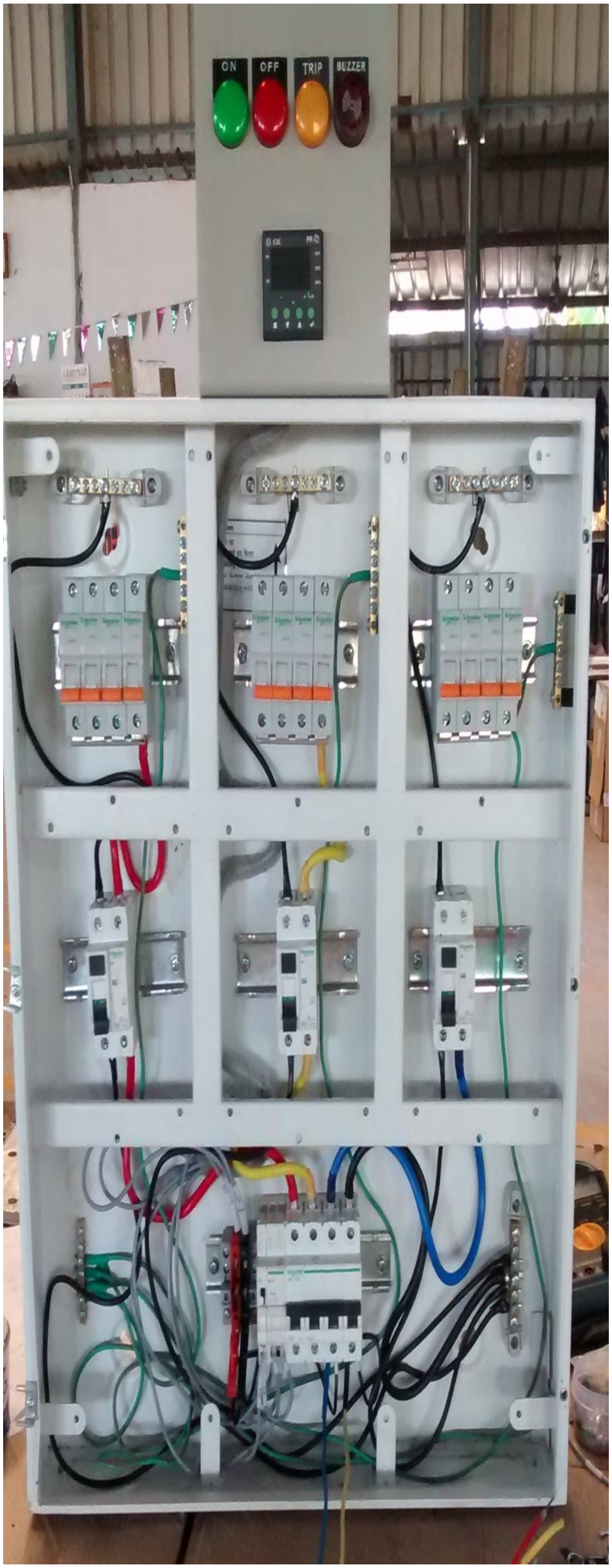

Figure 2: Actual Image of derived model after fabrication

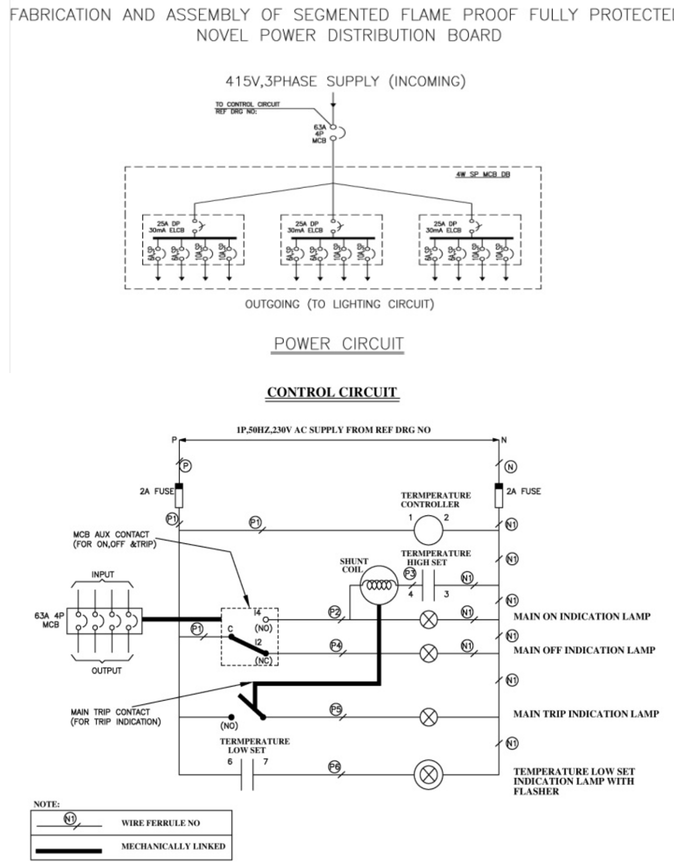

Figure 4:Control Circuit

Normally the three phase input power supply with neutral which is 3 phase 4 wire are connected to the incoming switch and single phase connections are tapped Out between phase and neutral this leads to lot of unbalance and lack of flexibility from maintenance point of view.

V. COST ANALYSIS

The cost of normal conventional DB costs Rs.8000/- but after the fabrication and assembly and other components for a 12 way outgoing DB with 12 MCB having a rating of 6/10AMPS each and three ELCB and one Incoming four pole MCB with all these components the cost was found to be Rs.12,000/-. With additional novel protection schemes and accessories, i.e., with temperature controller and tripping circuit arrangement the cost would be Rs.18,000/-. Rather to go with conventional TPN DB we can move for the proposed DB.

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VI. IMPLEMENTATION OF ELCB IN THE BOARD

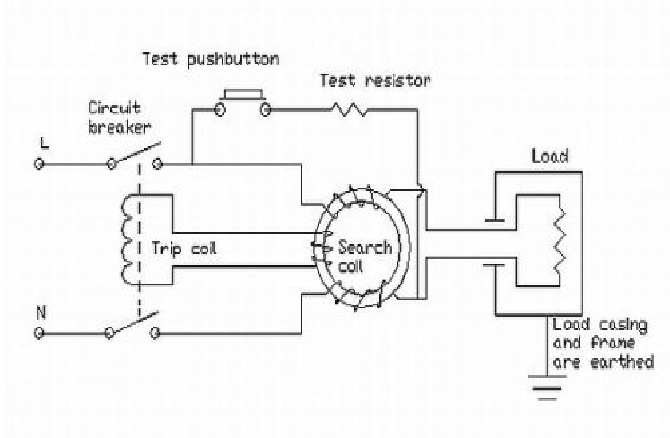

Figure 5: ELCB circuit

By implementing the ELCB(Earth Leakage Circuit Breaker) ,The Neutral and earth in each of the segments would get isolated.

VII. FRLS FEATURES

FLAMEGARD – SINGLE CORE, UNSHEATHED WIRES IN VOLTAGE GRADE 1100 V.

Nominal area of Copper Conductor	Number/ Nominal Diameter of strands	Thickness of Insulation (Nominal)	Approximate Overall Diameter of wire	Current carrying capacity# 2 wires, single phase		Resistance (Max.) per km. @20°C
				In conduit/ Trunking	Unenclosed — clipped directly to a surface or on a cable tray	
Sq. mm	mm	mm	mm	Amps	Amps	Ohms
1.0	14/.3*	0.7	2.7	11	12	18.10
1.5	22/.3*	0.7	3.1	13	16	12.10
2.5	36/.3*	0.8	3.7	18	22	7.41
4.0	56/.3**	0.8	4.3	24	29	4.95
6.0	84/.3**	0.8	4.8	31	37	3.30

Standard Base Colours: Black, Red, Blue, Yellow and Green (for earthing), with orange stripe, on request. # As per IS 3961 (Part V) : 1968
Supplied in 90 metre lengths in attractive cartons. Conform to IS 694:1990. BIS licence nos. CM/L-0382242 & CM/L-7306463
*As per conductor Class 2 of IS 8130:1984 **As per conductor Class 5 of IS 8130:1984

THE FLAMEGARD ADVANTAGE

TEST	FUNCTION	SPECIFICATION	TYPICAL VALUES	
			FLAMEGARD	ORDINARY PVC INSULATED WIRES
Critical Oxygen Index	To determine the percentage of oxygen required for supporting combustion of insulating material at room temperature	ASTM-D 2863	More than 29%	23%
Temperature Index	To determine at what temperature normal oxygen content of 21% in air will support combustion of insulating material	ASTM-D 2863 & BICC Handbook Chapter No. 6	More than 250°C	150°C
Light Transmission (Smoke density)	To determine the visibility (Light transmission) when insulating material is on fire	ASTM-D 2843	More than 40%	10-15%
Acid Gas Generation	To ascertain the amount of Hydrochloric acid gas evolved from insulation of wire under fire	IEC 60754-1	Less than 20%	45-50%

Other tests carried out are : Flammability test as per IEC 60332-1

VIII. CONCLUSION

Electricity consumers with consumption more than 150 HP will be categorized as HT consumers. For such consumers the Transformer will be located in the consumer promises and CAG (chief electrical Inspector to government) will conduct an annual inspection every year. This electrical Inspector do not accept such haphazard distribution wiring arrangement. For safety point of view it is mandatory to segment the distribution network to ensure safety and reliability in all Industrial and commercial sectors.

REFERENCES

[1] COMPARISON OF ANSI/IEEE AND IEC REQUIREMENTS FOR LOWVOLTAGE SWITCHGEAR- Copyright Material IEEE Paper No. PCIC 2003-13, Eddie Wilkie, Eaton Cutler-Hammer, 3990 Old Tasso Road NE, Cleveland, TN 37312,USA

[2] TECHNICAL SPECIFICATION FOR ELECTRICAL WIRING / PANELS/ SWITCH GEAR- specifications laid down in the Indian Standard I.S. 732 - l963 Code of Practice (revised) for Electric al Wiring Installations (system voltage not exceeding 650 volts) and IS 3043 Indian code of Practice for Earthing, wiring shall be according to the I.S specifications &NE.