INTERNSHIP REPORT

ON

POWER GENERATION, TRANSMISSION AND PROTECTION SYSTEM EQUIPMENTS OF DESH ENRGY LIMITED

SUBMITTED BY

MD. YEASIN ARAFAT

SID: 2008 – 3 – 80 – 002

NAYEEM AHSAN

SID: 2008 – 2 – 86 – 016

MD. NURUZZAMAN

SID: 2008 – 3 – 80 – 017

SUBMITTED TO

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FACULTY OF SCIENCE AND ENGINEERING

EAST WEST UNIVERSITY

In partial fulfillment of the requirements for the degree of

Bachelor of Science in Electrical and Electronic Engineering

(B.Sc. in EEE)

[SPRING – 2012]

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APPROVED BY

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DESH ENERGY

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TO WHOM IT MAY CONCERN

This is to certify that, Nayeem Ahsan, SID 2008-2-86-016, Md. Yasein Arafat, SID 2008-3-80-002 , Md. Nuruzzaman, SID 2008-3-80-017 have successfully completed their internship from Desh Energy Limited, Shiddhirganj, Narayanganj, from 27th December 2011 to 14th January 2012. They have completed 112.5 hours of their internship on power generation, transmission, and protection system of Desh Energy Limited. During the tenure of their training with us all the students put their best effort to comprehend the overall of Power Generation system.

The undersigned on behalf of Desh Energy Limited, recommending this work as the fulfilment of the requirements of EEE 499(Indutrial training) of the East West University,Dhaka.

I wish their success in life.

Engr. Md. Johurul Islam

Assistant Manager (Operation)

Desh Energy Limited

Acknowledgement

First of all we would like to thank the Almighty Allah for giving us the chance to complete our internship and prepare the internship report.

We would like to bring up the name of Dr. Khairul Alam, respected Chairperson and Dr. Anisul Haque former chairperson of the Department of Electrical and Electronic Engineering for his excellent guidance throughout the last four years.

We would like to show gratitude to Ms.Tahseen Kamal, Senior Lecturer, S. M. Shahriar Rashid, Lecturer, and Ms. Sohana Tanzeem, Lecturer, Department of Electrical and Electronic Engineering, East West University, for their imperative direction on total internship program and also for their guidance in preparing this report.

We are also grateful to Engr. Md. Showkat Ali Talukder – General Manager (Operation) of DEL, Engr. Md. Johurul Islam – Assistant Manager (Operation), Engr Md. Anwarul Haque – Assistant Manager (Fuel Section), Engr Md. Ruman Ali – Senior Engineer, and Engr K. M. Musa – Junior Engineer for allowing us to do the internship, observe and work with them.

At last we want to thank all of our faculty members and friends for their inspiration and co-operation throughout our whole academic life in East West University.

Executive Summary

Power is well considered as one of the most vital infrastructure capability for growth of country's economy. The significance of power cannot be denied. Socioeconomic development in Bangladesh is causing the increasing demands of electricity day by day. With the appearance of Market Economy, the demand of stable supply of power has become more and more important for trade, commerce, industry and agriculture for success of overall development of the country and alleviation of poverty.

Government of Bangladesh agreed in principle to the concept of private sector electricity generation. Government approved this project as a pilot project of private Power Generation. Accordingly a private limited company named Desh Energy Limited was formed and registered on 2000. The company has taken numerous development programs for increasing its generation which is the demand of time. The plant capacity of DEL in Narayanganj is around 100 MW.

The objective of our internship at DEL (Desh energy Limited), was to get a clear conception on power generation and transmission. Through this internship we got the opportunity to work as a member of a team which was involved in Fuel section, Generator section, transformer section, and substation. We learned about the protection and switchgear section of generator, transformer, and the whole power plant. We worked for fifteen days in power generation and maintenance system. The power station control system is automated and modernized. Generation, Protection, controlling and transmission to the national grid are the main aim to set up this power plant. There are various processes to produce electricity. Following necessary steps we generate electricity and transmit it to the national grid. We gathered experience in protection of some important equipment related to power generation process, such as generator protection, transformer protection, and substation protection, along with its operating principles, maintenance and testing system. We also gathered experience of controlling a power plant through operating and monitoring from the control room, with the help of our superintendent engineer. Upon completion of this internship, we are able to relate the practical experience with the theoretical knowledge in power sector. It has helped us to understand the practical problems better and their solutions related to several aspects of power plant.

Training Schedule

We started our internship training program at Desh Energy Limited, Shiddirganj, Narayanganj. The concerned head of fuel sections and Assistant Manager Engr Md. Anwarul Haque was the coordinator. The training schedule (27th December to 14th January, 2011 - 12, 09.00 to 17.00 hours excluding holidays) is provided below:

Date	Program	Department	Mentor	Hours
27.12.11 **9 am – 5 pm**	1. Introduction with DEL. 2. Safety issue related to power station. 3. Basic principle of fuel separation. 4. Visit the fuel system.	Fuel and safety	Engr Md. Anwarul Haque (Assistant Manager)	7.5
28.12.11 **9 am – 5 pm**	1. Operate the fuel separator. 2. Maintenance of fuel separator and fuel system.	Fuel and safety	Engr Md. Anwarul Haque (Assistant Manager)	7.5
29.12.11 **9 am – 5 pm**	1. Study about compressor, dryer, coolant. 2. DM plant working procedure.	Fuel and safety	Engr Md. Anwarul Haque (Assistant Manager)	7.5
30.12.11 **9 am – 5 pm**	1. Brief discussion about power station, generation, and related equipments.	Power generation	Engr Md. Ruman Ali (Senior Engineer)	7.5
31.12.11 **9 am – 5 pm**	1. Specification of important equipments. 2. Single line diagram of the bank. 3. Power generation process.	Power generation	Engr Md. Ruman Ali (Senior Engineer)	7.5

03.01.12 **9 am – 5 pm**	1. To know about the alternator, excitor, coupling mechanism crankshaft with alternator.	Mechanical and maintenance	Engr Md. Hakikul Islam (Shift in charge Engineer)	7.5
04.01.12 **9 am – 5 pm**	1. To know about starting procedure, cooling system, lubrication system. 2. Observed the different components of engine and crankshaft arrangements.	Mechanical and maintenance	Engr Md. Hakikul Islam (Shift in charge Engineer)	7.5
05.01.12 **9 am – 5 pm**	1. To know about the procedure of genset starting – closing, synchronizing with grid. 2. To know about HV panel, LV panel.	Control	Engr Md. Ruman Ali (Senior Engineer)	7.5
06.01.12 **9 am – 5 pm**	1. To know about the controlling system.	Control	Engr Md. Ruman Ali (Senior Engineer)	7.5
07.01.12 **9 am – 5 pm**	1. To know about substation.	Substation	Engr Md. Ruman Ali (Senior Engineer)	7.5
10.01.12 **9 am – 5 pm**	1. To know about the substation control room. 2. To know about the equipments and single line diagram of a substation.	Substation	Engr Md. Ruman Ali (Senior Engineer)	7.5
11.01.12 **9 am – 5 pm**	1. To know about working principle of transformer, and its equipments.	Protection and maintenance	Engr K. M. Musa (Junior Engineer)	7.5
12.01.12	1. To know about the schedule	Protection and	Engr K. M. Musa (Junior Engineer)	7.5

9 am – 5 pm	maintenance of genset.	maintenance		
13.01.12 **9 am – 5 pm**	1. To know about the genset protection from different faults.	Protection and maintenance	Engr K. M. Musa (Junior Engineer)	7.5
14.01.12 **9 am – 5 pm**	1. Power station protection scheme used by DEL.	Protection and maintenance	Engr K. M. Musa (Junior Engineer)	7.5

Total working days = 15 days and working hours in every day is 7.5 hours. So total working hour in 15 days = 15×7.5 = 112.5 hours.

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CHAPTER - 1
Introduction

In this chapter, we are going to discuss about the motive of this internship and the background of the company where we have done our internship.

1.1 Company Profile

Desh Energy Limited is a recently formed Private Limited Company in the energy sector of Bangladesh. The Company has been formed with a fundamental core value; to operate with seamless integrity in the pursuit of excellence in all its ventures. The company is a sister concern of Mohammadi Group, a renowned conglomerate of the country. After its formation in 2005, the company has participated in the International Tenders invited by the Power Development Board of Bangladesh for small capacity skid and barge mounted power plants ranging from 10MW-150MW capacities.

They also committed to help Bangladesh achieving its maximum potential in terms of energy security, a necessary requirement for economic and social growth in a developing country. Through our presence in the energy sector we not only strive to assist the government in providing the best solutions to further strengthen the sector and its infrastructure but also we hope that Desh Energy Limited is powering development for greater prosperity and a better future for the country.

Figure 1.1: Desh Energy Limited at Shiddhirganj

1.1.1 Current Projects

Desh Energy Limited Shiddhirganj quick rental power plant located in Shiddhirganj power plant in Adamjee, Narayanganj. The power plant utilizes 5 Banks of brand new 96 caterpillar D3512 diesel fuelled generator sets rated at 1200 KW at 0.8 plant factor (lagging) at 1500 RPM, 50HZ 11KV continuous services at site with a total generating capacity of 100 MW. The Plant is based on a 15 Year Power Purchase Agreement (PPA) with the Bangladesh Power Development Board (BPDB) and supplies power to BPDB's 11/132 kV grid in Shiddhirganj.

Another one is Desh Cambridge Kumargaon Power Company Limited is a Desh Energy subsidiary located in Kumargaon, Sylhet. It has 6 units of Brand New Caterpillar G3520C Natural Gas Fuelled generator sets rated at 1950 kW at 0.80 Plant Factor (Lagging) at 1500 RPM, 50HZ 11KV continuous services at site with a total generating capacity of 11.70MW. The Plant is based on a 15 Year Power Purchase Agreement (PPA) with the Bangladesh Power Development Board (BPDB) and supplies power to BPDB's 11/33 kV grid in Sylhet.

1.1.2 Number of Genset and their Production Capacity

The generated power from every bank is given on the table below –

Table1.1: List of Bank Capacity

PARTICULARS	Bank – 1	Bank – 2	Bank – 3	Bank – 4	Bank – 5
Installed Capacity(MW)	25.2	25.2	25.2	25.2	14.4
Present Contracted Capacity (MW)	21	21	21	21	12

1.2 Purpose of the Internship

The main objective of this internship is to gather practical knowledge and experience in Power plant and relate this knowledge with our academic courses. Following the guideline provided by the EEE Department of East West University, the internship can be viewed as a two part project. At first we spent fifteen days in Desh Energy Limited (DEL) to learn practically the process of power generation, protection, maintenance and distribution. On completion of this rigorous

training we are going to submit this report, which reflects our valuable experience regarding the function of diesel fuel, engine, alternator, transformer, substation of Desh Energy Limited.

1.3 Methodology

This internship report describes the fuel system, power generation, protection, maintenance, transmission, substation and its working system of Desh Energy Limited. Significant part of the report consists of detailed description of generation of power.

This report has been prepared on the basis of –

i. Information collected from primary sources (primary information has been procured through personal interview as well as discussion with senior engineers) of DEL.

ii. Information from secondary sources- secondary data has been gathered by using company website.

CHAPTER - 2
Fuel Section (Utilities)

2.1 Introduction

In this chapter we will discuss about the fuel system, compressor system and the necessity of De – Mineralized plant of Desh Energy Limited. Fuel is mandatory before generating power. In Desh Energy Limited diesel is used as fuel. Fuel flow and fuel separation process has a great impact on proper operation of the plant, along with the supply of compressed air supplied from the compressor to start the engine. The de-mineralization plant ensures the supply of de-mineralized water so that the mineral component of the water does not damage the pipelines. We have visited these sections from 27th December to 29th December 2011.

2.2 Diesel as a Fuel

Diesel is a middle weight product that is heavier than gasoline. It has the appearance of oil and is often referred to as diesel oil. It does not evaporate as quickly nor is it as volatile as gasoline. It takes less refining from crude oil to make diesel fuel, which often makes diesel less expensive than gasoline. The increased mileage and lower cost make diesel a popular choice of fuel in many parts of the world.

2.3 Fuel Flow System of DEL

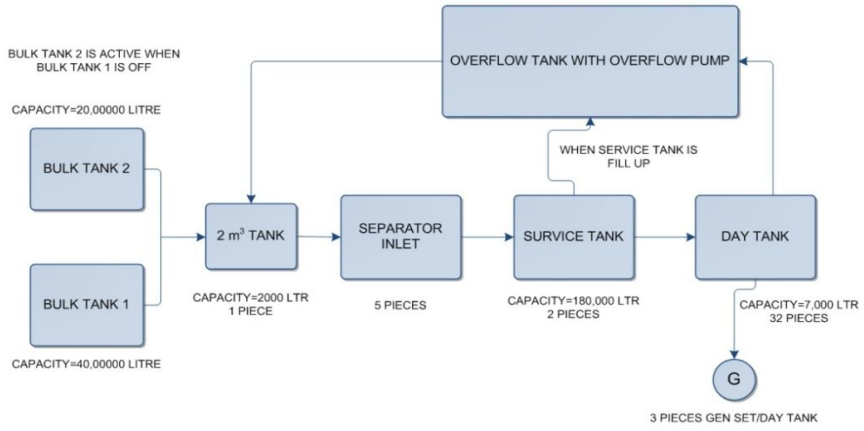


Figure2.1: Fuel flow system

A diesel genset is quite sensitive about the fuel injecting process. So it is need to control the fuel system from different kind of dust or unnecessary material. In DEL the fuel system maintain that requirements to get best fuel for genset.

2.4 Cause of Fuel Separation

Fuel separation is separation of fuel from different kind of dust or unnecessary material. The purpose of separation can be:

i. To free a liquid of solid particles.
ii. To separate two mutually insoluble liquids with different densities while removing any solids presents at the same time.
iii. To separate and concentrate solid particles from a liquid Fuel separator.

2.5 Fuel Separator

The fuel separator works as the following system.

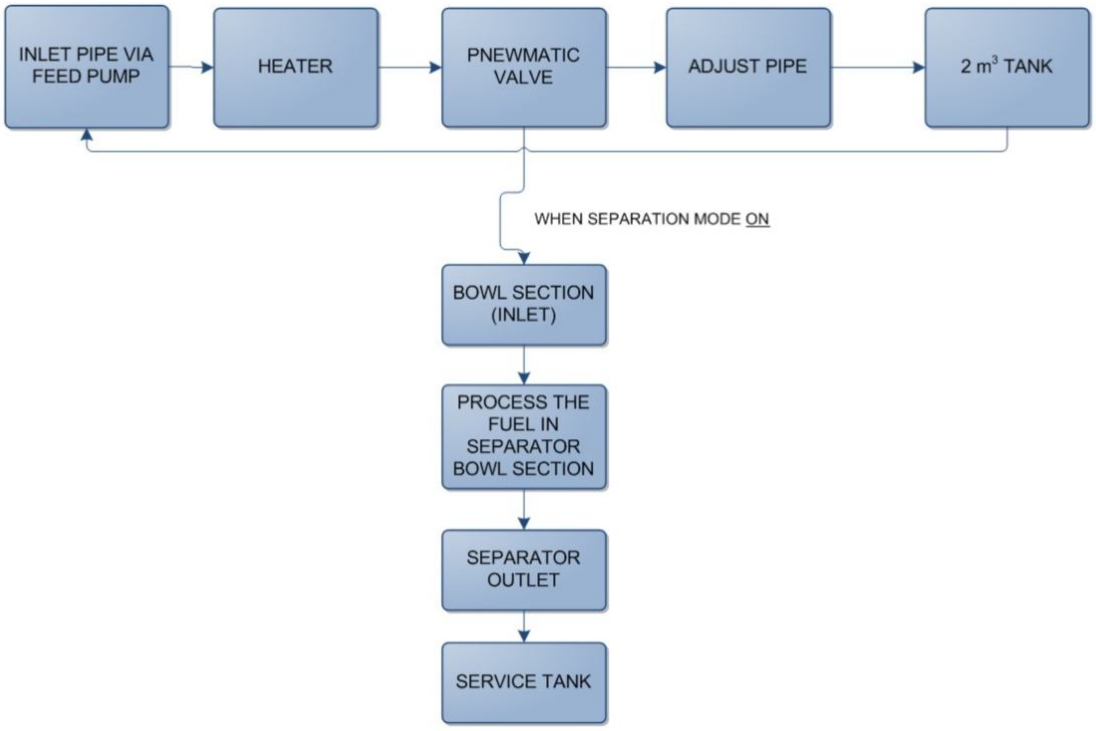


Figure2.2: Fuel separator system

2.5.1 Operating instructions of Separator

The process or operating instructions of separator at DEL is given below –

2.5.1.a Before normal start of separator

Following points are checked before starting:

i. It is ensured the bowl is clean and that the separator is properly assembled.
ii. It is made sure that all inlet and outlet couplings and connections have been correctly made and are properly tightened to prevent leakage.
iii. Then it is checked that the bolts of the outlet cover and the hooks and screws for the frame hood are fully tightened.
iv. Then the oil level is read. The middle of the sight glass indicates the minimum level. Refill if necessary up to slightly above the middle of the sight glass.
v. After that the break is released.
vi. It is made sure that the direction of rotation of the motor corresponds to the sign on the motor.

2.5.1.b Starting and running-up procedure of separator

The starting and running up procedure are given below –

i. After starting the separator, visual checking is performed to be sure that the motor and separator started to rotate.
ii. Then the direction of rotation is checked. It is made sure that the revolution counter runs clockwise.
iii. Attention must be taken for unusual noises or conditions. During this period smoke and odor may occur at the start when friction pads are new.
iv. Then the separator vibration is checked. Some vibration may occur for short periods during the starting cycle when the separator passes through its critical speeds. This is normal and passes over without danger.

2.5.1.c Stopping procedure of separator

The stopping procedures of separator are –

i. The oil feed must be turned off.
ii. Then sealing water is feed to empty the bowl from oil. When water flows out through the water outlet then feeding must stopped.

iii. Then the separator is stopped.

iv. After that the brake is pulled.

v. Then wait for the complete standstill (2-5 minutes) of the separator.

vi. Then the brake is released.

2.6 Compressor

Compressor is a device which is used to compress the air. The compressor used in the plant is generally rotator type. In Desh Energy Limited screw type compressor is used for compressing air. The advantage of this compressor is building high pressure with a shorter time.

2.6.1 Use of compressed air

For starting the engine we can use compressed air or battery. Generally for large size of engine or supporting small engine is used. Small engine will give the desired velocity to the main engine. Generally 5 – 10 BAR pressure is used to start the engine. Pressure vessel keeps the compressed air. The reservation of air is kept as an amount that can start for three times. Generally greater than 10.5 BAR it make a sense of no loading. The working pressure is between 8.5 – 10.5 BAR.

Figure 2.3:Kaeser compressor and dryer

2.6.2 Compressor and dryer operating procedure

The operating procedure of compressor and dryer is given below –

i. ON the power of compressor.
ii. Check the air pressure.
iii. Check eco – drain.
iv. Check alarm in compressor.
v. Start compressor.
vi. Always drain water from dryer before start and after stop the dryer.
vii. Start dryer.
viii. If the compressor is ON then it will start automatically when pressure falls below 8.5 BAR and stops when the pressure build up to 10.5 BAR.
ix. When compressor is ON load then always drain water manually ever through eco – drain works.
x. Never run both compressors with only one dryer.
xi. Both dryer can run with one compressor.

2.6.3 Dryer

Here we operate dryer with the compressor. Dryer works like a refrigerator system. Dryer is used for removing water. When temperature of air is decreased it releases moisture. The eco – drain bypass this moisture. There may be create water particles which harmful. So we need to compress the air again to dissolves all the water particles.

2.7 DM Plant

In DM Plant water is de-mineralized. At first the mineral water goes to the sand filter (0.5 micron). Then it goes to the Multimedia filter. This filter removes the clay and smell. Then it goes in Activated filter. It removes the Iron. After that in Cation filter this removes the base. Then Anion filter removes acid. After that it is mixed with bed filter. Mixed bed filter is the combination of Cation filter and Anion filter. Finally we get de-mineralized water.

2.7.1 Standard Operating Procedure of DM plant

We keep TDS from 0 to 150.We use this water in the radiator of engine. If the TDS is above 150 we need chemical regeneration.

2.7.1.a Flow chart of Regeneration

Regeneration means the de – mineralized water generation process from mineral water. The regeneration process of DM plant is given below –

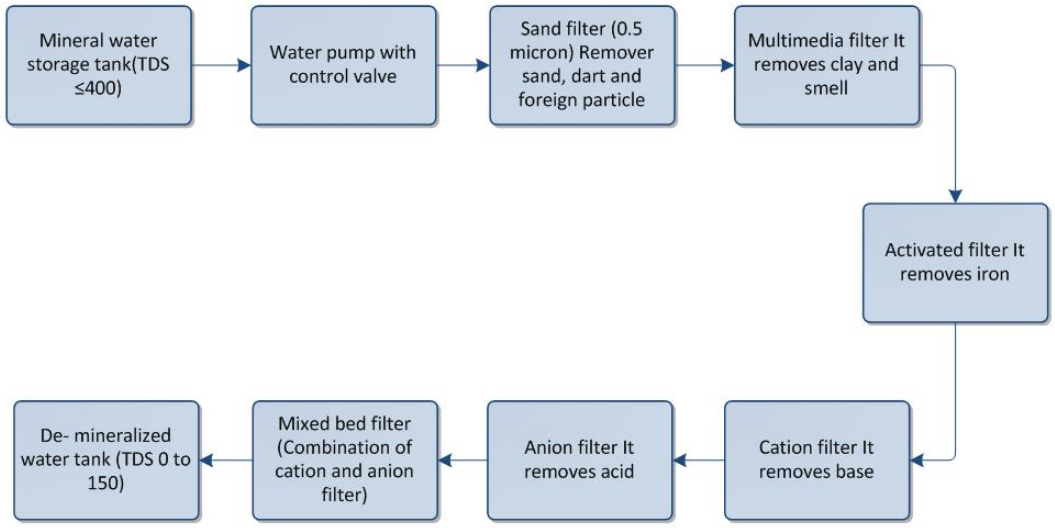


Figure 2.4: DM plant regeneration process

2.8 Conclusion

As we have discussed in the chapter, it can easily be understood that the fuel system and the related sections are essential for power plant operation. Through this chapter we have identified the key issues regarding the whole fuel system, fuel processing, DM plant, compressor system, and their working procedure. DEL is a diesel fuel based power station. So the concept of the fuel system of DEL is very important in the whole power generation system.

CHAPTER - 3
Power generation

3.1 Introduction

The amount of power generation in DEL is 100 MW at full load system. The power is generated using CATERPILLAR 3512 Gensets. There are 5 banks and every bank contains 21 gensets, except bank 3 which contains 12 gensets. All the gensets are diesel driven. The diesel engine drives the alternator which generates 600 Volts. The voltage generated is connected to a 600V/11KV transformer, which again is transformed in 132 KV in a Substation. The generated power is supplied to Shiddhirganj national grid. In this chapter we will discuss about the power generation equipments and the process of power generation. We have visited these sections from 30th December to 31th December 2011 and 3rd January to 5th January 2012.

3.2 Genset

Genset is the combination of engine and alternator. In genset the controlling systems of engine and alternator are attached. This genset can be handled manually or automatically using control system. For caterpillar genset Terberg control system is used. The CATERPILLAR 3512 Genset has a four stroke engine with 12 cylinder blocks.

Figure 3.1: CATERPILLAR 3512 GENSET

3.3 CATERPILLAR 3512 Engine

The CATERPILLAR 3512 Engine is used in DEL. The specific description of this engine is given below –

3.3.1 General Specs of CATERPILLAR 3512 Engine

The 3512 engine is a 4-cycle, turbocharged, direct-injected, liquid cooled V-12 with a 6.7-inch bore, 7.5-inch stroke, 13.5:1 compression ratio and a displacement of 3158 cubic inches. It is 9.5 feet long, 5.5 feet wide and 6.75 feet high and weighs 7.1 tons.

3.3.2 Capacities of CATERPILLAR 3512 Engine

The 3512's cooling system takes 75.8 gallons of coolant, with 41.5 gallons in the engine block and 34.3 gallons in the radiator. The oil sump holds 81 gallons of motor oil, which should be changed after every 1000 hours of operation. When running, this engine inhales about 3250 cubic feet of air per minute through a single-element, canister-type dry air filter. It emits 8185 cubic feet of exhaust gas per minute and pulls 44,000 cubic feet of air per minute through the radiator to cool the engine. It has a 24-volt DC starting system.

3.3.3 Specification of the engine

The specification of CATERPILLAR – 3512 engine is given below. The engine is diesel fuel type with 12 cylinders.

Table 3.1: Specification of CATERPILLAR 3512 Engine

ENGINE				
S/N – 1GZ05804		ENGINE MODEL – 3512		
AR NO – 2120324		ROTATION – CCN		
PERF SPRC – 0K6357		MAX ALT – 1500		
OEM NO				
FULL LOAD STATIC FUEL	22.90 mm			
FUEL TIMING	64.34 mm			
POWER	1310 KW	AT	1500	RPM
BARE ENGINE HIGH IDLE			1515	RPM

3.4 CATERPILLAR 3512 Alternator

Large-scale power is generated by three-phase synchronous generators, known as alternators. Synchronous generators convert mechanical power to electrical power.

3.4.1 Specification of the alternator

The alternator specification or name plate of the CATERPILLAR – 3512 genset is given below –

Table 3.2: Specification of CATERPILLAR 3512B alternator

CATERPILLAR					
ENGINE MODEL – 3512B				YEAR - 2009	
1714	KVA	1200	KW	0.7 COSΦ	50 Hz
3 PHASE		6 WIRE			
		X WYE		DELTA	
		X SERIES		PARALLEL	
GENERATOR		600 VOLTS		1649	AMPS
EXCITATION		34 VOLTS			7.38 AMPS
		826 FRAME			1500 REV/MIN
MAXIMUM TEMPARATURE RISE 80̊ C BY REISTANCE					
CLASS H INSULATION					

3.4.2 Construction

There is no air gap stator for making three phase voltage. To generate three phase voltage different tapping mechanism is used in CATERPILLAR 3512 genset. The CATERPILLAR 3512 alternator has four poles and the excitation voltage is 34 V DC.

3.4.3 Connection of alternator

Generally alternator output wye connection, but to avoid the neutral connection the output made delta connection. The 600 V generated voltage supply through the three pair of wire and connected on the primary side of the transformer. The transformer rating is 600V/11KV step up.

3.4.4 Starting and closing operation procedure of genset

For starting and closing the genset, the DEL followed the SOP or Standard Operation Procedure.

3.4.4.a Starting SOP

The starting SOP of an alternator or genset is –

i. Preliminary engine starting parameter (Lube oil level, Air pressure, Fuel line, Radiator water level, any type of leak (Coolant, Lube, or fuel), ESPB close or not, Electrical or Mechanical loosen portion etc) are checked.
ii. Crankshaft seals, crankcase, Battery Electrolyte level, oil filters, oil gallery plugs, sensors and valves covers are checked.
iii. The main circuit breaker (ACB) or the line circuit breaker is opened.
iv. The engine is set to HAND OFF mode from OFF mode in control panel.
v. The engine is started and allowed the engine to warm up.
vi. The alternator rated speed should be (1500 rpm) and rated voltage (600v). If the voltage is build up with the speed of alternator, then it is synchronized with the power grid.
vii. The load should be 60 percent.
viii. In order to maintain system frequency at a constant level the full load is incremented.

3.4.4.b General Stop/Isolation SOP

General stop procedure is –

i. Before stopping the engine the load is reduced to 60 percent.
ii. The STOP push button is pressed in CANTOP.
iii. It is run for 05 (Five) minutes for cool down and the engine is stopped.

3.5 Transformers

Transformer is another important part for power generation. Here we have discussed about the transformers which are used in DEL, their working procedure and the connection of transformer.

3.5.1 Specification of transformer

The specification or name plate data of the step up distribution transformer is given below –

Table 3.3: Specification of bank step up transformer

DISTRIBUTION TRANSFORMER	
3 PHASE	S/N – 10236132
FREQ – 50 Hz	YEAR OF THE MANUFACTURE – 2010
KVA – 4500	
VOLT HV – 11000 & LV – 600	TYPE OF COOLING - ONAN
AMPERE HV – 236.19	VECTOR GROUP YND11
IMPEDANCE % 9.5	TRANSFER OIL LITRE 3030
INSULATION CLASS A	TRANSFORMER WEIGHT 9540

3.5.2 Transformer connection

In DEL's bank transformer, three alternators jointly connected on the primary side of a 600V/11KV step up transformer via LV earth fault relay panel for 600 V systems. This panel is used for earth fault protection of the alternator. We will discuss details about LV earth fault relay panel in the protection part. The primary connection of transformer is delta and the secondary is wye. The secondary of the transformer goes to the HV (high voltage) panel and vacuum circuit breaker is used for HV panel protection scheme. The transformer cooling system is ONAN means Oil Nature, Air Nature system with class A insulation scheme.

3.6 Conclusion

In this chapter we have tried to discuss the whole power generation process and its necessary equipments. We have also discussed about two major components related to power generation i.e. genset and transformer. Besides these vital components, we have also discussed about internal mechanism of gensets and transformer construction and connection. Hopefully we have been able to properly deliver our understanding on these issues in this chapter.

CHAPTER - 4

Power Transmission

4.1 Introduction

We have already discussed how the alternator generates power and the connection of bank step up transformer in previous chapters. In the following chapter we will discuss about the secondary side of the transformer, connected to the High Voltage panel. The high voltage panel is actually the protection scheme, with Vacuum Circuit Breakers, control panel etc. In this chapter we will also discuss about the flow of power from bank to substation as the part of power transmission. We have visited these sections on 5th January 2012.

4.2 System diagram

The system diagram shows the power transmission from generated bank to grid. The whole process contains all the equipment such as genset, transformer, high voltage panel, low voltage panel, substation equipment etc.

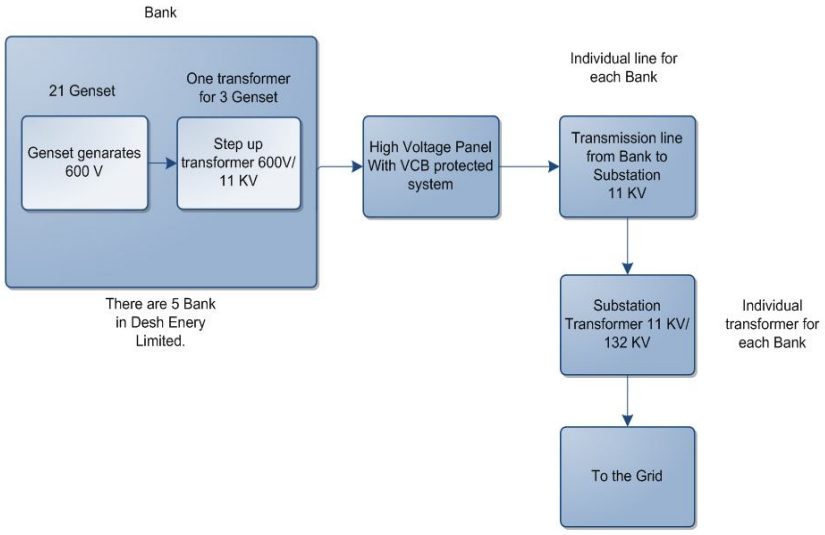


Figure 4.1: Power transmission system flow

4.3 Power flow

In Desh Energy Limited there are five power generation banks and every bank contains 21 gensets except the third one having 12 gensets. In system diagram we see that there are three

gensets connected to one step up transformer. In the primary side the genset supplies 600 V, three phase with three pairs of wire. The transformers step up the voltage up to 11 KV and supply it to the High Voltage Panel for protection scheme. From HV panel the power is transmitted to the substation with necessary protection such as VCB, Zigzag or earthling transformer. The zigzag transformer is used for additional protection of grounding. The details of zigzag transformer will discuss in the protection part. From HV panel one line goes to the zigzag transformer, another goes to the substation and the other line goes to the station transformer (rating 11KV/400V) to step down the voltage and the secondary of the station transformer is connected with Low Voltage panel. The bank has an internal demand. In this purpose the LV panel is important for every bank. In the LV panel there are two ACB (Air Circuit Breaker). One is used for protection and battery charging or bus bar power, and another one protects the emergency power line. The bus bar power line or internal usage line connected with 34 MCCB for internal use.

Figure 4.2: Single line diagram of a bank (in a Terberg control window)

4.4 Conclusion

In this chapter we have focused on the power transmission process of DEL. The transmission system consists of power generating Banks, power controlling room, substation etc which have been discussed elaborately in this chapter.

CHAPTER - 5
Substation

5.1 Introduction

The assembly of apparatus used to change characteristics of electric power supply e.g. voltage, ac to dc; frequency etc. is called a substation. Substations are important part of the power system. The continuity of supply depends to a considerable extent upon the successful operation of substations. A Substation is interconnected to generators, transformer, transmission and distribution lines and all other protecting and maintaining equipment's. A substation that has a step-up transformer increases the voltage while decreasing the current, and a step – down transformer decreases the voltage while increasing the current for domestic and commercial distribution. The word substation comes from the days before the distribution system became a grid. The first substations were connected to only one power station, where the generators were housed, and were subsidiaries of that power station. Substations generally have switching, protection and control equipment, and transformers. In DEL substation, circuits are used to interrupt any short circuits or overload currents that may occur on the network. In DEL substation different equipments are used to control the generated power when it is transferred to the grid. Generally power transformer, current transformer, potential transformer, isolators, busbar, lightening arrester, insulator, SF6 circuit breakers, different kinds of relays are the main equipment on DEL substation. In this chapter we are discussing about these components and its working procedure. We have visited these sections on 7th and 10th January 2012 under the guidance of superintendent Engr. Md. Ruman Ali. There we have spent around 15 hours.

In DEL the substation type is transformer type. After power generation the voltage level needs to increase. In DEL substation the transformers step up the voltage from 11KV to 132KV using 35000KVA, three phase JSB power transformer. It provides safe and reliable arrangement and capital cost is also low.

Figure 5.1: Site view of 11/132 KV DEL substation

5.2 Different components of a substation

In a substation there are lots of equipments use for transforming, transmitting, protecting the power systems. In DEL we observed these kinds of equipments. These are –

5.2.1 Transformer

There are two types of transformer generally used in the substation. Mainly transform the voltage level and measuring different data is the main use of transformer. Base on this fact we get –

5.2.1.a Power Transformer

Figure 5.2: Three phase, 35000 KVA, 11KV/132KV, 50 Hz power transformer.

In DEL substation they used five power transformers. This is used to step up the generated voltage coming from PSB-1, 2,3,4,5 respectively. The term power transformer is used to refer to those transformers used between the generator and the distribution circuits and are usually rated at 500 kVA and above. A power transformer is used in DEL substation to step- up the voltage. It is important part for a substation. The modern practice is to use three phase transformers in substations. The power transformers are generally installed upon lengths of rails fixed on concrete slabs having foundations 1 to 1.5 m deep. For rating up to 10 MVA, naturally cooled, and oil immersed transformers are used. For higher ratings, the transformers are generally normal and forced air cooled. The power transformers used in DEL are three phase, 35000 KVA, 11KV/132KV, 50 Hz transformer. The cooling system of transformer is ONAN means Oil Nature Air Nature type. The insulation class of the transformer is class A.

5.2.1.b Instrument Transformer

Instrument transformers are used for measuring voltage and current in electrical power systems. Also use for power system protection and control. Where a voltage or current is too large to be conveniently used by an instrument, it can be scaled down to a standardized low value. Instrument transformers isolate measurement, protection and control circuitry from the high currents or voltages present on the circuits being measured or controlled. There are two types of instrument transformer. These are –

i. Current transformer (CT):

Figure 5.3: 100:5 A Current transformer

A current transformer (CT) is a measurement device designed to provide a current in its secondary coil proportional to the current flowing in its primary. The main reason for using

current transformer in DEL substation is to reduce the line current, isolate the measuring instruments, and protects measuring instruments against short circuit currents, sense abnormalities in current and to give current signals to protective relays. It is designed to provide a current in the secondary winding which is proportional to the primary winding current. In DEL substation the rating of current transformer is 100:5 A.

ii. Potential Transformer:

Figure 5.4: Potential transformer for 132 KV line

Direct measurement of voltage in high voltage system is not possible because of insulation problem of measuring instruments. So we must need a transformer which takes high input voltage but the output voltage is low. This type of transformer is called PT. The instrument potential transformer (P.T) used in DEL substation to steps down voltage of a circuit to a low value that can be effectively and safely used for operation of instruments such as ammeters, voltmeters, wattmeter's, and relays used for various protective purposes. The primary of this transformer consists of a large number of turns of fine wire connected across the line.

5.2.2 Bus Bar

In electrical power distribution, a bus bar is a strip of copper or aluminum that conducts electricity within a switchboard, distribution board, substation or other electrical apparatus. Bus bars can have a cross-sectional area of as little as 10 mm^2 but electrical substations may use metal tubes of 50 mm in diameter (1,963 mm^2) or more as bus bars. Bus-bars is necessary when multi lines are operating at the same voltage have to be directly connected electrically, bus-bars

are used as the common electrical component. A bus bar may either be supported on insulators, or else insulation may completely surround it.

Figure 5.5: Bus bar connection of 132 KV line

Bus bars are protected from accidental contact either by a metal earthed enclosure or by elevation out of normal reach. Neutral bus bars may also be insulated. Busbars may be enclosed in a metal housing, in the form of bus duct or busway, segregated-phase bus, or isolated-phase bus.

5.2.2.a Bus-Bar arrangement

In substation several busbar arrangements system are followed. In DEL Single bus-bar system with Synchronization is used for transmission the power to the grid. For double bus bar arrangement an additional circuit breaker is required for bus tie. Since the bus tie breaker has to be able to be substituted for any line breaker, its associated relaying may be somewhat complicated. But single bus bar system with Synchronization does not require an additional circuit breaker.

In Single bus-bar system with Synchronization arrangement, the single bus bar arrangement is divided into section and load is equally distributed among all the sections. Any two sections get connected by a circuit breaker and isolators. The advantage of this arrangement is that if a fault occurs on any section of the bus bar. That section can be isolated without affecting the supply

from the other section and repair and maintenance of any section of the bus bar can be carried out by de-energizing that section only.

5.2.3 Circuit Breaker

Circuit breaker is the important equipment of a substation. A circuit breaker is equipment which can open or close a circuit under fault condition as well as normal operation. Unlike a fuse, which operates once and then has to be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation. Circuit breaker can be of many types. It is mainly divided on the basis of voltage level, construction type, interruption type and their structures. They are Low Voltage Circuit Breaker, High Voltage Circuit Breaker, Magnetic Circuit Breaker, and Thermal Circuit Breaker. We have seen the SF6 type of circuit breaker in the substation. The main reason of using this particular type circuit breaker in the substations is the fine arc extinguishing in short circuit condition. It is the commonly used circuit breaker in modern substation

5.2.3.a SF_6 circuit breaker

In DEL substation they used SF6 circuit breaker because it's operate within a very short period of time and provides accurate protection and its maintenance is much easier compare to others. The normal rated current is 1250 A.

Figure 5.6: SF_6 circuit breaker with normal rated current is 1250 A

5.2.4 Relays

There are several types of relay use to protect the power system in DEL. All the relaying is work on a basic function to protect the system.

5.2.4.a Different types of relays

In DEL different kind of relays are used. These are –

i. Percentage differential relay:

This type of relay is capable to identify internal fault only. There are two current transformers (CT) connected to the two end points of the protection part. The difference between two CTs current passes through the operating coil of the percentage differential relay. If difference is greater than zero then relay will operate.

ii. Distance relay:

The most common form of protection on high voltage transmission systems is distance relay protection. Power lines have set impedance per kilometer and using this value and comparing voltage and current the distance to a fault can be determined. There are different types of distance relay. Mainly impedance type, modified impedance type, reactance type, mho type distance relay are used in transmission system.

iii. Classical relay:

Classical relay is the first protection device. It is the most guaranteed relay. There are several types of classical relays in power system, but at substation they use electromagnetic attraction type double quantity classical relay. This relay has instantaneous operation, means operation time is constant. The construction of this relay is very simple and operating current can be adjusted easily. This type of relay uses most of the cases.

iv. Electrical relay:

This type relay is not modern relay. In this relay need to adjust the tripping condition manually. Suppose this relay is trip in one second when flow 5 amp fault current. For making this operation you need to set the value in time and amp manually.

v. Over current relay:

An over current relay is a type of protective relay which operates when the load current exceeds a preset value In a typical application the over current relay is connected to a current transformer and calibrated to operate at or above a specific current level. When the relay operates, one or more contacts will operate and energize to trip (open) a circuit breaker.

vi. Buchholz relay:

The incipient faults in transformer tank below oil level actuate buchholz relay so as to give an alarm. The generating arc due to faults causes decomposition of transformer oil. The product of decomposition more than 70% of hydrogen gases, which being light, rises upwards and tries to go into the conservator. The buchholz relay is fitted in the pipe leading to the conservator. The gas gets collected in the upper portion of the buchholz relay. Thereby the oil level in the buchholz relay drops down. The float, floating in the oil in buchholz relay tilts down with the lowering oil level. While doing so the mercury switch attached to the float is closed and the mercury switch closes the alarm circuit. Thereby the operators know that there is some incipient fault in the transformer. The transformer is disconnected as early as possible and the gas sample is tested. The testing of gas gives clue regarding the type of insulation failure.

When a serious short circuits occurs in the transformer, the pressure in the tank increases. The oil rushes towards the conservator. While doing so it passes through the buchholz relay. The baffles in the buchholz relay get pressed by the rushing oil. Thereby they close another switch with in turn closes the trip circuit of the circuit breaker. Thereafter the transformer is removed from the service.

5.2.5 Lightning arrester

A lightning arrester is a device used on electrical power system to protect the insulation system and other equipment from the damaging effect of lightning.

Figure 5.7: Lightening arrester, non linear resistor type

Lightning arrester is also known as surge arrester. It has also a nonlinear resistance with spark gap. Under the normal condition lightning arrester does not work but when the high voltage or thunder strike occur then air insulation of the gap breaks and arc is formed for providing a low resistance path to surge the ground. When the surge or thunder is over then the nonlinear resistance of the arrester becomes high and makes the path non-conducting. There are three types of lightning arrester used at DEL. These are –

i. Expulsion type
ii. Nonlinear resistor type
iii. Gapless metal oxide type

5.2.6 Isolator

Isolator or disconnecting switches operates under no load condition. It does not have any specified current breaking capacity or current making capacity. Isolator is not even used for breaking load currents. In DEL Isolators are used in addition to circuit breakers, and are provided on the each side of every circuit breaker to provide isolation and enable maintenance. While opening a circuit, the circuit breaker is open first, then isolator. While closing a circuit the isolator is closed first, then circuit breaker. Isolators used in power systems are generally three pole isolator. The three pole isolators have three identical poles.

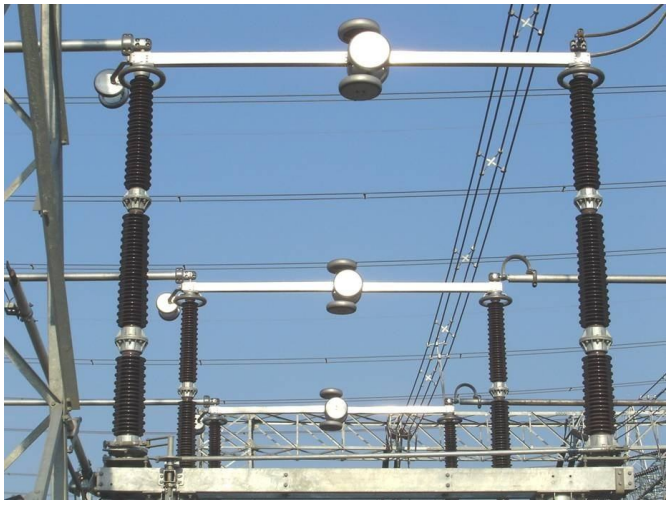


Figure 5.8: Electrical motor mechanism isolators

During the opening operation the conducting rods swing apart and isolation is obtained. The simultaneous operation of three poles is obtained by mechanical interlocking of the three poles. Further for all the three poles, there is a common operating mechanism. The operating mechanism is manual plus one of the following –

i. Electrical motor mechanism
ii. Pneumatic mechanism

With SF6 circuit breakers motor mechanism is preferred. Or with air blast system, pneumatic mechanism is preferred. In DEL substation the isolators operating mechanism is Electrical motor mechanism

5.2.7 Insulator

The insulator resists the current to be flown from the supports to the conductor. Three different type of insulator is used in transmission line which is depends on the amount of voltage range. DEL used the suspension type and strain type insulator.

5.2.8 AC and DC AUXILIARY SYSTEM for substation

In DEL power station there are AC and DC auxiliary system for substation. AC auxiliary system of substation supplies the typical loads which is very important for a substation. DC auxiliary system supply the backup loads which is primarily needed to run and maintenance the power stations and substation both.

5.3 Conclusion

The chapter discusses about the substation and its components i.e. CT, PT, lightning arrester, insulator, isolator, bus bar, transformer, SF6 circuit breaker, along with the working process and its importance. Mainly to control or modify the power, we require a substation. Therefore we have tried to develop a clear idea about substation and its components. One major limitation of DEL is that they don't use the double busbar system. Instead, they have used single busbar system with synchronization. Regular maintenance is important for good efficiency, which is discussed in details in the following chapter.

CHAPTER - 6

Operation and maintenance of substation

6.1 Introduction

Desh Energy Limited is a quick rental power station. They are concerned with power generation and transmission, not the distribution. The distribution of power is solely up to PDB. The substation authority of DEL maintains their substation on a regular basis. In the following chapter we have tried to elaborately discuss our understanding on the operation in DEL substation and the regular maintenance of the equipments of substation such as power transformer, instrument transformer, SF6 circuit breaker, isolator, lightening arrester etc. We have visited these sections on 7th and 10th January 2012 under the guidance of superintendent Engr. Md. Ruman Ali. There we have spent around 15 hours.

6.2 Operation of substation

In DEL substation mainly step up the voltage level coming from the different bank. Generally the line is 11KV and in substation the voltage is step up upto 132KV. After that the outgoing lines connect with the grid in various protection schemes.

This single line diagram represents the operation of substation, Where the 11 KV incoming line coming from bank. And the final output is connected with the grid.

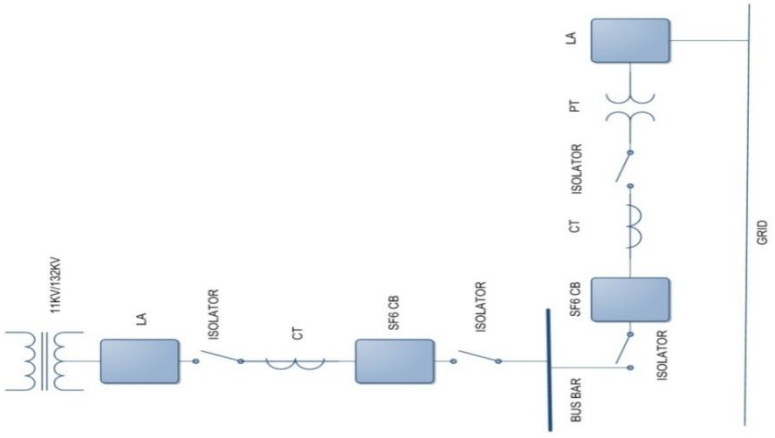


Figure 6.1: Single line diagram of DEL substation

6.3 Maintenance & Inspection of Substation Equipment's

There are two type of maintenance of substation. One is Preventive and Schedule Maintenance and Emergency or Break-down maintenance. The Inspection of Substation Equipment is daily Inspection, weekly Inspection, monthly Inspection, quarterly Inspection, half-yearly Inspection and annual Inspection. Proper installation and preventive maintenance of substation will assure continued electrical power supply and efficiency.

6.3.1 Maintenance of power transformer

Some test is needed to justify the condition of a power transformer. There are some tests to maintain the transformer oil. The test oil sample of transformer main tank & tap changer tank is to check condition of oil gauges and oil level. In DEL the test is done once in every three months by technician of BANGLA CAT.

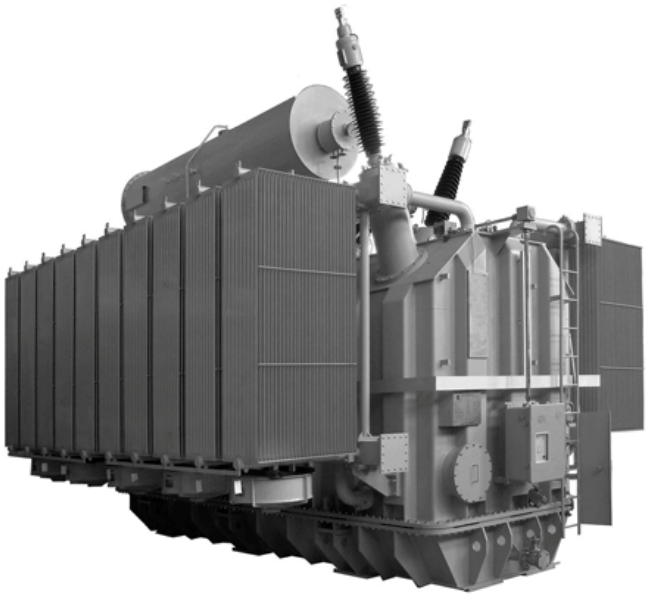


Figure 6.2: Three phase, 35000 KVA, 11KV/132KV, 50 Hz Power transformer

The following procedures are followed –

Test oil sample of transformer main tank & tap changer tank:

- **i.** Check condition of oil gauges and oil level
- **ii.** Check for oil leakage & integrity of gasket joints
- **iii.** Check the insulation resistance of bushing
- **iv.** Check that silica gel crystals are blue

v. Check the performance of oil temperature & winding temperature meter
vi. Change the oil of OLTC
vii. Check insulation resistance between each winding and ground.
viii. Calculate the Dielectric Absorption Ratio – DAR = (I.R. of 60 sec)/(I.R. of 15 sec)

6.3.2 Maintenance of some other substation equipment's

There are some other components which are needed to maintain for long running.

6.3.2.a Maintenance of breaker

The following conditions are checking to maintain the SF6 circuit breaker.

Figure 6.3: SF6 circuit breaker with normal current rating is 1250 A

i. Timing and Insulation resistance test
ii. Measurement of contact resistance
iii. Check SF6 gas pressure and the Charging Mechanism
iv. Check security of couplings and pipes
v. Measurement condensation temperature (Dew point) of gas
vi. Check operation of pressure gauges, hydraulic pressure and
vii. Check accumulator pre-charge pressure
viii. Check for oil leaks and low pressure oil tank oil level

SF6 circuit breaker is used in DEL substation. Breakers are vital element. So to ensure that the breakers are operating accurately different types of testing are required. Breaker testing are done after disconnect the breakers from the load and certain procedure are follows to disconnect the breaker.

6.3.2.b Instrument Transformer maintenance

There are two types of instrument transformer used in DEL substation. Current transformer and potential transformer are used for protection and metering.

Figure 6.4: Potential transformer for 132 KV line

The maintenance of this is given below –

i. Check of physical condition and the insulation resistance
ii. Check tightness of primary side & secondary terminals
iii. Check the ratio and Justify the accuracy
iv. Check for oil leakage for oil immerged CT and PT

6.3.2.c Lightening Arrester maintenance

Lightning arrester protects the transmission line and the bus-bar arrangement of substation. So the maintenance of lightning arrester is very important in the whole substation. There are three types of lightning arrester. They should be checked properly. The maintenance process of lightning arrester is –

i. Wash Diverter housing.
ii. Check for damage to porcelain housing and for deformation of corona or stress rings.

6.4 Conclusion

In this chapter we have discussed about the operation of substation and the maintenance of its important equipments. We have realized that proper maintenance of the equipments can increase its lifetime and deliver more efficiency. So maintenance is very important for the equipments of a substation. In DEL maintenance intervals varies with different equipments. It can be weekly, monthly, half yearly even yearly basis.

CHAPTER - 7
Switchgear protection

7.1 Introduction

The most important feature of a power system is Switchgear and protection, starting from power generation to uninterrupted power supply to the users connected to the power system. The objective of a protection scheme is to keep the power system stable by isolating only the components that are under fault, whilst leaving as much of the network as possible still in operation. Thus, protection schemes must apply a very pragmatic and pessimistic approach to clearing system faults. The DEL switchgear does both- de-energizing equipments to allow uninterrupted works and clearing faults downstream. The main goal of DEL switchgear system is to interrupt short-circuit and overload fault currents while maintaining service to unaffected circuits. Mainly we have discussed here the transformer protection, alternator protection, low voltage panel, high voltage panel. We have visited these sections from 13th to 14th January 2012 under the guidance of Superintendent Engr. K M Musa. There we have spent around 15 hours.

7.2 Transformer protection

There is various type of transformer in DEL. Transformers are protected primarily against faults and overloads. The type of protection for the transformers of DEL varies depending on the application and the importance of the transformer. The choice of protection for any given transformer depends upon a number of factors such as its size, importance, and whether it has no load or off load tap charger.

7.2.1 Types of Transformer Faults

Any numbers of conditions have been the reason for an electrical transformer failure. DEL Statistics show that winding failures most frequently cause transformer faults. Insulation deterioration, often the result of moisture, overheating, vibration, voltage surges, and mechanical stress created during transformer through faults, is the major reason for winding failure. Voltage regulating load tap changers, when supplied, rank as the second most likely cause of a

transformer fault. Tap changer failures can be caused by a malfunction of the mechanical switching mechanism, high resistance load contacts, insulation tracking, overheating, or contamination of the insulating oil. Transformer bushings are the third most likely cause of failure according to DEL. General aging, contamination, cracking, internal moisture, and loss of oil can all cause a bushing to fail. Transformer core problems have been attributed to core insulation failure, an open ground strap, or shorted laminations. Other miscellaneous failures have been caused by current transformers, oil leakage due to inadequate tank welds, oil contamination from metal particles, overloads, and overvoltage.

7.2.2 Electrical Type Transformer Protection

There are several types of electrical transformer protection used in DEL.

7.2.2.a Overcurrent Protection

Overcurrent relays generally provide higher sensitivity and fault clearing times can be achieved in some instances by using an overcurrent relay connected to measure residual current. Overcurrent relays do not have the same maintenance and cost advantages found with power fuses.

7.2.2.b Differential Relay Protection

The most widely used device for transformer protection in DEL is restrained differential relay. This relay compares current values flowing into and out of the transformer windings.

7.2.2.c Overexcitation Protection

Overexcitation can also be caused by an increase in system voltage or a reduction in frequency. It follows, therefore, that transformers can withstand an increase in voltage with a corresponding increase in frequency but not an increase in voltage with a decrease in frequency. Operation cannot be sustained when the ratio of voltage to frequency exceeds more than a small amount. Protection against over flux conditions does not require high-speed tripping. In fact, instantaneous tripping is undesirable, as it would cause tripping for transient system disturbances.

7.2.3 Mechanical Type Transformer Protection

There are two generally accepted methods used to detect transformer faults using mechanical methods in DEL. These detection methods provide sensitive fault detection and compliment protection provided by differential or overcurrent relays.

7.2.3.a Accumulated Gases

The first method accumulates gases created as a byproduct of insulating oil decomposition created from excessive heating within the transformer. The source of heat comes from either the electrical arcing or a hot area in the core steel. This relay is designed for conservator tank transformers and will capture gas as it rises in the oil. The relay, sometimes referred to as a Buchholz relay, is sensitive enough to detect very small faults.

7.2.3.b Pressure Relays

The second method relies on the transformer internal pressure rise that results from a fault. One design is applicable to gas-cushioned transformers and is located in the gas space above the oil. The other design is mounted well below minimum liquid level and responds to changes in oil pressure. Both designs employ an equalizing system that compensates for pressure changes due to temperature.

7.2.4 Thermal type transformer protection

In DEL thermal type transformer protection is insure by using different types of relying.

7.2.4.a Load Tap-changer Overheating

Damaged current carrying contacts within an under load tap changer enclosure can create excessive heating. Using this heating symptom, a way of detecting excessive wear is to install magnetically mounted temperature sensors on the tap-changer enclosure and on the main tank. Even though the method does not accurately measure the internal temperature at each location, the difference is relatively accurate, since the error is the same for each. Thus, excessive wear is indicated if a relay/monitor detects that the temperature difference has changed significantly over time.

7.2.5 Special Considerations

For transformer protection DEL consider some special condition.

7.2.5.a Current Transformers

Current transformer ratio selection and performance require special attention when applying transformer protection. Unique factors associated with transformers, including its winding ratios, magnetizing inrush current, and the presence of winding taps or load tap changers, are sources of difficulties in engineering a dependable and secure protection scheme for the transformer. Errors resulting from CT saturation and load-tap-changers are particularly critical for differential protection schemes where the currents from more than one set of CTs are compared. To compensate for the saturation/mismatch errors, overcurrent relays must be set to operate above these errors.

7.2.6 Special Applications

Some special application of transformer is used in DEL. Mainly use of ZIGZAG transformer is one special application. For double protection of earth fault, DEL uses NGR or Neutral Grounding Resistance and ZIGZAG transformer. Therefore the equipments cost is increased.

7.2.6.a Zig-Zag Transformers

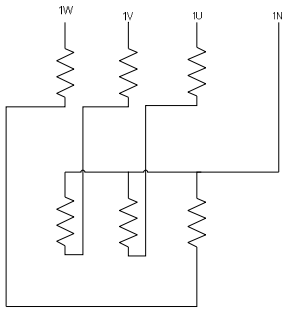
A zigzag transformer is a special purpose transformer with a zigzag or 'interconnected star' winding connection. The most common zigzag transformer application is for the derivation of a neutral connection from an ungrounded 3-phase system and the grounding of that neutral to an earth reference point. Zigzag transformers are also used to control of triple (3th, 9th, 12th, 15th, etc.) harmonic currents, to supply 3-phase power as an autotransformer (serving as the primary and secondary with no isolated circuits), and to supply non-standard phase-shifted 3-phase power.

The most common protection for Zig-Zag (or grounding) transformers is three overcurrent relays that are connected to current transformers located on the primary phase bushings. These current transformers must be connected in delta to filter out unwanted zero sequence currents. It is also possible to apply a conventional differential relay for fault protection. Current transformers in the primary phase bushings are paralleled and connected to one input. A neutral CT is used for the other input. An overcurrent relay located in the neutral will provide backup ground protection for

either of these schemes. It must be coordinated with other ground relays on the system. Sudden pressure relays provide good protection for turn-to-turn faults.

Table 7.1: Specification of ZIGZAG transformer

EARTHING TRASFORMER	
PHASE – 3	SERIAL NUMBER – 10136091
FREQUENCY – 50 Hz	YEAR OF MANUFACTURE – 2010
KVA – 200	STANDARD – IEC – 289
VOLTAGE – 1100 V	TYPE OF COOLING – ONAN
SHORT TIME CURRENT – 100/10 A/SEC	VECTOR GROUP – ZIGZAG
BIL KV L175AC28	TRANSFORMER OIL – 300 LITER
MEASURRED OHM/PHASE – ZERO	WEIGHT – 1300 KG
SEQUENCE – 1MP	



7.2.6.b Phase Angle Regulators and Voltage Regulators

Protection of phase angle and voltage regulators varies with the construction of the unit. Protection should be worked out with the manufacturer at the time of order to insure that current transformers are installed inside the unit in the appropriate locations to support planned protection schemes. In DEL Differential relays is used in conjunction to provide adequate protection for faults.

7.3 Alternator protection

Alternators are the most vital element in a power station. So their protection is necessary. There are 96 generators In DEL and all of them are with equal capacity of 1.2 MW. Therefore it is desirable and necessary to provide protection to cover the wide range of faults which may occur

in the modern generating plant.CAT digital voltage regulator (CDVR) is also used here for the protection of alternator.

7.3.1 Differential Protection for Stator Faults

Protections against stator phase faults are normally covered by a high-speed differential relay covering the three phases separately. All types of phase faults (phase-phase) will be covered normally by this type of protection, but the phase-ground fault in a high-impedance grounded generator will not be covered. In this case, the phase current will be very low and therefore below the relay pickup.

7.3.2 Protection against Stator Winding Ground Fault

Protection against stator-to-ground fault will depend to a great extent upon the type of generator grounding. Generator grounding is necessary through some impedance in order to reduce the current level of a phase-to-ground fault. In order to avoid this, DEL setup low impedance grounding through a resistance.

7.3.3 Field Ground Protection

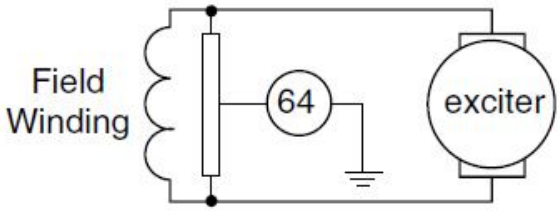


Figure 7.1: Voltage divider method

DEL use the technique involves connecting a resistor in parallel with the field winding. The resistor center point is connected the ground through a current sensitive relay. If a field circuit point gets grounded, the relay will pick up by virtue of the current flowing through it. The main short coming of this technique is that no fault will be detected if the field winding center point gets grounded.

7.3.4 Current Imbalance Protection

Current imbalance in the stator with its subsequent production of negative sequence current will be the cause of double-frequency currents on the surface of the rotor. This, in turn, may cause

excessive overheating of the rotor and trigger substantial thermal and mechanical damages (due to temperature effects).

In DEL time – overcurrent relay is used for this type imbalance. Ideally the negative sequence current should be measured in RMS magnitude.

7.3.5 Overexcitation Protection

When generator magnetic core iron becomes saturated beyond rating, stray fluxes will be induced into non laminated components. These components are not designed to carry flux and therefore thermal or dielectric damage can occur rapidly. The estimated value of the flux can then be compared to a maximum value threshold. With static technology, DEL used volts per hertz relay for the protection.

7.3.6 Overvoltage Protection

An overvoltage condition could be encountered without exceeding the volt=hertz limits. For that reason, DEL uses an overvoltage relay. The instantaneous is set to 130 to 150% of rated voltage and the inverse element pick-up voltage of 110% of the rated voltage.

7.3.7 Voltage Imbalance Protection

In DEL loss of VT signals detection is to use a voltage balance relay. When a fuse blows, the voltage relationship becomes imbalanced and the relay operates. The voltage imbalance is set at around 15%.

7.3.8 System Backup Protection

Generator backup protection is not applied to generator faults but rather to system faults that have not been cleared in time by the system primary protection, but which require generator removal in order for the fault to be eliminated. For the purpose of protecting against phase faults DEL uses an impedance-type relays.

7.3.9 Use of CDVR (Cat Digital Voltage Regulator)

This digital voltage regulator is used for the protection purpose. There are ten protective functions of this CDVR.

i. Generator Overvoltage

ii. Generator Under voltage
iii. Loss of Excitation
iv. Instantaneous Field Over current
v. Over Excitation
vi. Loss of Sensing
vii. Diode Fault Monitor
viii. Internal Watchdog Failure
ix. Internal Memory Failure
x. Fault Reset Closed Too Long

7.4 Low Voltage earth fault relay panel for 600V system

Low voltage or LV earth fault relay panel is used for earthing protection of 600V system or alternator. In DEL use one LV earth fault relay panel for three alternators.

7.4.1 Features

There are some features of this LV panel to use it in DEL. That's are –

i. Low-set neutral overcurrent stage with definite time or inverse time characteristic.
ii. High-set neutral overcurrent stage with definite time characteristic.
iii. Output relay functions to be freely configured.
iv. Flexible adaptation to different types of application.

7.5 High Voltage Panel

In DEL every power generation bank contains High Voltage panel or HV panel. The HV panel supplies the bank's outgoing line. In the HV panel, there are seven modules for seven transformer, one master module, NGR box, LV panel box. Generally protection the system, measuring different components and control the transmission process is the main work of HV panel. Here we discuss some useful components of HV panel.

7.5.1 Vacuum circuit breaker (Vacuum Interrupters)

Vacuum interrupters mounted vertically within the circuit breaker frame, perform the circuit breaker interruption. Consisting of a pair of butt contacts, one movable and one fixed,

interrupters require only a short contact gap for circuit interruption. The resulting high-speed operation allows the entire operating sequence, from fault to clear, to be consistently performed in three cycles or less.

Figure 7.2: 12 KV 630 A vacuum circuit breaker

7.5.2 Neutral Grounding Resistors (NGR)

Neutral Grounding Resistors or NGR is employed in AC distribution networks to limit the fault current which would flow from the transformer or generator neutral star point in the event of an earth fault in the systems. It is used when the neutral of supply transformer is accessible and its own impedance is not enough to limit fault current. The rating of the protection relays within the required time.

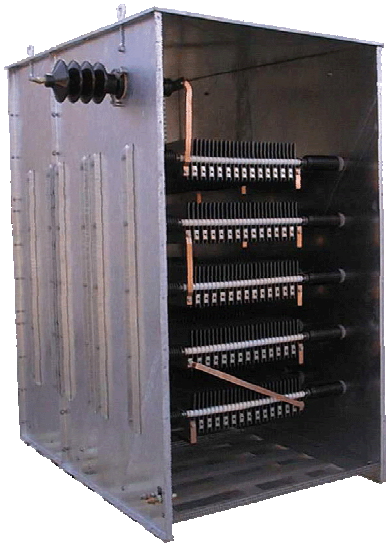


Figure 7.3: Neutral Grounding Resistors

7.5.2.a Features

i. Every resistance bank value is precise and determined at the manufacturing stage remaining constant throughout their life.
ii. Temperature Time constant is shorter allowing a resistor of shorter time rating to be used.
iii. Easily to install on site.
iv. Require virtually no maintenance and have a longer useful life.
v. No anti frost heating is required nor anti condensation heaters generally.
vi. Invariably the type of cooling will be natural air-cooling.

7.6 Low Voltage panel

In DEL low voltage switchgear or LV panel (hereafter called LT Panel) is applied for power control and distribution systems of AC 50Hz, rated working voltage up to 400V. In power station it is used for internal uses. The design meets with the standard of IEC439; GB7251 frame. The dimension inside of cabinet and separation cubicles is modular and carried out exchanged of the same unit in specification. Low voltage can endure the discharging; heat and mechanism stress caused by short circuit fault. Switchgear is divided into functional unit's compartment, cable compartment and insulation design of each unit. Every LV panel has two Air Circuit Breaker or ACB. One is used for connecting the internal bus bar power line, where another is connected as the backup or emergency power line. Internal thirty four batteries are charging via this LV panel. All the control system is also running via the supply of this LV panel.

7.7 Conclusion

The switchgear protection system in DEL has been discussed elaborately in this chapter. Every bank contains same protection scheme for faults. In modern power generation system, protection of all equipments can ensure more safety and longer life. In DEL the protection scheme for the equipments are of good standards, ensuring more safety and longer lifetime for the equipments. For example they used ZIGZAG transformer and NGR both to protect the earth fault current, which ensures more safety, but is more costly. Here, we have tried to develop a clear idea about the switchgear and protection scheme of DEL.

CHAPTER - 8
Control Systems

8.1 Introduction

A control system that provides an optimum performance without necessary adjustments is rare. Usually we find it necessary to compromise among many conflicting and demanding specifications and to adjust the system parameters to provide a suitable and acceptable performance. However, we often find that it is not sufficient to adjust a system parameter and thus obtain the desired response. Rather we are required to reconsider the control system design and insert additional components in the structure of the system. This additional component or device that equalizes for the performance deficiency is called compensator or controller. We have visited these sections from 5th to 6th January 2012.

8.2 Control System module

There are several techniques available to the control system engineer to design a suitable controller. One of the controllers widely used is the proportional plus integral plus derivative (PID) controller to reduce error from the system. For controlling the power generation and transmission the Desh Energy Limited use Terberg Control System. The control system is fully PID control system and the rating of the control panel is given below –

Table 8.1: specification of Terberg control system

Terberg Control System
Voltage = 600 VAC
Current = 1272 A
1 cu = 75 KA/1S
Frequency = 50 Hz

The microprocessor of this control system is designed using programming C language. This control panel is used to control the engine, alternator, process flow, power transmission to the grid and to monitor the whole power plant condition. The engine starting and closing is done by

this control module. So, manual operation is optimized. This control module also shows all the information and condition when the genset is on load or off load. If any fault occurs, this control module tries to determine the fault via different kinds of sensor. This control module is also used to change some parameters related to power generation process.

Figure 8.1: Terberg control system

8.2.1 Different component of Terberg control module

In Terberg control system module –

- **i.** Generator measuring supply module
- **ii.** Generator side line voltage divider module
- **iii.** Bus bar measuring supply module
- **iv.** Bus bar side line voltage divider module
- **v.** Crank batteries module (24 VDC)
- **vi.** Panel supply module (24 VDC)
- **vii.** Common supply module (24 VDC internal)
- **viii.** Common supply module (24 VDC external)
- **ix.** All kinds of sensors output module from the genset and power transmission
- **x.** Air Circuit Breaker module
- **xi.** Thermostat heater module
- **xii.** Thermostat ventilation module
- **xiii.** 230 VAC motor group supply module
- **xiv.** Monitoring module

In the Terberg control system there are 18 circuit breakers which are used to control different types of module. The air circuit breaker is used here to synchronize the genset with the grid. When the synchronizing is completed the air circuit breaker trips and supplies power to grid. The specifications of the air circuit breaker is given below–

Table 8.2: Air circuit breaker specification

SACE E3S/MS20	1 MICRO = 2000 A		V = 690 V		IEC 60947 – 3
Ve (V)	400/415	690	250	500	1 CW (1 S) = 75 KA
Ie (A)	200	2000	2000	2000	Vimp = 12 KV
CAT	AC – 23 a		DC – 23 A		
⎯⎯/⎯⎯	~ 50 – 60 Hz		1P = 2P		ABB SACE, ITALY

Several types of relays are used inside the panel. The relay rating is NPE 60.13, 10A, 250V. The battery rating of the control panel is given below –

Table 8.3: Battery rating

Battery rating of control panel
Maximum initial current – 4.8 A
Standby use = 13.6 – 13.8 V
Cyclic use = 14.5 – 14.9 V

8.2.2 Mode Selection

Selection mode can be done on 4 several ways:

Figure 8.2: Terberg control system switch option

8.2.2.a Option 1

This is a 4 pole static key-switch and can be used to switch the installation in Automatic, Off, Hand Off Load or Hand Load operation. With this key-switch it is not possible to switch the

installation in another mode by HMI (option 4), because it provides a static input. HMI will not overrule the static input. With a remote connection interference of a site operator is required to change from operation mode.

8.2.2.b Option 2

This pulse key-switch can be used to switch the installation in Automatic, Off, Hand Off Load or Hand Load operation. With this key it is possible to change from operation mode by HMI (option 4).

8.2.2.c Option 3

This key switch has the same functionality as the key switch at option 2; the difference is within the hardware. The inputs from the key switch are provided to an onboard print, as well as the output status LED's.

8.2.2.d Option 4

This is a selection mode by HMI (Human Machine Interface), by pressing the Enable Control Buttons the installation can be switched in Automatic, Off, Hand Off Load or Hand Load operation. If option 4 is combined with option 1, the actual mode will be shown, but cannot be changed.

8.2.3 Automatic Operation Mode

There are three types automatic operation mode used in DEL. These are –

8.2.3.a Control in Stand Alone Island

In automatic mode the engine will always start. The voltage and frequency will be controlled to the requested set-point set in the engine voltage / frequency controller. A stand alone engine has to pick up all load connected.

8.2.3.b Control in Multiple Engine Island

In automatic control at least one engine will always run. Other engines will be started according to the total bus bar load. If the load is less than the set stop load, engines will be stopped. The

voltage and frequency will be controlled to the requested set-point set in the engine voltage / frequency controller. Both real and reactive load will be shared among the running engines.

8.2.3.c Control in Parallel with Utility

This mode of operation is only applicable if the engines are running in parallel with the utility. In automatic mode the engine will start on load demand. The engine will start when the load request is higher than the set start load. The load and power factor will be controlled to the requested set-point set in the engine load / power factor controllers.

Figure 8.3: Terberg human management interface

8.2.4 Off operation Mode

The engine control is switched completely off; the engine cannot and will not start in any circumstances. If the engine is running and when the key switch is switched to the off position, the engine will stop directly. The engine will not cool down and the generator circuit breaker will be opened, the auxiliary's will continue running during the pre defined auxiliary cool down time set in the process variables.

8.2.5 Hand Off Load Operation Mode

The engine can be started with the start button in the panel door (hardware) or by the start button in HMI (software). The engine will start running without any load; this mode is independent from island or parallel operation. Normal start sequence will be applicable until the step "start up protection". The voltage and frequency will be controlled to the requested set-point set in the engine voltage / frequency controller.

When the installation is running off load it can be switched to hand on load or automatic, by switching in to one of these options the sequence steps voltage matching and synchronization will be executed, with the result that the generator circuit breaker will be closed.

8.2.6 Hand Load Operation Mode

DEL follows three types hand load operation. These are –

8.2.6.a Control in Stand Alone Island

The engine can be started with the start button in the panel door (hardware) or by the start button in HMI (software).

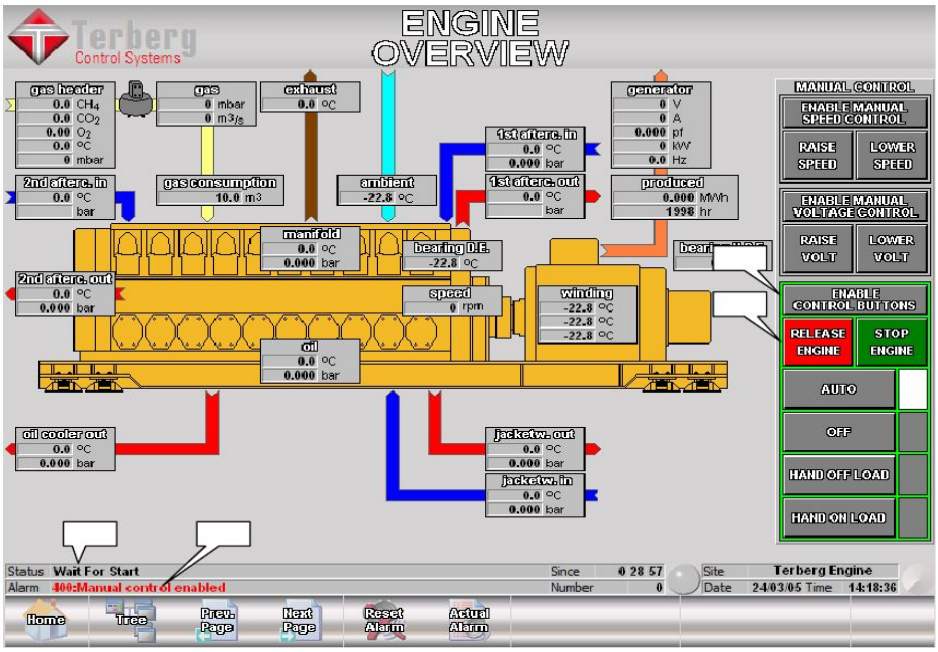


Figure 8.4: Engine overview in Terberg screen

The voltage and frequency will be controlled to the requested set-point set in the engine voltage / frequency controller. A stand alone engine has to pick up all load connected.

When the installation is running on load it can be switched to hand off load, then the generator circuit breaker will be opened right away. It is not possible as a single engine to ramp down.

8.2.6.b Control in Parallel with Utility

The engine can be started with the start button in the panel door (hardware) or by the start button in HMI (software). The requested load is assigned on the load control screen in the column forced control. This is a variable setting and can be modified by the operator. The load and power factor will be controlled to the requested set-point set in the engine load / power factor controllers.

When the installation is running on load it can be switched to hand off load, then the engine will start ramping down till the actual load is low enough and the generator circuit breaker will be opened.

8.2.7 Selected Mode Combined With a Master

In case of multiple engines in island or multiple engines parallel to the utility a master control panel will be connected to the system. With the master control panel it is also possible to start-up or stops the engines. Starting and stopping of the engines is only possible when the automatic mode is selected at the engine control panels.

8.3 Start up Sequence

Start up sequence of engine is important when anyone wants to start it from Terberg control system automatically. The startup sequence of an engine is –

8.3.1 Engine Wait for Reset

To start the engine the system has to be without faults, all alarms that prevent the engine to start up have to be cleared.

- **i.** Installation status indication shows Engine Wait for Reset. This means that there are alarms active that may prevents the engine from starting; all active alarms have to be cleared.
- **ii.** Actual alarm with alarm tag number, this alarm can prevent the engine from starting, or is used for status storage in the historical alarm list.

iii. Number of active alarms.

iv. On the actual alarm list screen the active alarms are displayed with a digital, analogue or software tag number. In this example the circuit breaker is connected on digital input 1.2. This tag number can be used combined with the electrical drawings to clear / solve an alarm. Note software alarms are displayed with a general tag, SOFTW.

8.3.2 Wait for Start

All alarms that prevent the engine from starting are cleared; the installation is ready to start.

i. Installation status indication shows 'wait for start', on pressing the release button the engine will start up.

ii. Enable Control Buttons; press on this button to enable the control buttons. When the buttons are enabled the area around the control buttons will be filled with a green color.

iii. When the control buttons are enabled the engine can be started with the Release Engine button.

8.4 CDVR (Cat Digital Voltage Regulator)

The Cat Digital Voltage Regulator is a microprocessor based control designed to provide precise voltage control, robust transient response, and generator protection with industry leading features and versatility.

Figure 8.5: CAT digital voltage regulator (CDVR)

8.4.1 Specifications

The specification of digital voltage regulator used in DEL is given below –

Table 8.4: CDVR Specifications

CDVR General Specifications	
Voltage Regulation	±0.25% no load to full load
Temperature Drift	±1.0% for a 40° C change
Response Time	Maximum of 10 milliseconds
Variable Sensing Range	90 to 600 Volts
Control Power	24 Vdc Supply (18 to 30 Vdc, 5VA)
CDVR Environmental Specifications	
Operating Temperature	–40° C to 70° C (–40° F to 158° F)
Storage Temperature	–40° C to 85° C (–40° F to 185° F)
Relative Humidity	95% non-condensing 30° C to 60° C
Salt Spray	5% for 48 hrs at 38° C at 115% nominal o/v
Vibration	4.5G (peak) 18-2000 Hz in 3 perpendicular planes

8.4.2 Protective functions

The protective functions of CDVR are –

- **i.** Generator Overvoltage
- **ii.** Generator Under voltage
- **iii.** Loss of Excitation
- **iv.** Instantaneous Field Over current
- **v.** Over Excitation
- **vi.** Loss of Sensing
- **vii.** Diode Fault Monitor
- **viii.** Internal Watchdog Failure
- **ix.** Internal Memory Failure
- **x.** Fault Reset Closed Too Long

8.5 Power transmission control panel

These control panel systems located on the control building of the DEL. The main work done by this control system is the power transmission from DEL to grid

8.5.1 Different components of this control system

Different modules are used to operate this control system. These are discussed below –

8.5.1.a 132KV Controlling panel

In this panel the flow of power is measured by energy meter. One backup energy meter is used for the condition if the main or master energy meter is not operating. To get the reading, energy = reading * multiplied factor. Here the unit of energy is MWH, unit of reading is KWH and the multiplied factor is 960.

Figure 8.6: Energy meter to calculate the power flow

8.5.1.b Automatic voltage regulator panel

This panel regulates the three phase voltage as automatic. We can analyze that change through a operating interface as shown below –

Figure 8.7: Automatic voltage regulator panel

8.5.1.c AC and DC distribution panel

These two panels ensure the internal AC and DC distribution of the power plant. All the meter are shows the current status of internal power distribution.

Figure 8.8: AC and DC distribution panel

8.5.1.d Line differential relay panel

This module contain differential relay with monitoring interface. We can change the relay parameter automatically through this interface. If any fault occurs in the line, the relay panel changes the status and makes an alarm.

Figure 8.9: Line differential relay panel

8.5.1.e 132 KV outgoing feeder relay panel

This relay panel contains trip circuit supervision relay, trip relay, operating interface related with 132 KV outgoing feeder. The operator can monitor the outgoing feeder line if any fault is occurring through the operating interface.

Figure 8.10: 132 KV outgoing feeder relay panel

8.5.1.f 110 TP 40 float CUM boost charger with DVR

In this pane,l the backup battery system and battery charger system are included. In case of power station shut down, these backup battery system supply power to important part of power station.

Figure 8.11: 110 TP 40 float CUM boost charger with DVR

Battery charger specification is –

Table 8.5: Battery charger specification

BATTERY CHARGER	
Type 110 TP 40	Number f phases – 3 phase
Frequency – 50 Hz	Float voltage – 126 V
AC input voltage – 415 V	Boost voltage – 153 V
AC input current – 12.5 A	Current limit – 40 A
DC output voltage – 110 V	MPG SL no. – 75833577
DC output current – 40 A	

8.5.1.g 11 KV/132KV GT control panel

Figure 8.12: 11 KV/132 KV GT control panel – upper part

This panel controls the output supply using switching system. The transmission data as amount of power transmitted, amount of reactive power, if any circuit breaker trips or any fault occurs can check from here. There are 5 GT control panels for 5 banks and one GT control module as master. When we transmit the power we need to check the fault clearance. If not then this can be clear automatically from this panel. We can control the following condition using this module –

- **i.** Buchholz relay trip
- **ii.** Pressure relief device
- **iii.** Oil temparature high trip
- **iv.** Winding temparature trip
- **v.** O/C trip
- **vi.** E/F trip

vii. Protection relay fault
viii. Trip circuit not healthy
ix. Differential trip
x. Referance trip
xi. MCB trip control panel
xii. MCB trip relay panel
xiii. SF6 gas pressure low
xiv. Oil level low alarm
xv. OTI alarm
xvi. WTI alarm
xvii. OLTC buchholz trip

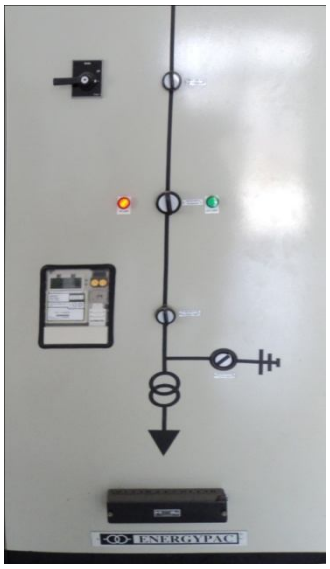


Figure 8.13: 11KV/132KV GT control panel – lower part

8.6 Conclusion

In this chapter, we have familiarized with the power generation control system. Mainly we have discussed about the controlling system of different machine, switchgear system of DEL. In generation level all the control systems are used for the power generation process where the substation control system manages the safety transmission of generating power. We have tried to make a clear sense about the DEL control system.

CHAPTER - 9

Cause of tripping and maintenance

9.1 Introduction

In a power station the power generation equipments can stop or the protected devices trip for various reasons. After tripping we need to clear the fault. To ensure the continuous supply of power and to increase the efficiency maintenance is essential. During our intern period at DEL we get a theoretical as well as practical knowledge about the tripping conditions and maintenance procedure. We have visited these sections from 11th to 12th January 2012.

9.2 Tripping reason

There are several reasons for tripping the power generation system. In DEL most common tripping reasons are –

- **i.** Air filter jam
- **ii.** CDVR breaker change
- **iii.** Plant trip
- **iv.** Radiator cover open
- **v.** Radiator fan greasing
- **vi.** PO generator alarm
- **vii.** Lube oil life time over
- **viii.** Higher RPM than rated RPM
- **ix.** Higher voltage than rated
- **x.** CDVR shut down
- **xi.** GECM shut down
- **xii.** Shifting of voltage phase
- **xiii.** Jacket water temperature high
- **xiv.** Lost of synchronizing
- **xv.** Power cable terminal box vibration
- **xvi.** Radiator coolant shortage
- **xvii.** Air entire into the fuel line

xviii. Fuel differential pressure high

xix. cranking problem

xx. P.O Under Frequency Inverse Trip

xxi. Insulating of the cable on the transformer

xxii. Lube oil outer valve tighten

xxiii. Plant tripped due to under frequency

xxiv. Fuel level of the day tank is too low

xxv. Non –Driven temperature high

xxvi. When increase load 70% to 95% & pyrometer not showing.

xxvii. Radiator water level Indicators problem

xxviii. Air filter too much vibrate

xxix. Air filter Indicator s damage

xxx. Cylinder temperature low (460) & when engine taken load then start few minute abnormal sound

When the genset is tripping it need to maintenance with proper care.

9.3 Maintenance

There are two types of maintenance.

i. Schedule maintenance

ii. Trouble shooting

In DEL schedule maintenance is mainly practiced. Schedule maintenance is mainly preferred for getting good efficiency of the system. Routine maintenance instructions consist of scheduled inspections of all equipment related to power generation and transmission. When a need for service or repair is indicated, manufacturer's literature is referred for specific information. Service records of the auxiliary power systems are filed in the installation's PHB office.

9.3.1 Separator maintenance

Separator is the most important part for fuel separation process. Periodic (preventive) maintenance reduces the risk of unexpected stoppage and breakdown of the separator. The following directions for periodic maintenance give a brief description of which components to be cleaned, checked and renewed at different maintenance intervals. Daily checking consists of minor check points to carry out for detecting abnormal operating conditions.

9.3.2 Engine maintenance

In DEL the maintenance of engine is a part of scheduled maintenance. There are several types of maintenance.

9.3.2.a Daily

i. Cooling System Coolant Level – Check
ii. Driven Equipment - Inspect/Replace/Lubricate
iii. Engine Air Cleaner Differential Pressure – Check
iv. Engine Air Pre cleaner – Clean
v. Engine Oil Filter Differential Pressure – Check
vi. Engine Oil Level – Check
vii. Fuel System Fuel Filter Differential Pressure – Check
viii. Fuel System Primary Filter/Water Separator – Drain
ix. Fuel Tank Water and Sediment – Drain
x. Instrument Panel – Inspect

9.3.3 Alternator maintenance

Mainly winding insulation, bearing connection, cleaning of the rotor – stator are the main maintenance for alternator.

9.3.3.a Winding insulation

Winding insulation is checked before initial start - up. Measurement is made of the insulation resistance of the winding. The insulation resistance needs greater than 3 M ohms. Generally, it is measured in an interval of 6 – 8 months during normal operation.

9.3.3.b Bearing connection

For smooth bearing connection it needs to put recommended grease. Also the temperature and vibration of the bearing is needed to be checked. This is a monthly checking process.

9.3.4 Transformer maintenance

In order to keep the transformer operation effective, it should be properly maintained. Additional attention should be given if the transformer is operating at full load or operating in an extreme or hazardous condition.

9.3.4.a Regular inspection of the transformer

To ensure the transformer is operating properly and efficiently, it should be regularly inspected. Proper attention should be given in the following points –

i. The oil temperature should be inspected frequently, especially if the transformer operates at or near rated load.
ii. The oil level should be inspected frequently to ensure the oil at the correct level.

Figure 9.1: Oil tank of a transformer

iii. The transformer oil should be tested periodically, depending on the operating conditions. Pay special attention to the oil's dielectric strength and whether it needs filtering.
iv. The breather requires regular inspection. Replace the silica gel as soon as the pink color appears. The period of the inspection should be determined according to the maintenance procedures, depending on the loading cycle and local conditions.

9.4 Conclusion

In this chapter, we have discussed about the tripping conditions and the maintenance of different components specially engine, alternator, and transformer. Regular maintenance can make the system more efficient. In DEL, mainly separator, genset, and transformer maintenance are more important than other equipments.

CHAPTER - 10

Conclusion

10.1 Our achievements

From this internship, we got different knowledge about power system engineering and its equipment and we got the practical experience about the process of power generation and transmission. From the first day of the internship the engineers of DEL always motivate us to learn some practical experience with DEL about the power generation process. So, finally we make good achievements after completing our work.

10.2 Problem faced

In DEL we faced some problems because we did not complete all the courses related to power. Not only the electrical or electronics, in a power station mechanical part is also needed due to heavy equipment. So, we faced problem when we needed to know about the complex mechanical engineering.

10.3 Recommendations

Some recommendations are given below for the students to do their internship program in a better way –

- **i.** More theoretical knowledge should be gathered about power generation, protection system, and power equipment.
- **ii.** Every candidate should complete the related courses mainly Power stations, switchgear and protective relays and power electronics before going for internship.
- **iii.** Internship time period 15 days (100 hours) is not enough to be able to understand the functions of a power plant efficiently. So, if the time period is increased it would be much better for the students.

10.4 Discussion

In this internship report, we tried to make a clear understanding about the power station and power generation on a perspective of an Electrical and Electronics Engineer. In DEL, we got the practical experience with our theoretical knowledge. To know mechanical part beside the electrical part is important in a power station. We tried to include the details of our intern work. In the first chapter, we have discussed about the DEL and the purpose of this internship. Fuel or utilities are very important parts for generating power energy. The fuel system and separating process of fuel in DEL is discussed on chapter two. Mainly we have included the fuel, compressor and DM plant section in details. In the next chapter, we discussed about the power generation process, description of different equipment of a genset and transformer. We tried to make a complete idea about the power generation system in brief. The power generation process starts after fuel purification or supplying to the genset and ends after making successful generation of 11 KV voltage by transformer. All the processes such as power generation, voltage transformation and controlling are happening automatically in the bank. In chapter four, we have discussed about the transmission process of power in DEL from individual bank to substation. In substation the voltage is stepped up to 132 KV from 11 KV. The details of substation and its equipment are discussed on the next chapter. Maintenance and operation of substations are discussed on chapter six. DEL is very much concerned about the regular maintenance of the equipment of substation. Protection and switchgear of the system is another important part which is discussed on chapter seven. DEL tries to ensure a good and cheaper protection system, but in some point they give higher priority to the protection scheme without compromising the higher cost. For example they use ZIGZAG transformer and NGR for double protection of earth related fault. Maximum power stations use only one of them in the purpose of protection. The controlling systems of DEL include the automatic monitoring process of all the equipment and control all the parameters. DEL established an automatic control system to ensure faster operation and accurate measuring. In chapter eight, we have discussed about the control system of DEL. Finally, we have discussed about the tripping causes and maintenance procedure of important equipment such as fuel separator, genset, and transformer in chapter nine.

The authorities in DEL were very much concerned about all kinds of safety issues. The friendly environment in DEL encouraged us to co-operate with each other. We have learnt a lot and obtained practical knowledge from our internship at DEL.

Appendix

Daily Activity Report

Department of Electrical and Electronic Engineering
East West University
EEE 499
Industrial Training
Daily Activity Report

Separate Daily Activity Report should be completed by each intern for every day of work and should be signed by the mentor from the company and the academic advisor. Copy of all the reports should be attached to the final internship report.

Name of the company:	Desh Energy Limited.
Name of the student:	Md. Yeasin Arafat.
ID:	2008-3-80-002.

Date:	27th December 2011
Start time/End time	09.00 to 17.00. hours.
Location:	DESh Energy Limited. Narayanganj
Mentor:	Engr. Md. Anwarul Haque.

General Instructions:

a. It is the intern's duty to make sure that all his/her daily activity reports are appropriately signed by both the mentor and the academic supervisor.
b. The daily report should be a brief narration of the activities during the internship period in the eyes of the intern and should be completed and submitted by every intern irrespective of the number of partners s/he might have for the presentation and final report writing purpose.
c. The report should not be a compilation of lectures notes taken during the internship, rather it should depict what the intern has learned on a particular day.
d. In case of any confusion, interns are strongly recommended to consult their respective academic supervisors.

Department of Electrical and Electronic Engineering
East West University

Address the following points briefly (Use additional page if necessary)

1 What was the objective of the day's activities? (If applicable. list multiple objectives)

1. Introduction with Desh Energy Limited.
2. Basic Principle of fuel separation.
3. Visit of the fuel system (overall).

2. List the day's activities according to the order of objectives listed in 1. Mention the specifications of the equipments used/visited. Comment on how these activities fulfill your objectives.

1. (a) Visit the whole power station.
2. (a) Study the theory of Basic Principle of fuel separation
   (b) Discuss about the fuel separation Process and its benifits.
3. (a) Visit the fuel transmission system and saw the machine of equipment used for fuel separation.
   (b) In 'DEL' the separator name is ALFA LAVAL SEPARATOR MAB206S-24.

3. Relate your practical activity with the theoretical knowledge you gained in the respective academic course.

from academic course we know we need to purify the fuel of generator to safe the operation. We need to separate the other element ~~of~~ from fuel. In this session we are familier with this.

27.12.11
Signature of the mentor with date
Name: Md. Anwarul Haque.
Designation: Asst. Manager
Contact Phone #: 01670251652.

Tahseen Kamal 01.2012
Signature of academic supervisor with date
Name: Tahseen Kamal
Designation: Senior Lecturer

Department of Electrical and Electronic Engineering
East West University
EEE 499
Industrial Training
Daily Activity Report

Separate Daily Activity Report should be completed by each intern for every day of work and should be signed by the mentor from the company and the academic advisor. Copy of all the reports should be attached to the final internship report.

Name of the company:	Desh Energy Limited
Name of the student:	Md. Yeasin Arafat.
ID:	2008-3-80-002.

Date:	28th Decembers 2011
Start time/End time	09.00 to 17.00
Location:	Adamjee, Narayanganj
Mentor:	Engr. Md. Anwarul Haque

General Instructions:

a. It is the intern's duty to make sure that all his/her daily activity reports are appropriately signed by both the mentor and the academic supervisor.
b. The daily report should be a brief narration of the activities during the internship period in the eyes of the intern and should be completed and submitted by every intern irrespective of the number of partners s/he might have for the presentation and final report writing purpose.
c. The report should not be a compilation of lectures notes taken during the internship, rather it should depict what the intern has learned on a particular day.
d. In case of any confusion, interns are strongly recommended to consult their respective academic supervisors.

Department of Electrical and Electronic Engineering
East West University

Address the following points briefly (Use additional page if necessary)

1 What was the objective of the day's activities? (If applicable. list multiple objectives)

1. Operate the fuel separator.
2. Maintenance of fuel separator.
3. Maintenance of fuel system.

2. List the day's activities according to the order of objectives listed in 1. Mention the specifications of the equipments used/visited. Comment on how these activities fulfill your objectives.

1. (a) Firstly I had observed the whole process of fuel separation.
   (b) After that I did it myself. (The operation).

2. (a) Gathered the knowledge of specification of every components of fuel separator.
   (b) Study about the trouble of fuel separator.
   (c) Study about the regular check up of fuel separator.
   Model of fuel separator is MAB 206S-24.

3. (a) Study about the fuel impurities and its maintenance.

3. Relate your practical activity with the theoretical knowledge you gained in the respective academic course.
The diameter of the injector of a engine is so small, About 1 micron. So if the fuel is not get ~~clarify~~ purified the injector can blocked by unwanted particles and baffles the regular flow. So fuel maintenance and as a machine Separator maintenance is important. Operate the fuel separator is means control the fuel separation process. The process liquid comes through the inlet pipe and process by separator bowl and supply to the service tank via outlet pipe.

Tahseen Kamal 19.12.2012

Signature of the mentor with date
Name: Md. Anwarul Haque.
Designation: Asst. Manager
Contact Phone #: 01670251652.

29.12.11

Signature of academic supervisor with date
Name: Tahseen Kamal
Designation:

Department of Electrical and Electronic Engineering
East West University
EEE 499
Industrial Training
Daily Activity Report

Separate Daily Activity Report should be completed by each intern for every day of work and should be signed by the mentor from the company and the academic advisor. Copy of all the reports should be attached to the final internship report.

Name of the company:	Desh Energy Limited
Name of the student:	Md. Yeasin Arafat
ID:	2008-3-80-002

Date:	29-12-2011
Start time/End time	09.00 - 17.00
Location:	Adamjee, Narayanganj
Mentor:	Engr. Md. Anwarul Haque.

General Instructions:

a. It is the intern's duty to make sure that all his/her daily activity reports are appropriately signed by both the mentor and the academic supervisor.
b. The daily report should be a brief narration of the activities during the internship period in the eyes of the intern and should be completed and submitted by every intern irrespective of the number of partners s/he might have for the presentation and final report writing purpose.
c. The report should not be a compilation of lectures notes taken during the internship, rather it should depict what the intern has learned on a particular day.
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Department of Electrical and Electronic Engineering
East West University

Address the following points briefly (Use additional page if necessary)

1 What was the objective of the day's activities? (If applicable. list multiple objectives)

1. Study about Compressor, Dryer.
2. Study about DM Plant.
3. Study about coolant. ~~System~~.

2. List the day's activities according to the order of objectives listed in 1. Mention the specifications of the equipments used/visited. Comment on how these activities fulfill your objectives.

1. Study about the compresser process and why air need to compress. Dryer mechanism.
2. DM Plant and its working flow. Study about why need a DM Plant.
3. @Study about coolant system and how it maversed.
   (b) The Process of coolant ~~system~~ in this Power Plant.

3. Relate your practical activity with the theoretical knowledge you gained in the respective academic course.

To starting motor compressed air is needed ~~of~~ we with a ~~velocity~~ pressure of 5-7 bar. And 3times air is preserve for one engine. ~~Also~~ Dryer reduced the extra water or Moisture from air. we know for coolant system ~~de~~ water is needed and that water is coming from DM Plant ~~to~~ for supplying de-mineralized water for machine safty.

Yasmeen Kamal 19.01.2012

Signature of the mentor with date
Name: Md. Anwarul Haque.
Designation: Asst. Manager
Contact Phone #: 01670251652.

20-12-11

Signature of academic supervisor with date
Name:
Designation:

Department of Electrical and Electronic Engineering
East West University
EEE 499
Industrial Training
Daily Activity Report

Separate Daily Activity Report should be completed by each intern for every day of work and should be signed by the mentor from the company and the academic advisor. Copy of all the reports should be attached to the final internship report.

Name of the company:	Desh Energy Limited.
Name of the student:	Md. Yeasin Arafat
ID:	2008-3-80-002

Date:	30-12-2011
Start time/End time	09.00 — 17.00
Location:	Adamjee, Narayanganj
Mentor:	Engr. Md. Ruman Ali

General Instructions:

a. It is the intern's duty to make sure that all his/her daily activity reports are appropriately signed by both the mentor and the academic supervisor.
b. The daily report should be a brief narration of the activities during the internship period in the eyes of the intern and should be completed and submitted by every intern irrespective of the number of partners s/he might have for the presentation and final report writing purpose.
c. The report should not be a compilation of lectures notes taken during the internship, rather it should depict what the intern has learned on a particular day.
d. In case of any confusion, interns are strongly recommended to consult their respective academic supervisors.

Department of Electrical and Electronic Engineering
East West University

Address the following points briefly (Use additional page if necessary)

1 What was the objective of the day's activities? (If applicable. list multiple objectives)

1. Brief discussion about power station, generation and related equipment.

2. List the day's activities according to the order of objectives listed in 1. Mention the specifications of the equipments used/visited. Comment on how these activities fulfill your objectives.

1. Study about power station.
2. Discussed about the equipments ~~of~~ which are used in here..
3. Discussed about the basic principle ~~am~~ of power generation and its transmission.

3. Relate your practical activity with the theoretical knowledge you gained in the respective academic course.

In academic course we read the theoretical part of power generation and here we study about the practical process of power generation. Visualize all the equipment related to power generation.

~~and~~

30.12.11

Signature of the mentor with date
Name: Md. Ruman Ali
Designation: Sr. Engr.
Contact Phone #: 01719612069

Yasmeen Kamal 19.01.2012

Signature of academic supervisor with date
Name:
Designation:

Department of Electrical and Electronic Engineering
East West University
EEE 499
Industrial Training
Daily Activity Report

Separate Daily Activity Report should be completed by each intern for every day of work and should be signed by the mentor from the company and the academic advisor. Copy of all the reports should be attached to the final internship report.

Name of the company:	DESH ENERGY Ltd.
Name of the student:	Md. YEASIN ARAFAT.
ID:	2008-3-80-002

Date:	31-12-2011
Start time/End time	09.00 to 17.00
Location:	ADAMJEE, NARAYANGANJ
Mentor:	Engr. RUMAN ALI.

General Instructions:

a. It is the intern's duty to make sure that all his/her daily activity reports are appropriately signed by both the mentor and the academic supervisor.
b. The daily report should be a brief narration of the activities during the internship period in the eyes of the intern and should be completed and submitted by every intern irrespective of the number of partners s/he might have for the presentation and final report writing purpose.
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Department of Electrical and Electronic Engineering
East West University

Address the following points briefly (Use additional page if necessary)

1 What was the objective of the day's activities? (If applicable. list multiple objectives)

1. Specification of important equipment.
2. Single line diagram.
3. Connection of transformer.

2. List the day's activities according to the order of objectives listed in 1. Mention the specifications of the equipments used/visited. Comment on how these activities fulfill your objectives.

1. List all Specification from Name plate of the equipment.
   - (a) Alternator
   - (b) Engine
   - (c) Distribution transformer
   - (d) Distribution transformer (Use for station. Step down)
   - (e) Air Circuit Breaker.
   - (f) Earthing transformer.
2. Draw the single line diagram of Power transmission from generation.
3. Primary and secondary connection of a transformer are observed.

3. Relate your practical activity with the theoretical knowledge you gained in the respective academic course.

Here the specification of the equipment shows the capacity, maintenance and safty of the equipment. Also the connection of equipment is observed, as Δ and Y type connection of transformer. The single line diagram shows the power flow after generation. It also shows ~~where we~~ how the Protection scheme is used for Power supply in Main bus.

28.12.11
Signature of the mentor with date
Name:
Designation:
Contact Phone #:

Yasmeen Kamal 19.01.2012
Signature of academic supervisor with date
Name:
Designation:

Department of Electrical and Electronic Engineering
East West University
EEE 499
Industrial Training
Daily Activity Report

Separate Daily Activity Report should be completed by each intern for every day of work and should be signed by the mentor from the company and the academic advisor. Copy of all the reports should be attached to the final internship report.

Name of the company:	Desh Energy Limited
Name of the student:	Nayeem Ahsan
ID:	2008-2-86-016

Date:	03-01-12
Start time/End time	9am — 5 pm
Location:	Desh energy Limited, Narayanganj.
Mentor:	MD. Hakikul Islam.

General Instructions:

a. It is the intern's duty to make sure that all his/her daily activity reports are appropriately signed by both the mentor and the academic supervisor.
b. The daily report should be a brief narration of the activities during the internship period in the eyes of the intern and should be completed and submitted by every intern irrespective of the number of partners s/he might have for the presentation and final report writing purpose.
c. The report should not be a compilation of lectures notes taken during the internship, rather it should depict what the intern has learned on a particular day.
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Department of Electrical and Electronic Engineering
East West University

Address the following points briefly (Use additional page if necessary)

1. What was the objective of the day's activities? (If applicable, list multiple objectives)

(i) To know about the alternator practically.
(ii) To know about the exciter practically.
(iii) To know about the working principle of alternator and crank shaft.

2. List the day's activities according to the order of objectives listed in 1. Mention the specifications of the equipments used/visited. Comment on how these activities fulfill your objectives.

(1) Discussion on the operating principle of an alternator.
(2) We observed alternators of 4 pole
(3) We observed terminal box, rectifier circuit, rotor, stator
(4) We observed potential transformer 1 and 2 (PT1, PT2)
(5) Also observed DVR (Digital voltage regulator.

3. Relate your practical activity with the theoretical knowledge you gained in the respective academic course.

From our theoritical course we know about alternator and its construction. Here we practically observed an alternator and differents parts of it and also the number of pole.

Signature of the mentor with date
Name: Md. Hakikul Islam
Designation: Shift-in-charge
Contact Phone #: 01716-308973

Signature of academic supervisor with date
Name: S.M. Shahriar Rashid
Designation: Lecturer

Department of Electrical and Electronic Engineering
East West University
EEE 499
Industrial Training
Daily Activity Report

Separate Daily Activity Report should be completed by each intern for every day of work and should be signed by the mentor from the company and the academic advisor. Copy of all the reports should be attached to the final internship report.

Name of the company:	Desh energy Limited
Name of the student:	Nayeem Alvan
ID:	2015-2-86-016

Date:	04 - 01 - 18
Start time/End time	9am - 5 pm
Location:	Desh Energy Limited, Narayanganj
Mentor:	MD Hakikul Islam

General Instructions:

a. It is the intern's duty to make sure that all his/her daily activity reports are appropriately signed by both the mentor and the academic supervisor.
b. The daily report should be a brief narration of the activities during the internship period in the eyes of the intern and should be completed and submitted by every intern irrespective of the number of partners s/he might have for the presentation and final report writing purpose.
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Department of Electrical and Electronic Engineering
East West University

Address the following points briefly (Use additional page if necessary)

1. What was the objective of the day's activities? (If applicable, list multiple objectives)

(i) To observed the different types of parts of an engine
(ii) To know about starting system, cooling system, lubrication system.
(iii) To practically observed the crank shaft arrangement

2. List the day's activities according to the order of objectives listed in 1. Mention the specifications of the equipments used/visited. Comment on how these activities fulfill your objectives.

(i) Discussion on the working principle of engine.
(ii) Discussion on the starting procedure of an Diesel engine.
(iii) We observed different parts of Diesel engine such as air filter, fuel filter, lube oil filter, cylinders, fuel oil pump, water cooler pump, jacket water pump.
(iv) We also observed fly wheel and crank shaft arrangement.
(v) Discussion on the cooling system and lubricating system.
(vi) We observed radiator.

3. Relate your practical activity with the theoretical knowledge you gained in the respective academic course.

From our theoritical course we knew about different types of engine. Here we observed a brand stock diesel engine and it's arrangement.

Signature of the mentor with date
Name: Md. Harikul Islam
Designation: Shift-in-Charge
Contact Phone #: 01716-306773

Signature of academic supervisor with date
Name: S.M. Shahriar Rashid
Designation: Lecturer

Department of Electrical and Electronic Engineering
East West University
EEE 499
Industrial Training
Daily Activity Report

Separate Daily Activity Report should be completed by each intern for every day of work and should be signed by the mentor from the company and the academic advisor. Copy of all the reports should be attached to the final internship report.

Name of the company:	Desh Energy Limited
Name of the student:	Nayeem Alam.
ID:	2007-2-50-016

Date:	23-01-12
Start time/End time	9am - 5 PM
Location:	Desh Energy Limited, Nasirabad, CTG.
Mentor:	MD. Ruman Ali

General Instructions:

a. It is the intern's duty to make sure that all his/her daily activity reports are appropriately signed by both the mentor and the academic supervisor.
b. The daily report should be a brief narration of the activities during the internship period in the eyes of the intern and should be completed and submitted by every intern irrespective of the number of partners s/he might have for the presentation and final report writing purpose.
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Department of Electrical and Electronic Engineering
East West University

Address the following points briefly (Use additional page if necessary)

1. What was the objective of the day's activities? (If applicable, list multiple objectives)

To know the operating and shut down procedure of engine practically.

2. List the day's activities according to the order of objectives listed in 1. Mention the specifications of the equipments used/visited. Comment on how these activities fulfill your objectives.

(i) First we check the lube oil level by using deep stick.
(ii) Then we check the fuel supply.
(iii) Then we check the coolant level from inspection glass.
(iv) Then we check air pressure.
(v) Also check air hidden condition.
(vi) Then we open fuel supply valve.
(vii) Then set the engine in hand crank mode from control panel.
(viii) Then start the engine by pressing start button.
(ix) Then check the synchronizing condition & after synchronizing load transfer to national grid.
(x) Finally we stop the engine by pressing stop button.

3. Relate your practical activity with the theoretical knowledge you gained in the respective academic course.

Here we produce electricity by using generators and prime mover and then trans load to national grid. From our theoritical course we learn about the procedure of electricity generation.

19.02.12
Signature of the mentor with date
Name: Md. Rumen Ali
Designation: Jr Eng
Contact Phone #: 01719612069

19.01.12
Signature of academic supervisor with date
Name: S.M. Shahriar Rashid
Designation: Lecturer.

Department of Electrical and Electronic Engineering
East West University
EEE 499
Industrial Training
Daily Activity Report

Separate Daily Activity Report should be completed by each intern for every day of work and should be signed by the mentor from the company and the academic advisor. Copy of all the reports should be attached to the final internship report.

Name of the company:	Desh Energy Limited
Name of the student:	Nayeem Ahsan
ID:	2005-2-55-016

Date:	06-01-12
Start time/End time	9am - 5pm
Location:	Desh Energy Limited, Narayanganj
Mentor:	Md. Ruman Ali

General Instructions:

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Department of Electrical and Electronic Engineering
East West University

Address the following points briefly (Use additional page if necessary)

1 What was the objective of the day's activities? (If applicable, list multiple objectives)

To know about the controlling system and the equipment used for controlling purpose.

2. List the day's activities according to the order of objectives listed in 1. Mention the specifications of the equipments used/visited. Comment on how these activities fulfill your objectives.

1. Discussion about on PLC system, which is used here.
2. Discussion on the controlling system of the plant.
3. Practically observed control panel, master control panel, switchgeared, centrally control panel.
4. practically know how to start and stop engine by using control panel.
5. Then we observed how to control different parameter related to power generation from master panel.

3. Relate your practical activity with the theoretical knowledge you gained in the respective academic course.

From our theoritical knowledge we knew about different types of controlling system. Here are observed the implimentation of it and controlling parameters and procedure.

06.01.12
Signature of the mentor with date
Name: Md. Ruman Ali
Designation: Sr. Engr
Contact Phone #: 01819612069

10.01.12
Signature of academic supervisor with date
Name: S-M Shahrior Rashid.
Designation: Lecturer

Department of Electrical and Electronic Engineering
East West University
EEE 499
Industrial Training
Daily Activity Report

Separate Daily Activity Report should be completed by each intern for every day of work and should be signed by the mentor from the company and the academic advisor. Copy of all the reports should be attached to the final internship report.

Name of the company:	Desh Energy Limited
Name of the student:	Naveem Ahsan
ID:	2008-2-86-016

Date:	07-01-12
Start time/End time	9am - 5 pm
Location:	Desh Energy Limited, Narayanganj.
Mentor:	Md. Ruman Ali

General Instructions:

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Department of Electrical and Electronic Engineering
East West University

Address the following points briefly (Use additional page if necessary)

1. What was the objective of the day's activities? (If applicable, list multiple objectives)

To know about substation and it's arrangement practically.

2. List the day's activities according to the order of objectives listed in 1. Mention the specifications of the equipments used/visited. Comment on how these activities fulfill your objectives.

① Discussion on substation and it's classification.

② Practically observed substation arrangement.

③ Practically observed CT, PT, SF_6 circuit breaker, isolators, lightening arresters, busbar disk, power transformer

3. Relate your practical activity with the theoretical knowledge you gained in the respective academic course.

Here we practically observed a substation and also CT, PT, LA, isolators, SF_6 breakers and also the purpose of using this which we have learned from our academic course.

Signature of the mentor with date
Name: MD. Ruman Ali
Designation: Sr. Engr.
Contact Phone #: 01719612069

Signature of academic supervisor with date
Name: S. M. Shahriar Rashid
Designation: Lecturer

Department of Electrical and Electronic Engineering
East West University
EEE 499
Industrial Training
Daily Activity Report

Separate Daily Activity Report should be completed by each intern for every day of work and should be signed by the mentor from the company and the academic advisor. Copy of all the reports should be attached to the final internship report.

Name of the company:	Desh Energy Limited
Name of the student:	Md. Nuruzzaman
ID:	2008-3-60-017

Date:	10.01.12
Start time/End time	09:00 AM to 05:00 PM
Location:	Siddhirgonj, Narayangonj
Mentor:	Md. Ruman Ali

General Instructions:

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b. The daily report should be a brief narration of the activities during the internship period in the eyes of the intern and should be completed and submitted by every intern irrespective of the number of partners s/he might have for the presentation and final report writing purpose.
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Department of Electrical and Electronic Engineering
East West University

Address the following points briefly (Use additional page if necessary)

1. What was the objective of the day's activities? (If applicable. list multiple objectives)

1. To know about the substation control room.
2. To know and observed the single line diagram of the sub station.

2. List the day's activities according to the order of objectives listed in 1. Mention the specifications of the equipments used/visited. Comment on how these activities fulfill your objectives.

1. We observe 132 kV metering panel, DC distribution panel, AC distribution panel, Relay panel, Battery and chargers panel, 11kV/132 kV GT for control panel.

2. We observed every component of a sub station and draw a single line diagram for the sub station

3. Relate your practical activity with the theoretical knowledge you gained in the respective academic course.

Here we are familiar with different control panel box used in a sub station. Also, we draw single line diagram for sub station which is taught in our academic course.

10.01.17

Signature of the mentor with date
Name: Md. Ruman Ali
Designation: Sr. Eng
Contact Phone #: 01719612069

Signature of academic supervisor with date
Name:
Designation:

5/6/17

Department of Electrical and Electronic Engineering
East West University
EEE 499
Industrial Training
Daily Activity Report

Separate Daily Activity Report should be completed by each intern for every day of work and should be signed by the mentor from the company and the academic advisor. Copy of all the reports should be attached to the final internship report.

Name of the company:	Desh Energy Limited
Name of the student:	Md. Nuruz zaman
ID:	2008-3-80-018

Date:	11.01.12
Start time/End time	09:00 AM to 05:00 PM
Location:	Siddhirganj, Narayanganj
Mentor:	Md. Musa

General Instructions:

a. It is the intern's duty to make sure that all his/her daily activity reports are appropriately signed by both the mentor and the academic supervisor.
b. The daily report should be a brief narration of the activities during the internship period in the eyes of the intern and should be completed and submitted by every intern irrespective of the number of partners s/he might have for the presentation and final report writing purpose.
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d. In case of any confusion, interns are strongly recommended to consult their respective academic supervisors.

Department of Electrical and Electronic Engineering
East West University

Address the following points briefly (Use additional page if necessary)

1 What was the objective of the day's activities? (If applicable. list multiple objectives)

To know about Transformers.

2. List the day's activities according to the order of objectives listed in 1. Mention the specifications of the equipments used/visited. Comment on how these activities fulfill your objectives.

1. Briefly discussed about the principle of transformers.
2. Observed different kind of transformers used at here
3. Collected name plate data of a distribution type transformer from the bank.
4. Discussed about the protection of different type of transformers such as distribution type, substation type, zig zag type etc.

3. Relate your practical activity with the theoretical knowledge you gained in the respective academic course.

In academic course, we studied about the principle of transformers but there we saw the transformers practically. We gathered knowledge about the protection of transformers. We also saw the oil chamber, buchholz relay and their working principle.

11.01.12

Signature of the mentor with date
Name: K.M. Musa
Designation: Jr. Engr.
Contact Phone #: 01912321958

Signature of academic supervisor with date
Name:
Designation:

5/6/12

Department of Electrical and Electronic Engineering
East West University
EEE 499
Industrial Training
Daily Activity Report

Separate Daily Activity Report should be completed by each intern for every day of work and should be signed by the mentor from the company and the academic advisor. Copy of all the reports should be attached to the final internship report.

Name of the company:	Desh Energy limited
Name of the student:	Md. Nuruzzaman
ID:	2008-3-80-012

Date:	12.01.12
Start time/End time	09:00 AM to 05:00 PM
Location:	Siddhirgonj - Narayangonj.
Mentor:	K.M. Musa

General Instructions:

a. It is the intern's duty to make sure that all his/her daily activity reports are appropriately signed by both the mentor and the academic supervisor.
b. The daily report should be a brief narration of the activities during the internship period in the eyes of the intern and should be completed and submitted by every intern irrespective of the number of partners s/he might have for the presentation and final report writing purpose.
c. The report should not be a compilation of lectures notes taken during the internship, rather it should depict what the intern has learned on a particular day.
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Department of Electrical and Electronic Engineering
East West University

Address the following points briefly (Use additional page if necessary)

1 What was the objective of the day's activities? (If applicable. list multiple objectives)

1. To know about the regulare ore schedule maintenance of generatore (engine + alternatore).

2. List the day's activities according to the order of objectives listed in 1. Mention the specifications of the equipments used/visited. Comment on how these activities fulfill your objectives.

1. Schedule maintenance includes — lube oil change, changing lube filter, ~~and~~ fuel filter, aire filter, radiatore, coolant, watere reparatore filtere and tapped adjustment. The changing procedure depends on the working houre of an engine.

3. Relate your practical activity with the theoretical knowledge you gained in the respective academic course.

First we study about scheduled maintenance and then we do it practically. In power generation plant, schedule maintenance results uninterrupted powere generation with minimum disturbancers.

Signature of the mentor with date
Name: K. M. Musa
Designation: Jr. Engre
Contact Phone #: 01912371958

Signature of academic supervisor with date
Name:
Designation:

Department of Electrical and Electronic Engineering
East West University
EEE 499
Industrial Training
Daily Activity Report

Separate Daily Activity Report should be completed by each intern for every day of work and should be signed by the mentor from the company and the academic advisor. Copy of all the reports should be attached to the final internship report.

Name of the company:	Desh Energy limited
Name of the student:	Md. Nuruzzaman
ID:	2008-3-80-017

Date:	13.01.12
Start time/End time	09:00 AM to 05:00 PM
Location:	Siddhirgonj, Narayangonj.
Mentor:	K. M. Musa

General Instructions:

a. It is the intern's duty to make sure that all his/her daily activity reports are appropriately signed by both the mentor and the academic supervisor.
b. The daily report should be a brief narration of the activities during the internship period in the eyes of the intern and should be completed and submitted by every intern irrespective of the number of partners s/he might have for the presentation and final report writing purpose.
c. The report should not be a compilation of lectures notes taken during the internship, rather it should depict what the intern has learned on a particular day.
d. In case of any confusion, interns are strongly recommended to consult their respective academic supervisors.

Department of Electrical and Electronic Engineering
East West University

Address the following points briefly (Use additional page if necessary)

1 What was the objective of the day's activities? (If applicable. list multiple objectives)

1. To know about the generator protection from different fault.

2. List the day's activities according to the order of objectives listed in 1. Mention the specifications of the equipments used/visited. Comment on how these activities fulfill your objectives.

1. To protect the gen-set different kinds of relays are used in Turcberg control system.
2. For earth fault protection, LV Earth Fault Relay Panel is used.
3. GECM (Generator Engine Control Module) is used for master tripping.
4. CDVR (Cat Digital Voltage Regulator) is used to protect ton faulty condition.

3. Relate your practical activity with the theoretical knowledge you gained in the respective academic course.

From academic course we know, different kinds of relays are used for gen-set protection for different fault. Practically we saw impedance type, differential type, Earth fault relay panal etc are used for the protection of generator.

13.01.19

Signature of the mentor with date
Name: K.M. Musa
Designation: Jr. Engr.
Contact Phone #: 01912371958

Signature of academic supervisor with date
Name:
Designation:

Department of Electrical and Electronic Engineering
East West University
EEE 499
Industrial Training
Daily Activity Report

Separate Daily Activity Report should be completed by each intern for every day of work and should be signed by the mentor from the company and the academic advisor. Copy of all the reports should be attached to the final internship report.

Name of the company:	Desh Energy Limited
Name of the student:	Md. Nuruzzaman
ID:	2008-3-80-017

Date:	14.01.12
Start time/End time	09:00 AM to 05:00 PM
Location:	Siddhirgonj, Narayangonj
Mentor:	K.M. Musa

General Instructions:

a. It is the intern's duty to make sure that all his/her daily activity reports are appropriately signed by both the mentor and the academic supervisor.
b. The daily report should be a brief narration of the activities during the internship period in the eyes of the intern and should be completed and submitted by every intern irrespective of the number of partners s/he might have for the presentation and final report writing purpose.
c. The report should not be a compilation of lectures notes taken during the internship, rather it should depict what the intern has learned on a particular day.
d. In case of any confusion, interns are strongly recommended to consult their respective academic supervisors.

Department of Electrical and Electronic Engineering
East West University

Address the following points briefly (Use additional page if necessary)

1 What was the objective of the day's activities? (If applicable. list multiple objectives)

1. Analyze different faulty condition of a gen-set.

2. List the day's activities according to the order of objectives listed in 1. Mention the specifications of the equipments used/visited. Comment on how these activities fulfill your objectives.

1. We analyze the fault occured in last one yeare.
2. Discussed about the tripping condition and maintenance.
3. Generally gen-set tripps for value adjustment (fuel), adjustment of fly wheel angle, jam air filter, the time of changing CDVR breaker, plant trip, opening of radiator cover, radiator fan grarring etc.

3. Relate your practical activity with the theoretical knowledge you gained in the respective academic course.

In academic course we to are taught about some major fault of gen-set. But here we learnt about so many reasons for faults beside major faults.

14.01.12

Signature of the mentor with date
Name: K.M. Musa
Designation: Jr. Engr.
Contact Phone #: 01912 371958.

Signature of academic supervisor with date
Name:
Designation:

5/6/12