A

Project Report

On

"CASE STUDY ON MANUFACTURE OF PANEL & CAPACITOR BANK"

Project Report Submitted in partial fulfillment of the requirements

Of the degree of

Bachelor of Engineering in Electrical Engineering

Submitted by

PRASAD SATAPPA DALVI (17DEE45)

HARSHADA VIJAY TANDALE (17DEE48)

SHUBHAM ANANDA KARANJVADE (17DEE50)

UNDER THE GUIDANCE OF

Prof. SYED KALEEM

DEPARTMENT OF ELECTRICAL ENGINEERING

ANJUMAN-I-ISLAM

KALSEKAR TECHNICAL CAMPUS

NEW PANVEL-410206

UNIVERSITY OF MUMBAI

Academic year 2019-2020

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Date :-

(Prof. SYED KALEEM)

Project Guide

Approved by:-

(Prof. SYED KALEEM)

Head of Department

(Dr. ABDUL RAZZAK HONNUTAGI)

Director

ANJUMAN-I-ISLAM

KALSEKAR TECHNICAL CAMPUS

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CERTIFICATE

This is to certify that the below mention students has satisfactorily completed his project work titled **"CASE STUDY ON MANUFACTURE OF PANEL & CAPACITOR BANK".** Along with his batch mates in partial fulfillment for the **Bachelor of Engineering in Electrical Engineering** under the **UNIVERSITY OF MUMBAI** during the academic year 2019-2020.

- PRASAD SATAPPA DALVI (17DEE45)
- HARSHADA VIJAY TANDALE (17DEE48)
- SHUBHAM ANANDA KARANJVADE (17DEE50)

In a manner satisfactory to warrant is acceptance as a pre-requisite to their Degree in Bachelor of Electrical Engineering.

Date:- ----------

Internal Examiner

(Prof. SYED KALEEM)

External Examiner

DECLARATION

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

DATE ……

PRASAD SATAPPA DALVI **…….....……**

HARSHADA VIJAY TANDALE **……..**

SHUBHAM ANANDA KARANJVADE **…….....**

ACKNOWLEDGEMENTS

We would like to acknowledge the contributions of those who assisted in the preparation of this report.

We are particularly grateful for the work done by members of my group. Before we get into this report we would like to thanks to the members of the group who are a part of this report and have given their unending contribution from start to end of this report.

We would like to give special thanks to **Prof. SYED KALEEM** for her guidelines & reference of B.K.ELECTRICALS Company for our project.

We are thankful **WAJID KHAN** sir Director of "**B.K.ELECTRICALS**". For giving us the opportunity to gain knowledge about designing of panels for protection of Transformer.

We would like to our **Prof. SYED KALEEM** for providing as the required guidance in process of preparing the report. We would also like to express our deep regards and gratitude to the director **Dr. ABDUL RAZZAK HONNUTAGI**.

We would like to express our gratitude towards our parents for their kind co- operation and encouragement which help us in completion of this project.

We have taken lots of efforts in this project. However, it would not have been possible without the kind support and help of many individuals and organizations. We would like to extend our sincere thanks to all of them.

PRASAD SATAPPA DALVI

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ABSTRACT

As we know that power system load is increasing day by day as the industrial and commercial load are increasing . In modern power system most of the load is inductive load to compensate this inductive load capacitive load is must require . Inductive load is consume reactive power in the system which affect generation of plant the main application of apfc panel is it has automatic capacitor which connected according to requirement of reactive power.

Control Panel as the name implies, are used to provide proper control of operations of any electrical equipment's. These are also used to protect the electrical. Equipment's from being damaged due to various faults like short circuit, overload and Earth leakage etc.

Electrical control panels and capacitor bank are important system or equipment in electrical industries also in other industries so we going to do a case study on that.

They are found in factories to monitor and control machines or production lines and in places such as nuclear power plants, ships, and aircraft and mainframe computers.

protection is mainly provided through panels. A panel is used for controlling and giving the indication about the faults in system or any machines etc. It also disconnect the system from supply of there is a fault. Different panels are used for different location, scheme of protection, according to consumer demand etc. In which some of the panels are RTCC, MBox, TJB, etc. Here we deal with different methods or steps that are involved in dedication of our group members.

Capacitor banks are applied in power systems to provide reactive power. The reactive power results in lower current in lines upstream of the bank improving system voltage and power factor and reducing line losses. Capacitor banks can be configured as filters for harmonic reduction. The protection systems for capacitor banks include fuses, surge arresters, and protective relays. This paper focuses on protective relaying philosophies of grounded and ungrounded Y-connected shunt capacitor banks, which are commonly applied on industrial and utility power systems.

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CHAPTER 1

1.1 INTRODUCTION

Figure 1.1 control Panel

Control Panel as the name implies, are used to provide proper control of Operations of any electrical equipment's. These are also used to protect the electrical Equipment's from being damaged due to various faults like short circuit, overload and Earth leakage etc... A control panel is a flat, often vertical, area where control or monitoring instruments are displayed or it is an enclosed unit that is the part of a system that users can access, such as the control panel of a security system (also called control unit). They are found in factories to monitor and control machines or production lines and in places such as nuclear power plants, ships, and aircraft and mainframe computers. Older control panels are most often equipped with push buttons and analog instruments, whereas nowadays in many cases touchscreens are used for monitoring and control purposes.

Simplification of engineering and precise control of manufacturing process can result in significant cost savings. The most cost-effective way, which can pay big dividends in the long run is flexible automation; a planned approach towards integrated control systems. It requires a conscious effort on the part of plant managers to identify areas where automation can result in better deployment/utilization of human resources and savings in man-hours, down time. Automation need not be high ended and too sophisticated; it is the phased, step-by-step effort to automate, employing control systems tailored to one's specific requirements that achieves the most attractive results.

That is where Industrial electronics has been a breakthrough in the field of automation and control techniques. It is required System design and specification, Electrical and mechanical design using industry standard CAD tools and E plan, PL software development Panel manufacture to highest quality Panels and systems can be tested to customer specification and test procedures On-site commissioning using equipment's. Diagnostics and troubleshooting Control Panel as the name implies, are used to provide proper control of operations of any electrical equipment's.

These are also used to protect the electrical equipment's from being damaged due to various faults like short circuit, overload and earth leakage etc. The control panel is used to configure and manage almost all aspects of Windows, including keyboard and mouse functionality, users and passwords, power options, network settings, desktop background, display settings, sound settings, mouse settings, hardware and software options, installation and removal of programs, parental control, speech recognition, etc.

Electrical Power constitutes a major component of the manufacturing cost in industry. In an electrical installation, power factor may become poor because of induction motors, welding machines, power transformers, voltage regulators, arc and induction furnaces, choke coils, neon signs etc. A poor power factor for the plant causes huge amount of losses, leading to thermal problem in switchgears. However power factor is controllable with a properly designed power factor improvement capacitors system. The power factor correction obtained by using capacitor banks to generate locally the reactive energy necessary for the transfer of electrical useful power, allows a better and more rational technical-economical management of the plants.

1.2 HISTORY OF PANELS:

From the early 1900s to the 1950s, the most common service supplied 120-volts, and 30-amps to the home. The panels used plug fuses to protect circuits and a knife-blade switch to disconnect power to the whole panel. It is not feasible to add branch circuits to a 60-amp fuse panel.

The electrical service panel, commonly known these days as a breaker box, has come a long way since the early 1900s. Almost every home has some type of service panel, whether it be a fuse panel or a circuit breaker panel. Commonly, these service panels are located in utility rooms, garages, or basements. Along with the main service panel, you may also have a subpanel, a small breaker box that supplies power to a specific area of your home such as a garage, outbuilding, or large home addition.

A distribution board is a component of an electrical system. It separates the power supply into several circuits in an enclosure. It provides each circuit with its protection system by using a fuse or circuit breaker

CHAPTER 2

LITERATURE SURVEY

2.1 : LITERATURE SURVEY :

Use the following graphic guide and procedure for each standard panel to complete the Panel Survey for each circuit breaker panel:

Four Measurements for Each Panel

#1: Measure the spacing between the circuit breaker center lines (see "1" on diagram)

#2: Count the number of potential breaker spaces on just one (1) side of the panel (see "2" on diagram)

#3: Measure the distance from the centerline between the two columns of breakers to the maximum position of the breaker handle in the "off" position. (See "3" on diagram)

#4: Measure the distance from the surface of the front panel to the top surface of the circuit breaker. Indicate "actual" height as appropriate. (See "4" on the diagram)

Name (required):

Company (required):

Company Address (required):

City (required):

State (required):

Zip Code (required):

Telephone (required):

E-mail (required):

Facility Name:

Facility Location:

- **Enter the Circuit-Breaker Panel Information for each panel**

Panel #

Panel Location:

Building:

Columns:
- 1
- 2

#1 Spacing:

#2 Number:

#3 Distance:

#4 Height:

Panel #:

Panel Location:

Building:

Columns:
- 1
- 2

#1 Spacing:

#2 Number:

#3 Distance:

#4 Height:

Panel #:

Panel Location:

Building:

Columns:
- 1
- 2

#1 Spacing:

#2 Number:

#3 Distance:

#4 Height:

Panel #:

Panel Location:

Building:

Columns:

- 1
- 2

#1 Spacing:

#2 Number:

#3 Distance:

#4 Height:

Alternatively, you may choose to print a Panel Survey Procedure and a blank Standard Panel Survey
Data Sheet and fax them to Stranco Inc. upon completion.

CHAPTER 3

TENDER
(TERMS & CONDITIONS)

3.1 TENDER TERMS & CONDITIONS :

1. **Scope of Work:**

   Vendor Shall complete the work for complete supply and installation of all electrical panels at the site which includes supply of materials and provision skilled labour, machineries tools, tackles, etc., as further described in this WO and respective Annexus to this WO.

2. **Contract value:**

   Subject to the full, final and timely performance of the Works By the vendor, knowledge foods shall and pay an amount of Rs:12,90,684/- (rupees: twelve lakh ninety thousand six hundred and eighty four only). All payments made by knowledge foods to the vendor shall be subject to tax deduction at source as per prevalent law and rate in force from time to time.

3. **Basis of Price:**

   The contract value mentioned herein above is a stated in annexure A, quotation duly accepted by Knowledge Foods inclusive of all taxes and duties.

4. **Escalation:**

   There shall be no escalation on the Contract Value as stated here in above clause 2 and the same shall be in force until the date of full and final handover of the work to knowledge foods.

5. **Schedule of Work:**

   This contract shall come into effect from **31st May 2019** and the work is expected to complete on or before **25th July 2019**. In the event the timelines specified herein above are extended due to reason attributable to vendor, vendor shall be responsible for to pay liquidated damages of **1%** of the contract value for every week delete to a maximum of **5%** contract value, unless the same has been extended due to knowledge foods. In the event this agreement is extended for reason stated herein above no additional monetary compensation shall be provided to the vendor.

6. **Quantity Variation and Extra / Additional Items:**

   a) **Quantity Variation:**

   Quantity variation statement with rates shall be submitted within two weeks after the approval of all drawings by architect and M/s knowledge foods pvt.Ltd.

   b) **Extra / Additional Items:**

   For all extra items rates for which are neither available in the work order nor derivable from the work order needs to be pre-approve by knowledge foods.

7. **Terms of Payment:**

- 80% Immediately i.e. **INR-10,32,547**
- 20% Balance on completion i.e. **INR-2,58,137**

Bank Details:

Bank Name: Axis Bank

Bank Branch: Mahalaxmi Branch

Account Number: 914020054670684

IFSC Code: UTIB0002623

8. **Completion Period:**

   The work shall be completed and successfully handed over to Knowledge Foods on or before **25th July 2019.**

9. **Defeat liability period:-**

   The defect liability period will be of 12 months from the date of completion of work a certified by knowledge foods appointed manager charge.

10. **rate of progress:-**

    If the rate of progress is observed to be e inadequate to meet target completion dates knowledge foods shall notify so from time to time and the vendor shall take all necessary action to expedite works and improve progress to the extent necessary failing which knowledge foods will be at liberty to expedite and complete such works By engaging other Agencies and actual cost incurred along with overhead if any will be debited to vendors account.

11. **Relationship :-**

    vendor is an independent vendor. nothing in this work order shall be constructed as creating any relationship between knowledge foods and vendor or as creating any relationship between knowledge foods and vendors related persons .neither vendor, nor any of its related persons shall be deemed employees of knowledge foods.

12. Compliance with laws vendor shall comply with all applicable laws rules, ordinances, regulations executive orders of any government or government authority or statutory body having or asserting jurisdiction over the subject matter hereof, and Expressed public policies.

13. Governing law and dispute resolutions:- this agreement shall be governed and construct in accordance with laws of India and shall be submitted to the exclusive court of Mumbai.If any dispute arise between the parties hereto during the subsistence of this agreement or thereafter in connection with validity interpretation, implementation or alleged material breach of provision of this agreement or regarding a questions including the questions as to whether the termination of this agreement by one party hereto has been legitimate ,both parties hereto shall endewear to settle such dispute amicably. if the parties fail to bring about an amicable settlement, either party to the dispute may give notice of invocation of the the arbitration provisions contained herein ,to other in writing in accordance with Indian Arbitration and conciliation act ,1996. The parties shall mutually appoint a sole arbitrator and in the event of dissent,either party shall appoint one arbitrator each and the two appointed arbitrators shall appoint the third arbitrator to preside over the arbitratioration proceedings. The proceedings of arbitration shall be in English language and at Mumbai.

14. Alterations of work:-

Knowledge foods, in its sole discretion, reserves the right to altering the drawings, and nature of work and of adding or deleting any item of work. Knowledge foods also reserves the right to carry out portion of work either departmentally or by other Agencies or by any other means, should the need arise. Such additions or deletations shall not affect the consideration of the contract price.

15. Independent Contractors:-

This agreement is entered into between the parties on a principal to principal basis and nothing in this agreement shall constitute or be deemed to constitute a partnership or vendor between any of the parties hereto and none of them shall have any authority to bind the other in any way.

16. Sub Letting :-

The vendor shall not, assign this contract to any third party without the written consent of knowledge foods and any such assignment made by the vendor without the written consent of knowledge foods shall be null and void.

CHAPTER 4

4.1 Manufacturing of Panels (Overall Process) :

There are Four types of Panel:
1) Single Front Drawout Panel
2) Double Front Drawout Panel
3) Single Front Non-Drawout Panel
2) Double Front Non-Drawout Panel

- **Three tyeps of sheets are use for manufacturing of panel :-**
  a. MS (Mild Steel)
  b. GI (Galvanised Iron) (265 GSM & 165 GSM size sheets are used in GI)
  c. Aluzinc (Aluminum and Zinc)

- **Raw material Inspection done before the cutting of panel**

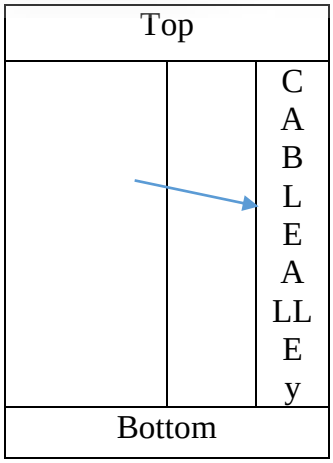
1. Waveness test
2. Checking the material finishing
3. Length , Width, Thickness are check or calculate
   (L=2500MM). (Width=1250MM)

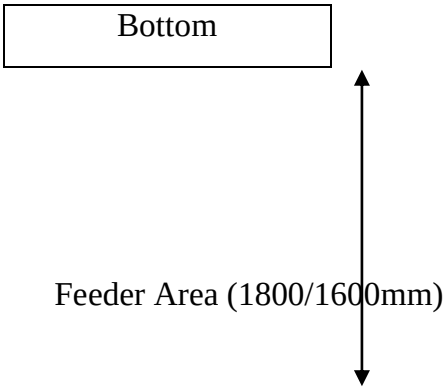
- **There is two types panels are used**

1. Bolted
2. Weleded

But generally welded are used because of bolted can get loose and required inspection and maintenance

Overall Process for Designing of Panel:
1) As a Example When Client Required Single Front Drawout Panel Then We will fill the Technical Data sheet.
2) In Technical Data Sheet we are required IP level, Cable Entry, Busbar (Vertical & Horizontal), Busbar Type(Aluminium or Copper), Rating, Forms of Segregation,etc.
3) Then we will start the General Arrangement.





4) This Arrangement is Finalised then designing in start on Autocad or Automation.
5) Then Realised the drawing cutting start thorugh the cutting machine according to the programme or software.
6) Cutting is Completed then start the bending the parts if, they parts are required to bend.
7) Then we will start the powdercoating process.
8) It is over then the assembling the parts is started through the or with the help of welding.

4.2 Powdercoating & Fabrication :

- **Fabrication process are divide into different steps**

1. Steel metal sheet are check
2. Cutting (As per dimension Or requirement),(According to the layout Or design)
3. Smoothing
4. Bending
5. Powder coating (8 Tank Process)
6. Assembled
7. Structure

What is Powdercoating?

Powder coating is an advanced method of applying a decorative and protective finish to a wide range of materials and products that are used by both industries and consumers. The powder used for the process is a mixture of finely ground particles of pigment and resin, which is sprayed onto a surface to be coated. The charged powder particles adhere to the electrically grounded surfaces until heated and fused into a smooth coating in a curing oven. The result is a uniform, durable, high-quality, and attractive finish.

Powdercoating Process is a Eight Tank Process:

1) The material is precleaned before processing to the eight tank pre-treatment process.

2) Then material is passed through the eight tank process and which are As follows:

A) Degreasing

B) Water rinse

C) Derusting

D) Water rinse

E) Activation this to give uniform coating of zinc phosphate

F) Phosphating :-

This from coating of zinc phosphate (4 & 6 micron on the safe clean surface of ms)

G) water rinse

H) Passsivation

I) Drying

3) Again the material part are cleaned and hang it to the conveyer belt and passed it on to powder coating.

4) The specified power colour sprayed on the material for approx 80 to 120 microns.

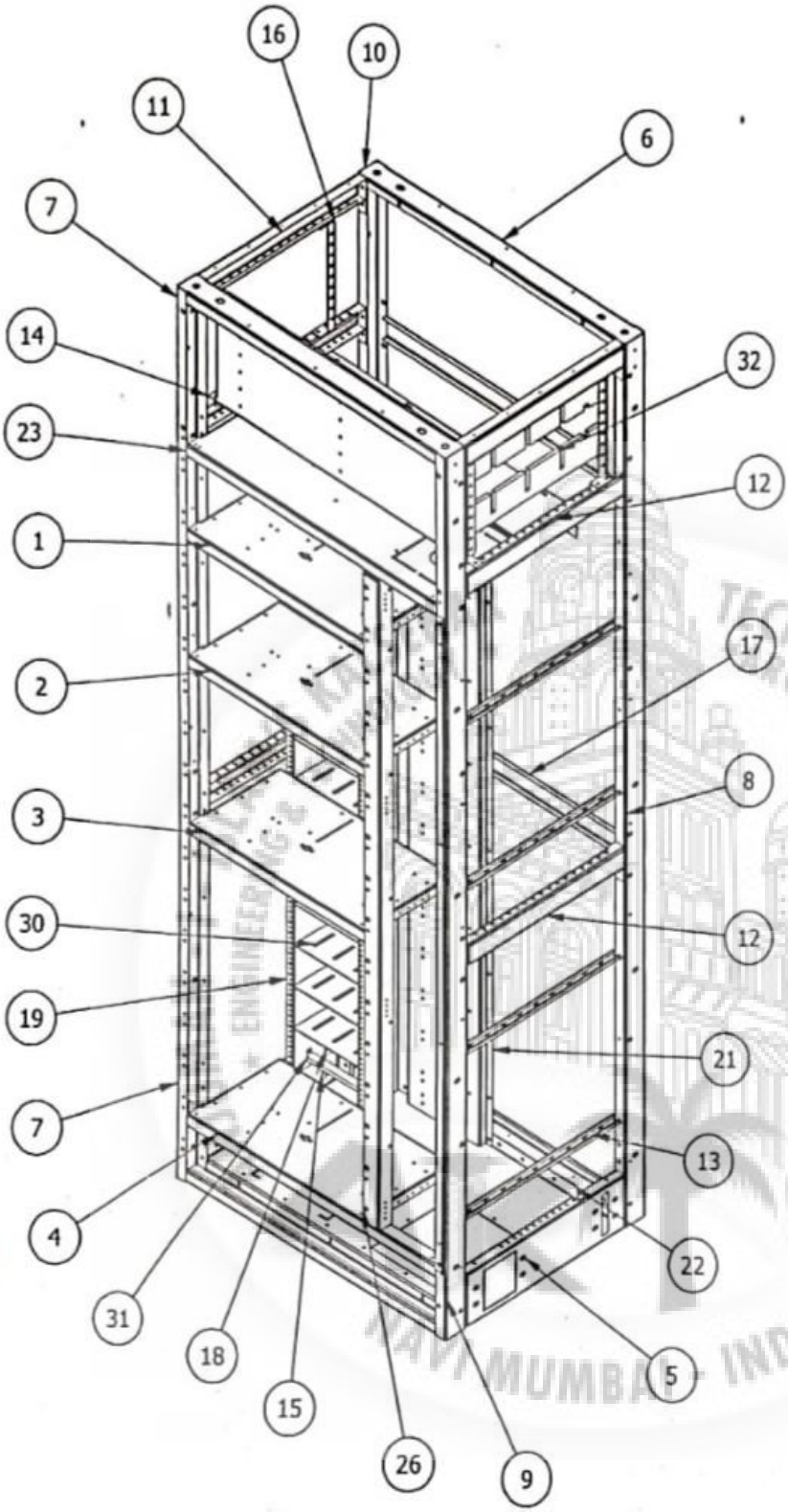
5)After this powder coated material is conveyed for the drying where the material is heated at 198 degree for 1 hours.

6) Then the material is conveyed to dispatch area.

7) In dispatch the powder coated material is inspected whether the powder coating is done properly or not.

8) After based on inspection final touch up is done in order to maintain uniformity.

9) Material is then packed so that it doesn't get damage during transportation.



PARTS LIST	
ITEM	description
1, 2, 3, 4	Mid Tray
5	Bottom Sheet SFDO
6	Top Bottom Channel
7	Front Pillar LH SFDO
8	Rear Pillar LH SFDO
9	Front Pillar RH SFDO
10	Rear Pillar RH SFDO
11	Side Top Channel
12	Side Mid Top Centre Channel
13	Cable Support
14	Horizontal Control Bus Guard
15	Horizontal Earth Bus Channel
16	Busbar Angle
17	Rear Frame Edge
18	Back Plate
19	Z-Support LH
20	Z-Support RH
21	OutGoing Plate
22	Cross Angle Plain
23	Top Tray
24	Bottom Tray
25	Top Guard Front SFDO
26	Vertical Edge
27	Tray Clit LH
28	Tray Clit RH
29	Top Tray Angle
30	Plain Vertical BB Support
31	Z-Support FRP
32	Single Run Busbar Support

5.1 DISTRIBUTION PANEL :

A distribution board is a component of an electrical system. It separates the power supply into several circuits in an enclosure. It provides each circuit with its protection system by using a fuse or circuit breaker.A typical electrical distribution board includes the following components – bus bar, fuse links, switches, bypass equipment and residual current detector (RSD). In today's world, safety is of the utmost importance when it comes to working with wires and cables at home.

Power distribution panels are a critical component of electrical supply systems that divide an electrical power feed into subsidiary circuits, while providing a protective fuse or circuit breaker for each branch circuit in a common enclosure. We offer a vast array of enclosures and internal components and will design and manufacture any number of power distribution panels to meet your project-specific requirements. These distribution panels are specially designed, assembled, wired, tested in accordance with industry standards and applicable regulations. Our panels are always built using methods and materials to maximize personnel safety, along with maximum space utilization and cost effectiveness.

Some of our standard options:

Varied enclosure options available

Pole configuration SP/N, DP, TP & TP/N

Hinged cover on all enclosures

Option of door interlock

External handles are pad-lockable in off position

5.1.1 Distribution panel component :

Main breaker:

This large circuit breaker is known as the main breaker, and it plays a crucial role in the electrical system by offering the means of disconnecting power to the entire circuit breaker panel and hence shutting off power to the entire house.

Circuit Breakers :

A circuit breaker is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by excess current from an overload or short circuit. Its basic function is to interrupt current flow after a fault is detected.

Bus Bars:

In electric power distribution, a busbar is a conductive material which is factory assembled to distribute electric power from a supply point to numerous output circuits, with greater ease and flexibility. For any distribution assembly, the busbar constitutes the real "backbone

5.1.2 Types of electrical distribution boards:

Based on the application and requirements, here are some distribution boards (aka electrical panel boards) that one can choose:

Fuse Boxes:

A fuse box refers to a consumer unit where all the electricity is controlled and distributed. It's important to know where it is located in your home because, in the event of an emergency, it is vital to find your fuse box with ease and turn it off to avoid a catastrophe. They contain three components – main switch, circuit breakers and residual current device

Main Breaker Panel:

A commonly used distribution board, main breaker panels protect the circuits and keep an eye on the panel's amperage capacity. They protect the circuits from getting overheated, with a breaker connected by 3 wires along each circuit. Incidentally, given its function, the main breaker panel can cut power to the house including the circuit breakers.

Main Lug Panel:

Main lug units are essentially used as a distribution board when there appears to be the main breaker upstream. Line wires run into these lugs, wherein the main lug panel can be used as a sub-panel when it is connected to a breaker from the main panel. In the event of an emergency, the disconnection at the meter can cut power without it entering the house.

Subpanels :

Subpanels are easy to install, safer and efficient for homes. They are smaller and help in distributing power to a specific part of your home or area in the property, focusing as a satellite circuit breaker panel specifically convenient to the area it functions for. They get their power from the main panel and are free to adjust the current distribution around the area or property. They, however, do not have disconnects.

Transfer Switches:

A transfer switch shifts load between two electrical sources. Often described as a type of subpanel, transfer switches are best for backup power generators wherein they convert generator power to electrical power via the breaker panel. The idea is to have the best quality switchboard connection that ensures a seamless supply of power and guarantees safety. There are essentially two

types of transfer switches – Manual Transfer Switches and Automatic Transfer Switches. Manual, like its name suggests, works when one operates the switch to generate the electrical load to the backup power. Automatic, on the other hand, is for when the utility source fails and the generator is used to provide electrical power temporarily. Automatic is considered more seamless and easy to use, with most homes opting for this convenient distribution board.

It is important to understand the different purposes of the distribution board. Bearing industrial uses in mind, different boards are suggested based on electricity and power usage and usage of cost-efficiency products. Here are some of the types of distribution boards used in industries:

Motor Control Centers (MCCs)
User-Friendly Human Machine Interface (HMI)
Operator Panels
Industrial Hydraulic Control Panels
Programmable Logic Controller (PLC) Panels
Industrial Hydraulic Control Panels

Important points to note about electrical distribution boards:

Invest in the necessary components: It should be understood that in addition to the cables and circuits, an electrical distribution board warrants a fuse link, a bus bar, a residual current detector and bypass equipment. For protection against shock or fire, the residual current detector is required.

5.2 ASSEMBLY PROCESS OF PANEL :

5.2.1 . Electrical Custom-built Assemblie :

We have in-house infrastructure and business capability to manufacture any type of electrical custom-built assembly. We specialize in manufacturing the following:
Power Control Centers-Up to 5000A
Generating Set Panels, AMF Panels, Auto Synchronizing and Load Sharing Panels using PLC controls.

Motor Control Centers-Up to 3200A, draw-out or non draw-out type.
Power Distribution Boards (AC/DC Distribution Boards upto 1000A/630A respectively)
Cubicle design giving a flush and elegant appearance sheet steel of desired thickness
Industrial designs using angle iron frame.Feeder Pillars-Both outdoor and indoor type for street lighting, distribution, telephone network distribution, and power distribution for multi-story complexes or residential areas.Special type of motor starters and panels for Air Conditioning Plants, i.e., AHU Panels, HVAC panels

Process Control Panels with mimic diagrams :

Control & Relay Panels up to 66kVA.rising Mains up to 1600A for distribution in multi storey buildings with adaptor boxes and tap off boxes and bus ducts upto 6300Amps.
PLC Panels for process automation industries.
Bus trunking up to 4000Aover-head busbar systems rated from 100A to 400A for industrial bays having multiple machines where power supply can be tapped off directly to the machines with the help of tap-off or plug-in boxes.
HT Panels up to 11kV.cable Trays-Ladder or Perforated type and Raceways.

5.2.2. Fabrication, Pre-treatment and Painting:

The housing is fabricated out of 14 gauge MS sheets and is of welded or bolted construction. The base is made of 10 gauge channel with removable gland plate on top and holes for grouting at the bottom.our Fabrication facility is spread over 5000sq.ft area and includes state-of-the art shearing and bending machines. We have CNC based machines to have any type of bends or cut-outs required in the enclosures. Our comprehensive tooling division ensures any type of specialized or customized fabrication works can be undertaken by us.

Unique features of our pre-treatment and paint shop:

Large size and 8 tanks.

Phosphoric acid based pre-treatment chemicals.

Boilers for adequate heating of tanks.

Powder Painting booth of Thermax make.

Electrostatic guns for uniformity of paint coating (used from 2 sides).

Electric hoist for better object movement.

Diesel Fired and Electric Heated Baking Oven-size 2.8 x 2.7 x 1.8 meters (H x L x W)

Air compressor with moisture and oil preventing filters.

Fabrication:

Fabrication is the first stage of production process and is performed inside the factory premises. Fabrication is done according to work order drawings using CNC based machines such, power press, press brake, notching and electric welding machines. Completion of fabrication is followed by inspection done by our QC Inspection Team as per the quality plan.

Pre-treatment and Painting:

The second stage is the pre-treatment of the product. This activity ensures that the metal surface is free from traces of oil, grease and rust and a very thin layer of iron phosphate is deposited before it is painted for good adhesion of paint. Pre-treatment is done by following a process of dipping in tanks of 3000mm (long) x 1100mm (wide) 1200mm (deep) by help of electric hoist of 3ton capacity running over the tanks.

Painting:

After the completion of pre-treatment process, the product is ready to be painted. This activity is performed to cover the metal surface with non-rusting material and to give the desired shade and finish to the product. We have a facility for both liquid paint as well as powder coat paint. As a standard practice we provide powder coat paint, whereas liquid paint is available on demand/special application

5.2.3. Assembly:

Various activities are performed in this section. These activities are generally independent of each other and may not be done in a sequential manner.

I. Assembly of Panels:

Panel joining and base channel fitting.

Door channel fitting.

Door gasketing

Door fitting, adjustment and lock fitting.

Top plate and bottom plate fitting.

Lifting hook fitting.

II. Busbar:

Switchboards incorporate 3-phase, 4-wire, 50 Hz suitably rated Electrolytic Copper or Aluminum bus bars which are air insulated. The bus bars are mounted on SMC/DMC supports providing spacing as per IS guidelines. Hylum sheet brackets by counter-sunk screws and specially designed acrylic sheets shrouding are provided in order to provide protection to the operator.

Busbar fitting includes:

Busbar support fitting.

Busbar preparation, sleeving and fitting.

Fitting of earth Busbar / Earthing bolt.

To facilitate earthing, a G.I. bar 50 x 6mm or 25 x 6mm size is provided at the bottom of each panel. These bars are painted in green shade for identification, with sufficient unpainted space spared for earthing connections. Also, earthing stickers are fixed on the outside of the panel from where the connection is to be taken.

III. Component Fitting:

Feeder Name Plates as per the feeder descriptions are fixed over each feeder, and similar name plates are also provided on the front of the panel board.

5.2.4. Wiring, Terminals and Hardware:

Wiring of equipment: is carried out inside the factory premises with insulated, flexible copper conductors. Selection of colour and size of control wiring, identification of control wires by PVC ferrules is done according to work order drawings. Size of the conductors is selected as per current ratings of various feeders.

Terminal & Hardware:

For terminating control inter-connections, suitable terminals are provided for equipment. These are suitably numbered to ensure proper connections and to facilitate ease of maintenance. All other hardware accessories such as lugs, glands, locks, etc are used as per our strict quality control measures.

5.2.5. In-house Testing:

After assembly each switch Board, LT Panel and Bus Duct is thoroughly tested. Suitable tests are carried out to ensure continuity of operation. In-house tests cover the following:

Wiring Continuity Test

Insulation Resistance Test

Earth Continuity Test

Earth Resistivity Test

Testing of Polarity of non-linked Single Pole Switches.

Operation checks

Besides the above, any other test specified by the local authority shall also be carried out.

CHAPTER 6

6.1 FIRE CONTROL PANEL :

Figure 6.1 Fire Control Panel

Introduction

A fire panel is a safety appliance that commercial buildings typically require in order to set into motion a number of tasks that could save lives and minimize property damage. If you're in charge of ensuring a building has all the required features necessary for the sake of safety, you might be in the market for a fire panel. Before you start looking for one, you should get to know what the typical fire panel does, which buildings need one and which features to look for in a fire panel.

Why do you need a fire panel in your Building:

The point of a fire alarm control panel is to activate a quick emergency response when there's a fire so everyone in the building has a chance to get out safely. Different fire panels on the market have different features, so the capabilities of this product can vary. For example, a basic fire panel might sound an alarm to alert everyone of the danger. Some fire panels also call the fire department, and some even activate the building's sprinkler system to try to put the fire out fast. The capabilities depend on which fire panel you decide to buy.

If you're wondering how the fire panel works in general, note that when a fire breaks out, the fire panel receives a signal from smoke detectors, the fire sprinkler system, a manual call point or a pull switch in the building. This means it can't detect the fire on its own, but it can respond to the signals it gets from the systems that detect the smoke. At that point, the fire panel's response is activated, which might include making a loud noise and lighting up to warn people of the fire, and then it may send a signal to the fire department or alarm company to get emergency crews to rush to the building and put out the flames.

6.2 MAIN TYPES OF FIRE PANELS :-

There are two main types of fire panels available.

1.Conventional panel
2.Adderesable panel

Conventional panel have been around for years, so you might see them in older buildings. They work by responding to changes in an electrical current, such as when a smoke detector identifies smoke and changes the current in response. Once the fire panel detects this current, it sounds the alarm. The conventional fire panel is installed in different zones—such as the first floor, second floor, etc.—so it's often also called a zoned panel.

The newer type of fire panel is called an addressable panel. This system runs off modern technology, since it features a microprocessor that sends data from devices in the building to the panel, rather than just sensing changes in electrical currents. Every device in the building's fire detection system has its own address, so the addressable fire panel can identify which device the signal is coming from. This makes it easy to locate the device that has sent signals to the fire panel.

6.3 MANUFACTURING PROCESS:

The sheet metal enclosure for the Control Panel is designed and fabricated in the unit. The components are bought out from the reputed sources and fitted at appropriate places on the panel as per manufacturers design.

6.4 Fire control panel Applications :-

Easily expandable and flexible, the PROACTIV FACP is ideally suited for high-risk commercial, institutional and industrial installations including:

1. Power and other utility sites
2. Warehousing and logistics
3. Telecommunications
4. High-tech manufacturing (for example, semiconductor fabrication)
5. Public buildings, transport facilities and shopping centers

CHAPTER 7

7.1 Capacitor bank and reactive power compensation panel :

Design of reactive power compensation panel is much different and not that simple like standard distribution panel. When dealing with such panels, there are dozen of parameters to specify and other things to take care of.

The aim of project called „Reactive power compensation panel" was to design capacitor bank with **rated power of 20kVar and rated voltage of 400V** adapted for operation with mains, where higher order harmonics are present. The capacitor bank was to be power capacitor based with automatic control by power factor regulator.

In this capacitor bank there are 5 capacitors are connected 1kvar,2kvar,4kvar,8kvar,15kvar.

Figure 7.1

This type of device was chosen as a compensator, because of its price compared i.e. to active filters. The capacitor bank will be launched as a new product of the company, so it is necessary to meet all the standard`s requirements in terms of the elements, dimensions, connections, cross section of the wires, capacitor protection since it needs to be tested and accepted by certified laboratory.

Bearing above in mind, first thing to do is to investigate basic requirements for capacitor banks according to the polish standards.

Access to the particular elements within the capacitor bank should be easy, so that there is no problem to replace an element in case of failure

Index of protection depends of the place of the installation of a capacitor bank. If the capacitor bank is to be placed in the same place as the main switchgear or utility room next to it, IP 20 is enough.

Section construction – in a device for reactive power compensation particular sections can be determined, placing them in separate partitions or within the same cubicle.

Marking – each capacitor bank has to have nameplate, which contains information about: manufacturer, identification number, date of manufacture, rated power in [kVar], rated voltage in [V], min and max ambient temperature, index of protection, short circuit strength in [A]

7.2 Contents:

1. Enclosure
2. Arrangement of the elements
3. Power capacitors and detuning reactors
4. Acceptor circuit
5. Number and type of capacitors
6. Contactors
7. Protection
8. Connection diagram
   - 8.1 Main circuit
   - 8.2 Control circuit

1. Enclosure

Having above information, it is possible to find fitting cubicle for the elements of the capacitor bank. Because the device is going to operate at the mains, where higher order harmonics are present, power capacitors must be protected by reactors. Each capacitor emits additional amount of heat as well as a reactor.

Capacitors and reactors working in improper thermal conditions are exposed for danger of

overheating and its life expectancy gets shorter.

In order to avoid this, one needs to follow few rules, that will prevent unwanted effects. These are as follow (generally for switchgear cubicles):

1. The distance between air inlet and outlet should be possibly far in order to provide the maximum speed for the air stream.
2. The dimension of the inlet should be at least 10% bigger than the outlet

   Vertical dimension of the inlet/outlet should be the bigger one.
3. Avoiding air flow at the right angle or zigzag line.
4. In case of forced cooling, ventilators should be placed at the bottom of the cubicle in order to launch a cold air into the switchgear.
5. Choosing the fun, the real air flow should be considered, since theoretical one can be can be higher in terms of counter pressure effect.
6. Since one knows that ventilator has to be placed, it is needed to calculate the efficiency of the cooling system. Generally, we can assume that the power loss of the power capacitor (including wires, discharging resistor and contactors) is approximately **7W per / kvar – for acceptor circuit** (capacitor and reactor).

2. Arrangement of the elements:

The arrangement of the elements inside the enclosure should be easily available for maintenance and replacement, and each element should be clearly marked according to the technical documentation.

In the project, in terms of the construction of the enclosure, following solution was taken into account (see figure 3 below).

Elements no.1, 2 (violet font) these are the metal plates which constitute panels for contactors and protection equipment of particular sections of capacitor bank.

Element no. 3 represents the barrier between capacitor and reactor.

All the elements 1,2,3 come from the same manufacturer, taken from the same catalogue, in order to make easier construction of next device of similar type and decrease parts diversity.

The next requirement for the reactors is to be placed above the capacitors, since they evolve much more heat than capacitors which is lighter and could go up causing the capacitor temperature to rise. If one wants to place the reactors in the same cubicle, they should be physically separated by a barrier.

That is what was mentioned in EN 61921:2005 Section construction**.** In the project, the barrier was carried out by means of a metal plate placed between capacitors and reactors**.**

3. Power capacitors and detuning reactors:

The next step is to choose appropriate power capacitors. It means, that one needs to pay attention to its rated voltage and power. Since the capacitors will be working in series with reactors, what will cause the voltage at the capacitors' terminals to rise.

According to data sheet given by the manufacturers most of the capacitors cannot withstand the voltage of $1.1 \times U_n$ longer than 8 hour per day. For this reason, there is a need to apply the power capacitors with the rated voltage higher than the voltage of mains.

By reason of this one must take under consideration a statement below:

As the voltage rises or drops, the reactive power of the capacitor changes as well, according to the formula:

$$Q_R = Q_N \left(\frac{U_S}{U_N}\right)^2$$

Where:

Q_R – calculated power of the capacitor

Q_N – nominal power at rated voltage

U_S – voltage of a mains

U_N – rated voltage of capacitor

Project rated power of the capacitor bank equal to **400V**. Let's carry out an example calculation. Considering power capacitor with rated power of **20 kvar** and rated voltage of **440V** supplied by mains at **U_n=400V**.

$$Q_R = 20\left(\frac{0.4}{0.44}\right)^2 = 16{,}52\text{kVar}$$

This type of calculation is true, if there is no reactor connected in series with capacitor. Once we know the total reactive power of the capacitors, **we can choose series of capacitors for PF correction**. There is 20kvar to be divided. Taking this into account, at his point, one needs to consider the number of capacitors that will be used.

4. Acceptor circuit :

Power electronic based devices have significant, negative influence on the power quality. Since its number is increasing nowadays, it leads to designing more and more capacitor banks, that are well prepared to work with distorted voltage and current.

This is obtained by, so called **detuning reactors**, which are interconnected with capacitors within the circuit breaker (CB). Capacitor and reactor connected in series is referred to as an **acceptor circuit**.

This connection is depicted in the picture below:

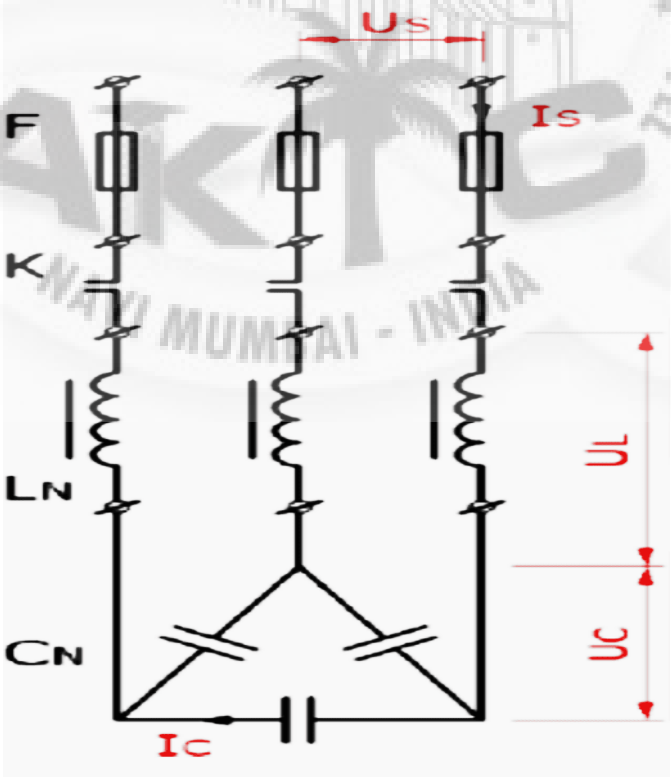


Figure 7.2 – The section of detuned capacitor bank

Table 1 – **Data for calculation**

Capacitor		
Rated power	Q_{cn}	20 kvar
Frequency	f_n	50 Hz
Rated voltage	U_{cn}	440 Volts
Other		
Mains rated voltage	U_n	400 Volts

The total power of the capacitors that are used in capacitor bank will be bigger, than assumed rated power of CB. It arose due to reactors connected with capacitors in series. Since voltage will be increased at the capacitor terminals, up to the 430V, overrated capacitors had to be used with the nominal voltage of 440V.

However, nominal power of the capacitor is reached at its rated voltage, so i.e. **20kvar at 440V**. If the mains voltage is 400V, capacitor nominal voltage 440, and reactor cause voltage change at the capacitor terminals as well as launch additional reactive power to the circuit, all the calculations introduced in this article must be done.

5. Number and type of capacitors :

In capacitor bank for 20KVar 5 capacitors are used are
1 KVar, 2KVar, 4KVar, 8KVar, 15KVar. Also load requirement assume to be extra i.e.5%

Characteristics of chosen capacitors:

The company produces Capacitors in MKP and MKV systems. Both dielectric systems are **self−healing**. Metal plated layer is evaporated in case of the voltage breakdown. Formed insulating surface is very small and does not effected the functionality of the capacitor.
Capacitors windings are inserted into aluminum container. Container is equipped with the **overpressure disconnector**.

Figure 7.3 Dry Cylindrical Capacitor by WORLDTEK POWER OPERATOR

Sequence of a letter	Feature	Letter	Description
1	Application	C	PF protection
2	Number of phases impregnat	S	Single phase, Three phase without impregnat
3	Cooling case construction	A	Steel insulated case

In order to check, if the capacitors are suitable for reactive power compensation and match the project assumptions, one can decode the capacitor type description in compliance

6. Contactors :

The last step is to select the **protection of the capacitors as well as the contactors**. In order to do so, one has to scheme the catalogue cards of the manufacturers.

Contactors for the capacitor banks are specially designed, taking into account life expectancy of the contacts, as well as an extra module limiting the inrush current of the capacitor.

Separate contactors can be used for R phase. The output R phase is consider as a common, RYB phase connected input to output through contactors.

7. Protection :

The short circuit protection of the capacitors is provided by the switch disconnectors. For the capacitors the fuse link rated current should be **1.6 time of the rated reactive current of the capacitor**.

Not only capacitors should be protected against short circuit, but the whole capacitor bank as well. Usually, in the switchgear from which the CB is supplied, there is an additional circuit breaker for the capacitor bank.

Its value should be selected as:

Standard capacitor bank: **1, 36 × I_n**

Overrated capacitor bank: **1,50 × I_n**

Capacitor bank with reactors (n=4.3): **1,21 × I_n**

The next important issue is to provide proper section of the wires and conductors, which has to be able to withstand at least 1,5 of the nominal reactive current.

Different contactors amd MCB are used for protection of ratings 6A, 16A, 32A, 32A.

8. Connection diagram:

8.1. Main circuit:

The next task, which designer has to handle is to create the connection diagram for all the elements that were selected to be used in the capacitor bank. The capacitor bank should has two technical drawings, namely, main circuit diagram and control circuit diagram.

The main circuit diagram should provide information how to connect the capacitor bank to the supplying switchgear:

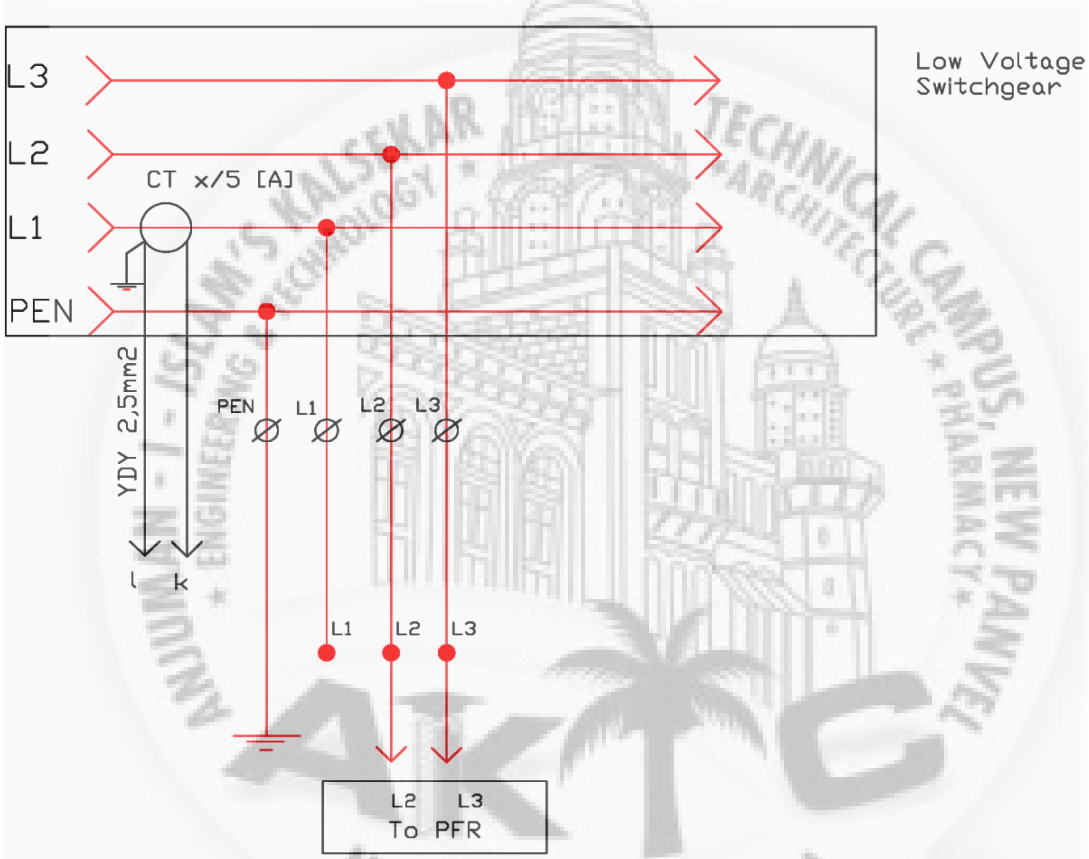


Figure 7.4 – Supplying network

There is three phase network incoming to supply the capacitor bank (Low Voltage switchgear). From the feeder, the incoming power is distributed through the bus bars mounted in the capacitor bank. The cross section of the bus bars is chosen so that it can easily withstand the current flowing through the device.

Moreover, it is important to know the proper number of isolators holding the busbars, since it determines short circuit strength of the device. In case of the capacitor bank, there are three insulators which gives short circuit strength of about 20 – 30kA.

The connection points (red dots) L1, L2, and L3 represents the point of connection of the capacitors and reactors with the bus bars.

8.2. Control circuit :

In order to connect all the control equipment and protection one needs a terminal stripe. Terminal stripe will cross all necessary wires in order to make the circuit work.

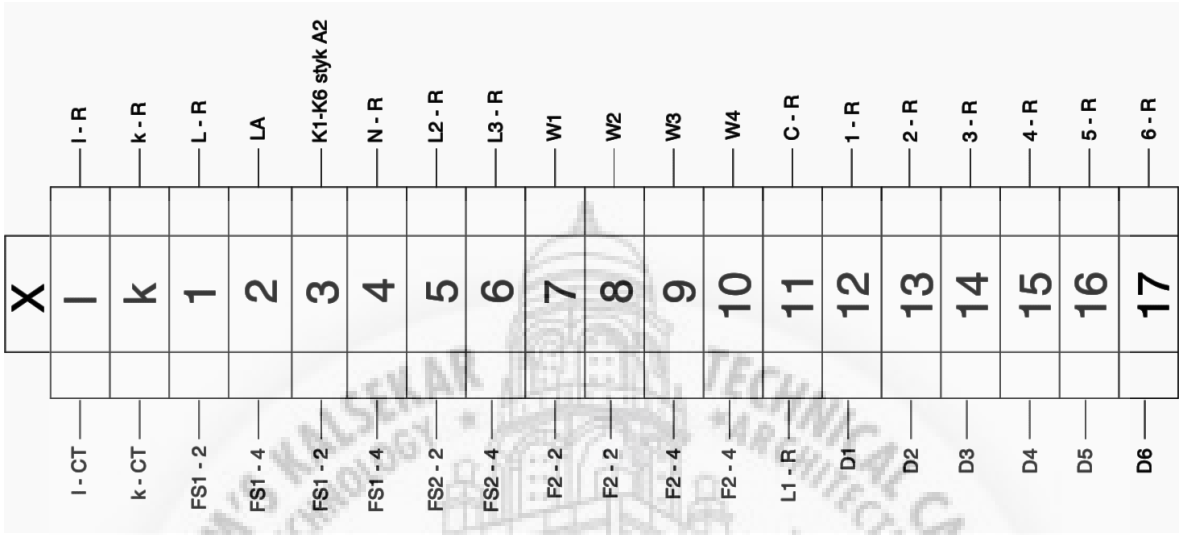


Figure 7.5 – Terminal stripe of capacitor bank

The terminal stripe needs to be provided together with the control circuit diagram for the wireman, who was going to connect the equipment. The bottom part of the terminal stripe is dedicated for the wires coming from:

Current transformer **l – CT** and **k – CT** from the supplying switchgear

Short circuit protection of regulator, ventilators **(FS – 1…F2.4)** as well as for the reactors **(D1 – D6)**

The upper part of terminal stripe contains the outputs, which are connected through the wires with the control, protection and cooling equipment. The letter **"R"** denotes the Power Factor Regulator i.e. "l – R " is a connection of the terminal "l" of the current transformer with the terminal "l" on the power factor regulator and so on. W1 – W3 terminals are assigned to ventilators.

Extraction of terminal stripe :

According to the terminal stripe, one can wire the circuit step by step.

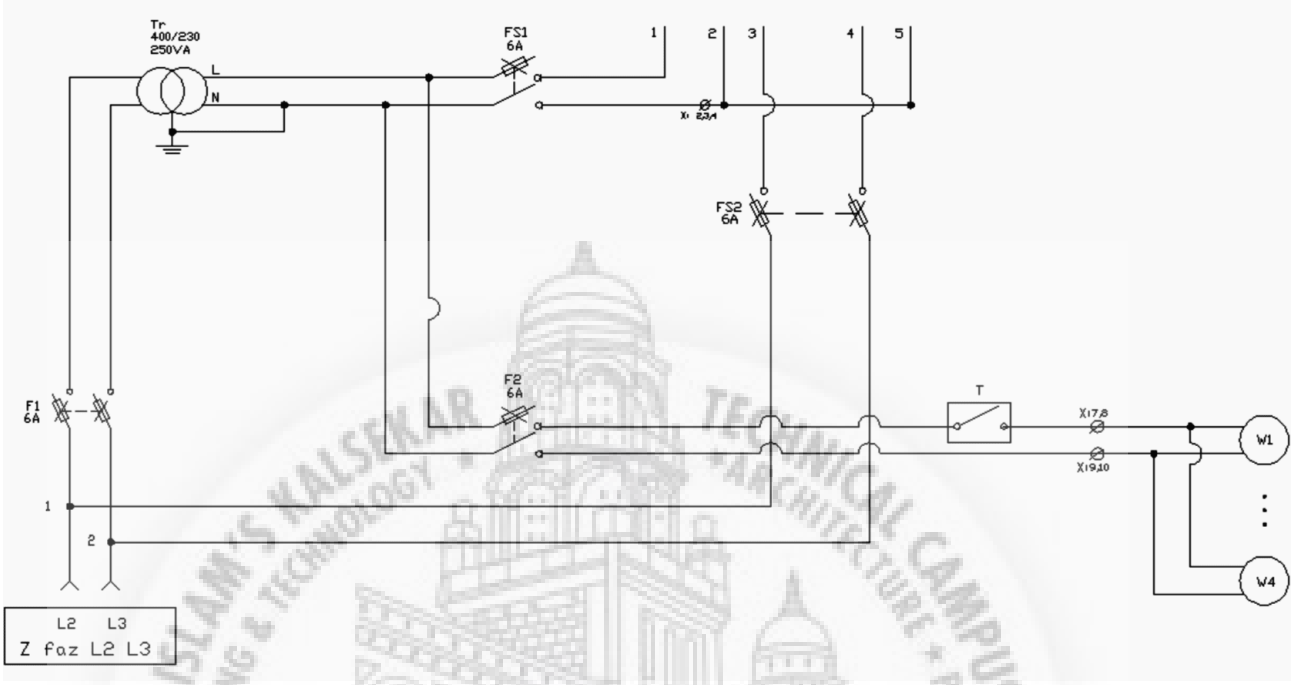


Figure 7.6 – Control circuit of capacitor bank (click to expand scheme)

First, on needs to use the phases L2 and L3 in order to supply the transformer **Tr 40/230V (250VA)**. The transformer is protected from short circuit by **two-pole switch disconnector F1** whit the fuse link of **6A**. At the output of the transformer, one gets the phase L (230V) and the neutral N.

The transformer will supply the equipment which needs 230V AC source to operate, that are:

Ventilators

Power factor regulator

Coils of the contactors

The ventilators are controlled by the thermostat **T** which will turn them on when the temperature will rise above 35 degrees of Celsius. The phase L2 and L3 is connected to the power factor regulator through the fuse **FS2**.The next picture will continue from the points 1, 2, 3, 4 and 5 at the very bottom of the figure above.

the layout of the **power factor regulator RMB 10.6**.

Figure 7.7

Power factor regulator RMB 10.6 – A miniature version of the regulator, designed for small, low-cost capacitor batteries. Mounting on a 35mm DIN rail. Has 6 outputs on contact relays.

The regulator has got three terminal stripes:

l, k, alarm

L1, L2, L3, N

C, 1 – 6

The terminals "l" and "k" provide connection for the current transformer mounted on the phase L1 in the main switchgear. The input alarm is connected in series with the lamp "LA" mounted on the door of capacitor bank. The lamp will light up every time, when contact "ALARM" inside the power factor regulator will close down.

The light will signalize each improper operation or error in the capacitor bank, Thanks of mounting it on the doors, it will be visible from far distances.

The second terminal stripes contains terminals L1, L2, L3 and N. The terminal L1 and N is connected to the phase L and neutral wire N of the transformer respectively. In this way, one provides the supply source for power factor regulator.

Phases L2 and L3 are connected to terminals L2 and L3 respectively. These terminals are responsible for the measuring of the voltage. Moreover, phases L1, L2 and L3 are leaded through the switch WL1. This solution lets disconnect the capacitor bank without disconnecting it at the main switchgear i.e. for the maintenance.

The last terminal stripe will control the coils of the contactors. The terminals 1 to 6 are connected to the coils of the contactors which trip the contacts in order to switch the capacitor on or off. They are followed by the contacts D1 – D6. These are responsible for the thermal protection of the reactors.

In case, when the temperature rise above the limit, that is safe for the reactors, the contact "D" of the reactor will switch off the circuit capacitor reactor .

Putting all these diagrams together, one obtains complete control circuit diagram for the capacitor bank.

7.3 Application of reactive compensation panel

The benefits are :

- Cheaper electricity rates, no reactive power charges
- No need for reinforcement of transmission or distribution systems
- Correct dimensioning of distribution system and equipment brings savings at source

The scheme includes

- RTPFC Panel
- APFC Panel

RTPFC Panel Application :

- 2 Phase Welding M/C
- Automobile Industry
- Rolling Mill

APFC Panel Application :

CNC Machine
- Film Industry
- Automobile Industry

CONCLUSION

Control panel design starts with the basics, and it's not just about selecting a cabinet and back panel to house your electrical control hardware. It's about creating a design to control a machine or process. To do that, hardware must be purchased and mounted on a back panel and then wired and integrated into the machine.

The modern tendency in industry is to produce as cheaply and quickly as is economically possible and the advantages which can be derived from the use of electricity have led to a steady increase in the amount of electrical apparatus used for industrial purpose. Therefore, some form of power factor correction is required in all the industrial facilities. Shunt capacitors are widely used in power factor correction applications. The shunt capacitors provide kVAR at leading power factor and hence the overall power factor is improved.