STUDY ON 630 KVA SUB-STATION MANUFACTURING PROTECTION AND CONTROL SYSTEM

A Field study report submitted in partial fulfillment of the requirements for the Award of Degree of Bachelor of Science in Electrical & Electronic Engineering

Submitted by

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FACULTY OF ENGINEERING

DAFFODIL INTERNATIONAL UNIVERSITY

December 2020

APPROVAL LETTER

Daffodil International University

A Distinguished LANDMARK in Higher Education

Faculty of Engineering
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September 27, 2020

To,
The Managing Director
Betco Power Limited.
Khejurbag Road, Ekuria South Keraniganj,
Dhaka

Subject: Regarding field study purpose.

Dear Sir,

Please note that the following Seven (07) students of Electrical & Electronic Engineering Department of Daffodil International University are willing to do field study at your organization (**BETCO POWER LIMITED).** The duration of the field study will be at least two (02) months being effective from **October 13, 2020.**

Therefore, you are requested to permit them to avail the opportunity on several convenient dates.

Details of the students are as follows:

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Sincerely,

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Deputy Managing Director
Betco Power Ltd.

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DECLARATION

We declare that this internship report is based on “Study on 630 KVA Sub-station manufacturing protection and control system” at Betco Power Limited. The work materials found by other researchers are referred by reference. This internship report is submitted to Daffodil International University for achieving B.Sc. degree of Electrical & Electronic Engineering. This internship report has not been fully submitted for any degree prior to the degree.

Supervised by

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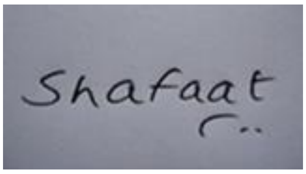

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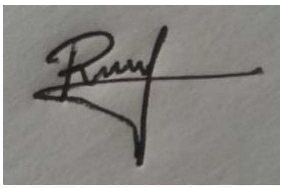

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Dedicated

To

Our Parents

ACKNOWLEDGEMENT

First, we thank Allah or God. Then we took this opportunity to support, motivate and guide us through the study of this field by our field study supervisor Dr. M. Shamsul Alam, Dean and Professor of the EEE Department for his honor.

Their endless patience, scientific guidance, constant and active encouragement, constant and active supervision, constructive criticism, valuable advice, reading and correcting many short drafts at all stages have made it possible to conduct this whole field study.

I also express my deep gratefulness to Mohammad Al Mamun (Deputy Managing Director) and Mithun Saha (Factory Manager). I am also grateful to the technician Zakaria Hossain of Betco Power Ltd. who always showed their respect and helped a lot during my internship.

I would like to thank my colleague at the entire session at The Daffodil International University, who participated in this discussion during the completion of the session.

Finally, I have to accept with due respect the continued support and patience of my parents.

ABSTRACT

The report explains substation and control, switching, protection equipment, voltage step equipment and sub-transmission voltage for primary distribution voltage for residential, commercial and industrial loads. In analyzing this data, we also found total cost, consumer satisfaction and certain limitations. The following research paper indicates that practical experiments are being conducted on the respective substations, High Tension panels (HT), the operation of Low-Tension panel (LT) and the Power Factor Improvement (PFI) during the field study period. In addition, the field study provides practical knowledge on the equipment of certain equipment for Molded Case Circuit Breaker (MCCB), miniature circuit breaker (MCB), three-phase circuit breaker, magnetic conductor, magnetic conductor, single-phase circuit breaker, magnetic conductor, High Rapture Capacity (HRC) fuse. Provides a convenient decimation on the HT counter, distribution panel (DB), Sub Distribution Board (SDB), air circuit breaker (ACB), load brake switch (LBS), vacuum circuit breaker (VCB), Power Factor Improvement (PFI) and transformer.

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LIST OF ABBREVIATIONS

HRC	High Rupturing Capacity
RT	Resettable Thermistor
PFC	Power Factor Control
MCB	Miniature Circuit Breaker
MCCB	Molded Case Circuit Breaker
CT	Current Transformer
PT	Potential Transformer
HT	High Tension
LT	Low Tension
PFI	Power Factor Improvement
MC	Magnetic Conduction
KV	Kilo Volt
CB	Circuit Breaker
VCB	Vacuum Circuit Breaker
TPMCB	Triple Pole Miniature Circuit Breaker
TPMCCB	Triple Pole Molded Case Circuit Breaker
ACB	Air Circuit Breaker
BBT	Bus Bar Trucking
DMD	Deputy Managing Director
A.C.	Alternating Current

LIST OF ABBREVIATIONS

D.C.	Direct Current
VA	Volt-Ampere
SLD	Single Line Diagram
LBS	Load Break Switch
DB	Distribution Board
SDB	Sub Distribution Board
A	Amperes
KVA	Kilovolt-Ampere
NO	Normally Open
NC	Normally Close
ET	Electromotive Turn
LC	Low Current
LV	Low Voltage
KVAR	Kilovolt-Ampere Reactive

Chapter-1

INTRODUCTION

1.1 Introduction

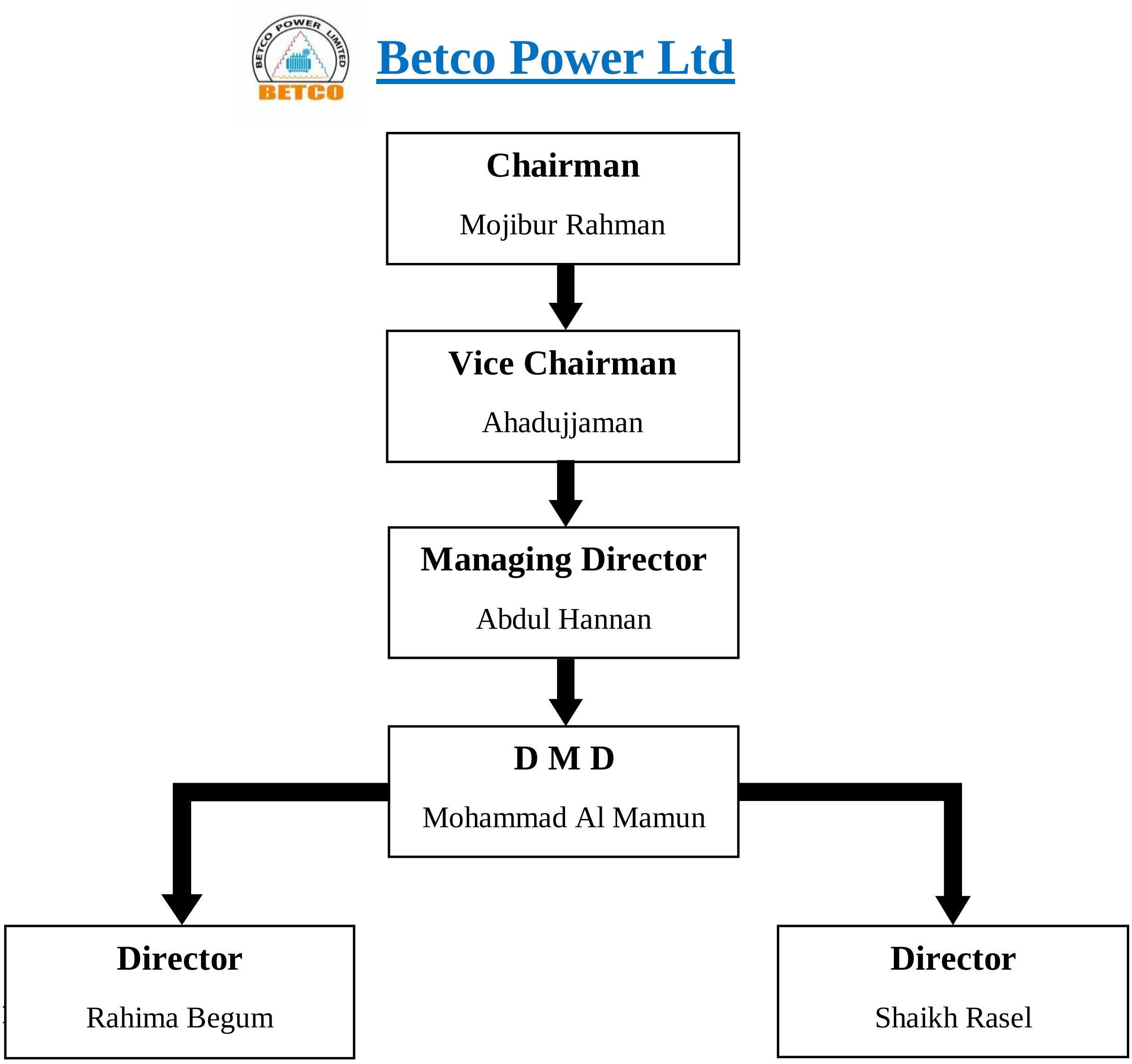
Substation is part of power generation, transmission and distribution system. Substations move the voltage from high to low, or vice versa, or complete any of the many other important tasks. Power can flow through multiple substations between the plant and the consumer, and the voltage can change in several phases. Substations generally have switching, safety, control and axle. The distribution circuit is fed from an adapter located in a substation, where the voltage is reduced by the high values used in the power transmission.

It was a great opportunity to train at Betco Power Limited, a sub-plant manufacturer. There were opportunities to visit the establishment side during this training. Betco Power Limited has many products and installations in Dhaka. I visited (housing, garment sand and factory) and established the side at Petco Power Co., Ltd. During my training period I worked in various departments such as substation manufacturing, operation and maintenance, load management, line maintenance, power factor monitoring and commercial operation of Betco Power Limited.

1.2 Company Information

Bangladesh was created under the term Dhaka-based Betco Bismillah Electric Technology Company, which was founded a year ago in a business that includes transformers, power stations and replacement units. Over time, our activities focus on the production of a eddy. We offer a wide range of power and power supply transformer designs that provide the reliability, durability and efficiency needed for utilities, industrial and commercial applications. Our activity is to manufacture power and distribution transformers and supply related power station equipment, generators, BBTs and solar energy solutions so that Bismillah Electric Technology Companies based in Dhaka, Bangladesh, can provide the word 10 years ago. Over time, our activities focus on the production of a eddy. We offer a wide range of power and power supply transformer designs to meet the reliability, durability and efficiency required for utility, industrial and commercial applications. Our activities include manufacturing energy transformers and distribution and related power station equipment, supplying generators from reliable support services, supplying BBT and solar energy solutions, and providing comprehensive power solutions for valued customers/customers.

1.3 Overview of Betco Power Ltd



1.3.1 Objective/Mission

Our goal is to overcome client exceptions. We focus on continuous improvement of our products and services. We aim to be a leading specialist-oriented company in product manufacturing. We will continue to be leaders in the country's electricity sector. We provide our employees with a safe environment and give back to the communities in which we participate.

1.3.2 Dear Valued Customer

The business approach of Betco Power Limited is mobility and flexibility. Every member of the Betco staff is well aware that customer is our number one priority and customer satisfaction is our primary business goal. We take care to the opportunity to meet the needs of our customers who are interested in building relationships.

Chapter-2

POWER SYSTEM

2.1 Power system

Today's electrical system is the current (A.C). The electricity system is a community that includes generation, transmission and distribution systems. It uses the volume of electricity (e.g. coal, diesel and gas) and converts it into electric power. The power plant produces power through transformers for transmission and distribution. Electricity is produced at the power plant which usually gets away from the consumer. It is transmitted to the consumer through a large network of transmission and distribution. Some power supply features (such as voltage, current, frequency, PF etc.) have changed in many places in the power system line.

2.2 Single Line diagram of power system

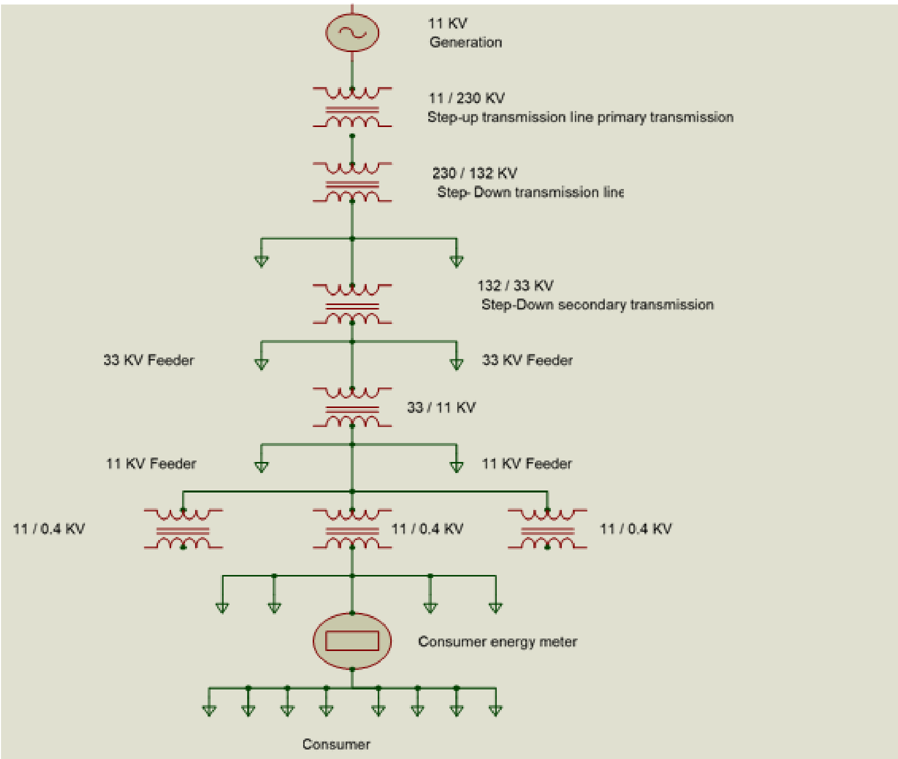


Fig: Power system Single Line diagram.

Chapter-3

SUB-STATION

3.1 Theory of Sub-station

This substation is part of the power generation, transmission and distribution system. Some characteristics (e.g. voltage, frequency, pf., A.C to D. C etc.) the assembly of the equipment used to rotate is known to provide electricity as a substation.

Some basic processes of substations are:

- Getting high voltage energy from power plants.
- To reduce voltage to a suitable price for near distribution.
- Supply of conversion features.

Electricity can also go along the flow across quite a few substations between plant and consumer production, and the voltage addition can rotate in quite a few steps.

3.1.1 Transmission Sub-station

A transmission substation connecting two or more transmission lines. The easiest place to case is the voltage equals all transport lines.

In such cases, the substation includes high-voltage switches that allow lines to be connected or isolated for the removal of malfunctions or maintenance. The transmission station can also have transformers to change the voltage stages between two transmission voltages, voltage control/unit correction of the power issue such as capacitors, reactors or static VA carter's and transformer transmission stage, to handle power with flow between two adjacent power systems.

In addition there is a large amount of safety and control equipment (voltage, current transformers, and relay systems).

3.1.2 Distribution Sub-station

The sub-distribution station transfers electricity from transport equipment to a distribution system in an area. Input for sub-distribution stations usually has at least two transmission lines or two sub-data transmission lines.

The distribution of voltage is usually medium voltage, depending on the distance of the serviced site between 2.4 and 33 KV and the practices of utility around. In addition to changing the voltage, the function of the sub-station is to isolate mistakes in transmission or distribution systems. Sub-distribution stations can be additionally voltage regulators, although on long distribution circuits (several km/mi), voltage management equipment can also be installed in addition to the line. With high voltage switching, switching systems and backups towards low voltage, complex sub-distribution stations can be discovered in downtown areas of megacity.

3.2 Single Line Diagram:

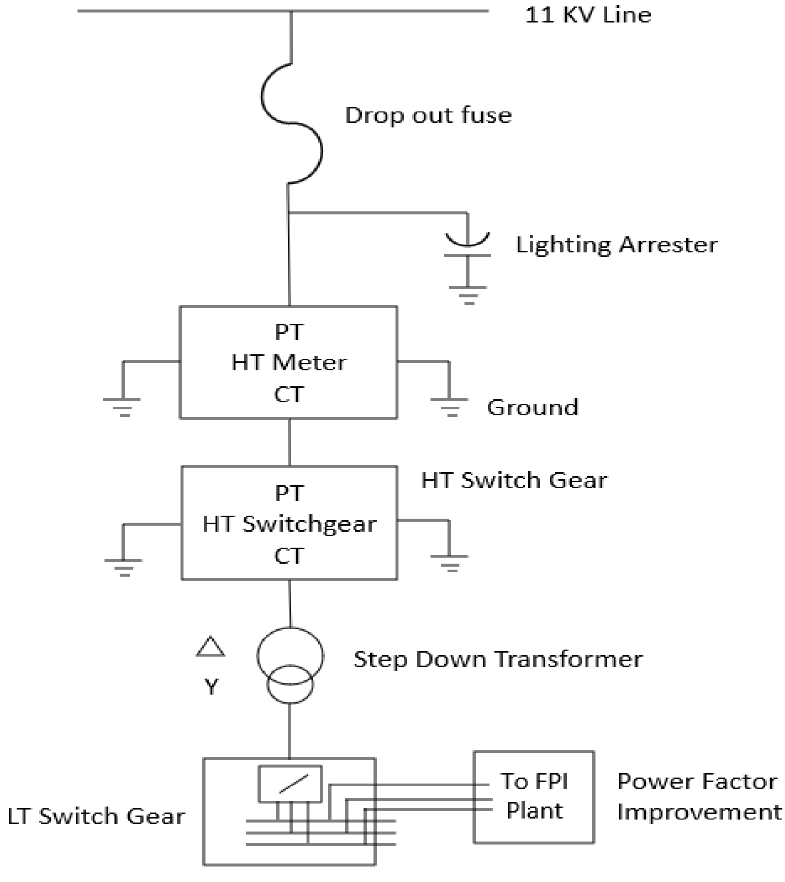


Fig: Sub-Station Single Line Diagram (11/0.415KV).

3.3 11/0.415 KV Sub-Station Block Diagram:

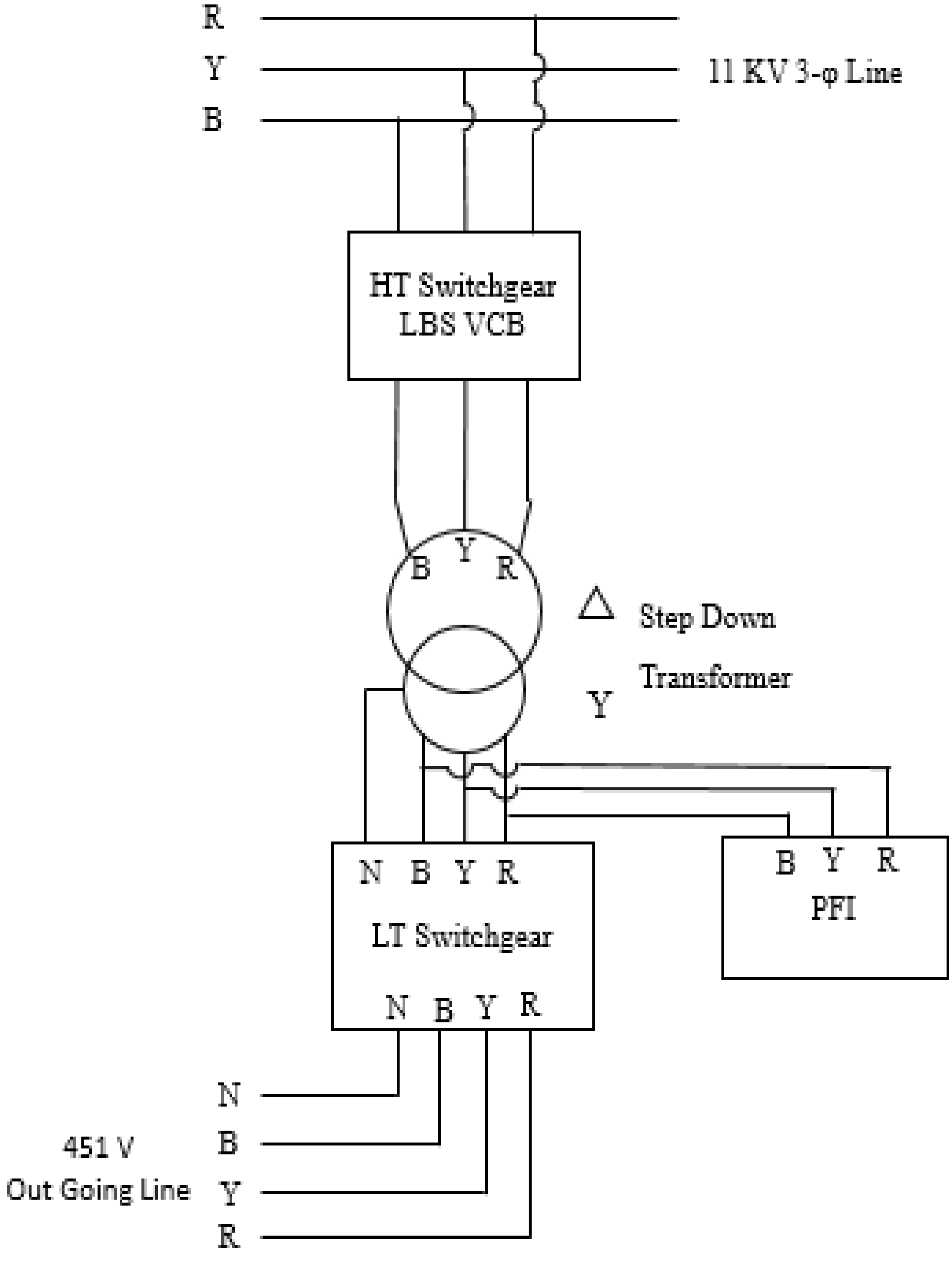


Fig: 11/0.415 KV Sub-Station.

3.4 Short Definition of Sub-station uses Equipment's:

3.4.1 Relay

A relay is a powered electric switch. It contains a set of input stations for individual or specific control signals and a set of running connection stations. Switching can also have any amount of contacts in two contact forms, such as creating contacts or deleting contacts or their combinations.

Fig: Relay.

3.4.2 HRC fuse

The HRC fuse element is used to display short circuits or defects for specified periods of time. If the error is removed in that specified period the fuse element is still safe and it does not melt or break. The fuse elements are placed inside the airtight container.

Fig: HRC Fuse.

3.4.3 RT fuse

Researchable (RT Mods research tab) electric powered fuses to mitigate short circuits. When positioned somewhere on a power network, each fuse will safely discharge up to three of network's batteries, mitigating or stopping the explosion.

Fig: RT Fuse.

3.4.4 Magnetic Conduction

The process that placed the conductor in a magnetic field (AC) changes the causes of tension generating through the driver. Pattern of electromagnetic consistency. This type of coupling is classified by a magnetic area modified through a wire or wire ring. Magnetic conductivity is the opposite of magnetic frequency and resembles an electric-sized conductor. Now let the magnetic flow have the intensity of the magnetic flow, extended using the transverse section of the magnetic circle, added in this area.

Fig: Magnetic Conduction (MC).

3.4.5 Capacitor

A capacitor is a passive electronic thing that collects energy as an electric field. In its easiest form, condenser consists of two panels that differ from insulating materials known as insulators. The ability without delay corresponds to the surface areas of the panels, and is proportional to the separation of panels. Excess capacity insulation material depends on the insulating stability of the panels.

Fig: Capacitor.

3.4.6 Over Current Relay

A relay that exceeds the current is a type of defensive sequence that works when the load exceeds the current pick-up price. It has two types: the current IOC and real-time fixed-time (DFC) relays. When the relay works, one or additional contact circuit breakers are useful and active to visit.

Fig: Over Current Relay.

3.4.7 PFC Relay (Power factor control)

Interactive power control sequence is capable of measuring the reactive power and active power of the respective power grid. The machine operates in tandem with the power factor correction system, and controls the target power factor programmed using activation capacitors or inactivity.

Fig: PFC Relay.

3.4.8 Amp meter

The ammeter is a measuring tool used to measure the current in the circuit. Electrical currents are measured in amps (A), for this reason the name. The tools used to measure small currents, in the range of amps or mic ropers, are accurate or micrometers.

Fig: Amp Meter.

3.4.9 Volt meter

A voltmeter is a tool used to measure the potential difference in electrical propulsion between two workers in the electric circuit. Analog scales pass the indicator on a scale proportional to the circuit voltage; Digital voltmeter devices provide a digital voltage screen using a representative digital converter.

Fig: Voltmeter.

3.4.10 Circuit breaker

Circuit breakers are an electrical switch that automatically works designed to defend the electrical circuit from damage caused by overload or short circuit. Its main advantage is to become aware of an error situation, and by interruption of continuity, to stop the electrical flow without delay. Unlike valves, which work as soon as possible and then need to be replaced, the circuit breaker (manually or automatically) can be reset to resume regular operation. The circuit breakers come in a variety of sizes, from small tools that protect individual household equipment to a huge switch designed to protect the power surge circuits powering the entire city.

Fig: Circuit Breaker.

3.4.11 MCB

A miniature circuit breaker (MCB) automatically turns off electrical circuits for a strange mesh case means loaded with overload as well as a defective case.

Fig: MCB.

3.4.12 MCCB

Molded Case Circuit Breaker (MCCB) is a circuit breaker and a flying device assembled in case of mildew. Even in case of overloads and short circuits, this power can be automatically cut. It is intended for the highest rated current and is commonly used in industrial applications. Its standard range is 250A-800A.

Fig: Molded Case Circuit Breaker (MCCB).

3.4.13 Thermo-stator (Fº)

Thermistor is a thermal resistor used to measure temperature. It consists of semiconductor materials due to the fact that it has all positive and negative temperature coefficient. Positive temperature coefficient means that temperature resistance will increase with increase and negative temperature coefficient is proportional to reverse temperature resistance.

Fig: Thermo-stator (Fº).

3.4.14 Current Transformer

A current transformer is a machine that is used for the transformation of current from a higher value into a proportionate current to a decrease value. It transforms the high voltage current into the low voltage current due to which the heavy current flows via the transmission lines is safely monitored by using the ammeter.

Fig: Current Transformer.

I. Specification

Serial No: ME 1910226.

Rated current ratio: 60/5A.

Rated voltage: 11 KV.

Frequency: 50-60 Hz.

Accuracy Class 1S11S2 Class 0.5.

Rated output 10 VA.

Accuracy class 2S12S2 Class 10P10.

Rated output 15 VA.

II. Test data

Room temperature 22 °C relative humidity 52 %.

Test of insulation resistance: Primary winding-to-secondary winding and ground 2500 MΩ Between secondary winding and ground 500 MΩ.

Short-time power frequency withstand voltage test: Primary winding-to-secondary winding and ground 28 KV 1 min. between secondary winding and ground 3 KV 1 min.

Polarity test: Subtractive polarity.

Error test: Load power factor = 0.8 lagging.

Table: Current Transformer.

Accuracy grade	**Secondary load (VA)**	**Percentage of current (%)**	**Error of ratio (%)**	**Error of angle (‘)**
$1S_1 1S_2$ 0.5 Class	10	1		
		5	-0.49	24
		20	-0.20	16
		100	-0.06	6
	2.5	5		
		20		
		100	+0.27	7
		120		
$2S_1 2S_2$ 10P10 Class	15	50	+0.32	
		100-120	+0.42	
		50		
		100-120		

3.4.15 Potential Transformer

A potential transformer is the converter that is used to measure and replace the voltage that is higher in value to reduce voltage. As the effort increases, potential adapters come into play, they put in the protected range to carry the value of the voltage. It can be measured with tools such as voltmeter or watt hour meter and so on.

Fig: Potential Transformer.

3.4.16 Bus-Bar

The bus bar is a copper metal bar, conductor or set of conductors that are used to distribute electrical energy as a junction or node. The only bars that make the distribution of electricity much simpler, much less expensive and extra flexible. Only the construction bar is red using aluminum and copper. Different types of bus bars use switchgear, plate and bus track placed in containers for nearby high stream. The high stage voltage bus bar is used in the substation, generating and separating the feeder. The house uses wires only in a bar in the distribution box, plates of packaging plates.

Fig: Bus Bar.

Chapter-4

HT SWITCHGEAR (VCB)

4.1 Theory of Switchgear

A switchgear cover is a standard term that includes all related switch units with power system protection. It also contains all the equipment's related to control, measurement and regulation of electrical power systems. These units logically group switchgear types. In different terms, the structures used to switch, control and preserve electrical circuits and a variety of electrical equipment are identified as switchgear.

Fig: Controlling (Inter Lock System).

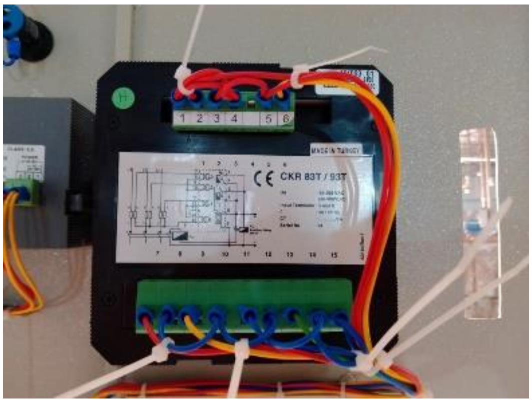


Fig: Over Current Relay Connection.

Fig: VCB (VD4)

Fig: HT Switchgear

4.2 Features of Switchgear

a) **Complete reliability:** With the continued trend of interconnection and increased plant production capacity, the need for a reliable switch has become of paramount importance. This is not surprising because switchgear is added to the power system to improve reliability. When there is an error on any part of the power system, the switch should work to separate the faulty section from the remaining circuit.

b) **Absolutely certain discrimination:** When an error occurs on any section of the power system, you should be able to distinguish between the faulty section and a healthy section. The wrong part of the system should be isolated without affecting the proper section. This will continue to supply.

c) **Quick operation:** When there is an error on any part of the power system, the switch should operate quickly so that there is no damage to generators, transformers and other equipment by short circuit currents. If the error is not quickly cleared by switchgear, it is likely to spread to healthy parts, thus endangering the complete closure of the system.

d) **Provision for manual control:** A switchgear must have provision for manual control. In case the electrical (or electronics) control fails, the necessary operation can be carried out through manual control.

e) **Provision for instruments:** There must be provision for instruments which may be required. These may be in the form of ammeter or voltmeter on the unit itself or the necessary current and voltage transformers for connecting to the main switchboard or a separate instrument panel.

4.3 Advantage of Switchgear

Energy Saving: the power consumption is decreased by means of at least 40% to 50%. Old machines or components consume a large amount of energy. Replacing the entire machine or part of it will minimize the consumption to a certain limit.

Greater Durability: Retrofitting will make a machine extra durable. Suppose the older machine would have lasted a year or two, however when retrofitting is finished to a particular part, the machines existence will increase by using saying at least 10 years.

Lower Cost: Replacing the entire equipment is incredibly high-priced and a reason of an awful lot burden to the buyer. But changing simply a section of it costs lots much less and is without difficulty a suitable option. Retrofitting a section of the machine will decrease the expenses.

Reduce Downtime: The most important component in an electric powered circuit may be prevented while doing retrofits for the times that are except regular electricity agreement. Several retrofits can be done in one support visit.

Elimination of Prolonged Project Timelines: No business client needs to notice the records is the facts of the growth of the challenge to be completed correctly. This leads to extra expected project cost. It additionally leads to complicating client ideas. This much less worried character leads to extra extension of task timelines and extra expenses.

Repair of Gear: Retrofitting does no longer involve renovation of the older gears however they are correctly changed. This is the fantastic choice for the industrial houses. The procedure of rebuilding industrial equipment is to operating standard is common in each and every enterprise and for this reason the energy industry is no longer an exception to it.

Facilitate Higher Control Over Energy: It has an insufficient chief manage cell which helps in troubleshooting the necessary capabilities. A servicing may additionally assist in growing the manipulate over the power engineering units. It is performed through decreasing the analytical costs than troubleshooting by using software of control updates that are programmable

4.4 Types of Switchgear

a) LBS → Load break switch
b) VCB → Vacuum circuit breaker

LBS → 315 KVA – 500 KVA

VCB → 315 KVA – up to 4000 KVA.

There is no HT Switchgear of 4000 KVA.

4.5 Equipment's of HT Switchgear

1) Over current relay – 1 Nos
2) Amp meter – 3 Nos
3) Voltmeter – 1 Nos
4) Selector switch (v) – 1 Nos
5) Indicator lamp – 5 Nos
6) RT fuse – 5 Nos
7) Circuit breaker -3 Nos
8) Tharmostator (F°) – 1 Nos
9) Connector 38 Nos
10) CT
11) PT
12) Earthing
13) Heater
14) VCB
15) Bus-Bar
16) Bus-Bar Insulator
17) Spiral Band
18) Cable Tie
19) Nut
20) Screw
21) Channel
22) Body
23) MS-sheet
24) HT wire

4.6 Vacuum Circuit Breaker Power Diagram:

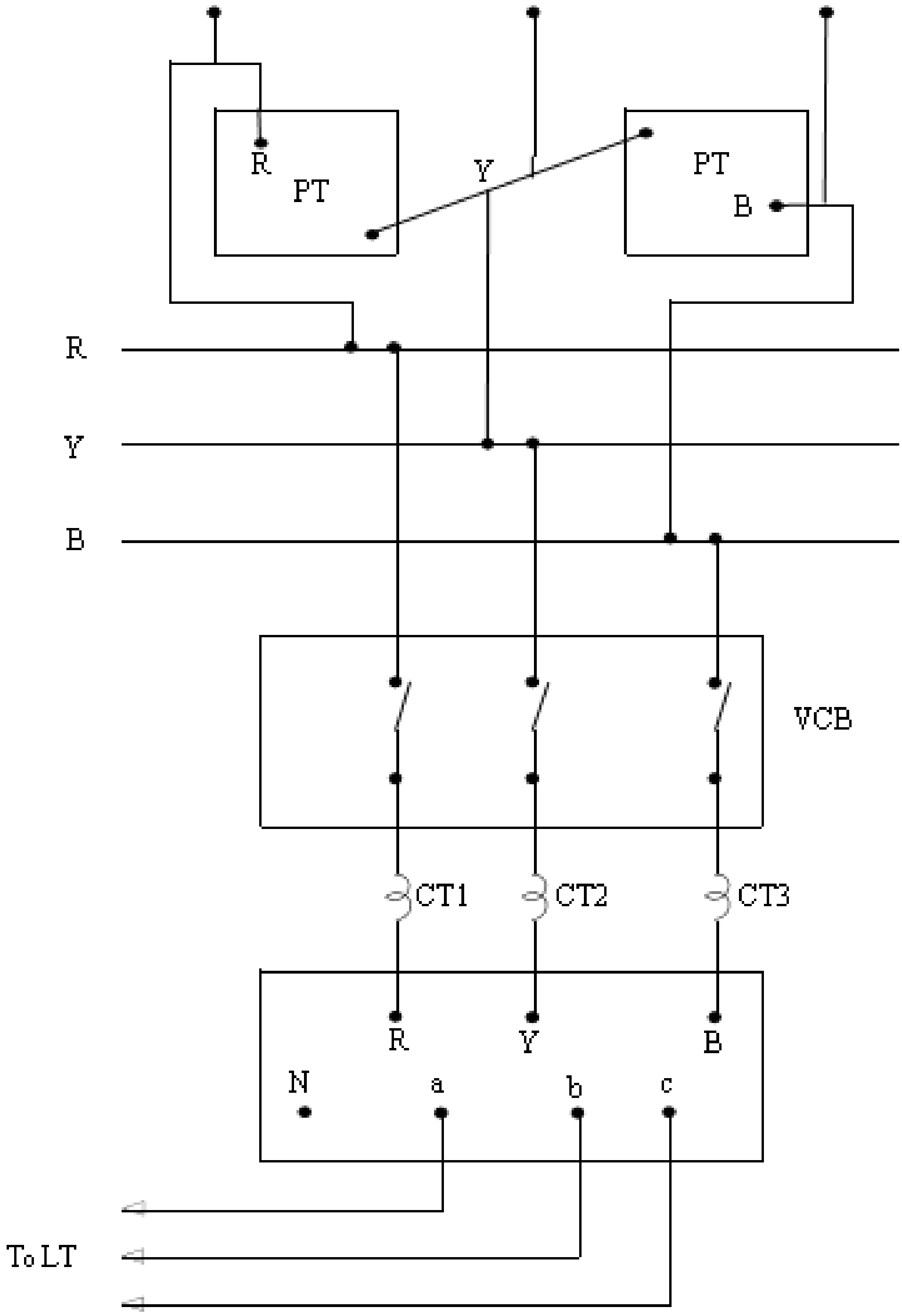


Fig: Power Diagram (VCB).

4.7 Control Diagram:

Power circuit & circuit breaker	Indication	MFM	Power pack	Protection relay

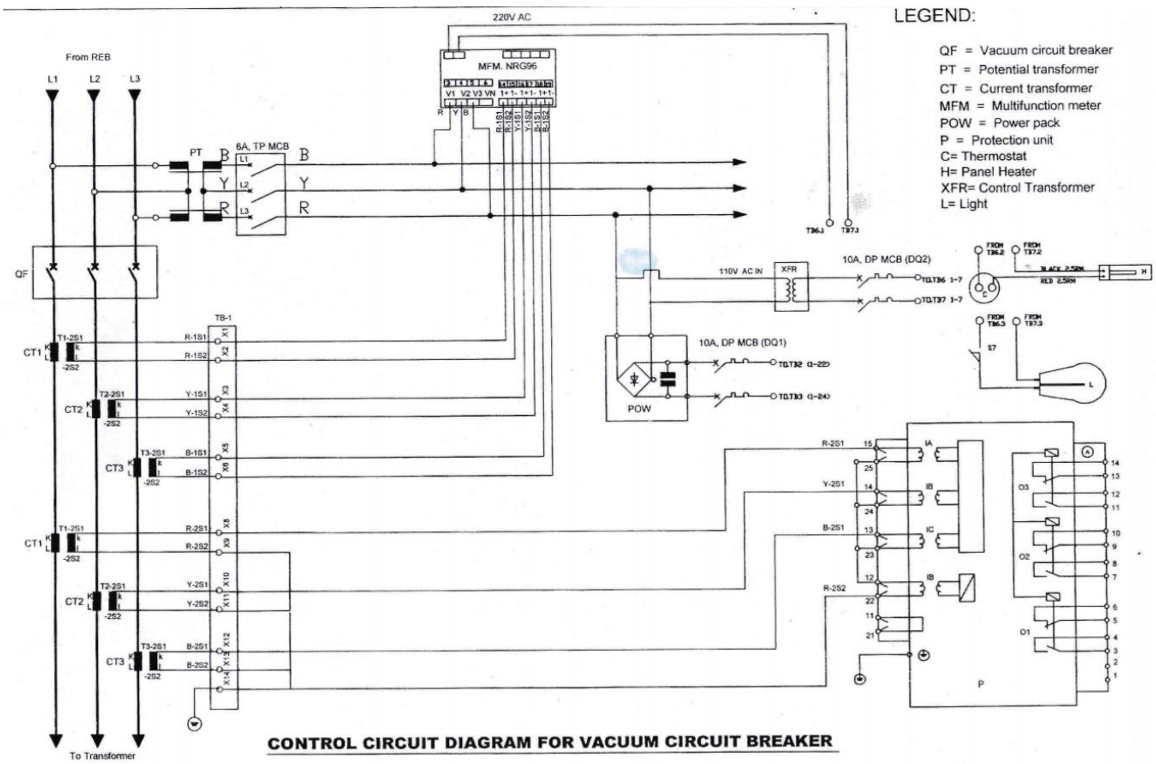


Fig: Control circuit diagram for vacuum circuit breaker.

Charging Motor	Closing Circuit	Tripping Circuit	Warning	Protection Relay

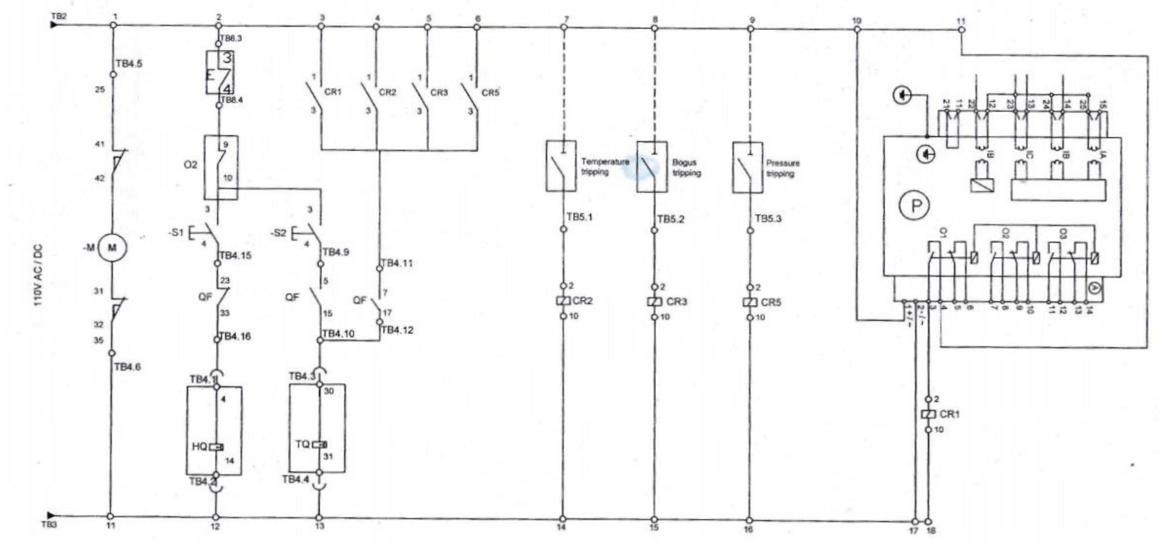


Fig: Control circuit diagram for vacuum circuit breaker.

Indication	Tripping & Alarm

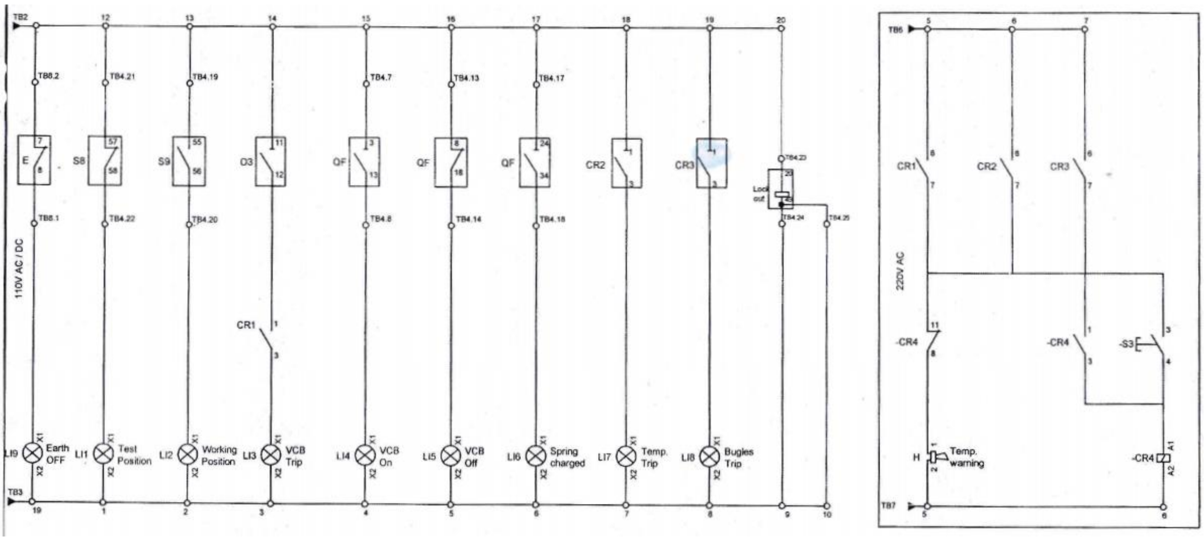


Fig: Control circuit diagram for vacuum circuit breaker.

Chapter-5

TRANSFORMER

5.1 Theory of Transformer

A transformer is an inactive electrical system that transfers electrical power from one electrical circuit to another, or more than one circuit. A different current in any single coil of the adapter produces a different magnetic flow at the heart of the adapter, which stimulates various to lithic electrical pressures in any individual coil wound around the equal core. Electric power can be transferred between different coils except for a metal connection (conductor) between two circles. The Faraday Proliferation Act discovered in 1831 describes the effect of induced voltage in any coil due to a change of magnetic flow surrounded by a file path.

Fig: HT, LT Coil & Tap Changer.

Fig: HT & LT Terminal

Fig: Transformer Tank Up.

5.2 Types of Transformer

(1) According to working procedure

  a) Step up Transformer

  b) Step down transformer

(2) According to Core types

  a) Core type transformer

  b) Shell type transformer

  c) Spiral Core type transformer

(3) According to use

  a) Power transformer

  b) Distribution transformer

  c) Auto transformer

  d) Instrument transformer

  e) Current transformer (CT)

  f) Potential transformer (PT)

(4) According to phase

  a) Single phase (1- Φ)

  b) Three phases (3- Φ)

(5) According to Frequency

  a) Audio frequency

  b) Ratio frequency

5.3 Different parts of Transformer or Equipment's

1) Silicon core
2) HT cupper
3) LT cupper
4) Transformer oil
5) Tap charger
6) Body sheet
7) Radiator sheet
8) Core channel
9) Press board

10) HT Brushing
11) LT Brushing
12) Welding rod
13) HT Terminal rod
14) Gasket sheet
15) Base channel
16) Temperature meter
17) Cupper bar
18) LT Bush nut
19) Conservator plate
20) Breather pipe
21) Gasket
22) Thread taps
23) MS pipe socket
24) Max pipe socket
25) Min pipe socket
26) MS pipe
27) MS Bolt
28) MS nut
29) MS washer
30) Crap paper

5.4 Transformer Design and Calculation

Let,

K is the constant

Standard value of k = 0.4 – 0.45

Electromotive turn, ET = $k \sqrt{KVA}$

$= 0.45 * \sqrt{630}$

$= 11.294$

$= 11.3$ volt

$$\text{HT turn} = \frac{11000}{ET}$$

$$= \frac{11000}{11.3}$$

$$= 973.45$$

$$= 974 \text{ Nos}$$

$$\text{LT turn} = \frac{415}{ET}$$

$$= \frac{415}{11.3}$$

$$= 36.72$$

$$= 37 \text{ Nos}$$

Turn Ratio, a = HT Turn/LT Turn

= 974/37

= 26.32

Design LT Turn = 37 Nos

Design HT Turn = 37*26.5%

= 974+2.5%

= 999 turn

HT conduction area, $A = \frac{KVA}{KV*CD*\sqrt{3}*\sqrt{3}}$

$$= \frac{630}{11*2.65*3}$$

$$= 7.2 \text{ mm}^2$$

Dia of HT wire, $d = \sqrt{\frac{A*4}{\pi}}$

$$= \sqrt{\frac{7.2*4}{\pi}} = 3.02 \text{ mm}$$

So, Design of HT wire size = 30 SWG

LT Conductor Area,

$$A = \frac{KVA}{KV*CD*\sqrt{3}}$$

$$= \frac{630}{0.415*3.9*\sqrt{3}}$$

$$= 244.73\ mm^2$$

$$= 9*8.6*2.8$$

Gross core Area,

$$Ag = \frac{10^4*ET}{4.44*f*B_{max}*0.97}$$

$$= \frac{10^4*11.3}{4.44*50*1.7*0.97}$$

$$= 308.67\ cm$$

Core dia,

$$d = \sqrt{\frac{Ag*4}{\pi*0.945}}$$

$$= \sqrt{\frac{308.67*4}{\pi*0.945}}$$

$$= 203.9\ mm$$

$$= 205\ mm$$

5.4.1 Body Design

630KVA*01 Nos:

Length = 1180mm, Width = 480mm, Height = 1010mm.

Body sheet size = 1600mm*1010mm*13SWG = 02 Nos

Top plate = 1310mm*610mm*6mm = 01 Nos

Base plate = 1210mm*510mm*4mm = 01 Nos

Conservator sheet size = 950mm*610mm*16SWG = 01 Nos.

Angle = 2″*5mm = 50kg, Flat Bar = 45kg

Core Channel = 6″*1100mm = 04 Nos.

Base Channel = 5″*720mm = 02 Nos.

Hole = 18mm, Pya = 2″

5.4.2 Coil Design

630KVA

LT = 20 turn

= (8.6*3*9) 22.95 = 23

HT = 20*45.9

= 918*2.5% = 941

5.4.3 Core Design

<u>630KVA</u>	WH-362 mm	LC-354 mm
A-Core	B-Core	C-Core
772*205-91.10 mm	567*205-45.55 mm	913*205-91.10 mm
767*200-36.96 mm	567*200-18.48 mm	908*200-36.96 mm
757*190-50.82 mm	567*190-25.41 mm	898*190-50.82 mm
747*180-37.45 mm	567*180-18.72 mm	888*180-37.45 mm
737*170-30.24 mm	567*170-15.12 mm	878*170-30.24 mm
727*160-25.45 mm	567*160-12.73 mm	868*160-25.45 mm
717*150-21.91 mm	567*150-10.95 mm	858*150-21.91 mm
707*140-19.11 mm	567*140-9.56 mm	848*140-19.11 mm
697*130-16.80 mm	567*130-8.40 mm	838*130-16.80 mm
687*120-14.83 mm	567*120-7.41 mm	828*120-14.83 mm
677*110-13.10 mm	567*110-6.55 mm	818*110-13.10 mm
657*90-21.70 mm	567*90-10.85 mm	798*90-21.70 mm
637*70-16.51 mm	567*70-8.25 mm	778*70-16.51 mm
617*50-11.94 mm	567*50-5.97 mm	758*50-11.94 mm

5.5 Transformer test

5.5.1 Ratio

AB= 414=15.16=15.54=15.92=16.36=16.72

BC=413=15.16=15.54=15.94=16.36=16.73

CA=410=15.31=15.66=16.06=16.48=16.91

5.5.2 No Load test

ab = 415	a = 9.2	1.50
bc = 416	b = 8.09	P_{NL} = 920W
ca = 418	c = 8.73	2.42

5.5.3 Full load test

AB = 496	A = 33.1	a = 878	4.1
BC = 495	B =33.2	b = 874	P_{FL} = 7500
CA = 495	C = 33.2	c = 864	11.6
		n = 24	

5.5.4 Insulation test / megger test

HT to body = above 500MΏ

LT to body = above 500MΏ

HT to LT = above 1000MΏ

HT to HT = above 630MΏ

LT to LT = above 630MΏ

5.6 Instrument Transformers:

A transformer that is used to measure electrical quantities like current, voltage, power, frequency and power factor is acknowledged as an instrument transformer. These transformers are in general used with relays to protect the power system.

5.6.1 CT Diagram

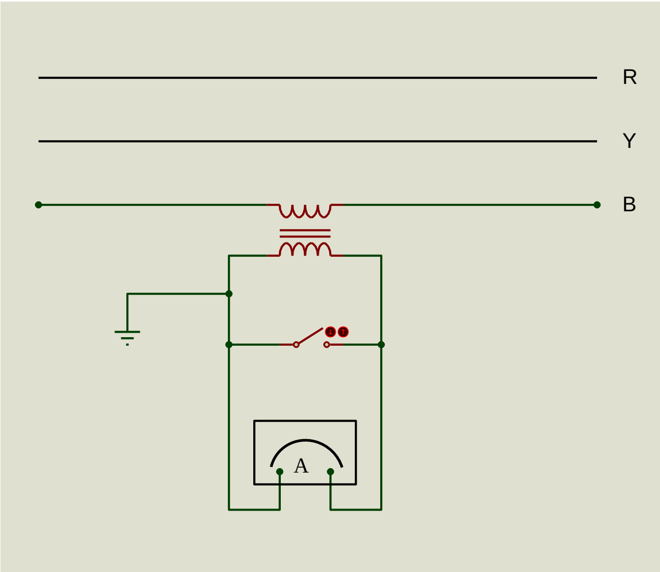


Fig: Current Transformer Diagram.

5.6.2 PT Diagram

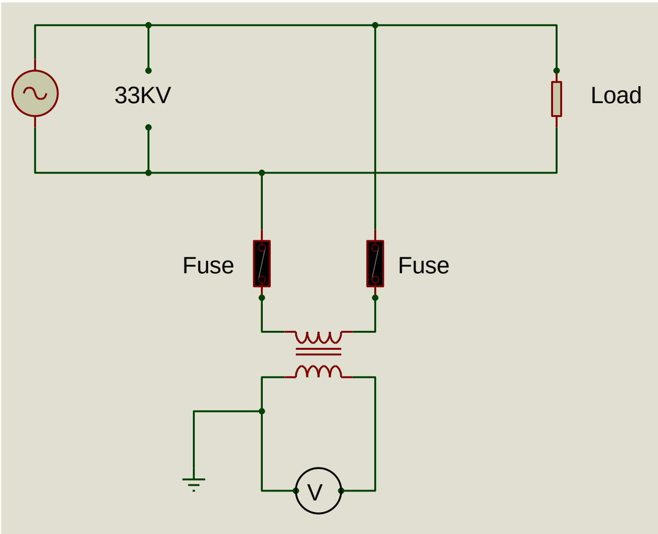


Fig: Potential Transformer Diagram.

5.7 Diagram of transformers

5.7.1 Single phase diagram

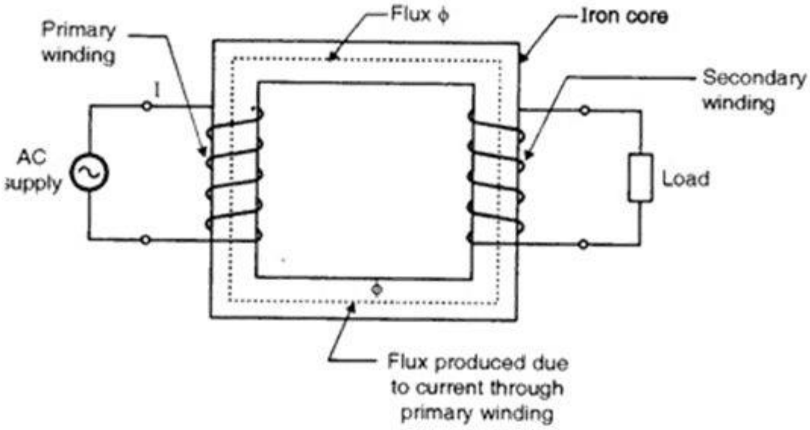


Fig: Single phase diagram.

5.7.2 Three phase diagram

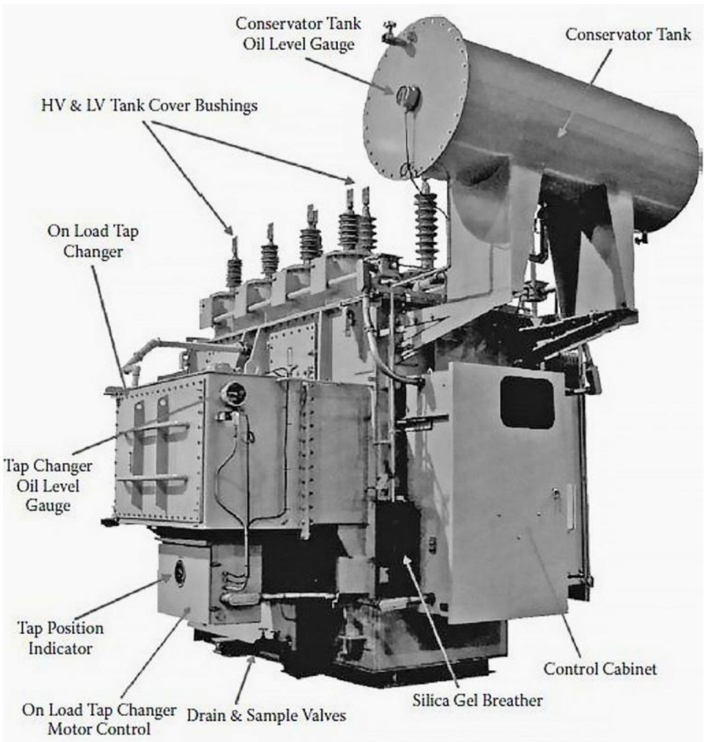


Fig: Three phase diagram.

5.7.2.1 Star-Star connection

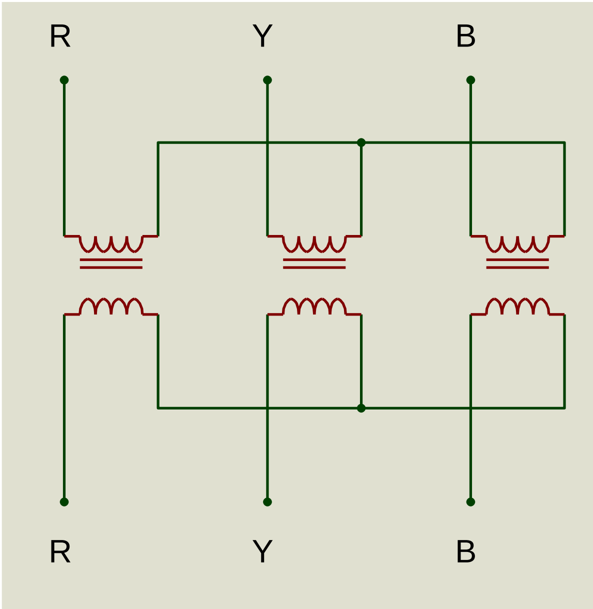


Fig: 5.7.2.1 Star-Star connection.

5.7.2.2 Star-Delta connection

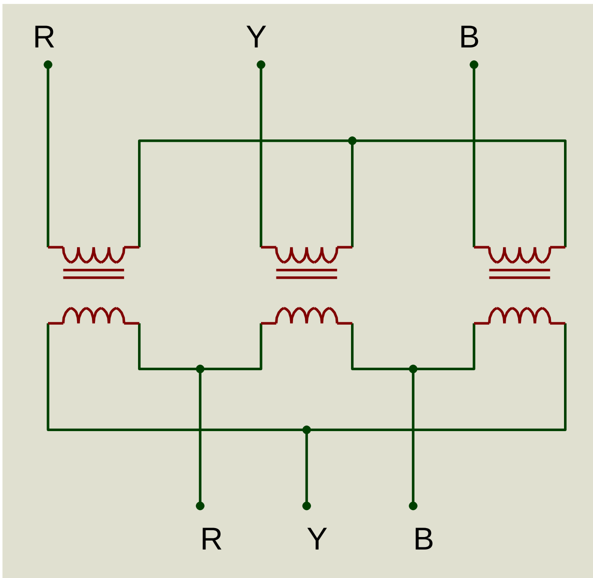


Fig: 5.7.2.2 Star-Delta connection.

5.7.2.3 Delta-Delta connection

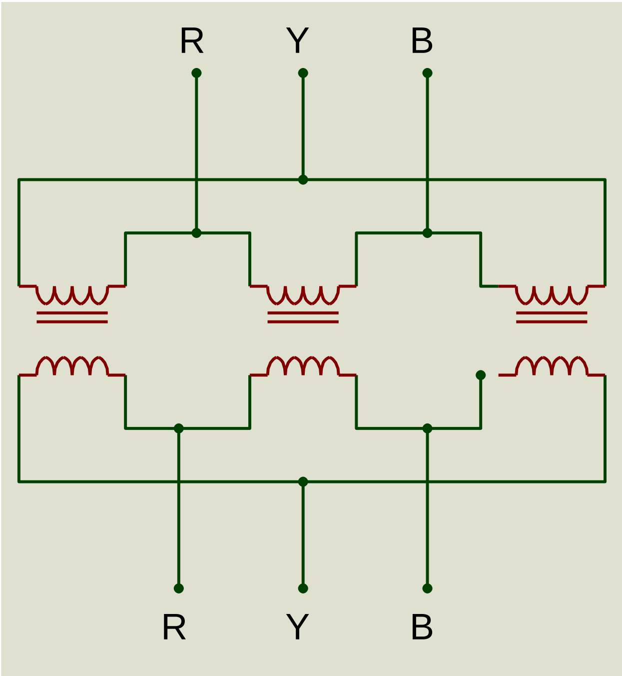


Fig: Delta-Delta connection.

5.7.2.4 Delta-Star connection

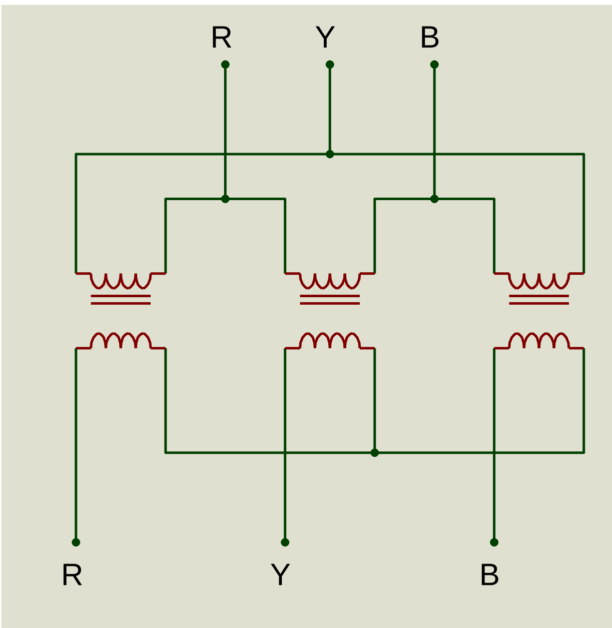


Fig: Delta-Star connection.

5.7.3 Transformer Core

Fig: Transformer Core.

5.7.4 Transformer Coil

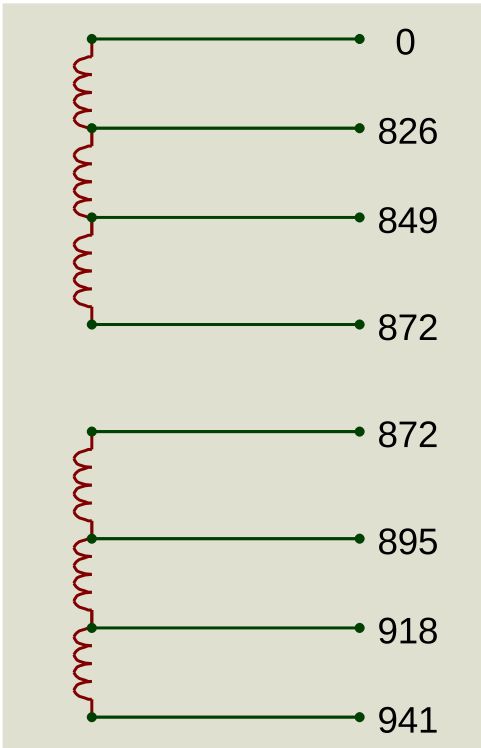


Fig: Transformer Coil.

5.7.5 LT Coil diagram

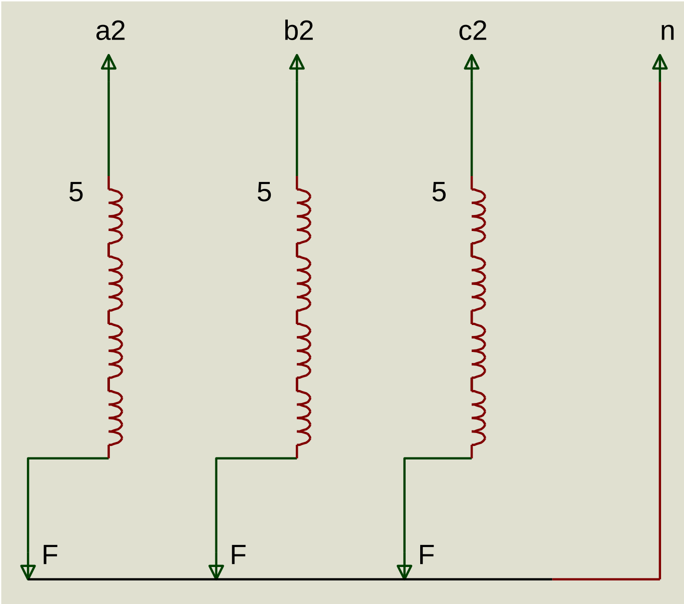


Fig: LT Coil diagram.

5.7.6 HT coil diagram

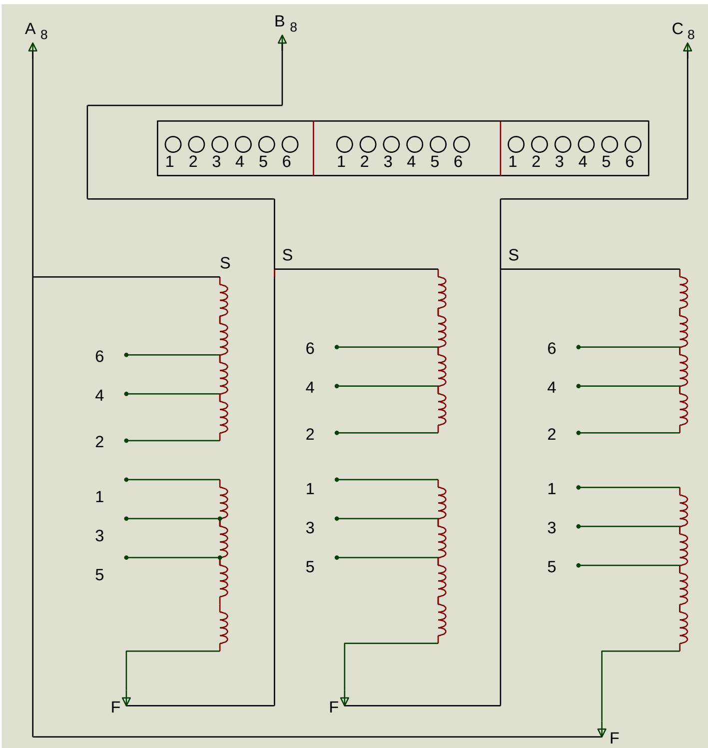


Fig: HT coil diagram.

Chapter-6

LT SWITCHGEAR

6.1 Theory of LT Switchgear

Electric switchgear is usually rated as high as 1KV as a low voltage switchgear. LV switchgear time period consists of low voltage circuit breaker, switch, off-load electrical insulation, HRC fuses, earth leakage circuit breaker, miniature circuit breakers (MCB) and molded case circuit breakers (MCCB) etc. All accessories required to protect the LV device are the most unusual use of LV switchgear in the LV distribution panel.

Fig: Controlling Connection.

Fig: TPMCCB.

Fig: LT Switchgear.

6.2 Calculation of LT Switchgear

LT Calculation:

630 KVA Transformer

160% LT Switchgear

630*160% = 1008 Amp

= 1200 Amp

Bus-bar Calculation:

We know,

$1mm^2$ current Density 1.6 A

Normally,

(1.6-2) Amp

So,

2 Amp for = $1mm^2$

1200 Amp for = 1200/2

= $600\ mm^2$

$\underset{\text{Width}}{60} * \underset{\text{Thicknes}}{10} = 600\ mm^2$

6.3 Type of LT Switchgear

1) TPMCB (Triple Pole Miniature Circuit Breaker)
2) TPMCCB (Triple Pole Molded Case Circuit Breaker)
3) ACB (AIR Circuit Breaker)

6.4 Equipment's of LT Switchgear

1)	Indicator Lamp	3 Nos
2)	Amp meter	3 Nos
3)	Voltmeter	1 Nos
4)	Voltmeter selection switch	1 Nos
5)	RT fuse	3 Nos
6)	CT Connector	
7)	CT	3 Nos
8)	Bus-Bur	
	Width	60
	Thickness	10
9)	TPMCCB	1200 A, 600A
10)	Panel box	
11)	Fiver board or Bus-Bur insulator	

6.5 LT Rating

LT → 100A	ACB → 800A
150A	1000A
200A	1200A
250A	1600A
300A	2000A
400A	2500A
500A	3000A
600A	3500A
1000A	5000A
1200A	

6.6 LT Power diagram

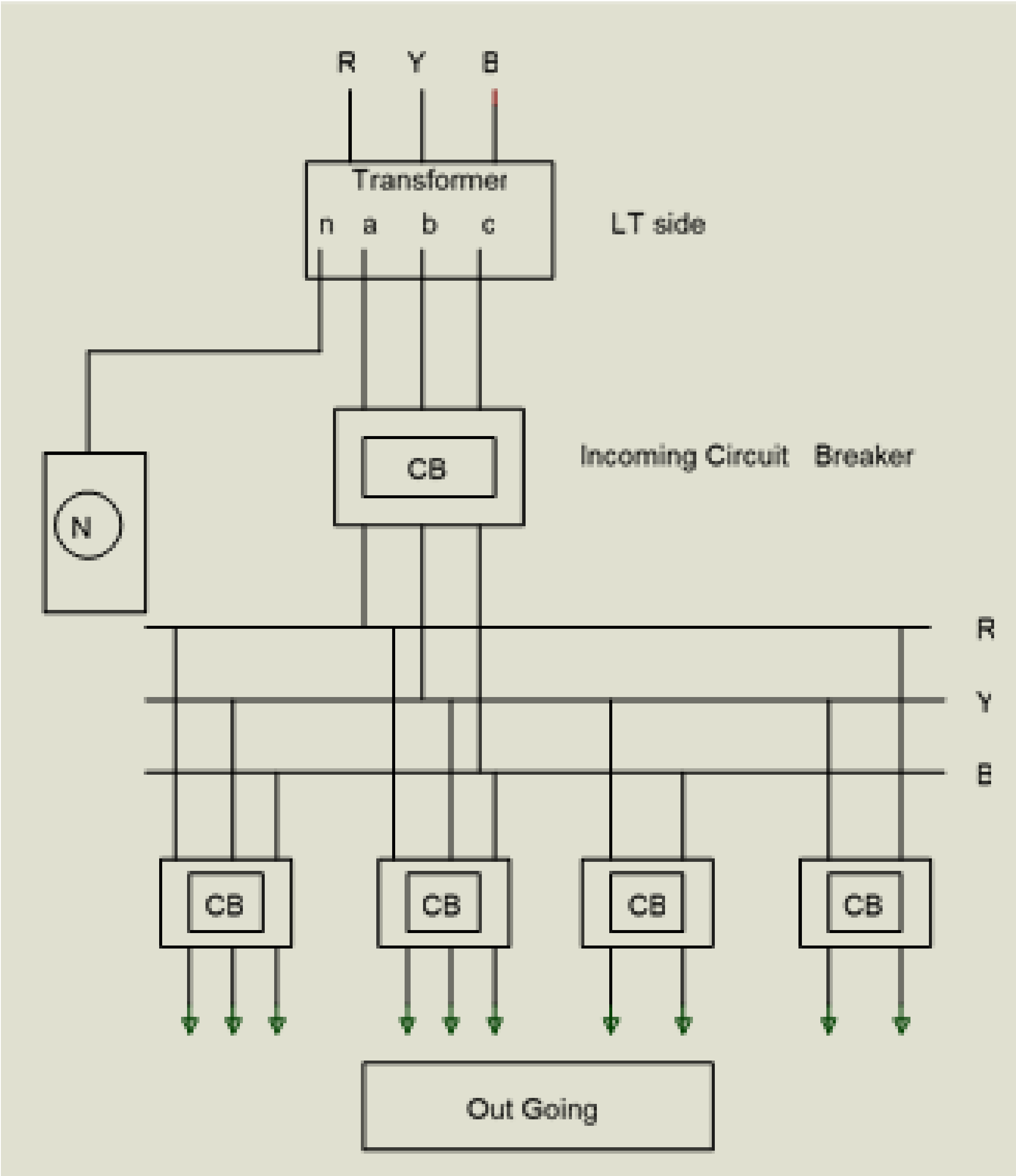


Fig: LT Switchgear Power diagram.

6.7 LT control diagram

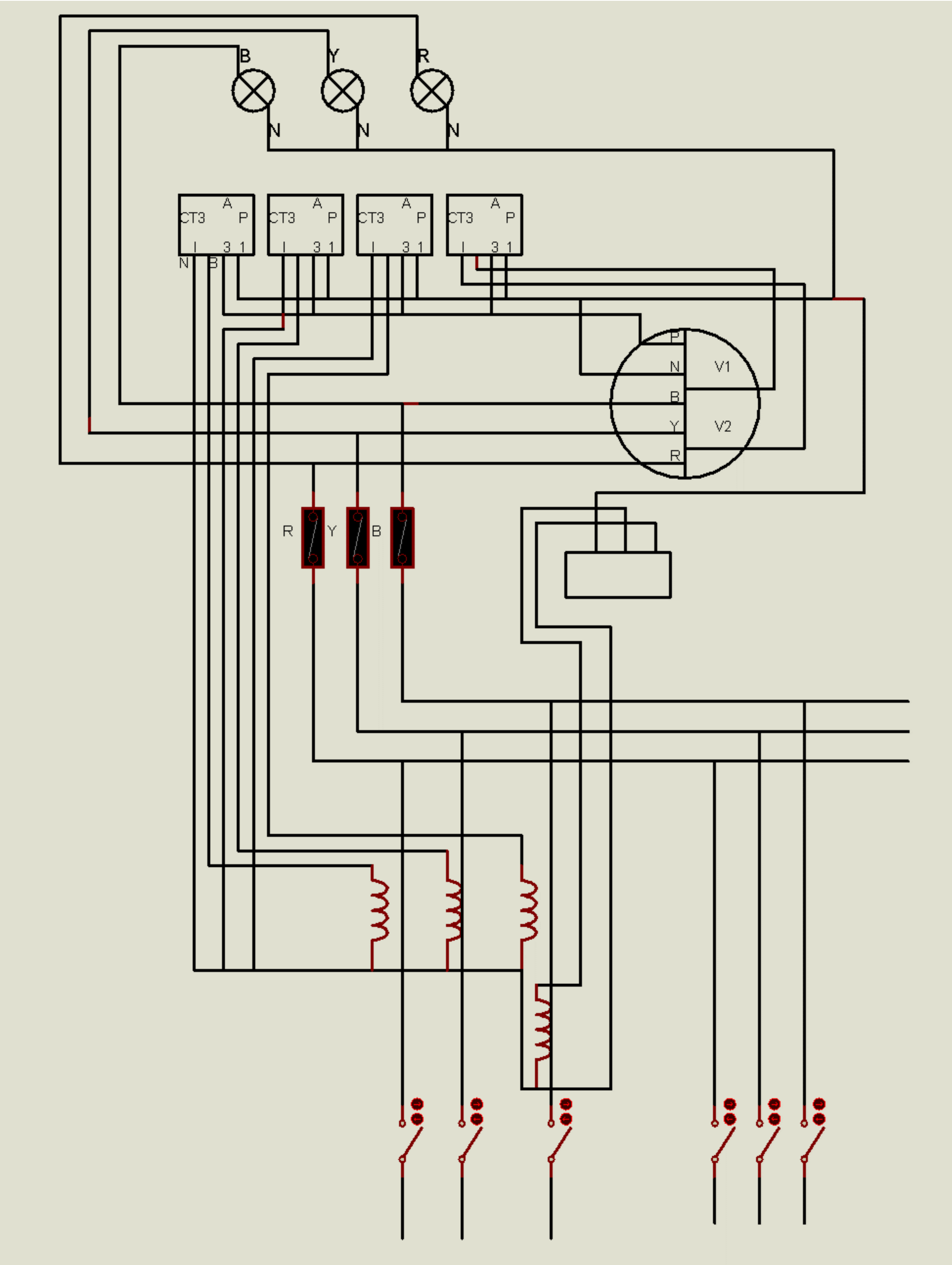


Fig: LT Switchgear control diagram.

Chapter-7

PFI

7.1 Theory of PFI

Power factor correction is the way capacitors are used to reduce the reactive power factor of AC circuits so that they can be effectively improved and the current is reduced. For continuous resistance load, the current is proportional to the applicable voltage, so the energy destroyed using the resisting load will be linear.

Fig: Power Factor improvement Plant (PFI).

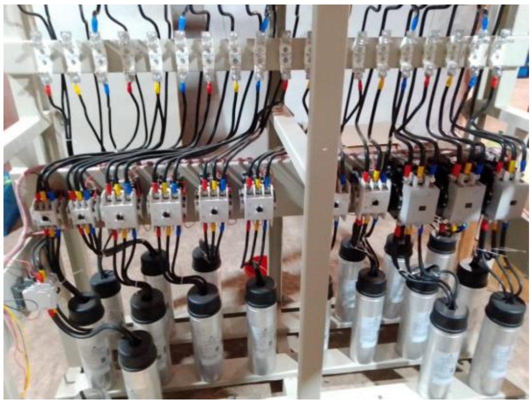


Fig: PFI Connection.

7.2 Reasons of Low Power Factor

Seeing the low power factor is undesirable from the economic factor. Usually, 0 • Less than 8 is the power factor of the whole load on the supply system. The reasons for the capacity factor are as follows:

a) Most a.c motor are of induction type (1φ and 3φ induction motors) which have less underdeveloped power factor. These engines operate in a very small power plant at light load (0.2 to 0.3) and increase to 0.8 or 0.9 at full load.

b) Arc lamps, electric discharge lamps and industrial heating furnaces work with a low lagging power factor.

c) The load on the power supply system is variable; High and low at different times throughout the morning and evening. The power supply voltage is increased during the low load period, which will increase the magnetization current. This is done by reducing the power factor.

7.3 Methods of PFI

Normally, the power factor of the entire load in a large power plant is 0 • 8 to 09 in the area. However, from time to time it is reduced and in such cases, it is recommended to take different steps to improve the power factor in general. This can be done through the following tools:

a) Static capacitors.
b) Synchronous condenser.
c) Phase advancers.

Static capacitor:

The power factor can be multiplied using connected capacitors parallel to devices that work in the retarded power factor. Condenser (commonly known as stable capacitors) neutralizes the current leading and partially or underdeveloped reaction element of the current load at all. This increases the capacity factor of pregnancy. For three-stage loads, capacitors can be added to a delta or star. Fixed capacitors are always used to improve the power factory in factories.

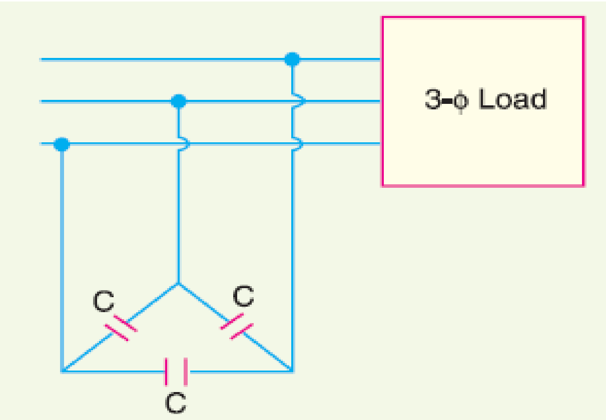


Fig: Static Capacitor (a).

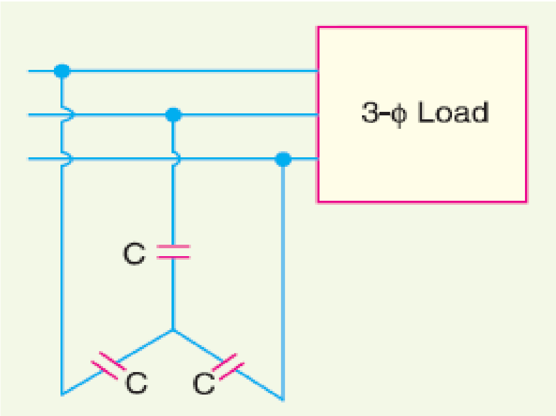


Fig: Static Capacitor (b).

Synchronous condenser:

The synchronous motor takes the mainstream when more enthusiastic and, therefore, acts as an capacitor. The stressful synchronous motor that works on the load is determined as a synchronous capacitor. When such a parallel machine is added to the supply, it takes the mainstream that partially neutralizes the reaction factor lagging behind the load. 3φ load takes il current on low power factor late cos φL. The synchronous condenser takes the current chat that goes into the voltage using the φm angle. The resulting current is the total face of I IM and IL and stays behind the voltage using φ angle. Obviously the φ is much less φL so that φ cos exceeds φL. Thus, the power factor is increased from THE ΦL COS to cos φ. The synchronous condenser is generally used in large critical secondary supply stations to correct the power factor.

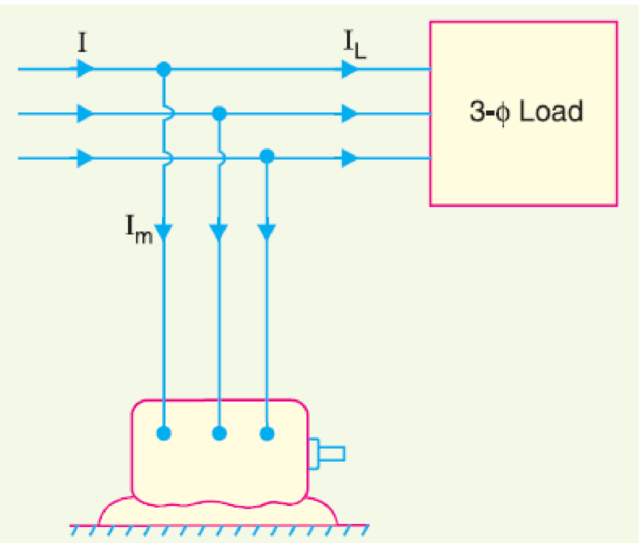


Fig: Synchronous Motor.

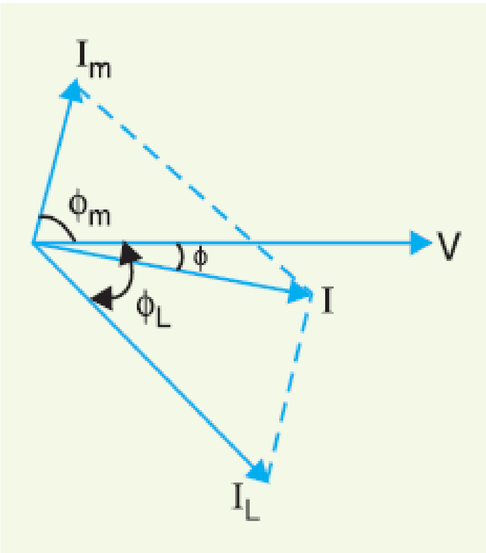


Fig: Synchronous Angle.

Phase advancers:

The progress phase is used to improve the power factor on induction engines. The low power factor of the induction engine is due to the fact that its stator curved current orientation stunts that lag behind the display voltage using 90 degrees. If it can be provided by some different amp turns .c the source, the stator winding of the exciting current will be relieved and the power factor of the engine can be improved. This is done only a.c which is done with the help of advanced step. The progress phase is installed on the shaft evenly as the main engine in the rotor circle of the main engine. It provides an exciting amp that turns into a rotor circle at slip frequency. By providing additional amp turns of essential, the induction engine can be built to work on a leading power factor like the buoyed-than-enthusiastic engine. 2. Applicants have two main advantages on the platform. First, exciting amp turns are also provided in the slip frequency, and therefore, the KVAR interval drawn using the engine is greatly reduced. Secondly, an advanced stage can simply be used where the use of synchronous engines is unacceptable. However, the most important drawback in the progress phase is that it is no longer economical for engines below 200 hp.

7.4 PFI calculation

630 KVA

60% PFI

So,

PFI = 378 KVAR

≃ 380 KVAR

Bus-bur Calculation

1.39 is Constant

So,

380*1.39 = 528.2 Amp

= 530 Amp

We know,

Current Density = 106 for $1mm^2$

Now,

2 Amp for $1mm^2$

So,

528.2 Amp for = 530/2 mm^2

= 300 mm^2

= 60*5

⬇ ⬇

Width Thickness

7.5 Equipment's of PFI

1) Panel Box
2) Bus-Bar
    a) Length = 1270 mm
    b) Wight = 60 mm
    c) Thickness = 5mm
3) HRC Fuse – 39 pic
4) MC: 12 stage

    32-1

    40-2

    50-5

    85-1

    100-3

5) Wire: 6 rm, 10 rm, 16 rm
6) Capacitor: 17 pic

    10 KVAR - 1pic

    20 KVAR- 5pic

    25 KVAR- 4pic

7) Indicator lamp- 12 pic
8) PFC Relay- 1 pic
9) RT Fuse- 3 pic
10) Connector- Control Connection from LT – CT
11) Bus-Bar Insulator (Air metal)

7.6 PFI single phase diagram

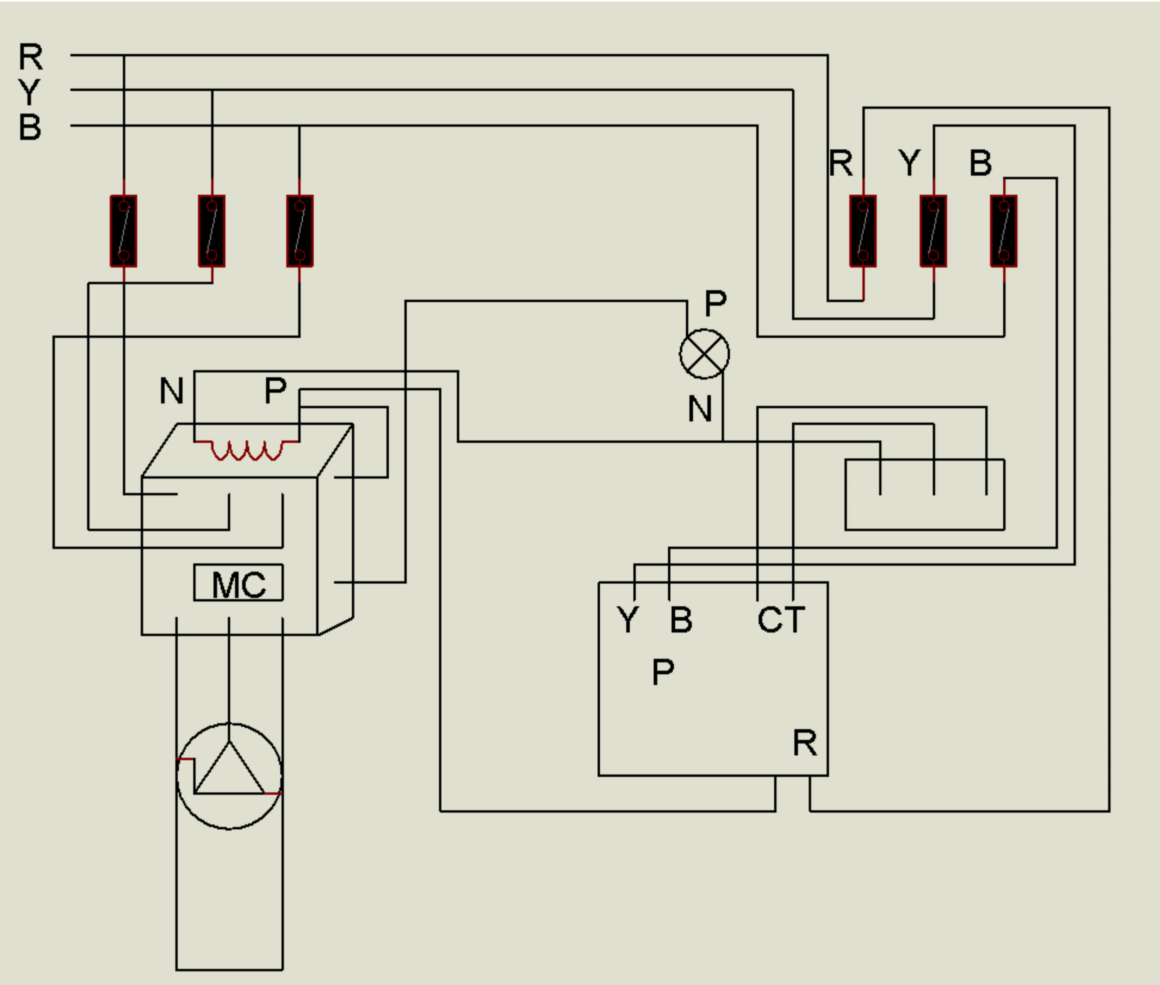


Fig: PFI single phase diagram.

7.7 PFI Control Diagram

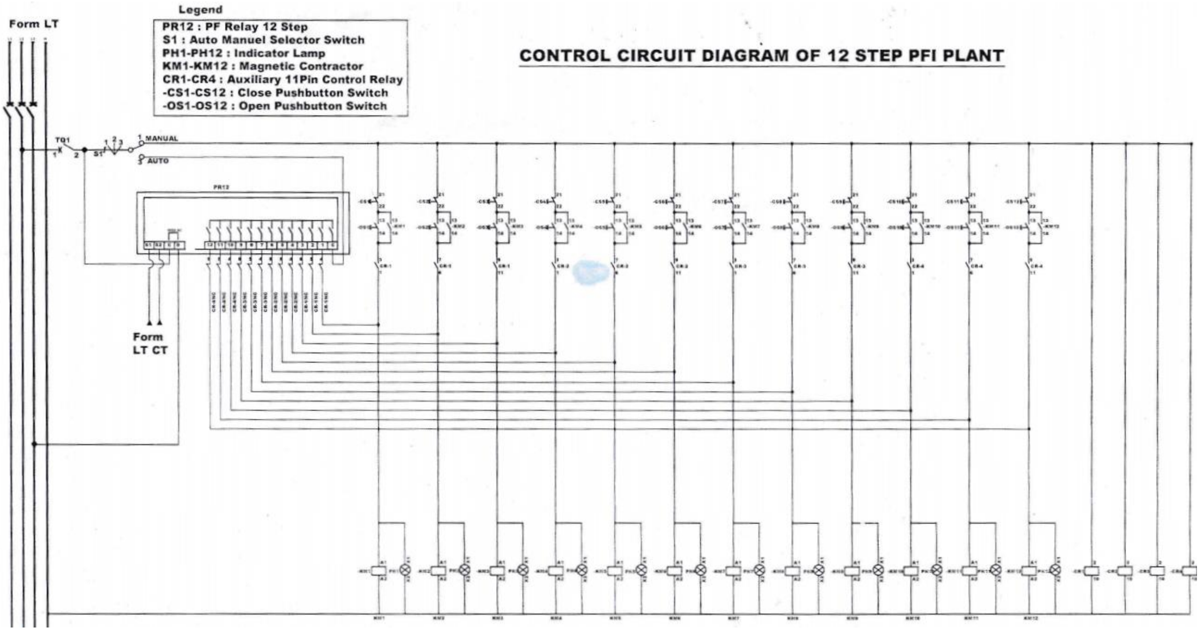


Fig: Control circuit diagram of 12 step PFI plant

7.8 PFI Advantages & Disadvantages

Advantages:

a) They have low losses.

b) They require little maintenance as there are no rotating parts.

c) They can be easily installed as they are light and require no foundation.

d) They can work under ordinary atmospheric conditions

e) By varying the field excitation, the magnitude of current drawn by the motor can be changed by any amount. This helps in achieving step less control of power factor.

f) The motor windings have high thermal stability to short circuit currents.

g) The faults can be removed easily.

Disadvantages:

a) They have short service life ranging from 8 to 10 years.

b) They are easily damaged if the voltage exceeds the rated value.

c) Once the capacitors are damaged, their repair is uneconomical.

d) There are considerable losses in the motor.

e) The maintenance cost is high.

f) It produces noise.

g) Except in sizes above 500 kVA, the cost is greater than that of static capacitors of the same rating.

h) As a synchronous motor has no self-starting torque, therefore, an auxiliary equipment has to be provided for this purpose.

Chapter-8

DISCUSSION AND CONCLUSION

8.1 Conclusion

Power is needed for any kind of production. For profitable production, power should be properly used. Betco power Limited uses power from DESA as well as produces power by their gas generators. They supply power from control room to different loads. For controlling power they use different circuit breakers and relays. For their industrial automation part, they use relay, magnetic contactor, timer, variable frequency inverter, sensor and PLC. Proper uses and maintenances of these equipment have made their production profitable and are leading the company to forward.

8.2 Future Scope

This report will cover and offer the opportunities to know different types of machinery used in, Power Generation and Controlling System of various arising problem during Power generation. I can learn a lot from here, such as sub-station, protection, switch gears, bus bar, and power factor improvement and about their operation. Those who come here they are about the real knowledge will. In future how goes to Betco Power limited they learn about substation, alternator, High Tension panel (HT), low tension panel (LT), power factor improvement (PFI), bus bar and power generator.

8.3 Limitations

Although I have done my best to prepare this report, there are still some limitations to the study. The main limit of the study was insufficient raw data. As an intern in a private organization, maintain some standards and regulations for the company. Therefore, it was very difficult for me to get a general picture of the demand for the business system and services in various sectors. This report is also some restrictions like I can't get a copy of the document from the company's computers because it's confidential. So, I lost some data. Therefore, it was not possible to submit a full report such as statistics, financial participation etc. in relation to the subject or opportunity. During the report, attention had to be paid to the report, which contained no confidential information of the company and harmed the organization in its strategic intelligence.

References

1) Power diagram & Control diagram is collect from real life field study practical experience.

2) Company:

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ii. Mithun Saha (Factory Manager)
iii. Zakaria Hossain (Technician)

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i. V.K Mehta (Power System)
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