Daffodil International University

Dhaka, Bangladesh

Thesis Report

On

Field Study On Green Power Transformer Company

This thesis has been submitted to the Department of Electrical and Electronic Engineering in partial fulfillment of the requirement for the degree of Bachelor of Science in Electrical and Electronic Engineering

Prepared By:

MD. Sohel Rana	ID: 172-33-464
MD. Zahirul Islam	ID: 172-33-501
Shainur Rahman	ID: 172-33-533

Department of Electrical and Electronic Engineering
Faculty of Engineering

Supervised by:
Md. Mahbub –Ud- Jaman & Md. Sohel Rana
Lecturer
Department of Electrical & Electronic Engineering
Daffodil International University

APPROVAL LETTER

This thesis report titled **"Field Study On Green Power Transformer Company ",** submitted by Mohammad Sohel Rana ID:172-33-464, Md. Zahirul Islam ID: 172-33-501 & Shainur Rahman ID: 172-33-533 of the Department of Electrical & Electronic Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical & Electronic Engineering and approved as to its style and contents. The presentation has been held on January, 2021.

DECLARATION

We hereby claim that this thesis is based totally on the end result observed via ourselves. The materials of work discovered through different researchers are stated with the aid of reference. This thesis is submitted to Daffodil International University for partial success of the requirement of the degree of B.Sc. In Electrical and Electronics Engineering. This thesis neither in complete nor in component has been previously submitted for any degree.

Supervised by:	**Submitted by:**
Md. Mahbub-Ud-Jaman & Md. Sohel Rana **Lecturer** Department of Electrical & Electronics Engineering **Daffodil International University**	Mohammad Sohel Rana, Md. Zahirul Islam & Shainur Rahman ID: 172-33-464, ID: 172-33-501 & ID: 172-33-533 **Batch: 24th** Department of Electrical & Electronics Engineering **Daffodil International University**

CONTENTS

List of Figures & Table

ACKNOWLEDGEMENT

First of all, the complete reward to ALMIGHTY ALLAH, the author of the universe and whatever on this universe. He made us splendid creature, blessed us to perform this work. We are very grateful to Allah Almighty, who has provided us such an opportunity to gain expertise in Green Power Company Ltd. We would really like to explicit our cordial gratitude to my Internship manual, Md. Mahbub-ud-Jaman Department of Electrical & Electronic Engineering. Daffodil International University for his honest efforts to make this challenge as a success one. It turned into his guidance and relentless motivation at some point of the course of uncertainties and doubts that has helped us immensely to head in advance with this project. I would like to specific my heartfelt thankfulness to Md. Mahbub-ud-Jaman & Md. Sohel Rana Lecturer of the Department, Electrical Engineering for his guidance and aid. I am additionally grateful to the faculties of Electrical Engineering Department for presenting their helpful arms in the course of the direction of our undertaking. It turned into a wonderful experience to do internship over right here. We learnt many tasks practically which we've got learnt theoretically in advance. We additionally pay our gratitude to the Almighty for enabling us to complete this Internship Report inside due course of time. Words are only a few to explicit substantial humble obligations to our affectionate Parents for their prayers and sturdy willpower to permitting me to acquire this process.

ABSTRACT

This task gives the idea of designing a sub-station. By public demand they ordered us to make their required instruments. Sometimes they order instrument to us with the complete plan and design, sometimes we get order with the rating of instrument then we plan and we design. Sometime we do the complete project of a sub-station. We make transformer and all necessary panels for controlling and maintaining that sub-station. We also provide services to our honorable customers. If they have any damage products , we provide service to them.

Sub-station is all about power distribution. It is very much important for an Electrical and electronic Engineer. It is vital part of complete electrical system. So choose it because we always interested about how the power distributed as it is also very important for us. We have learnt many important things which strongly related with our study. We can use this knowledge in our real life as it has great section to use this knowledge.

We have invested our full day to achieve important knowledge and experience which will help us to develop power distribution system. We learn every steps of power distribution system related to a sub-station.

To accomplish this sub-station Transformer, VCB, LBS, Transformer, ATS, HT switchgear, LT switchgear, Power Factor Improvement (PFI), Magnetic Contact Switch, Module Case Circuit Breaker (MCCB), Miniature Circuit Breaker (MCB), ACB and Copper bars are used.

Chapter – 1

Introduction

1.1 Background of the Study:

The power company includes a huge variety of numerous manufacturing strategies and products. The maximum seen products of the power company are sub-station based which are HT switchgear panel, LT switchgear Panel, Power Factor Improvement Panel, Transformers, Vacuum Circuit Breaker (VCB), ACB, Automatic Transfer System etc. For the demanding position of these devices a large part of agency is involved with the manufacture of the component. After producing electrical power we need to distribute it properly and in safely way. Different level of consumer need different type of power. For controlling and maintain different type of power we also need various power distribution system and switchgears. As an Electrical & Electronics Engineer we need to understand properly the power system. This is why we were very much interested to look into this. There are many manufacturer company out there. For large amount of public demand many low class manufacturer get involved so that they could earn something but they actually responsible for bad image of our engineering. We are here to do something better for our consumer. For full filling our knowledge we had to experience this.

Objective of the Study

The main objective of the study is to access the academic knowledge in every part of my job and internship and to know the sub-station.

The main Objectives of the study are:

1. Planning a sub-station .
2. To Learn, How to Control the electrical Power and protecting the power equipment.
3. How to plan ,make and service every equipment of a sub-station.
   Such as High Tension Switchgear, Vacuum Circuit Breaker (VCB), Load Break Switch (LBS), Transformer , Automatic Transfer System (ATS), Low Tension Switchgear, Power Factor Improvement (PFI) ,Automatic Voltage Regulator (AVR), Ring Main Unit(RMU).

1.2 Limitations:

The section of this chapter deals with the limitations of the study that are as below:

1. We can't acquire all the information of the Green Power Transformer Company Ltd because of the company internal rules.
2. I haven't any permission to get every information about the equipment.

Chapter – 2

Company Profile

2.1 Introduction

Green Power Electrical & Electronics was founded by Engr. Gulzer Rahman & Engr. Abdul Awal**,** back in the year 2004. Green Power offers a full complement of specialized engineering management service, efficient Electrical & Electronics equipment to Govt. Autonomous & private organizations in Bangladesh. Green Power professionals have been Engineers, design, manufacturing, supply, installation, testing and commissioning with a proven track record of successfully working with national & international companies, contractor & all type of Electrical & Electronics equipment manufacturer.

We also provide the subsequent planning, implementation, evaluation, operation and maintenance of power plant, power sub-station & transmission, distribution and automation.
Green Power has no compromise with dysfunction, disruption and inefficiency.
Our aims are high in the field of power engineering and energy solutions and we create smart partnership venture and strategic alliance with the more established players in the engineering industry for expertise and technology transfer.

2.2 History of Green Power Transformer Company

"Green Power Electrical & Electronics" made its humble debut in 2004, is involved in the manufacturing and marketing of electrical and electronics product, headed by Engr. Gulzer Rahman & Engr. Abdul Awal, who are professionally competent, dynamic, well experienced with wide and varied background.

2.3 Clients and Products: **Bangladesh Army , Bangladesh Navy, Bangladesh Commission of Atom Research, Power Development Board, OWASA, CDA, BRTA, BUET, KUET, UNDP, Grameenphone, Robi Axieta Ltd, Bangladesh, TelliTalk, AB Bank Ltd, Agrani Bank Ltd, Al-Arafa Islami Bank, Bank Asia, BCB, Dhaka Bank Ltd, ICB Islami Bank, Islami Bank Bangladesh,Jamuna Bank, Podma Company, Pubali Bank Ltd, Rupali Bank Ltd, SBI, Standard Chartered, Southeast Bannk Ltd, Bangladesh Shilpa Bank, BAKASIBO, UCB, Uttara Bank ltd, WZPDCL, ACME, Unicef, SQUARE, Sajeeb Group, Radiant**

Pharmaceuticals, Partex Star, Nasir Group, Incepta, Healthcare Pharmaceuticals ltd, BEXIMCO Pharma and Government, Non Government, Autonomous, Private Organizations, Industry, Factories, Hospitals, Medical Center, Banks,
Market, Shopping center, High-rise Commercial Complex, Telecom, Data Center, Universities, Residential Complex & More.
More than 3000 Valuable Clients

Products are Oil cooled Transformers, Automatic Voltage Regulator (AVR), High Tension Switchgear, Automatic Transfer Switch (ATS), Low Tension Switchgear, Power Factor Improvement (PFI) and UPS

2.4 Company Basic Information:

Company Basic Information

01	**Location**	Mazar Road, 209/B 1st colony
02	**Address**	Green Power, Mirpur Mazar Road & Podma Crossing Savar
03	**Nearest Port of Loading**	Cittagong, Benapol, Dhaka Airport
04	**Tel. No.**	+88028032647-8, +88029013474, +880171308210
05	**Email**	Greenpoweree@msn.com
06	**Legal Status**	Private Company
07	**Year of Foundation**	2004
08	**Certifications**	ISO: 9001:2008; OHSAS: 14001:2004

Daily Average Production Capacity

Product Name:	Production Unit	Capacity
Transformer	2	06 pcs
AVR	3	10 pcs
HT switchgear	3	10 pcs
ATS	3	10 pcs
LT switchgear	3	10 pcs
PFI	3	10 pcs
UPS	3	10 pcs

2.5 Safety Precautions:

In order to avoid the hazards on the plant, company train their employees for the Safe handling and operation of materials and units installed on plant. So for this company follow following steps:

1. Give Knowledge
2. Give Training
3. Trouble Shooting
4. Smoking is strongly prohibited on all areas of the plant.
5. Leakages may occur and so serious damage can occur

Even a small mistake on the plant can cause a serious damage so MMM (Nab, Machine, Material) Is very Important

2.6 Different Safety Signs:

Safety signs are used for indication of the chance worried at the same time as carrying out the positive movement. They are very beneficial in for the concern as they deliver clear guideline approximately the hazard that one ought to face at the web site in which they are erected. Some unique protection symptoms are:



In safety there is a rule of triple **M.**

- Man Safety
- Machine Safety
- Material Safety

2.6.1 Man safety:

In safety the primary component is guy safety. Man, safety is one of the important things between the regulations of protection. Man, protection method the way to safe guy in operating region (plant). Mask, safe- shield, gloves and many others are supplied for protection. Also, no need of cellular.

2.6.2 Machine safety:

Machine safety is also crucial. The problem shoot, renovation of temperature is the important one. No use of cell near to gadget because safety of tripping and matching of frequency.

2.6.3 Material safety:

The protection of fabric is also vital. The aspect like sand is safe in keeping with its manner of protection. Other things like PTA, MEG are keep in keeping with its situations.

2.6.4 Power Distribution:

The feeder lines are fed to the panels placed there which are related to each brilliant with bus couplers alongside VCB breakers. From there, these lines are fed to Substation wherein the voltage is Step down from 11KVA to 400V. The strains from the transformers are fed to LVD Room in the shape of bus wires. The bus wires are fed to the panels in LVD Room in which the panels are connected in the shape of Ring Main System together with Power Factor Control and ACCB Breakers for protection purpose. From there, the energy is provided in addition as in step with requirement.

Chapter – 3

Sub-Station

3.1: Introduction:

In electrical, Sub-Station is a transmission or Distribution system from where electrical power starts transmitting or distributing. Voltage is also transformed from high to low or the reverse by using transformers. Step-up transformer is used to step up the voltage from low voltage and Step-down transformer used to step down the voltage from high voltage. We will design a complete sub-station from start to the end. The SLD of a sub-station is given below:

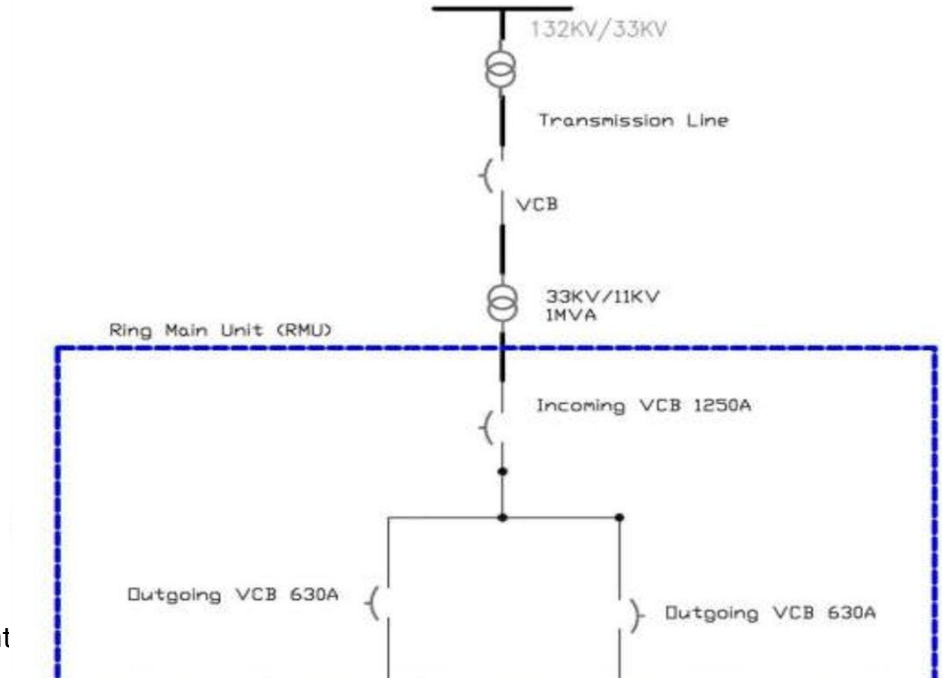


FIG 3.1 : SLD of a Sub-Station

Chapter -4

Transformer

4.1 : Transformer is the most important part of a sub-station. When we talk about sub-station , transformer comes first to talk about. In electrical ,Transformer is generally used for transforming the voltage high to low and vise-versa. Transformer transforms voltage without changing its power. It transfer voltage by the law of electro-magnetic field. There are many kind of transformer. Transformer rated in KVA which indicates it load capacity in power. In our industry we made step down transformer which reduces the voltage from high to low for distributing. The ratings of transformer are 50KVA, 100KVA, 150KVA, 200KVA, 250KVA, 315KVA, 400KVA, 500KVA, 630KVA, 750KVA, 800KVA, 1000KVA, 1250KVA, 1500KVA, 1600KVA, 2000KVA, 2500KVA, 3000KVA.

We also make Automatic Voltage Regulator Transformer (AVR) which regulates the voltage automatically. If the voltage decreased or increased from the required voltage then AVR regulate the voltage to the required voltage. It has range such as 380 to 460V. AVR can stabilize the voltage at 415 into this range. We use three separate transformer for regulating the each phase voltage. We made AVR in different rates. The highest rating of AVR we made is 1600KVA AVR. We sink the whole transformer into oil. Oil cooled AVR is more safer and more cheaper than dry type AVR**.**

Parts of a transformer:

1. Core

2. Winding

3. Insulation

4. Tank

5. Terminal and bushings

6. Transformer oil

7. Oil Conservators

8. Breather

9. Radiators and fans

10. Explosion vent

11. Tap changers

12. Buchholz relay

In Green Power Transformer Company, We made each and every components here. We have skilled worker for making these perfectly.

4.2 Some pictures:

Fig 4.1 Transformer 500KVA

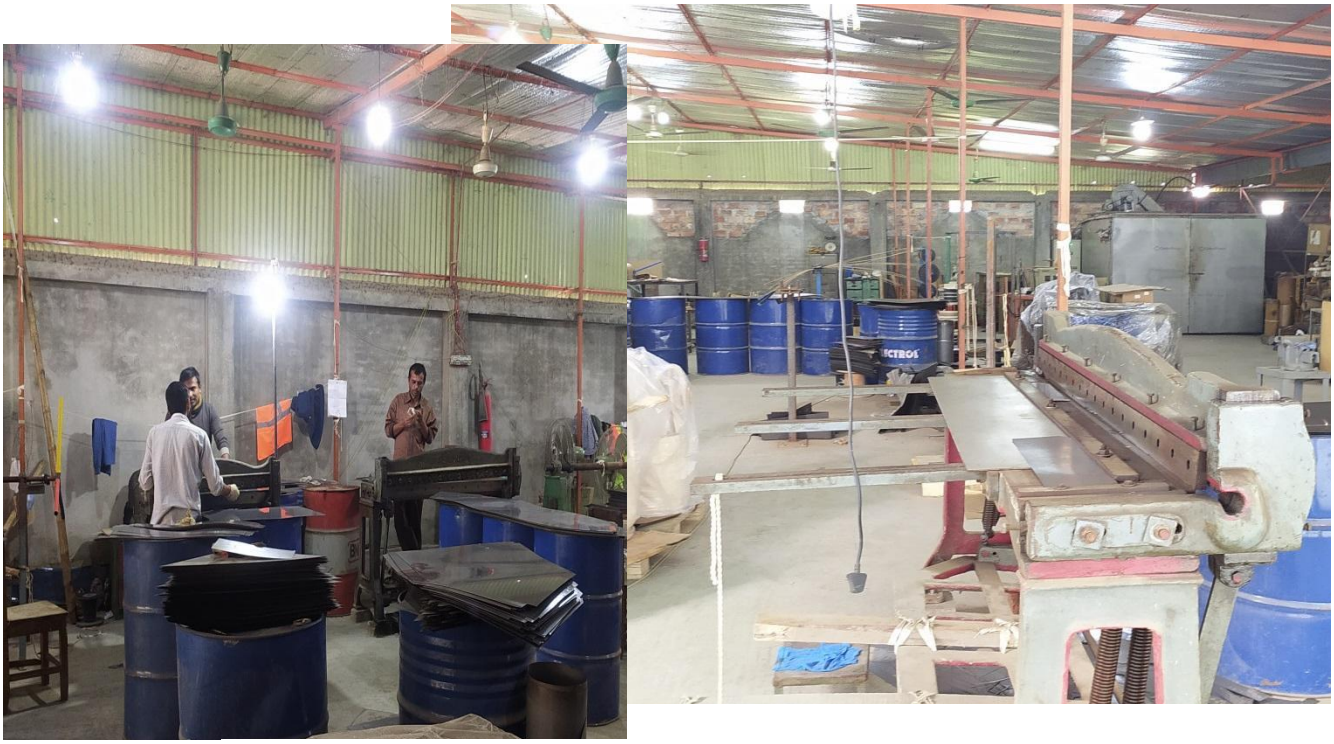


Fig 4.2 Transformer Production Room (Core & Copper)

Fig 4.3,4 Transformer Copper Winding and Tank

Fig 4.5 Tap Changer

Fig 4.6 Core assembling

4.3 Apparatus are used in equipment:

For power distributing equipment as RMU,LBS, HT, ATS, LT,PFI ,there are some common components we have used . We will not discuss about these common components again when the topic will be shown. We will discuss about these components in details with calculation.

The list of components are commonly used in our equipment:

a) Circuit Breaker
b) Magnetic Contact (MC)
c) Cable
d) Volt. Meter
e) Amp. Meter
f) Volt. Selector
g) Amp Selector
h) Thermistor
i) Timer Relay
j) OMRON

k) Current Transformer (CT)
l) Potential Transformer (PT)
m) Copper Bar (Bus Bar)
n) Indicating lamp
o) PUSH Button Switch
p) Cooling Fan
q) Heater

a) **Circuit Breaker:** A circuit breaker generally works as a switch and protection. There different types of circuit breaker. We used 2 type of circuit breaker in LT switchgear. MCB and MCCB are two types of circuit breaker we used in LT switchgear. MCB consider for Miniature circuit breaker and MCCB is considered for Molded case circuit breaker.

MCB also has different types of Circuit breaker as Single Pole (SP) circuit breaker , Double pole , Triple pole and 4p circuit breaker. We used MCB in current range of 6 – 63 A. For more current we can also use MCB but it won't be safer than MCCB.

So when we need to put any 50A and more CB we use MCCB. It works very faster in current than MCB.

Figure: 4(a) MCB (Schneider& ChiNT)

a)

Figure: 4(a) MCCB (Schneider& ChiNT)

MCB MCCB MCB MCCB

b) **Magnetic Contact (MC):** Magnetic contact is also a switching device. It's also connects or disconnect the flow of electricity. It works as the electromagnetic low. It has a coil when we supply power to the coil , then the coil works as a magnate and pulls the moving contact so Normally Close (N/O) become open and Normally Open (N/O) become close. It is very useful in electrical panel. There are many kinds of magnetic contact but they works in the same way. Some figures are in bellow. In PFI, MC is rated as double of capacitor rating. Suppose, for 50 KVAR capacitor, MC will be 100A.

Some ratings of MC are 12A, 18A, 22A, 25A, 32A, 40A, 50A, 65A, 80A, 85A, 100A, 220A, 250A.

Fig: 4 (b): Magnetic Contact (HYUNDAI) & DONG-A

c) **Cable:** Cable is a connecting wire made by copper. We use cable to connect circuit breaker with bus-bar and other components. Sometimes we use copper bar as connector when the flowing current amount is large. Else we use different RM connecting wire for different amount of flowing current. Sometimes we use copper bar as a cable when more current is flowing because it is more safer.

Table No. 01

SL No	Cable Size	Ampere Rating
01	1.5 RM	22 A
02	2.5 RM	30 A
03	4 RM	40 A
04	6 RM	50 A
05	10 RM	69 A
06	16 RM	95 A
07	25 RM	120 A
08	35 RM	160 A
09	50 RM	195 A
10	70 RM	245 A
11	95 RM	300 A
12	120 RM	360 A
13	150 RM	405 A
14	185 RM	460 A
15	240 RM	555 A
16	300 RM	640 A
17	400 RM	770 A
18	500 RM	855 A

19	650 RM	1030 A

d) **Volt. Meter:** Volt meter measures and shows the voltage in the phase. There are two type of volt meter. Those are analogue volt meter and digital volt meter.

Fig: 4(d) Analogue volt, meter

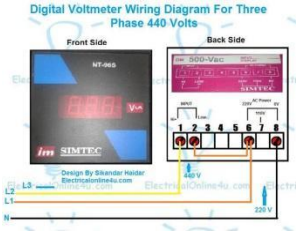


Fig:4 (d) Digital meter

** Note: **We can use multi-meter for measuring and shows the volt and current ampere. Then we don't need volt and amp meter separately**.**

e) **Amp. Meter:** Ampere meter measures and shows the flowing current through the phase bars. There are two types of meter we used in LT . Those are: 1. Analogue meter 2. Digital Meter

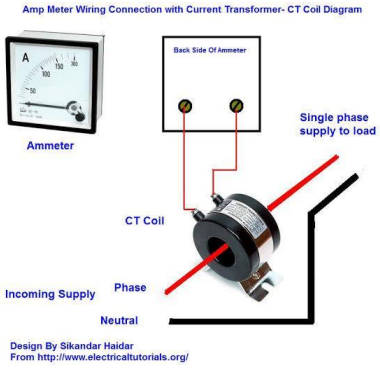


Fig: 4(e) Analogue Amp. meter meter

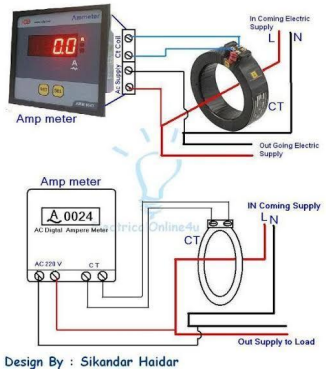


Fig: 4(e) Digital Amp.

f) **Volt. selector:** Volt selector select the phases for reading their voltage.

Fig 4(f): Volt selector

g) Amp. Selector: Amp selector select the current transformer's S1 and S2 terminals for reading current of the phases.

Fig 4(g): amp selector

h) **Thermistor:** Thermistor is a thermo resistor which changes it's resistance due to temperature. We use a thermistor which is also working as switching and it works in a temperature range. When panel temperature goes under the selected temperature, thermistor works as close circuit and switched the heater we use in LBS and VCB. When the temperatures go up than the selected temperature, thermistor switched off the heater. So this thermistor measures the temperature and also works as switch.

i) **Timer Relay:** Timer Relay is a switching device which works delay within setup time. It trigger the switch when the time comes to its end. It's very essential components we used in protection devices such as ACB, VCB, ATS and more other devices. It has also normally open (N/O) and normally close (N/C) switch. When it's coil supply it's start ticking and after a while N/O becomes N/C and N/C becomes N/O.

Fig 4(i): Timer relay

j) **OMRON:** OMRON is also a relay which works as switch. It has the same principle as Timer. Only the difference is OMRON don't take time to triggering the switches. It works very fast.

Fig 4(j): OMRON

k) **Current Transformer (CT):**

Current transformer used to measure current. It is also transformed the current to small so that it could be easy to measuring. Current transformer also has primary and secondary side. It secondary side provides the current which is proportional with primary side. Current Transformer used in high

Fig 4(k): CT

l) Potential Transformer(PT):

Potential Transformer is generally used to measure high voltage. It's voltage ratio is equal in primary to secondary. Actually it steps down the voltage for measuring. It's primary coil has a large amount of turn and secondary has very low amount of turns so that the higher voltage comes to very low voltage so that it can be easy and safe to measure that voltage.

In LBS,VCB we used two PT for measuring the high voltage. By two PT, we made open delta connection so the voltage become 110 v from 11Kv. We know in delta connection line voltage and phase voltages are equal. We use that 110v for measuring the high voltage and supplying the reading meter and to the indicating lamp through a MCB (TP).

Fig 4(l): PT

m) **Copper Bar:** When many electric component and devices need to consume power from one point we need to use bus-bar. From bus bar they all can collect power. Its easy and more safe to deliver power than adding all point together at one point. Bus bar generally made by copper . So we also call it Copper Bar.

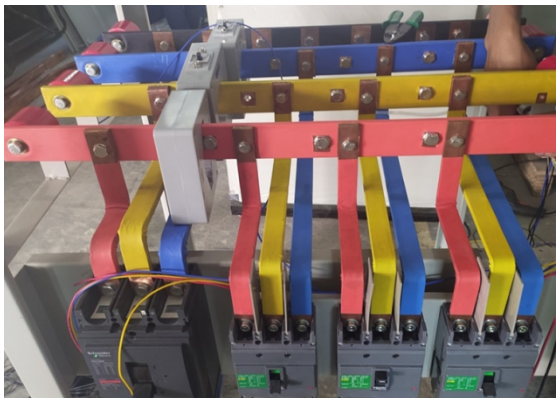


Fig: 4(m): Bus-bar / Copper Bar

We use different sizes Copper Bar and it depends on current flowing. We have a calculation method to measure copper bar depending on current.
The method is = **Wide×Depth×1.6** where 1.6 is copper density.

Example 4.1: A LT switchgear rating is 1000A . what will be the size of it's main copper bar?
We know Bus bar sizes according to current: Wide×Depth×1.6

= 50×15×1.6 = 1200A

If the bar size bigger according to current, it's not a problem. Because modified bar cost more than generally we get the bar available in market.

n) Indicating lamp: Indicating lamp is a lamp which indicate about whether the phase or line is ON/OFF. We use many kinds of and type of indicating lamp  arount 110v/220v .

Fig: 4(n): Indicating Lamp

o) **PUSH Button Switch:** A push button switch is a simple mechanism switch which turns On and OFF power supply. It has no coil but it has simple switch mechanism of N/O and N/C. It contacts the load with power and also cut off the power from the load.

p) Cooling Fan: Cooling Fan helps to reduce the heat produces in a panel or equipment. It also helps to get out the heat by air through air filter. For flowing of current, heat produces in component and it needs to get out or there can be happened any accident. So for safety purpose we use cooling fan in a panel.

q) **Heater:** Heater is use to produce heat. Heater reduces the moist environment. Moist environment is very risky for high voltage equipment. There can be fire or something for happening any accident. So we use heater for solving this problem. But if heater produces heat continuously, that will be also risky cause there will be blast. So we use heater through a thermistor. Here, thermistor works as a switch. Thermistor measure the temperature , when the temperature goes very low it turn on it's switch and heater starts to produce heat and when temperature get at the general level thermistor also measure this and turn off the heater. We used heater in VCB, LBS.

Chapter – 5

Ring Main Unit (RMU)

Objective (To know):

- **What is RMU**
- **Why do we need RMU?**
- **What are the apparatus of RMU?**
- **Wiring Diagram.**

5.1. RMU:

Ring main Unit (RMU) is a ring unit of a switching system which is used in High voltage system to turn ON/OFF, control, maintain sub-station separately. First it is used in United America then it is being used mostly in all countries. It one unit, two switching system that connect the load to the main power. **Our RMU was 1250A rated. It has two switching of 650A**.

5.2 Necessity of RMU:

RMU is very important for making easier to manage electrical distribution system. It is safe , easy to install and maintenance. It is also reduce the operational costs. It takes very less place to install. RMU made by **Vacuum Circuit Breaker (VCB)** which is very safe and more protecting system than other. It is all-in-one. It is also called as smart grid solution. For these huge amount of advantage now people are heading through using RMU Because they can control multiple distribution system from one panel and one place.

5.3 The apparatus of RMU:

a) Vacuum Circuit Breaker (VCB)
b) Miniature Circuit Breaker (MCB)
c) Potential Transformer (PT)
d) Current Transformer (CT)
e) Amp. Meter
f) Volt. Meter
g) Volt Selector
h) Inverse Definite minimum Time Relay (IDMT Relay)
i) Copper Bar
j) Push Button Switch
k) Thermistor
l) Heater

We have already discussed about some apparatus. Now we are going to discuss about which we don't discuss about.

Vacuum circuit breaker used in RMU because RMU is for high capacity distribution system. 500KVA or for more capacity we use VCB.

h)

IDMT Relay (Inverse Definite Minimum Time Relay) are protection relays. They are used on transmission lines to see to that the line current doesn't exceed safe values and if it does, triggers the circuit breaker. IDMT means inverse definite minimum time. So as the current keeps increases, the relay takes minimum time to trip the circuit. Inverse means "higher the current value, lesser the time taken for the relay to trip the circuit". That is why the relay is referred as inverse definite minimum time over current relay or simply IDMT relay.

IDMT Relay:

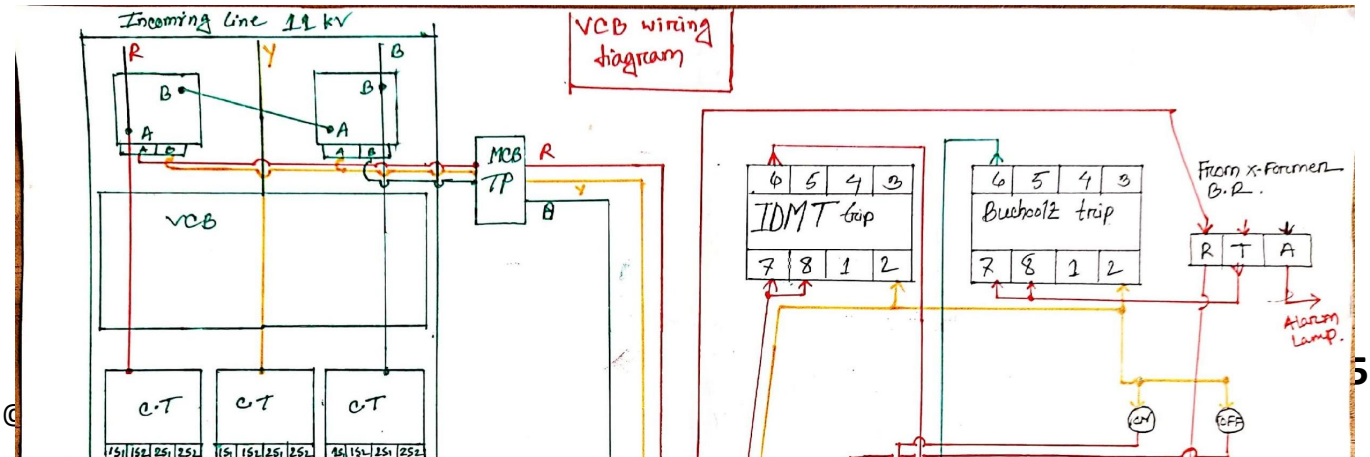
C) **Potential Transformer (PT):** We use 100VA PT for incoming VCB and 50VA PT for outgoing VCB. Incoming VCB was 1250A , so it's PT rate is high and outgoing VCB was 650A , so it's PT rate is low.

d) **Current Transformer (CT):** We use 400/5/5A CT for incoming and outgoing both VCB. Because the current in RMU was very high.

g) Copper Bar: Our VCB incoming current was 1250A. as we know copper bar sizes are depend on current rate. So for incoming VCB the copper bar sizes were=Wide×Depth=60×6 and outgoing VCB, copper bar was=60×5×1.6 where 1.6 is copper density.

5.4 Wiring Diagram of VCB:

As we know, we used VCB for completing the RMU**.**



Chapter – 6

Load Break Switch (LBS)

Objective (To know):

- What is Load break switch (LBS)?
- Why do we need LBS?

- What are the apparatus of LBS?
- Wiring Diagram

6.1 Load break switch (LBS):

What is load break switch? It is defined by it's name. Load break switch break the conducting system from the consumer. It connects and disconnects the source from the consumer. It can break the connection from the consumer by manual, and tripping. It is very useful for on-load making and breaking in low voltage. LBS generally used when the distribution transformer is 500KVA or less than 500KVA.

6.2 The purpose of using LBS:

As we know LBS is working as the principle of a switch. It turns on and off the electricity connection from the consumer. It can safely disconnect load from the source. It is a switch so it does control and protect. LBS used in High Tension side of a Transformer for protecting the transformer and maintenance it. It is used when the sub-station is under 500KVA. It works good in this range but for more KVA transformer we have to use VCB for better safety and control.

6.3 The apparatus of LBS:

a) LBS
b) KV meter
c) KV selector
d) Ampere meter
e) Amp selector

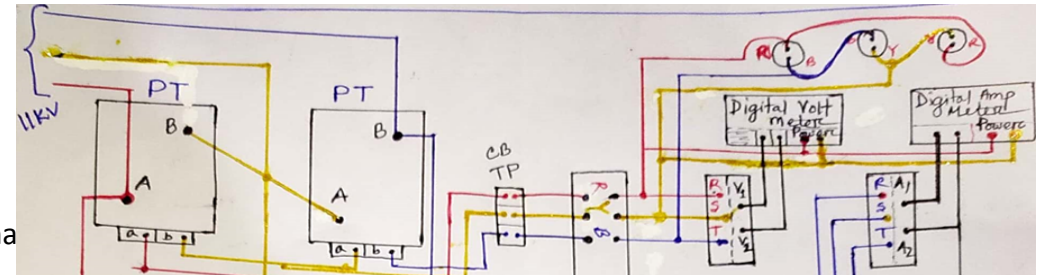
f) Connectors
g) MCB-TP
h) Indicating lamp
i) Potential Transformer (PT)
j) Current Transformer (CT)
k) Thermistor
l) Heater
m) Copper Bar

a) Load Break Switch (LBS):

Load break switch break the electric conducting system from the consumer. It connects and disconnects the source from the consumer. It has fuse. When any large current flows through the fuse, for protecting the line it cut off by itself. Further we just need to change the fuses. It's very simple to install than other Circuit breaker as VCB. It has also simple wiring diagram. It has a coil which takes DC voltage from AC source by rectifying it. We can turn off this LBS through that coil. When we supply power to the coil it pushes a little hammer to the tripping point for turning it off. But we can't turn it on by that coil. We have to turn it on manually all the time.

f) **Connector Strips:** Connector links two terminals together. There are many kind of connector we use in panel . The connector show in fig: 3. 3 is named as it number of pin such as 3pin connector, 12 pin connector.

6.4 Wiring Diagram: The wiring diagram of an LBS is shown below:



Chapter – 7

Automatic Transfer Switch (ATS)

Objectives:

(i) What is ATS?

(ii) What is the purpose of using ATS?
(iii) How it works
(iv) The components of an ATS
(v) The wiring diagram of an ATS

7.1 ATS: ATS is stands for Automatic Transfer Switch. Automatic Transfer switch Transfers essential power to the load. It is generally used to uninterrupted the production system of a industry. This ATS is made by two ACB.

Figure 7.1: ATS 2500A

7.2 The purpose of using ATS: ATS is an automatic power transfer system. All Industry and Factory run by PDB electrical power. But they can't provide us with uninterrupted power due to short circuit, maintenance the distribution system or any other reason. We want to continue our production so we can not wait to come PDB electric power. So we need auxiliary power system to continue our production. We use Generator as auxiliary power supply. ATS supply the auxiliary power to the load when PDB supply is off. We can also switch the power system manually but it will take more time automatic system which will reduce our production system.

7.3 Working principle: The ATS we made , We made it by 2ACB . One ACB for PDB power supply and another ACB for generator Power supply. 2ACB are connected as interlock system. In ATS, Interlock system means when PDB power is ON , Generator power supply will be OFF automatically by ATS system

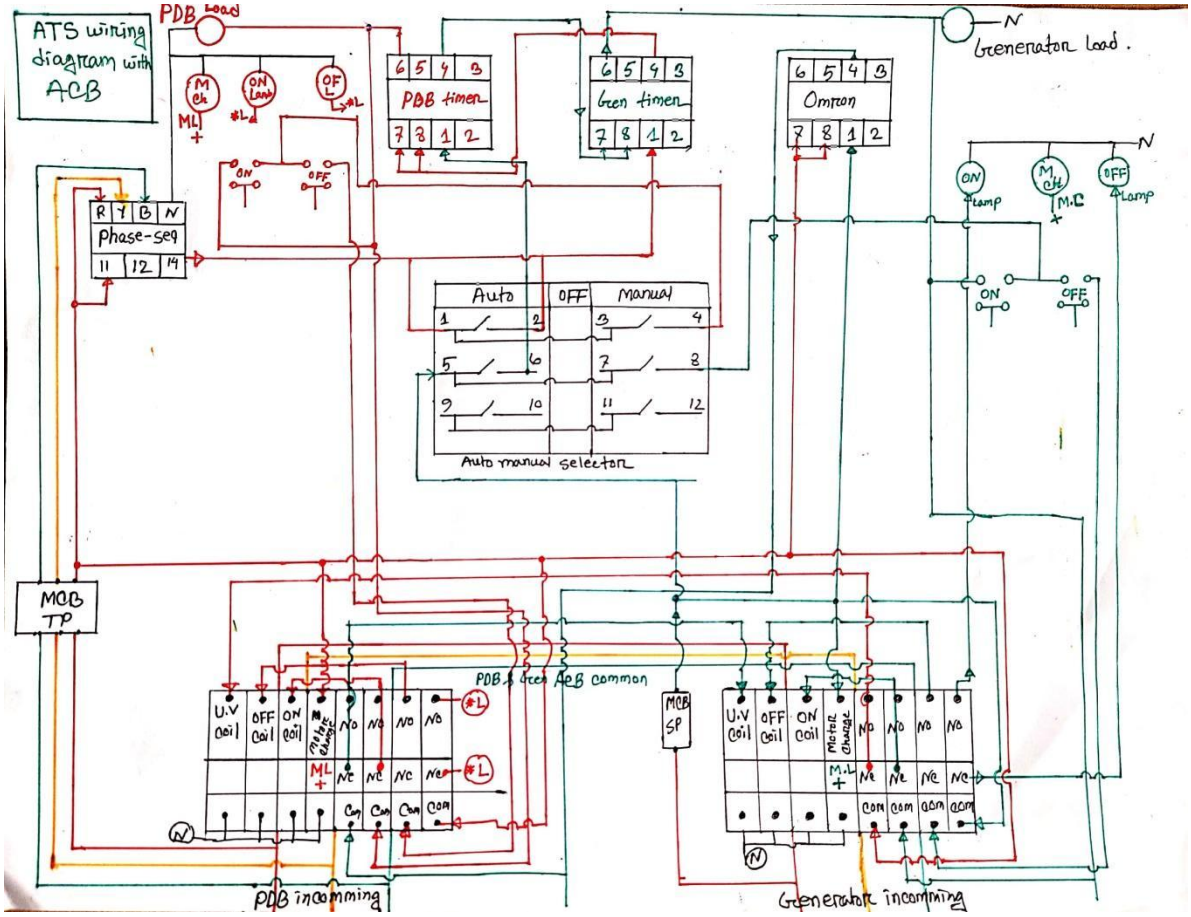
and When PDB power supply stopped Generator power supply will be started. When the PDB power will come, Generator power supply will turn OFF.

7.4 The apparatus of ATS:

a) Air Circuit Breaker (ACB)
b) OMRON
c) Timer Relay
d) Miniature Circuit Breaker (Tipple Pole)
e) Copper Bar
f) Wires
g) Cable channel
h) Volt. Meter
i) Amp. Meter
j) PUSH button Switch

e) Copper Bar: This ATS was 2500A. We use two copper bar to manage the flow of current through copper bar. We know copper bar size= Wide×Depth = 80×10×1.6 where 1.6 is copper density.

7.5 Wiring Diagram: Wiring Diagram of an ATS is shown below:



Chapter – 8

Low Tension Switchgear (LT Switchgear)

Objective (To know):

a) **What is LT switchgear?**
b) **What is the purpose of using LT switchgear?**
c) **What it's rating and How it is calculated?**
d) **What are the apparatus of an LT switchgear?**
e) **Knowledge of apparatus.**
f) **Wiring Diagram.**

8.1 Low Tension (LT) Switchgear.

Switchgear is a system which switches and controls an electrical system. The combination of connecting , disconnecting , controlling and protection system of an electrical system is called switchgear. LT switchgear consider as Low Voltage (LV) switchgear. In includes low voltage circuit breakers and switches. It used in transformer secondary side which output voltage is 415-440 V**.**

Fig 8.1: LT Switchgear Panel

8.2 The purpose of using LT switchgear.

LT switchgear usually distributes the electrical power from transformer to MDB. It is used to protect, switch and controls the devices and equipment we run in our house and industries. It protects our equipment from any unwanted problem when it occurs in the line. If need any maintenance and service in hour house and industry we should cut off the flow of power due to safety and we can turn on/off power by LT switchgear. We can also control our loads by LT switchgear

8.3 The rating of an LT switchgear and how it's rated.

LT switch gear rated in Ampere Unit.

How it's rated:

LT switchgear rating depends on incoming breaker from a Transformer's LT side. Incoming breaker depends on incoming current from a Transformer's LT side

. We can see some example.

Example: 8.1

For 500KVA transformer which Low Voltage is 415V, calculate the rating of LT switchgear.

Given, Low Voltage =415 V

Transformer = 500KVA

Incoming current From the LV side (I) = $\frac{KVA}{\sqrt{3}\times LV}$

$= \frac{500\times 10^3}{\sqrt{3}\times 415}$ A

= 695 A

For 695 A incoming current we will use 800A MCCB . so the LT switchgear rating is 800A .

Example. 8.2

For 800KVA transformer which LV is 415V, calculate the rating of LT switchgear.

Given, Low Voltage =415 V

Transformer = 800KVA

Incoming current From the LV side (I) = $\frac{KVA}{\sqrt{3}\times LV}$

$= \frac{800\times 10^3}{\sqrt{3}\times 415}$ A

= 1112.96 A

For 1113 A, incoming current we will use 1250 A MCCB . so the LT switchgear rating is 1250A .

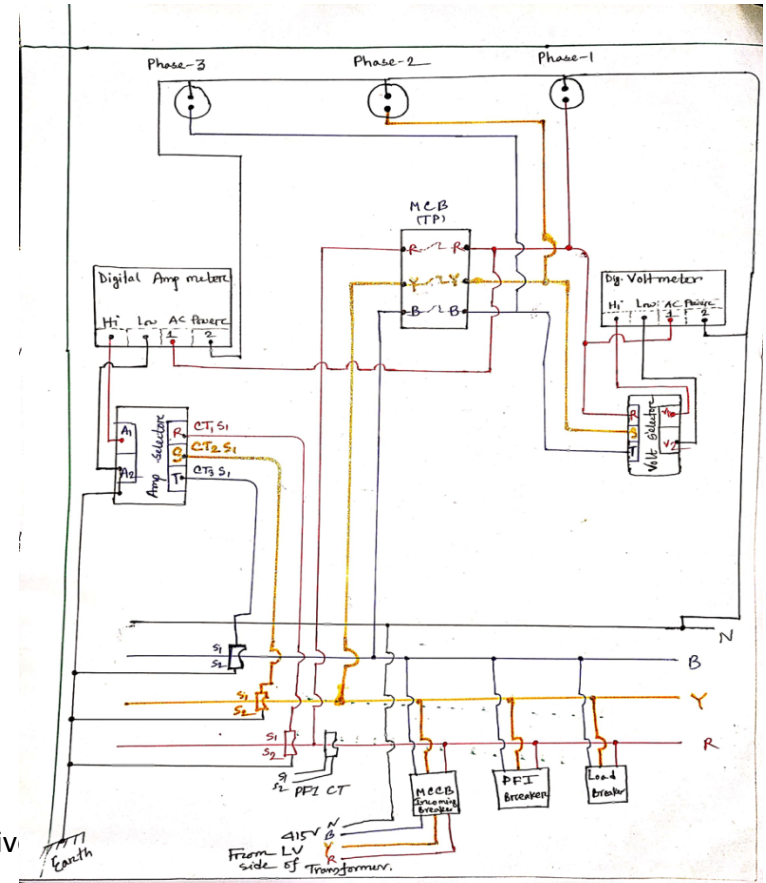
8.4 The Apparatus of an LT switchgear.

a. Circuit Breaker
b. Connector
c. Ampere meter
d. Amp selector
e. Volt meter
f. Volt selector
g. LT Current Transformer (CT)
h. Indicating Lamp
i. Bus bar / Copper Bar
j. Cable lux
k. Supporter or Insulator

For our Low Tension Switchgear of this sub-station we used 100/5/5A CT. We use copper bar the size of = Wide×Depth= 60×8

Our LT switchgear rate was 800A.

8.5 Low Tension Switchgear Wiring Diagram:



Chapter – 9

Power Factor Improvement (PFI)

Objective (To know):

a) What is Power Factor?
b) What is PFI?
c) Why do we need to improve it and How does it improve?
d) What it's rating and How it is calculated?
e) What are the apparatus of PFI?
f) Details knowledge of every apparatus.
g) PFI bank stages design.
h) Wiring Diagram

9.1 Power Factor:

Power factor is a cosine angle between voltage and current. Power factor mainly consider as the ratio between Real power and apparent power and is the cosine angle that leads or lags the current to the voltage Depending on loan, power factor varies. Current lags and leads the voltage with the angle of cosine. There are three types of power factor. These are 1. Unity power factor 2. Leading power factor and 3. Lagging power factor.

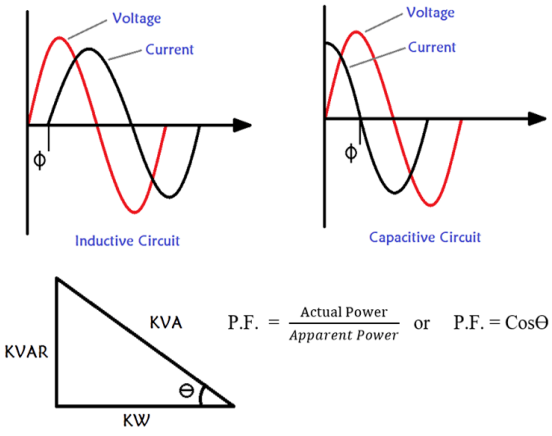


Fig: 9.1 Power Factor waveforms

9.2 Power Factor Improvement (PFI):

We have already known about power factor. Power factor lags when the load is inductive. In factory and Industry, most of the machines, equipment , devices are reactive load. As we know reactive load does lag the power factor. We need to improve this power factor. By which system we improve the power factor is called power factor improvement.

9.3 Why do we need to improve the power factor?

Lagging power factor is the reason for increasing electricity bills. In our Bangladesh, PDB delivers us electricity with 80% power factor. Our reactive loads will decrease the power factor and PDB will fine us for this. In low power factor current flows in minimum amount which is not good as it decrease our voltage to the load and it losses more power and it does our electric bill higher. Improved power factor can improve the voltage to the loads, reduce power losses, reduce electric bills and it increase current flowing capacity. Power factor improve by PFI. There are some improvement methods, we can use to improve power factor as Phase Advancer, Synchronous Condenser and Capacitor banks.

Here, We use capacitor banks to improve power factor. Because it's easier, cheaper to make and install than any other methods we have. It is more accurate and easy to plan and built a capacitor banks PFI panel.

9.4 PFI rating and calculations:

Capacitor bank based PFI is rated in KVAR. It's rating depend on the Transformer which we used in a sub-station.

9.5 Calculation: As we know, PFI rating depends on Transformer rating. 60% of a Transformer's rating is rated as PFI rating.

Let's see an Example.

Example: 9.1 **If a sub-station has a transformer of 500 KVA. What will be it's PFI rating?**

Given that,

Transformer = 500 KVA

PFI rating = Transformer rating × 60%

= (500 × 60%) KVAR

= 300 KVAR

Example: 9.2 **If a sub-station has a transformer of 1600 KVA. What will be it's PFI rating?**

Given that,

Transformer = 1600 KVA

PFI rating = Transformer rating × 60%

= (1600 × 60%) KVAR

= 960 KVAR

9.6 The apparatus of a Capacitor based PFI:

a) PFC relay
b) Capacitor
c) Magnetic Contact (MC)
d) MCB
e) MCCB
f) Bus-bar
g) Fan
h) Connecting wires

Fig: 9.2 PFI panel

a) **PFC relay:** Relay is a switching device which works with input signal or multiple signals. Power factor control (PFC) relay is a microprocessor based switching device. As we know, it works with signals. So it has coil mechanism which makes contact and break contacts. It has as set of switching and contacts terminal. It can work in low power signal. So it is very accurate to control relay switching for power factor.

Fig: 9 (a): PFC relay (Mikro)

b) **Capacitor :** Capacitor is a device which stored voltage when we supply voltage across it. So it is charged and it discharges when required. As we know Capacitive load leads the current with voltage in cosine angle. So capacitor is use to reduce the lagging angle and it is very effective.

Fig: 9(b): Capacitors

- **9.7 PFI Bank stages calculation and design:**

One capacitor is considered as a one stage bank of a PFI. For completing the rating, we need to use some capacitors and each capacitor consider as one stage bank of that PFI. We start selecting the capacitor from the lowest rating as capacitor bank. We keep one capacitor as a fixed stage because when the consumer is in no load mode , still the transformer deliver .8 power factor and it is also become a reason for increasing the electric bills. So we always need a capacitor that will be improving the power factor all the time. So in a Capacitor based PFI there is a fixed capacitor stage along with other stages. We design capacitor stages for a PFI this way.

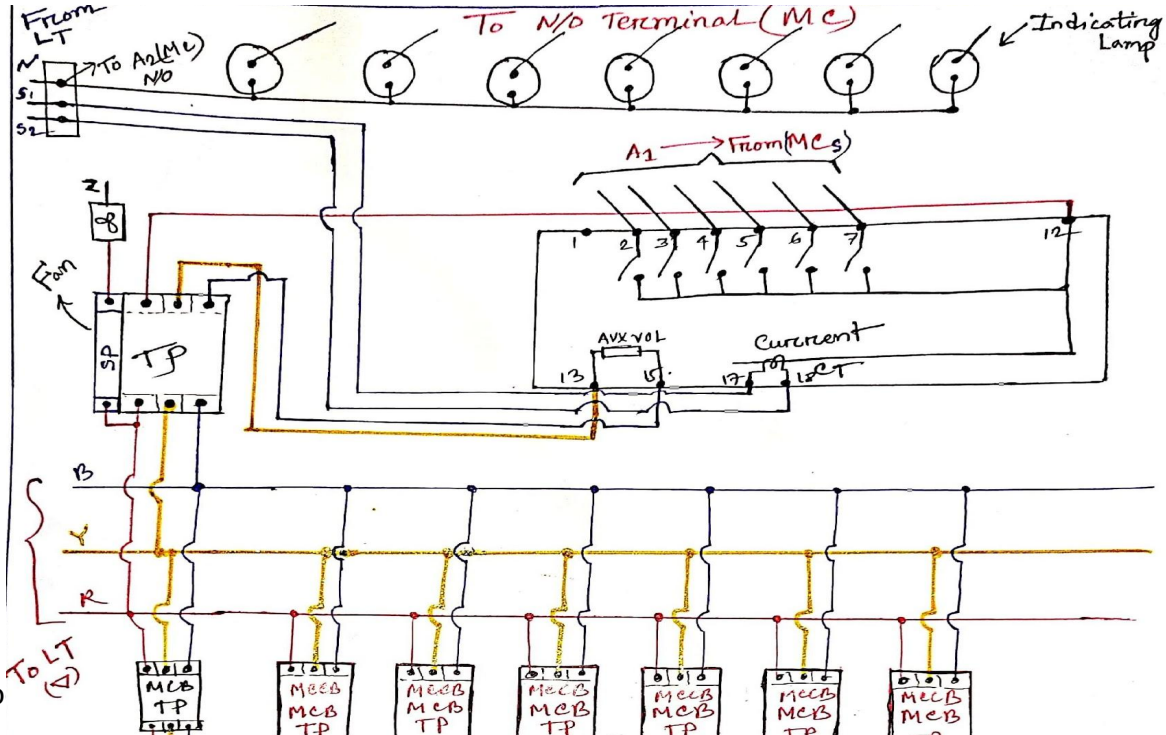
Here is an Example.

Example: 2.2 Arrange capacitor stages for 480 KVAR PFI with its MC, MCB, MCCB rating.

Fixed stage – 2.5 kvar, MCB = 12A

Stage No.	Capacitor	MC	CB	CB type
1.	2.5 kvar	12 A	12 A	MCB
2.	10 kvar	22 A	22 A	MCB
3.	12.5 kvar	32 A	32 A	MCB
4.	12.5 kvar	32 A	32 A	MCB
5.	20 kvar	40 A	40 A	MCB
6.	20 kvar	40 A	40 A	MCB
7.	25 kvar	50 A	50 A	MCCB
8.	25 kvar	50 A	50 A	MCCB
9.	50 kvar	100 A	100 A	MCCB
10.	100 (50+50) kvar	250 A	250 A	MCCB
11.	100 (50+50) kvar	250 A	250 A	MCCB
12.	100 (50+50) kvar	250 A	250 A	MCCB

- **9.8 PFI wiring Diagram:**



Problem and Solving Discussion

We did our field study in Green Power Transformer Company. Very much thanks to them for giving us such an opportunity. We respect them from our deep heart.

We found some problem while we were doing our field study:

- They have safety instructions and rules but no one follows it and no one force them to follow it, Worker and manager both were irresponsible about this. That was very sad to us.
- The waste their time where they could do the same work in sort time. They use manual work material.

- They can improve their product quality by improving their component such as wires , works material.
- They should be more aware about their worker safety.
- They Test their product such as Transformer, AVR in risky environment. Wire were open and power supplier was very far from the testing place. So they shouted to give every instruction and that is very risky. Suppose they shout to tell turn on/off the supply or regulate the voltage because the place is noisy. They can use Waki Taki to do this.

Conclusion

We have completed our Field Study On Green Power Transformer Company Ltd from Green Power Transformer Company. We chose this company because it is related with our career and study. This company works on Power equipment. Power distribution equipment is made by this company Such as Transformer, HT switchgear, VCB, LBS, RMU, ATS, AVR, LT switchgears, PFI etc. As an Electrical and Electronic Engineer, these things have great importance to us. Our career and Study is completely related with them.

We studied in Green Power Transformer company. We experienced with them how they design every step of power distribution system. They made and fix. Generally they take order and plan. Sometimes they got order with plan and they just do as they ordered with their design and plan, Sometimes they provide services to their clients.

We can say It a sub-station based company. We know sub-station is very important for distribution electrical power to the consumer. An Area, a village, a sector, in mill industry and factory need sub-station as their own demand. Specially big apartment and mills factory need their own sub-station for running their production perfectly.

Mills Factory owner need more voltage than general consumer. They have heavy machine to run. So they need higher voltage and low power loss. 415V supply voltage they require with .99 power factor. They need transformer as their own demanded capacity. So we provide service with transformer we make.

While we were experiencing how they make Transformer, HT, RMU,HT,VCB,ATS, LT and PFI we were getting introduce with the components they use to accomplish their work. They use those components as their clients demand and sometimes they do on their own way. We also experienced how they make panel and other parts related with their equipment.

We calculate the rating and rated the equipment and every apparatus we used for that equipment was completely according to the rate of that equipment. So proper rating and calculation is very much important for any equipment.

After our field study we are feeling like we are complete now in some way.

A major part of our study fulfilled with practical knowledge. We have achieved deep knowledge about a major part of our study. This field study expanded our knowledge.

References

The following is the reference list for any further information:

- ✔ Green Power Transformer Company Profile.
- ✔ www.google.com

- ✔ www.wikipedia.com
- ✔ www.herga.com
- ✔ www.ia.omron.com
- ✔ image.made-in-china.com
- ✔ www.eltime.co.uk
- ✔ www.researchgate.net
- ✔ cselectric.co.in
- ✔ www.electricalclassroom.com
- ✔ greenpower.com.bd
- ✔ www.youtube.com