East West University

**Internship Report**

**On**

**Power Generation, Transmission and Distribution**

**At**

**Ashuganj Power Station Company Limited (APSCL)**

**By**

**Mahafuzur Rahman (2009-1-80-008)**

**Mohammad Mijanaur Rahaman (2008-2-80-014)**

**Kaushik Debnath (2008-1-80-034)**

**Submitted To**

**Department of Electrical and Electronic Engineering**

**Faculty of Sciences 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, 2013**

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Approved By

| _____ | _____ | _____ |
|---|---|---|
| Academic Advisor | Academic Advisor | Department Chairperson |
| Dr. Anisul Haque | Fakir Mashuque Alamgir | Mohammad Mojammel Al Hakim |

# ASHUGANJ POWER STATION COMPANY LTD. (APSCL)

(An Enterprise of Bangladesh Power Development Board)


## Certificate

For

## Industrial Attachment Training Program

This is to certify that Mr. Mahafuzur Rahman , ID No. 2009-1-80-008 ,the Student of B.Sc in Electrical and Electronic Engineering from East-West University , Dhaka has successfully completed the Industrial Attachment Training Program held from 24-08-2012 to 07-09-2012. During the training period , he paid due attention to the practical work .

I wish him every success in life.

Manager (HRD)
Ashuganj Power Station Company Ltd.
Ashuganj, BBaria

# ASHUGANJ POWER STATION COMPANY LTD. (APSCL)

(An Enterprise of Bangladesh Power Development Board)

APSCL

## Certificate

For

Industrial Attachment Training Program

This is to certify that Mr. Mohammad Mijanur Rahaman , ID No. 2008-2-80-014 ,the Student of B.Sc in Electrical and Electronic Engineering from East-West University , Dhaka has successfully completed the Industrial Attachment Training Program held from 24-08-2012 to 07-09-2012. During the training period, he paid due attention to the practical work.

I wish him every success in life.

Manager (HRD)
Ashuganj Power Station Company Ltd.
Ashuganj, B-Baria

# ASHUGANJ POWER STATION COMPANY LTD. (APSCL)

(An Enterprise of Bangladesh Power Development Board)


## Certificate

For

## Industrial Attachment Training Program

This is to certify that Mr. Kaushik Debnath , ID No. 2008-1-80-034 ,the Student of B.Sc in Electrical and Electronic Engineering from East-West University , Dhaka has successfully completed the Industrial Attachment Training Program held from 24-08-2012 to 07-09-2012. During the training period , he paid due attention to the practical work .

I wish him every success in life.

Manager (HRD)
Ashuganj Power Station Company Ltd.
Ashuganj, B-Baria

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We want to thank the Managing Director of Ashuganj Power Station Company Limited (APSCL), Mr. Md. Nurul Alam (P.Engg.) to give us chance to complete our internship at APSCL. We would also like to thank Mr. Md. Luthfar Rahman, Manager (HRD) for his kind cooperation during internship period. We thank our mentor Assist. Engr. Mr. Golam Rabbani, Combined Cycle Power Plant, Ashuganj Power Station. He provided us the practical knowledge of the power plant, without his guidance and help we could not completed our internship. We also like to thank other Engineers and staff of APSCL for their cooperation with us.

We would like to express our best regards to our academic supervisors Dr. Anisul Haque, Professor, and Mr. Mashuque Alamgir, Lecturer, Electrical and Electronic Engineering Department, East West University, Bangladesh. Without the guidance of our supervisors we would not been able to complete our internship report properly. Finally we want to thank our departmental chairperson, Dr. Mohammad Mojammel Al Hakim.

# Executive Summary

Internship provides students the opportunity to test their interest in a particular zone and also provides students high level of practical knowledge. East West University has added this internship program for the graduating students to introduce them to the professional life.

We got an opportunity to complete our internship at Ashuganj Power Station which is the second largest power station in Bangladesh. Our internship started on 24th August, 2012 and ended on 07th September, 2012 which included 105 working hours. There we worked as a team and visited different units of APSCL. We got practical knowledge about power plants and observed the operating system of power plants. There we also got the knowledge of power distribution and maintenance of that plant.

We were assigned to the combined cycle power plant, but we were lucky because during this internship period we got a chance to visit steam power plant, gas engine power plant, substation, water management plant and other auxiliary components of power station. We gathered practical experience about different major components of power station such as diesel engine, compressor, combustion chamber, gas turbine, steam turbine, operation and control unit, cooling system and maintenance procedures of the plants. We gathered practical knowledge about different types of equipment used in the substation of the APSCL such as power transformers, instrument transformers, circuit breakers, relays, lightning arresters, bus-bar, and transmission and distribution system. We learnt about the water management system for all power generating units of ASPSL. Inside the report we described about our experiences at APSCL.

# Training Schedule

Table 1 contains our training schedule at Ashuganj Power Station Company Limited (APSCL). Our internship started on 24th August, 2012 and ended on 07th September, 2012. Our total working hours was 105 hours. We visited combined cycle power plant (CCPP), gas engine power plant, thermal power plant and substation.

Table 1: Training schedule.

| Day | Start/End time | Break time | Mentor | Location | Total hours |
|---|---|---|---|---|---|
| Friday 24/08/12 | 8am-4pm | 1pm-2pm | Engr. Golam Rabbani Assistant Engineer (CCPP) | APSCL | 7 |
| Saturday 25/08/12 | 8am-4pm | 1pm-2pm | Engr. Golam Rabbani Assistant Engineer (CCPP) | Gas engine power plant | 7 |
| Sunday 26/08/12 | 8am-4pm | 1pm-2pm | Engr. Golam Rabbani Assistant Engineer (CCPP) | Substation | 7 |
| Monday 27/08/12 | 8am-4pm | 1pm-2pm | Engr. Golam Rabbani Assistant Engineer (CCPP) | Combined cycle power plant | 7 |
| Tuesday 28/08/12 | 8am-4pm | 1pm-2pm | Engr. Golam Rabbani Assistant Engineer (CCPP) | Water management plant | 7 |
| Wednesday 29/08/12 | 8am-4pm | 1pm-2pm | Engr. Golam Rabbani Assistant Engineer (CCPP) | Combined cycle power plant | 7 |
| Thursday 30/08/12 | 8am-4pm | 1pm-2pm | Engr. Golam Rabbani Assistant Engineer (CCPP) | Combined cycle power plant | 7 |

| Day | Start/End time | Break time | Mentor | Location | Total hours |
|---|---|---|---|---|---|
| Friday 31/08/12 | 8am-4pm | 1pm-2pm | Engr. Golam Rabbani Assistant Engineer (CCPP) | Gas engine power plant | 7 |
| Saturday 01/09/12 | 8am-4pm | 1pm-2pm | Engr. Golam Rabbani Assistant Engineer (CCPP) | Combined cycle power plant | 7 |
| Sunday 02/09/12 | 8am-4pm | 1pm-2pm | Engr. Golam Rabbani Assistant Engineer (CCPP) | Thermal power plant | 7 |
| Monday 03/09/12 | 8am-4pm | 1pm-2pm | Engr. Golam Rabbani Assistant Engineer (CCPP) | Combined cycle power plant | 7 |
| Tuesday 04/09/12 | 8am-4pm | 1pm-2pm | Engr. Golam Rabbani Assistant Engineer (CCPP) | Combined cycle power plant | 7 |
| Wednesday 05/09/12 | 8am-4pm | 1pm-2pm | Engr. Golam Rabbani Assistant Engineer (CCPP) | Combined cycle power plant | 7 |
| Thursday 06/09/12 | 8am-4pm | 1pm-2pm | Engr. Golam Rabbani Assistant Engineer (CCPP) | Combined cycle power plant | 7 |
| Friday 07/09/12 | 8am-4pm | 1pm-2pm | Engr. Golam Rabbani Assistant Engineer (CCPP) | Combined cycle power plant | 7 |

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# Chapter 1: Introduction

## 1.1 Objective of Our Internship

The main purpose of the internship is to merge our academic knowledge with practical knowledge of power station. We took this program to fulfill our academic requirement. We chose a power plant for this industrial training for a close observation of a power plant and application of our academic knowledge in practical field. In our internship, we have focused on generation system, transmission process and maintenance of Ashuganj Power Station Company Limited (APSCL). Our main target was to get a complete overview of APSCL.

## 1.2 Introduction to APSCL

Ashuganj power plant was established in 1966 and it has been incorporated under the Companies Act 1994 on 28$^{th}$ June 2000. APSCL is the second largest power station in Bangladesh. This power station is standing on about 263.55 acres land. The installed generation capacity of APSCL is 777 MW. This plant has been playing an important role in the generation of power from 1970.

Geographical position of the power station is very suitable for power generation.

- APSCL is situated near the Titas gas field. Good quality and pressure of Methane gas is available at the power station from the Titas Gas Transmission and Distribution Company.
- APSCL is situated on the bank of the Meghna river. This river also makes the transportation of large equipments easier for this power plant.

## 1.3 Company Profile

Ashuganj power station is much experienced in power generation. The power station is generating power for last few decades and recently the power station has become a limited company. Table 2 shows the profile of APSCL and table 3 shows power generation capacity of APSCL.

## 1.4 Report Outline

In the chapter 1 we have discussed about our internship objective and APSCL. Chapter 2 discussed the gas engine power plant. In chapter 3 we discussed about the substation of APSCL. Chapter 4 is organized with the overview of combined cycle power plant. In the chapter 5 we have discussed about the necessity of water and water management system in

power plants. We have also discussed about the plant maintenance in chapter 6. In the chapter 7 we have mentioned about the thermal power plant. Chapter 8 is concluding chapter. In chapter 8 we have discussed about our improved knowledge about power station and the problems that we have faced during our internship. We have also mentioned some recommendations for the graduating students.

Table 2: Company profile of Ashuganj Power Station Company Limited [1].

| | |
|---|---|
| Name of the company | Ashuganj Power Station Company Limited (APSCL). |
| Corporate office | Ashuganj Power Station Company Ltd., Ashuganj, Brahmanbaria, 3402. |
| Date of incorporation | 28th June 2000. |
| Status | Public Limited Company. |
| Business | Power generation. |
| Installed capacity | 777 MW. |
| Present capacity | 731 MW. |
| Area of land | 263.55 acres. |
| Company website | www.apscl.com |
| Total number of generating units | 9 (6 steam turbines + 2 gas turbines + 1 gas engine). |

Table 3: Power generating unit description of APSCL [1].

| Plant description | Unit no | Unit description | Plant capacity |
|---|---|---|---|
| Plant 1: Thermal Power Plant | Unit 1 and 2 | Two steam units of 64 MW each. | 128 MW |
| Plant 2: Combined Cycle Power Plant | Unit 6, 7 and 8 | Two gas turbines of 56 MW each and one steam turbine of 34 MW. | 146 MW |
| Plant 3: Thermal Power Plant | Unit 3, 4 and 5 | Three steam units of 150 MW. | 450 MW |
| Plant 4: Gas Engine Power Plant | Unit 9 | Gas engine unit of 50 MW. | 50 MW |

# Chapter 2: Gas Engine Power Plant

## 2.1 Introduction to Gas Engine

The gas engine of APSCL has started power generation from 2011. There are 16 generators in the gas engine power plant. Each generates 3.345 MW (maximum), so that the total generation is 53.312 MW. 50 MW can be supplied to the National Power Grid after fulfilling internal requirement of the plant. Unit 9 is the gas engine power plant. The plant uses gas as a fuel. The gas is supplied by Titas Gas Transmission and Distribution Company. This gas contains more than 94 percent Methane. The gas comes through the pipes and maintains high pressure. This gas is cleaned by gas treatment plant. This gas is supplied through yellow colored pipes for easy identification. In the gas engine unit there is a control room used to control over the gas engines. Figure 2.1 shows the control room of gas engine.


Figure 2.1: Control room (left side) and a control panel (right side) of gas engines.

In the control room there are 18 digital control panels for 16 gas engines. Every 8 control panels are controlled by a master control panel. So there are 16 individual control panels and 2 master control panels for the 16 gas engines.

The operation starts from the gas mixture. At first the purified gas comes to the engine through gas line. Then this gas mixes with the air. The percentage of air and Methane ratio is controlled by using a valve called throttled valve. This gas mixture then goes to the compressor. The compressor is used to compress the mixture. The mixture then goes into the combustion chamber through a governor, the induced heat energy from combustion gives the mechanical energy required to drive the alternator. This mechanical energy is used to rotate the generator. Finally at the generator end we get the electrical energy. Individually generated

power from the engines is supplied through a common bus to the substation of this power plant. Then the generated power goes to the step up transformer and transforms the voltage from 11 kV to 132 kV. Afterwards, the power goes to the APSCL switchyard through 132 kV underground cables.

## 2.2 Gas Engine Design

### 2.2.1 Inner Constitution of a Gas Engine

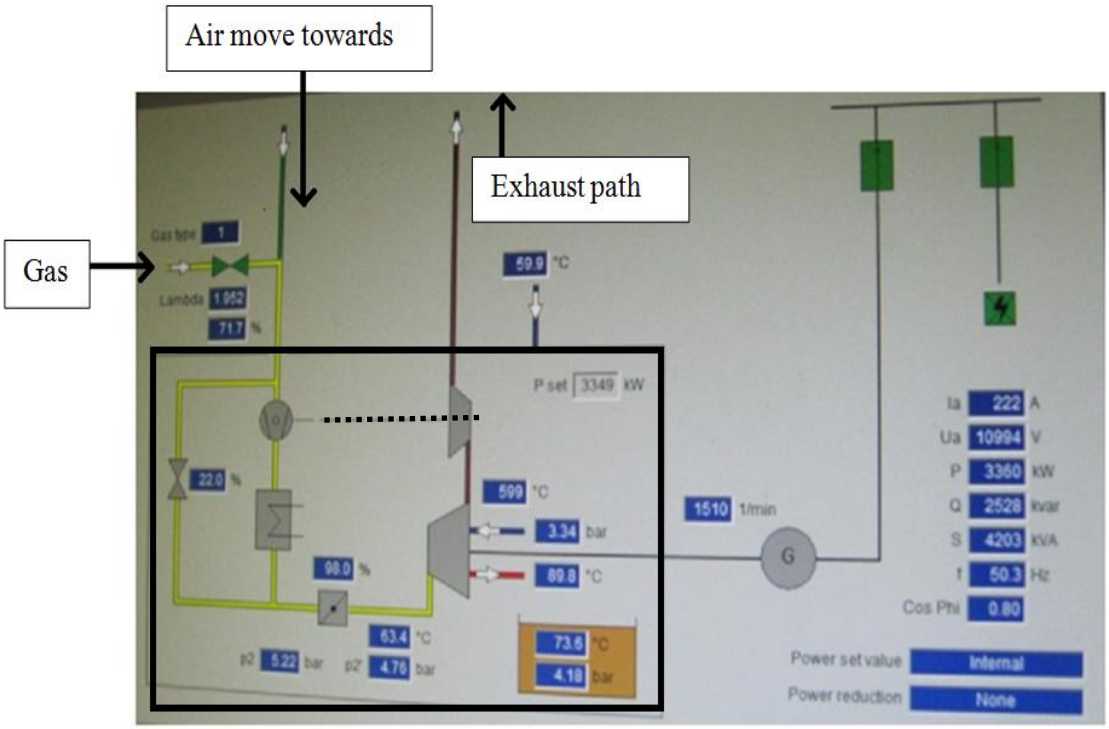


Figure 2.2: The internal schematic view of a gas engine.

Gas, air and the exhaust gas path are shown in figure 2.2 by directional arrows and the black color rectangular box indicating the gas engine components. The dotted line shows the coupling of compressor and additional turbine. The additional turbine is placed in the exhaust path of gas. A generator is placed beside the engine so that the engine can drive the generator. Generator is connected to the turbine through fluid coupling, in which two shafts are coupled using liquid medium to transfer mechanical energy. It is a technology where the turbine shaft rotates fluid (mainly oil) and this rotating fluid rotates the shaft of generator by using a mechanical arrangement. When the turbine rotates the generator also rotates with the same speed as the rotating shafts are coupled. In figure 2.2 the generator's rotating speed is 1510 rpm and the generated frequency is 50.3 Hz. When the rotating speed of a four pole generator is 1500 rpm, then the generator gives exact 50 Hz frequency.

### 2.2.2 Air-Gas Mixer

To make a proper combustion, the methane gas needs to mix with air at a proper ratio. For this purpose, air is taken by a pipe and methane is supplied by another pipe. This gas supplied is controlled by a throttled valve and during full load operation this valve releases 70 percent methane gas. This gas mixing process is called carburetion. Clean air is provided for the carburetion after filtering. Figure 2.3 shows the inhale way of air from atmosphere. The machine which is used for this purpose is called carburetor.

Figure 2.3: Air suction from atmosphere of a gas engine.

### 2.2.3 Compressor

The compressor is a very important part of a gas engine. There is a compressor in the gas engine. Low pressure air gas mixture comes into the compressor and gets compressed. The output end of the compressor is connected to the combustion chamber. The compressed mixture gains a pressure of about 6 bar. Then the gas mixture travels from the compressor end to the flow controlling valve where it drops a little pressure. The pressure rises in the compressor has a higher value than that is required for combustion. The compressor starts at a very early stage of engine start. The first challenge is to run the compressor. During the early starting time of compressor, auxiliary DC supply is provided. The DC power is provided by using DC battery. When the plant starts to generate the power, the auxiliary DC power source is shut down. Then the compressor is driven using the mechanical power from turbo-charger. The turbo-charger is explained in section 2.2.4.

### 2.2.4 Turbo-Charger

Turbo-charger is used to get higher efficiency from gas engine. Figure 2.4 shows the turbo-charger of gas engine. This is a special type of mechanical arrangement of compressor and a

turbine. This technique converts the energy of exhaust gas into mechanical energy and this mechanical energy is used to drive the compressor. Here gas engine is four stroke engine type. The temperature of the exhaust gas from the gas engine is about 500º C. This high temperature gas with a high velocity is able to drive a turbine. So in the outlet path of exhaust gas a turbine is set. The turbine is coupled to the compressor shaft. There is a gear system with the turbo-charger. When the turbine speed is higher than that of the coupled compressor, the auxiliary power gets disconnected.

Figure 2.4: The turbo-charger inside the engine room.

### 2.2.5 Exhaust Outlet Design

The exhaust gas from engines is taken to the common header. There are two common headers each connected to the exhaust pipes of gas engines. Eight exhaust pipes of eight engines are connected with common header. These two common header pipes remove all exhaust gases from system. Figure 2.5 shows an exhaust header pipe. The exhaust gas comes from the turbo-charger which is passed to the atmosphere through these two common headers. These common headers outlet are installed on the roof of power plant, which works just like a chimney.

### 2.2.6 Ventilation Fan

The ventilation fan is used to keep the engine room cool. There are two engine rooms each containing eight engines. When the unit runs, the internal temperature of the engine room gets about 39º C. The temperature difference is about 10º to 15º C between atmosphere and engine room when the ventilation fans are running. There are 4 fans to keep an engine room air circulating with atmosphere. The power required to drive the fan is taken from the generating power of the unit. Only a small portion is used for this purpose. Each fan

consumes 6.8 kW power. There is a multi stage net covering the air incoming path, so that obstructive materials cannot come into the engine room through the fan.

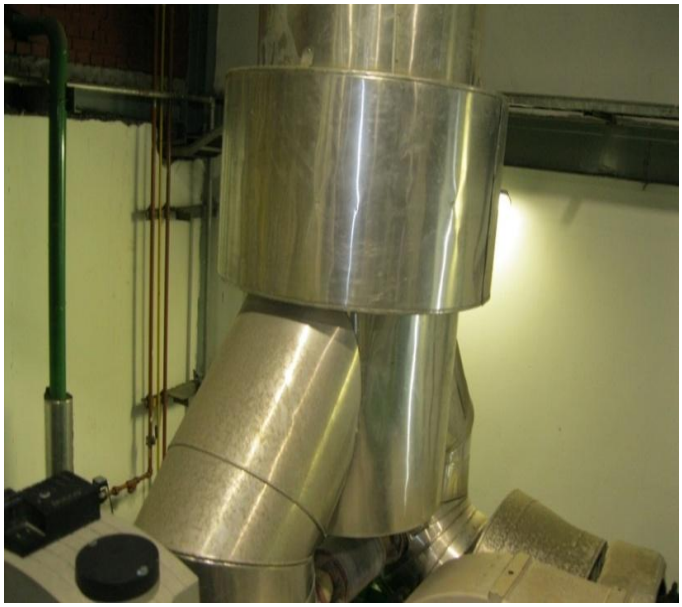

Figure 2.5: Gas exhaust path inside the engine room.

## 2.3 Engine Cooling System

The engine's combustion chamber gets heated due to continuous reaction of combustion. The temperature rise in the combustion chamber is about 1800º C. The outer structure of the combustion chamber also gets heated as a result of combustion. To keep the structure cool a water cooling system is used. It is very important to have a proper cooling system to maintain the efficiency of gas engine. Cool water is used to flow through the outer surface of the combustion chamber. To flow coolant a hollow area is designed inside the engine but outside the combustion chamber. There are two important elements for engine cooling system. These are cooling fan and water pressure vessel.

### 2.3.1 Cooling Fan

When water flows outside the combustion chamber, heat energy transfers from the metal to water. Therefore the water temperature rises very quickly. The water is flowing into the engine through a common header carrying cool water and going out from engine into a common header carrying hot water. Hot water is then made cool by using fan. At first, hot water is taken into roof (about 50 ft above from ground) by using water pump. So at the higher elevation the water gets higher potential energy. Then, the water is distributed under many fans. As a result cool water can flow from high altitude at a higher velocity into the engine which is at ground level. Figure 2.6 shows water cooling arrangement of gas engine.

Figure 2.6: Fans in water cooling system of gas engine power plant at APSCL.

### 2.3.2 Water Pressure Vessel

The plant has a water pressure vessel. Cool water comes from the main water reservoir with a certain pressure into the water pressure vessel. During the circulation of water if the pressure inside the engine gets lower than a certain value, the vessel valve is opened and water flows into the common header of water pipes. Figure 2.7 shows the water pressure vessel of gas engine unit.

Figure 2.7: Water pressure vessel.

## 2.4 DC Power Storage

The gas engine requires DC power for different purposes. In case of starting the gas engine we need DC power. The stored DC power is converted into AC power by using inverter. When plant is running, DC power is obtained by converting AC to DC. In the absence of generated power, required power can be provided from DC power storage. There are 24 DC batteries in the engine room, where each can supply 24 V. These are used as standby DC power supply. In the abnormal case, when the grid collapses, the DC power storage has a significant role in any power plant to restart the engines. Figure 2.8 shows two 24 V DC storage batteries.

Figure 2.8: The DC storage batteries inside the engine room.

### 2.4.1 Rectification

For DC power, the gas engine unit uses the auxiliary transformer. Each generator of the gas engine plant gives 11 kV output. Then the power is taken from generator to the control panel. Next by using step down transformer, the voltage of the generated power is taken to 400 V and 230 V AC. Afterwards, AC power is converted into DC power by using rectification panel. In the gas engine rectifier panel, bridge rectifier is used for rectification. The diodes of the rectifier are thyristor type. Then 120 V DC and 24 V DC power is used in some auxiliary purpose of gas engine power plant.

### 2.4.2 Battery Charger Control Panel

The rectified DC power is used to charge the battery. The rectified DC comes into the battery charger control panel. Figure 2.9 shows a DC charger control panel. This panel is only used to charge the batteries. The charger always indicates different states of battery charging condition. Digital signals are also sent to the data acquisition system. So a supervisor can check the condition of battery power from a computer.

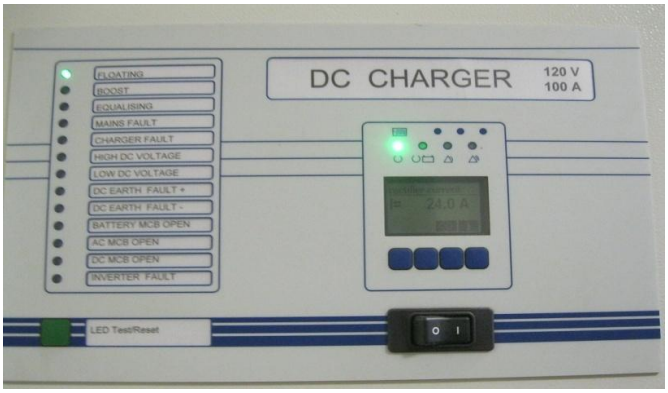


Figure 2.9: DC charger control panel.

The charger is so designed that the battery will start charging if the battery charge gets down from 120.7 V. The charger will automatically stop the charging if the battery power reaches at 127.5 V. There is a miniature circuit breaker (MCB) to protect the DC charger.

# Chapter 3: Substation

## 3.1 Introduction to Substation

Substation is an important part of a power system. The generated electric power from different power plants of APSCL goes to the substation. The substation transmits the generated power to the consumers by a transmission and distribution system. APSCL has its own substation and it's an outdoor type substation. Figure 3.1 shows the switchyard of APSCL. There are lots of equipments in the substation which are used for the protection of generation, transmission and distribution system. In this chapter we will describe the equipments of substation which are used by APSCL.

Figure 3.1: Substation of APSCL.

## 3.2 Components of Substation

Different types of equipments are used in the substation of APSCL. Some of these important components which we have seen in APSCL are described in the following.

### 3.2.1 Isolator

The main function of isolator is to separate high voltage conductors from earth. Isolators are located on both sides of the circuit breaker. Isolators do not have any rating for current breaking or current making. Isolators are interlocked with circuit breakers. The failure of a single isolator can cause the shutdown of a distribution line, which can cause disruption of power.

### 3.2.2 Lightning Arrester

Lightning arrester is a device which is used in power station to protect the transmission line and substation equipments from over current and voltage. Lightning arrester is also called

surge arrester [2]. Mainly six types of lightning arresters are used in outdoor type substations. These are as follows.

- Metal oxide lightning arrester,
- Rod gap lightning arrester,
- Horn gap lightning arrester,
- Expulsion type lightning arrester,
- Valve type lightning arrester.

In APSCL, Horn gap lighting arrester, Rod gap lighting arrester and Metal oxide (Zinc oxide) lighting arresters are used. The incoming transmission line of switchyard first comes through a lightning arrester. At substation of APSCL lightning arresters are also installed with different equipments such as power transformers and circuit breakers. Lightning arrester has two terminals, one is high voltage terminal and another is ground terminal. Under the normal condition it does not work but when high voltage or thunder surges on the system then lightning arrester provides a low resistance path for transferring this high voltage to the earth. There is a counter with each lightning arrester, where it counts the number of lightning on this device. Figure 3.2 shows a counter situated under a lightning arrester.

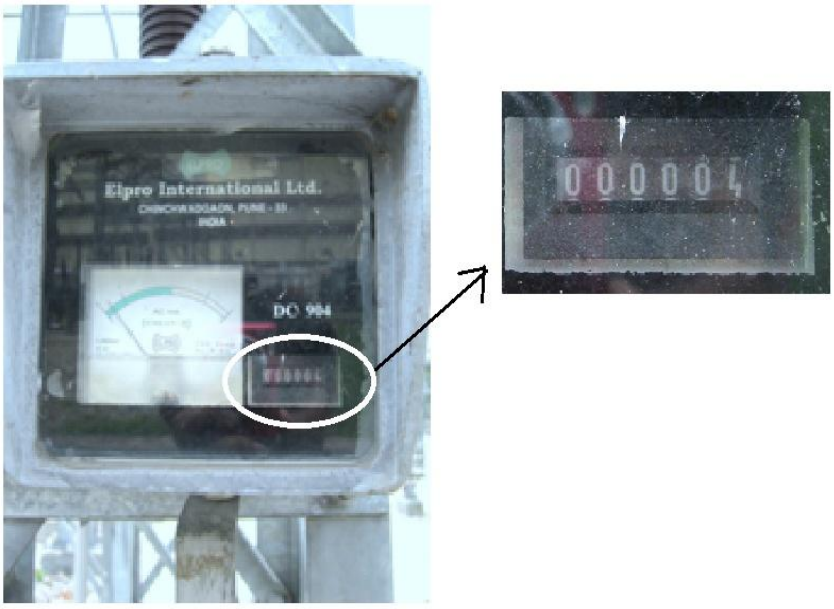


Figure 3.2: A counter under lightning arrester.

### 3.2.3 Bus Bar

Bus bar is an important element in the substation. It's an electrical conductor that helps to make a common connection between several circuits [3]. The maximum amount of current that flows through bus bar depends on the cross sectional area. Solid copper bus bars are used

at APSCL and the diameters of these bus bars are about 50 mm or more. Three types of bus bar designs are available. These are as follows.

- Single circuit,
- Double circuit and
- Ring circuit bus bar.

Double circuit bus bar is used in APSCL substation.

### 3.2.4 Transformer

Transformer is used to convert voltage or current. In substation it helps to step up or step down voltage for transmission or distribution of power. Mainly two types of transformers are used in the substation of APSCL. These are – power transformer and instrument transformer.

**1. Power Transformer**

High power ratings transformer is called power transformer, which is generally used in high voltage power transmission network. The power transformers of APSCL are commonly step up transformer. From the generators of different power plants we get different types of voltages. These are transformed as follows.

- 11 kV to 132 kV (generated from gas engine power plant, Unit 9),
- 11 kV to 132 kV (generated from thermal power plant, Unit 1 and 2),
- 13.8 kV to 132 kV (generated from combined cycle power plant, Unit 6, 7 and 8),
- 15.75 kV to 132 kV and 15.75 kV to 230 kV (generated from thermal power plant, Unit 3, 4 and 5).

Generated voltages are transformed depending on the power demand using step up transformer for long distance transmission. Three phase power transformer is used for this purpose. Table 4 shows ratings of a step up power transformer used in combined cycle power plant.

Table 4: Power transformer ratings of combined cycle power plant.

| Parameter | Value |
|---|---|
| High voltage side | 132 kV |
| Low voltage side | 13.8 kV |
| Rated power | 76 MVA |
| No of phases | 3 |
| Primary side connection | Δ |
| Secondary side connection | Y |

## 2. Instrument Transformer

In substation, bus bar and other lines carry high current and high voltage but our measuring equipments are operating on low voltage and low current. So to protect these from destruction, we need to use instrument transformers. Current transformer and potential transformer are two types of instrument transformers. These instrument transformers supply the required current and voltage which is essential to operate those measuring and protection of equipments.

**Current Transformer:** Current transformer helps to transform current from higher to lower value, which means that current transformer steps down current to a required ratio. Current transformer is connected in series with the system. In substation we can easily identify current transformer because current transformer is connected in series. There are many current transformers used for the measuring purpose. During our internship we have visited 132 kV transmission lines where we observed a current transformer with the ratio, 800:1. It means if primary current is 800 A then secondary current will be 1 A. Its burden is 30 VA. So the load connected to the secondary side should be under 30 VA.

**Potential Transformer:** Potential transformers step down voltage for measuring instruments on a required ratio. Potential transformer is connected parallel with the system. As potential transformers are connected across the line, we can identify potential transformer easily in substation. Table 5 shows potential transformer ratings at APSCL. This potential transformer is connected to the 132 kV bus.

Table 5: Potential transformer ratings.

| Parameter | Value |
|---|---|
| Rated voltage | 132 kV |
| No of phase | 1 |
| Ratio | 132000:110 |
| Burden | 60 VA |

### 3.2.5 Relay

Relay is a protective electrical switch which is mainly used for detecting any type of abnormal condition of the system. It provides a signal to the circuit breaker to take steps for that abnormal condition [4]. At APSCL we were introduced to different types of relays which were used in substation. In this section we describe about those different types of relays.

**Distance protection relay**

Distance protection relay mainly depends on the impedance of the circuit. The impedance of the circuit changes when a fault occurs. That time of the circuit is changed. Then distance protection relay calculates this new impedance and determines the approximate location of the fault. By calculating that distance it sends a signal to the circuit breaker for trip of the circuit [5]. It also sends a message of that fault location to the control unit.

**Buchholz relay**

Buchholz relay is a protective switch which is applied in transformers and reactors. Reactor is a device which is made of coil that introduces inductance into a circuit. It is used to eliminate the alternating component of current in long transmission lines and to improve power factor. There is a conservator above the transformer. Conservator is an external oil reservoir [6]. The purpose of this relay is to sense the fault inside the tank and send the signal to circuit breaker for trip of the circuit of the transformer. Usually this relay is full of oil. When high eddy current, over heating or partial discharge occurs within the tank, that time bubbles are formed inside the tank. These bubbles rise through the pipe from tank to conservator. As a result the oil level inside the relay is displaced and activates the alarm.

**Auto re-closing relay**

Auto re-closing relay is generally used in overhead transmission lines. In transmission line when any fault occurs, this relay detects the fault and closes the system for 0.3 second by disconnecting the transmission line. After 0.3 seconds the relay reactivates the line again. If fault is found again during the reactivation time it closes the system once more for 3 minutes. If the fault is present again within these 3 minutes, it closes power supply of that line permanently. It is necessary to remove faults to active the relay again manually.

### 3.2.6 Circuit Breaker

Circuit breaker is related to relay. When any fault occurs, relay sends the signal to circuit breaker and circuit breaker helps to remove this fault part from the system. Sometime fault creates arc and circuit breaker helps to extinguish this arc. At APSCL we observed the SF6, minimum oil and air blast circuit breakers [7].

**SF6 circuit breaker**

At APSCL, SF6 circuit breakers are used with 230 kV bus bars. This circuit breaker consists of sulfur-hexafluoride gas. Sulfur hexafluoride (SF6) is an inert gas which has a good dielectric and arc extinguishing properties [7]. This dielectric property is much higher than air, so SF6 breakers can operate very quickly. This breaker can trip the circuit breaker within half cycle (10 ms). Figure 3.3 shows a SF6 circuit breaker at APSCL.

**Minimum oil circuit breaker**

At APSCL minimum oil circuit breakers are used with 132 kV bus bars. This circuit breaker uses less amount of oil comparing to oil circuit breaker. This circuit breaker uses dielectric oil for arc extinction. Normally current carrying contacts are separated under oil, so when arc creates the heat, the arc decomposes the oil and creates gas [8].

Figure 3.3: SF6 circuit breaker of APSCL switchyard.

**Air blast circuit breaker**

At APSCL air blast circuit breakers are used with 132 kV bus bars. Air blast circuit breaker was installed in APSCL in early life of the power station. Air blast circuit breaker is also called compressed air circuit breaker. High compressed air is supplied on the arc by a nozzle at the time of contact separation. For this air blast circuit breaker needs an auxiliary compressed air system to supply the air. Compressed air helps to remove ionized medium near the contact. Compressed air chamber fills up again with high pressurized air after extinguishing an arc [9].

## 3.3 Transmission Line

In power station we produce electric power and we need to supply this power to consumers. Transmission line is a medium by which we can supply electric power from one place to another. We can transmit this power by 2 ways. One is underground cables and other is overhead lines. Underground system is much expensive then overhead line. So it has limited use for distribution in congested area where safety and good appearance are the main consideration. Over head lines are more popular. At APSCL we observed 3 types of

transmission lines.

- 33 kV transmission lines used to transmit power to local area near the APSCL.
- 132 kV transmission lines used to transmit power to national grid.
- 230 kV transmission lines used to transmit power to national grid.

## 3.4 Communication Systems on Substation

At APSCL there is a control room in substation. From this control room a supervisor can control many important parts of switchyard. For the communication purpose APSCL uses different communication methods. These are as follows.

### 3.4.1 Power Line Communication

Power line communication is a technology by which we can deliver high speed voice, data, and video over existing power transmission line. APSCL uses narrow band power line communication system. This system works at 10-30 kHz. This method is used to communicate from the substation and by using repeaters, signal can be extended. This system is cost effective.

### 3.4.2 Wireless Communication

In order to access information from substation we use wireless communication technique for grid construction or maintenance. There are lots of techniques available at present. At APSCL, radio frequency is used by which the whole area can come under a wireless communication system. This wireless communication is mainly used when we need to communicate from control room to repairing area.

# Chapter 4: Combined Cycle Power Plant

## 4.1 Introduction to Combined Cycle Power Plant

It is a power generating system where a gas turbine produces electricity and the exhaust of this gas turbine is used to run steam turbine and produce electricity. Here two types of turbines run at the same time by using one common fuel supplying system. So this is called combined cycle. It is a popular system for producing electricity because of higher efficiency and cost effectiveness. For this reason APSCL has a plan of setting up another combined cycle power plant in this year. Figure 4.1 shows two gas turbine units (GT1 and GT2) and one steam turbine unit (ST1) of combined cycle power plant. The present capacity of combined cycle power plant of APSCL is shown in table 6. The combined cycle power plant of APSCL consists of three units. These are as follows.

- Two gas turbines units,
- One steam turbine unit.

Table 6: Power generation capacity of combined cycle power plant of APSCL.

| Plant description | Maximum capacity | Present capacity |
|---|---|---|
| Gas turbine unit-1 | 56 MW | 40 MW |
| Gas turbine unit-2 | 56 MW | 40 MW |
| Steam turbine unit | 34 MW | 20 MW |
| Total combined cycle power plant | 146 MW | 100 MW |

## 4.2 Turbine Units

There are two gas turbine units and a steam turbine unit installed at the combined cycle power plant.

### 4.2.1 Gas Turbine Unit

In the gas turbine unit there is a gas turbine. The gas turbine gives the mechanical energy. A continuous combustion process produces hot gas. The hot gas drives the gas turbine. The mechanical energy of turbine is used to generate electrical energy.

The size of the gas turbine unit is much smaller than the steam turbine unit. Because gas turbine unit does not need any kind of boiler like steam turbine unit. Gas turbine unit startup

time is much faster compared to the steam turbine unit. The maintenance cost of gas turbine unit is low comparing to the steam turbine unit because gas turbine unit design is much simpler.

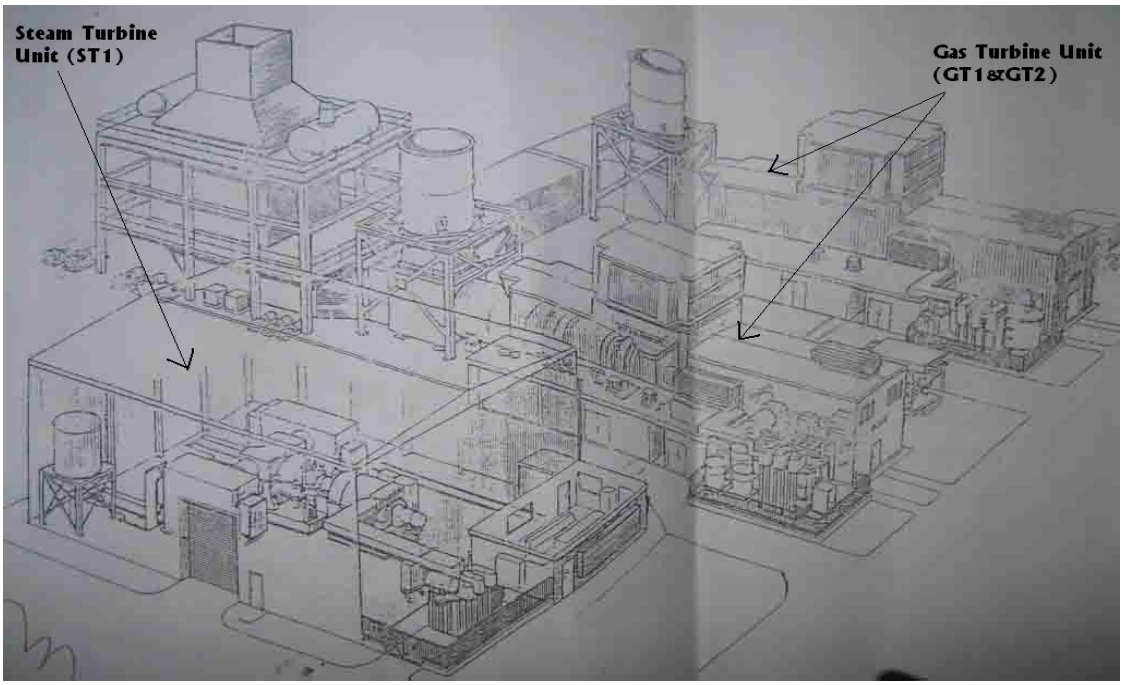


Figure 4.1: Combined cycle power plant design view.

There are three most important components of gas turbine unit. These are as follows.

- Generator,
- Turbine,
- Compressor.

They are placed on the same axis with coupling among these. Fluid coupling technique is used in all coupling sections. Fluid coupling is a technology where the turbine rotates a fluid (mainly oil) and this rotating fluid rotates the generator. The compressor of gas turbine unit takes air from air filter which is attached to the compressor. The air filter can filter out 0.1 µm particles in air. There is a diesel engine used to rotate the common shaft at the beginning when the plant starts. A digital tachometer is used as speed sensor. A comparator is used to compare the input and the output speed of an auxiliary engine coupling.

When the combustion starts, the speed of the common shaft starts to increase. Air-fuel controller is used to control the combustion, which usually controls the flow of fuel. The diesel engine is disconnected automatically (at 1800 rpm) when the common shaft speed is more than the diesel engine driving speed.

There is a lubricating oil tank used to supply oil at different bearing. The lubricating oil creates force at different bearings at the beginning, when the common shaft starts to rotate. Due to centrifugal force after starting rotation the common shaft goes to center. AC and DC both types of pumps are installed in gas turbine unit. Normally AC pump is used for starting bearing lubrication. After a certain rotational speed in gas engine, fuel is injected to combustion chamber. Spark injection is needed to start combustion. The output of combustion is hot gas. The hot gas drives the turbine. Due to increased kinetic energy of turbine, compressor's rotor shaft speed also increases. As a result compression of air is also increased. As a consequence combustion also increases gradually. The output from combustion end goes into the turbine through the transition pipe. The figure 4.2 shows a transition pipe, opened for maintenance.

Figure 4.2: Transition pipe.

Impulse turbine is used in gas engine unit. When the gas hits the blades of turbine then the turbine rotates and gives mechanical energy. The gas turbine is a composition of nozzles and blades. The nozzles are fixed and blades are rotating. Nozzles only guide the flow of combusted gas and blades help to rotate the impulse turbine. There are 16 stages of nozzles and blades in the gas turbine. Each stage of turbine contains 59 blades. The nozzles and blades are arranged in a manner that a group of 2 stages fixed nozzles placed before a group of 2 stages rotating blades repetitively. Burnt gas first comes to the 1$^{st}$ stage nozzles then hits the 1$^{st}$ stage turbine blades. After that gas moves to the 2$^{nd}$ stage nozzles and these nozzles guide the air flow to the 2$^{nd}$ stage turbine blades. In the same way the gas reaches last stage of blades and exit.

The excitation of rotor starts when rotating speed of turbine reaches to 2200 rpm. It is important for the rotor protection to start the excitation at optimum speed of turbine. If we excite the rotor at low rpm, the inductive reactance will be low and it will act like a short circuit and will damage the rotor windings. When the generator speed becomes 3000 rpm, it will provide 50 Hz frequency. The generator output voltage will be 13.8 kV. A step up transformer is used to transform the potential into 132 kV. The process by which the generated power is sent to national power grid is called synchronizing. When the rotating speed of generator rises to 2900 rpm the synchronizing process also starts either manually or automatically. During our internship period we have seen a synchronizing process, which was for a gas turbine unit. 0.5% voltage variation between grid and supply is allowed according to national load despatch center. An auto synchronizer is used to perform this task easily.

### 4.2.2 Steam Turbine Unit

Steam turbine unit in combined cycle power plant is designed so that the waste gas from gas turbine unit can be used. The exhaust gas temperature from the gas turbine is at about 500˚ C. This heat energy carries the exhaust gas which is used to generate steam at a certain pressure. This steam turbine is capable of generating maximum of 32 MW. No external boiler furnace chamber is used to produce steam. The heated gas comes into the boiler directly from the gas turbine when the plant is in combined cycle mode or directly goes to the atmosphere through the vent when the plant is in open cycle mode. A motor driven gate is used to change the direction of exhaust gas of gas turbine. There is a de-mineralized water storage tank beside the boiler on the ground. This water is used to make steam in the boiler. A boiler feed pump is used to supply the water into boiler. Figure 4.3 show the boiler feed pump.

Figure 4.3: Boiler feed pump of steam turbine unit.

There are two types of evaporators in the steam turbine unit. These are low pressure and high pressure evaporators. Water converts into steam and the steam goes to the steam turbine through a pipe. There is a distance between boiler drum and steam turbine. Before traveling to turbine the steam comes from steam separator through super heater. Finally the steam turbine rotates due to the activity of high pressured steam. The used steam comes from turbine and it is converted into water by condensation because of high cost of de-mineralization. Figure 4.4 shows the condenser of steam turbine unit. In the condenser, water enters into the top side and goes out from bottom side.

Figure 4.4: The condenser of the steam turbine unit.

## 4.3 Plant Starting Conditions

To start the combined cycle power plant some pre-conditions must be satisfied. These are as follows.

- Power supplies should be at certain level:

  The auxiliary power supply is essential to run the unit. The auxiliary powers are taken from the 400 V bus. Different pumps need auxiliary power. The feed pumps needs each of 367 KW power. To run the combined cycle power plant AC and DC auxiliary powers should be prepared before plant starts.

- Steam turbine barring gear should be engaged:

  Steam turbine barring gear rotates the turbine rotor at low rpm when the plant turns off generating power. So in any emergency to shut down the plant, the barring gear can be made active manually or automatically.

- Valve position should be correct for starting:

  After starting the plant fuel should be supplied through the governor in efficient manner. All valves positions either open or close can be accessed manually. The governor valve, lubricant oil valves, water and gas pressure control valves should be on correct position to run the lube oil system, water circulation system properly.

- Trips and instrument air pressure should be right:

  Waste heat recovery unit needs to be run after starting the gas turbine unit. There are trip circuits to control the flow of air compressor unit. All the waste heat recovery unit trips must be well to operate successfully.

- Damper should be closed:

  Damper is used to control the flow of heated gas from gas turbine to steam turbine unit. The damper is needed to be open only when the combined cycle (gas turbine and steam turbine) runs. After the starting of gas turbine unit, the damper is open to run the steam turbine unit.

## 4.4 Significant Components of Combined Cycle Power Plant

The design of gas power plant is much simpler than steam power plant. Here all equipments are in interlock system. So it is important for gas power plant operation to operate its all equipments properly. The important parts of combined cycle power plant are as follows.

- Diesel engine,
- Torque converter,
- Auxiliary gear box,
- Exciter,
- Alternator,
- Compressor,
- Combustion chamber,
- Exhaust system.

### 4.4.1 Diesel Engine

The main purpose of diesel engine is to rotate the shaft until the combustion engine starts. In gas engine power plant combustion engine does not operate at the zero rpm of the shaft. At

1800 rpm shaft gets its own self driven speed. At that time this diesel engine turns off automatically. The capacity of diesel engine is 1400 HP.

### 4.4.2 Torque Converter

The weight of shaft is near about 150 tons. When the plant stops, the inertia of this shaft is too high. At that time if we want to rotate the shaft a heavy stress falls on the shaft. As the result the coupling point of shaft can be damaged. In order to solve this problem, we use torque converter. First diesel engine drives fluid then this fluid drives the shaft. This system is called fluid coupling.

### 4.4.3 Auxiliary Gear Box

In the power system exciter, alternator, compressor, turbine all are operated on a common shaft. Friction can be created at the bearings. So we need to supply lubricating oil at high pressure on those bearings. This lubricating oil helps to shift the primary position of the shaft. Inside the bearing, the shaft lays down when the rotor does not rotate. After starting rotation, the rpm of shaft increases. Lubricating oil helps to rotate the shaft without friction. Auxiliary gearbox supplies this lubricating oil in all bearing points. For this there are two lubricating oil pumps: ac lubricating oil pump and dc lubricating oil pump. Normally ac lubricating oil pump operates and dc lubricating oil pump is for back up. Lead acid battery is used to operate this dc lubricating oil pump. The plant will not operate if both these pumps do not work.

### 4.4.4 Exciter

Direct current is required to energize the magnetic field of the generator and this direct current source comes from an external source which is called exciter. This is important for AC power generating system. This exciter can be of 2 types- brush or brush less. Brush less exciter method is used to transfer the DC excitation to the generator fields.

### 4.4.5 Alternator

Turbine is usually coupled with alternator. Alternator converts the mechanical energy of turbine into electrical energy. 3 phase generator is used for this purpose. In the combined cycle power plant the generator output voltage is 13.8 kV and output power is 55.67 MW. The generator is two poles and rated speed is 3000 rpm.

### 4.4.6 Compressor

For the combustion of fuel we need fresh air. This air is collected by filters and these filters are stored at the high elevation because the air of higher elevation contains fewer particles. These air filters remove particles up to 0.1μm size. Particles of air are dangerous for the blades of turbine, which decreases the life time of the turbine. Then this fresh air heats up and

passes to the compressor. The compressor is used for providing air in an efficient manner to the combustion chamber. Compressor supplies air at high pressure. The axial flow compressor is used in the gas engine of combined cycle power plant. The compressor contains fourteen stages of rotor blades and fourteen stages of nozzles. The compression ratio is approximately 9.5:1. At 13,000 rpm, the engine can compress approximately 433 cubic feet of air per second. At the compressor ends the temperature rises of the air is about 550° F (287.78° C). In this axial flow compressor, each stage increases the pressure of air from the previous stage. A single stage of compression consists of a set of rotor blades and a set of nozzles. Rotor blades are attached to rotating shaft. The nozzles guide the air to flow into the next stage rotor blades at the most efficient angle. This process of air flow has fourteenth stages.

### 4.4.7 Combustion Chamber

Air comes from the compressor during the time when the shaft rotates at 700 rpm. There are 10 combustion chambers. There is a governor to control the supply of air and fuel. Air and fuel comes to the combustion chamber through governor. There is an injector which creates sparks as the result air blast with gas and created high temperature and pressure. Then this burnt gas supplies for the turbine. On combustion time the temperature of the combustion chamber is near about 1000º C. So supply of air over this combustion chamber reduces the temperature of the chamber. The temperature of this air is near about 200º C. If we want to produce more power then we need to supply more fuel to create more combustion.

### 4.4.8 Exhaust System

The temperature of exhaust gas from gas turbine is about 520º to 570º C. This burnt gas of gas turbine is used to run the steam turbine unit. The exhaust gas from gas turbine is passed to the boiler of steam turbine unit through a horizontal axis pipe. When the steam turbine unit is not used to produce electrical power, the burnt gas from gas turbine unit is used to leave into the atmosphere through a vertical pipe. This vertical pipe is connected to a chimney.

## 4.5 Plant Shut Down Procedure

In the case of any emergency, where we need to shut down the combined cycle plant, we need to consider barring system, lubricating oil system, waste heat recovery unit, synchronization with national power grid. For manually shut down the plant, first we need to cut off the power supply from national grid. Next the main fuel supply should be gradually turned off using the governor control. Then, the turbine rpm will start to decrease from 3000 rpm towards 0 rpm. Afterwards, the barring sequences should start when the plant is shut downed. After shutting

down the power generation, only lubricating oil system has to keep active. When the turbine reaches 20 rpm rotation speed than the barring gear has to be engaged with the turbine shaft. Next the turbine shaft has to rotate next 48 hours with 20 rpm. After 48 hours, the turbine shaft needs to be rotated with 1 rpm for the next 24 hours. If the barring sequence fails then the turbine shaft may be damaged.

# Chapter 5: Water Management

## 5.1 Requisite of Water for the Power Plant

Water has significant use in the power plant. In APSCL there are 6 steam turbine units. Together these six units produce about 600 MW. Water is used to generate steam in all thermal power plants, where steam is used in turbine as prime mover. Another application of water is to condensate the steam into water. The condensation is used so that the efficiency of the thermal power plant increases. Water is also necessary for different engine cooling system. At APSCL power plants need large amount of water.

## 5.2 Water Cycle Overview

Water is collected from river and then distributed into different areas. A portion of water is supplied to the condenser of different plants. Another portion of water is supplied to the water treatment plant. Water treatment plant produces de-mineralized water and this water is supplied to the boiler for steam generating purpose in all thermal power plants. De-mineralized water is also used in gas engine plant for cooling purpose.

## 5.3 Collection of Water

The plant is situated on the bank of the river, Meghna. Water is collected from this river. Meghna is formed inside our country by the joining of different rivers originating from the hilly regions of eastern India and the river ultimately flows into the Bay of Bengal. The river's average depth is 1,012 feet (308 m) and maximum depth is 1,620 feet (490 m). So Meghna is a great source of water for the power station. First water gets filtered and then is pumped with pumps into the water transmission line.

### 5.3.1 Filtering

Water gets filtered at an early stage, when water is coming directly from river containing a lot of small or big particles which are harmful and destructive to the plant. Water filtering is a multi stage process. At first, river water comes to a gate. The gate filters the water and removes the unwanted particles. Next water goes through another filter, which filters out smaller particles in water.

### 5.3.2 Pumping by Motors

After filtering, clean water comes to pump. There are four pumps each consuming 2.6 MW power. The rated voltage for these pumps is 6.6 kV. The maximum water pumping capacity of each pump is about 36,000 tons per hour. At a time three pumps keep running. In the case of

failure of any one pump, the fourth one will start to keep the water supply. Figure 5.1 shows a water pump.

Figure 5.1: Water pump of APSCL to collect river water.

## 5.4 Distribution of River Water

The filtered water comes into transmission line through water pumps. Next, water goes into condenser and water treatment plant through pipes.

### 5.4.1 Supply to Condenser

A large portion of water goes to the condenser. About 90,000 tons of water per hour is used for condensation purpose for all thermal power plants. The steam temperature is about 48˚ C when steam comes into condenser. The water takes the heat energy from the steam. From the condenser end the water comes out with higher temperature. Outgoing Water temperature is almost 44˚ C. Water then goes back to the river through the drains.

### 5.4.2 Supply to Water Treatment Plant

A portion of water is supplied to the water treatment plant. The water treatment plant has a significant role in thermal power plant. Natural water contains minerals and these mineral particles are harmful for the steam turbine. A water treatment plant removes these unwanted minerals from water. Figure 5.2 shows the water treatment plant of APSCL.

The process by which the dissolved gas is removed is known as water de-mineralization. The de-mineralized water is used for steam generation purpose.

Figure 5.2: Water treatment plant of the APSCL.

# Chapter 6: Maintenance

## 6.1 Common Shaft Alignment

Shaft alignment means installation of the shafts of motor and pump on right position. It is an important operation because misalignment of the shafts can reduce the life time of the plant. We need to keep the shafts of motor and pump on straight line position. But if the positions of shafts are changed then bearing part will not get the rotating force uniformly. As a result bearing and shaft can be damaged. Misalignment increases friction of shaft and makes it harder to turn and the drive motor has to draw more power where maintenance can shoot up. This can reduce the life time of a machine. On the other hand, these are not easy to replace. If we want to change bearing we need to turnoff our motor which is a time consuming process. So we need to align our motor with pump perfectly. For this we need to keep fixed either of these. Normally pump is kept fixed and we try to align the motor with the pump.

There are 3 methods of this alignment. These are as follows.

- Feeler gauge method,
- Dial indicator method,
- Laser beam method.

### 6.1.1 Feeler Gauge Method

Feeler is the easiest and least expensive method for doing alignment. Normally this method is used for very small pump or motor combination where there is not enough room to use other alignment methods. In this method first we need to fix the position of motor or pump. Then we need to reduce the vertical misalignment between pump and motor. The pump position is kept fixed in this type of alignment. We can shift upwards any shaft by placing some thin steel plates under the shaft that we are going to fix. This thin steel plate is called shim. The inserted shims can be removed to move the shaft poison downwards.

### 6.1.2 Dial Indicator Method

Dial indicator method is also called rim-face method. For this type of alignment we need 3 dial indicators (1 rim and 2 faces) and one plunger. The plunger is a spring loaded element that is used to rotate a dial’s needle clockwise and counter clockwise. The plunger moves a needle clockwise when pushed in and counter clockwise when let out. In this method dial indicators are placed in the coupling point of motor and pump. Three dial indicators, one rim and two faces, are placed on the motor shaft. Rim measures the offset position of the shafts and faces measure the shaft’s angularity.  From the reading of dial indicators the alignment is

done. Then shims are placed under the motor to reduce vertical displacement. Our main concern is to reduce error as much as possible. It is difficult to maintain 100% accuracy in the alignment. Only ±2% error is acceptable in dial indicator method. Figure 6.1 shows an arrangement of dial indicator method.

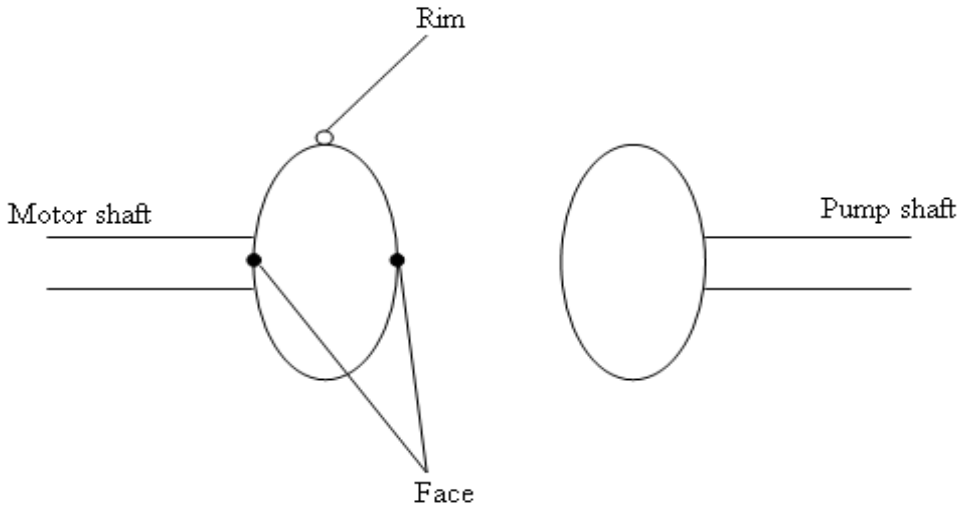


Figure 6.1: Dial indictor method.

### 6.1.3 LASER Beam Method

LASER beam method is the latest technology for alignment. In this system we first remove the coupling point then place LASER beam on motor shaft and a reflector is placed on the pump shaft. LASER ray goes to the reflector and after reflection receiver receives that data. Then we rotate those shafts 180º and take data again. The data is analyzed by the computer and we can get our error of motor shaft's position. Then by using shims we can reduce that error. Figure 6.2 shows an arrangement of laser beam method.

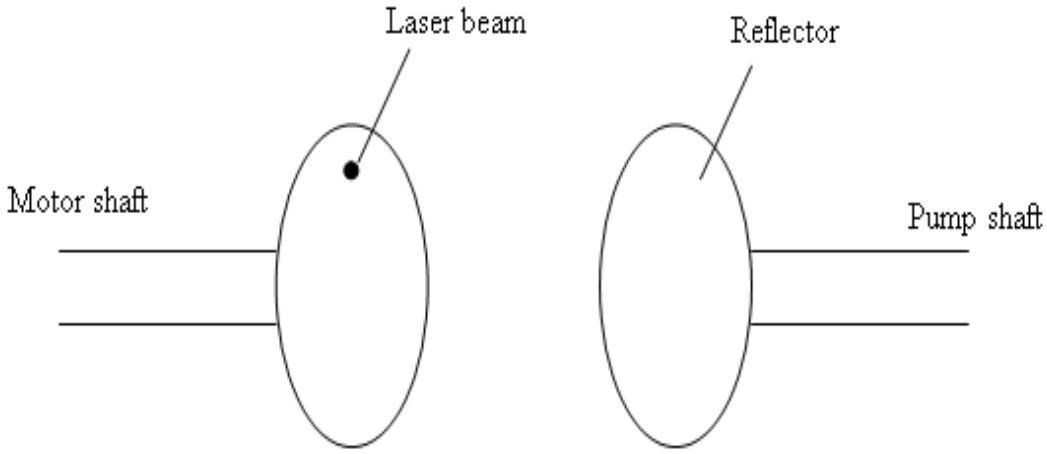


Figure 6.2: LASER beam method.

## 6.2 Megger Test (Insulation Test)

Megger test is done to check the insulting property of a device. Megger insulation tester is small portable equipment that can give us the reading of insulation. A good insulator's value always stays in mega ohm range. Moisture or foreign particles can create a path with lower resistance on the surface of insulator. As a result leakage current flows by that path.

## 6.3 PI Test of Instrument Transformer

PI test means polarization index test and this test is only for current and potential transformer. In switchyard each current or potential transformer faces this test twice a year. It means the ratio of 10 minutes insulation resistance to 1 minute insulation resistance of current transformer or potential transformer. The instrument transformer is said to be good if the experimental ratio is 1.5 or more.

## 6.4 Rotor Eccentricity

Rotor eccentricity means the abnormal condition formed by expansion of blades of turbine's rotor. From combustion chamber burnt gas comes to turbine to rotate the rotor. The temperature of this gas is too high, near about 1000º C. When this gas comes inside the turbine, it heats up the blades of turbine and the casing of turbine. But casing and blades temperatures are not the same so rate of increase in volume are not also same. The manufacturer of turbine provides a guideline to handle this situation. At the start we should do not provide the maximum heated gas to the turbine. We should heat turbine slowly otherwise, blades will heat up quickly. As a result turbine's blades will be larger and there will not be any gap between blades and case. These conditions can create an accident. On the other hand if turbine's case heats up more quickly than the blades, then the size of case will be larger and will create leakage. Burnt gas can go outside through this leakage. To avoid this unwanted problem we need to follow the rpm–temperature ratings of turbine. In the table 7 the turbine operation duration at different rpm is shown.

## 6.5 Vibration Monitoring

For maintenance sometimes it is needed to remove the blades of turbine and later if these blades are not installed perfectly, it can create vibration. For monitoring this vibration, engineers use radial vibration cobs which are used on both sides of the bearing point of the turbine shaft. For each bearing it needs to use two cobs and the angle between these cobs is 90º. If this angle is less or more than 90º, cobs will not work properly. Rotating cobs give us the measurement of mass unbalance, miss alignment of shaft and crack of the shaft. Here all

readings are observed on a proxy meter and this proxy meter connects with the rotating cobs through a cable. The name of this cable is 90 ohm extremis cable and the diameter is 8 mm.

Table 7: Rpm-temperature ratings of combined cycle power plant at APSCL.

| Procedure | Temperature | Rpm | Duration in minutes |
|---|---|---|---|
| Cold start | 100° C | 500 | 20 |
| | | 1500 | 40 |
| | | 2800 | 10 |
| | | 3000 | 10 |
| Warm start | 275° C | 500 | 10 |
| | | 1800 | 30 |
| | | 2800 | 10 |
| | | 3000 | 5 |
| Hot start | 350° C | 500 | 15 |
| | | 1500 | 20 |
| | | 2700 | 5 |
| | | 3000 | 10 |

# Chapter 7: Thermal Power Plant

## 7.1 Introduction to Thermal Power Plant

Thermal power plant is one of the most important power sources for our country. At present almost 45% of our national generation comes from thermal power plant. Thermal power plant converts heat energy of fuel combustion into electrical energy. In the thermal power plant a boiler converts water into steam at high temperature and pressure. This steam passes through turbine and helps to rotate turbine. Turbine is coupled with alternator. An alternator coverts mechanical energy of turbine into electrical energy. At APSCL there are 9 power generating units and among them 6 are thermal power units. The total capacity of thermal power plant is 578 MW. Figure 7.1 shows a boiler section of a thermal power plant.

Figure 7.1: Thermal power plant.

## 7.2 Major Parts of Thermal Power Plant

The aim of the thermal power plant is to convert the heat energy into electrical energy. In thermal power plants some major instruments are required to fulfill this energy conversion. In this section we will discuss some major parts of thermal power plant.

### 7.2.1 Low Pressure Heater

Low pressure heater heats feed water by the use of the steam which comes from low and intermediate pressure turbine through extraction lines or tubes. Feed water is pumped from

the hot well by condensate extension pump (CEP) into the LP heater. First water comes to low pressure heater, this heater is used to increase the temperature of water. It is divided in two parts LP1 and LP2. At first water comes to LP1 at 8 bar pressure and at that time the temperature of water is near about 45° C and then it moves to LP2 and there the temperature rises up to 160° C.

### 7.2.2 Boiler Feed Pump

A boiler feed water pump is a particular kind of pump which is used to pump feed water into a steam boiler. Boiler feed pump is used to feed water to steam generator boiler drum at desired pressure and temperature. Water goes to feed water tank at low pressure. The total capacity of this feed water tank is near about 172 tons. From this tank water goes to boiler through the economizer. Economizer is a device which is used to increase the temperature of water more before going to boiler by using the temperature of exhaust gas. This exhaust gas flows into the economizer before departure into the environment. Inside the boiler the pressure is about 140 bar so we need to force high pressure to supply water inside the boiler. By using feed pump, we can apply 155 bar pressure so that water moves easily to the boiler.

### 7.2.3 Boiler

The heat of combustion gas is utilized to convert water into steam. At APSCL 3 levels of boilers are used and each contains 3 burners. By these burners we heat up water inside the tube as the result the water inside the tube converts to steam. According to the relative position of hot gases and water boiler is of two types. These are as follows.

- Fire tube boiler,
- Water tube boiler.

In the fire tube boiler, hot gas flows through the tubes inside the water container. In the water tube boiler water flows through the tubes and hot gas flows over the tubes. Water tube boiler is used in the thermal power plant of APSCL. The properties of a water tube boiler are shown in the table 8.

## 7.3 Steam Generating Procedure

Boiler is the main part for producing steam. The operating system of the boiler is complex. There are several necessary steps before operating the boiler. Here we have explained the procedure.

Table 8: Properties of a boiler in thermal power plant.

| Parameter | Variable |
|---|---|
| Maximum evaporation capacity | 500 ton per hour |
| Maximum allowable steam pressure | 171 bar |
| Normal working pressure | 138.5 bar |
| Normal working temperature | 523° C |
| Feed water temperature | 246° C |
| Boiler type | Single drum |

### 7.3.1 Removal of Old Gas

After burning gas some old burnt gas remains inside the burner of boiler. This gas does not help to burn new gas properly. Without removing this old gas inside the burner, if we start burning new gas, burner can be exploded. So we need to remove old gas from the burner of boiler. By supplying the flow of air, we can remove this gas. This system is known as purging system.

### 7.3.2 Leakage Test of Gas Pipes

Before operating the boiler we need to perform leakage test of gas pipe line. If there is any leakage on the pipeline, through that leakage gas can come outside. For this leakage test, first we need to fill up pipe with gas and then stop valves of both sides to check the pressure inside the pipes for 10 minutes. If pressure falls down, that means leakages exist on pipes. We need to find out those leakages and fix those. If pressure remains constant that means there is no leakage on pipes.

### 7.3.3 Operation Inside the Burner

After testing leakage we will get a signal from the control room of thermal power plant, this means boiler is ready to operate. There are 9 burners inside the boiler but first we will operate 1 burner. Air pre heater heats up the air and then supplies it to the burner and through the inlet pipe gas will come to the burner. Injector creates spark as a result gas starts burning inside the burner. Figure 7.2 shows the looking glass of the burner of the boiler furnace chamber.

There is a flame detector with each burner. By using this detector operator receives a message signal into the control room. But manually, it needs to be checked whether burner is running or not because sometimes incorrect message also can be received by operator in control room. During that time gas is stored inside the burner and this gas contains high temperature

and pressure, so burner can explode because of high temperature and pressure. There are 6 gas pipe lines with each burner. At first 2 pipe lines are open and start burning gas because the temperature of the burner is normal. It is essential to increase the temperature of burner slowly. If 6 gas pipe lines are opened at the same time then the temperature inside the burner will increase rapidly. Burner can damage with the sudden change of temperature. To avoid this damage, operators need to check the water tubes and other functional conditions. The burner will start only if all conditions are satisfied and fulfilled. 5 to 9 burners run at a same time, but it depends on the load demand. Inside the burner, the temperature is near about 1200° to 1400° C.

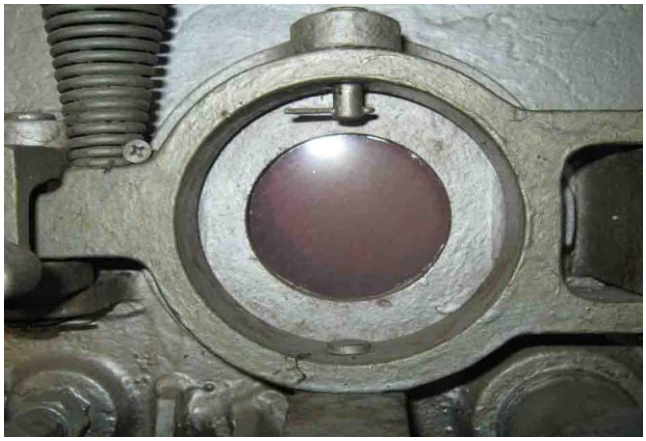

Figure 7.2: Burner view glass.

## 7.4 Steam Drum

Drum is one kind of container where the steam is stored after producing steam. The burning gas creates high temperature in the boiler. The thermal energy is transferred into water. As a result hot water inside the tube is converted into steam. Steam is lighter than water so it goes to top and it is stored inside the steam drum. There is a separator inside the steam drum, which separates water and steam. Inside the steam drum the temperature is near about 340° C. Inside the burner we burn gas continuously so steam is also produced continuously.

## 7.5 Heaters

Inside the thermal power plant there are different types of heaters which are used to increase the temperature of air, water and steam. Here in this section we will explain about these heaters.

### 7.5.1 Air Pre-Heater

Air pre-heater is used to increase the thermal efficiency of steam turbine power plant. At first, air is collected from environment by using a pump. This collected air is transferred to the

furnace chamber through the air pre-heater [10]. In the air pre heater, air gets thermal energy from the flue gas. Flue gas is the burnt gas of boiler. The heated air increases the efficiency of combustion. So the boiler steam generation efficiency also increases.

### 7.5.2 Super Heater

The steam of steam drum is wet, so it passes through super heater. In super heater steam is dried and super heated. Super heater has 3 parts. They are super heater 1, super heater 2 and super heater 3. First steam comes to super heater 1 where the temperature rises up to 370° C. Then steam goes to super heater 2 where temperature rises up to 480° C and finally it comes to super heater 3, here steam gets heated to 530° C. At this time the pressure of steam is 135 bar. Super heater helps to increase overall efficiency of boiler.

### 7.5.3 Low and High Pressure Heater

There are two low pressure heaters (LP1 and LP2) and two high pressure heaters (HP1 and HP2). Almost 400 tons condensate steam from turbine moves to low pressure heater every hour. First water comes to low pressure heaters and then goes to high pressure heaters. Low pressure heaters can develop temperature around 160° C and High pressure heaters can develop temperature around 250° C.

## 7.6 Turbine

Turbine section can be divided into 3 parts. These are high pressure turbine (HP) and inter mediate pressure turbine (IP) and low pressure turbine (LP). From heater steam comes to HP turbine and after rotating this turbine the temperature and pressure of exhaust steam falls down. The temperature is near about 300° C and pressure is near about 30 bar. Then the steam goes to the IP turbine. Before going to IP turbine the steam needs to be heated again. For this reason we need to supply steam to heater again and increase temperature to 530° C. This high temperature steam is supplied to IP turbine. From IP turbine the steam goes to LP turbine. After rotating these turbines steam moves to condenser. Steam rotates turbines at near about 3000 rpm and these turbines rotate generator and produce electricity.

## 7.7 Condenser

The exhaust steam of turbine moves to the condenser when the temperature of steam is near about 45° C. River water from water treatment plant is supplied to the condenser, which is the main resource of this condenser. River water removes the latent heat of the steam. As a result we get de-mineralized water and this water again use in the thermal power plant. For this reason it is called a closed cycle system.

# Chapter 8: Conclusion

It was a great opportunity for us to complete our internship in Ashuganj Power Station Company Limited (APSCL). APSCL is the second largest power plant in Bangladesh. APSCL is playing an important role in producing power for the nation and thus contributing to the country's economy. The authorities of APSCL are very considerate about all kinds of safety and security of that power plant. There we spent fifteen days and experienced a lot of things during our internship program under a friendly environment which encouraged us to learn more things about the power plant and its power system. At APSCL, we also observed the working environment and their official activities. The power plant is a combination of mechanical and electrical engineering, so both mechanical and electrical engineers are working at APSCL. Within this short period of time, we tried our best to acquire knowledge about steam, gas, and combined cycle power plant. We managed to gain practical knowledge about some major equipment of all these power plants. We also learned about the transmission and distribution system of power station. The theories that we have learned at the university could be observed at APSCL. We hope that this experience will extend our knowledge effectively and provide us best future in the field of power sector.

## 8.1 Problems

We faced some problems during our internship. The problems are given below.

(a) Practical participation (meaning hands-on experience) in different works of APSCL would give us more experience but practical participation was not allowed for internship students.

(b) We faced some problems in understanding the mechanical arrangement of power plant components.

(c) Sometimes we could not collect our necessary data or information due to privacy policy of administration.

(d) On that short period we wanted to have a good knowledge on combined cycle power plant. But during our internship period a gas turbine unit was under maintenance and our mentor sent us to different sections of APSCL.

## 8.2 Recommendations

We found a very good practical learning environment at APSCL. Some recommendations are given for the students who want to do their internship program.

(a) The internship program should be scheduled in such a way so that it does not clash with the university classes.

(b) Students must complete the courses related to their internship before beginning the program. Completing the related courses before the internship helps the students to understand the topic better.

(c) During training period there may be any fault in the general activities of power plant. It is necessary to learn about fault and how the engineers repair the faulty part. Students should visit that faulty section and should try to get a brief lecture on that fault from their mentor.

# References

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[10] V.K. Mehta and Pohit Mehta, "Generating Station" in *Principles of Power System*, 4th ed. New Delhi, India: S. Chand and Company Ltd, 2011, p.12.

# Appendix

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: | Ashuganj Power Station Company Limited. |
| Name of the student: | Mahafuzur Rahman |
| ID: | 2009-1-80-008 |

| | |
|---|---|
| Date: | 24/08/2012 |
| Start time/End time | 8am to 4pm, Break (1pm-2pm) |
| Location: | Unit 1 to Unit 9, Substation |
| Mentor: | Golam Rabbani |

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)

The objective of the day's
was to visit the Different Power plant
(Generation unit) of APSCL.

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. Visit to Unit 1 (Thermal plant, 64 MW)
2. Visit to Unit 2 (Thermal plant, 64 MW)
3. Visit to Unit 1, 2 and 3 (All are thermal plant with capacity each of 150 MW)
4. Visit to Unit 6 and 7 (GAS turbine, 56 MW) & Unit (Steam turbine, 34 MW).
5. Visit to substation (Link to 33KV, 132KV, 230KV transmission Line)
6. Visit to Unit 9 (GAS Engine) 53 MW.

By doing this Activities I have learn a overview of APSC

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

I knew about substation, transmissio
line and power ratings from EEE 442 (Switch
Gear and Protective Relays)

24/8/17
Signature of the mentor with date
Name:
Designation:
Contact Phone #: 01820661063

Engr. Golam Rabbani
Assistant Engineer
Combined Cycle Power Plant
APSCL, Ashugang
B-Baria

10.09.2017
Signature of academic supervisor with date
Name: Dr. Anisul Haque
Designation: Professor
EEE Department
East West University
Dhaka, Bangladesh.

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: | Ashugang Power Station Company Limited |
| Name of the student: | Mahafuzur Rahman |
| ID: | 2009-1-80-008 |

| | |
|---|---|
| Date: | 25/08/2012 |
| Start time/End time | 8am to 4pm Breaks (1pm-2pm) |
| Location: | 50 MWatt Gas Engine Plant, Unit-9 |
| Mentor: | Golam Rabbani |

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)

The objective of the day's activities was to
i) Learn about the GAS engine operation.
ii) Learn about the Equipment used on GAS engine Power plant.

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) Theoritical Discuss on GAS Engine.
ii) Operation Mechanism of a GAS Engine.
iii) Discussion on Different's type of equipment used.
- LEANOX (combasion system)
- SCADA (PLC based supervisory control and data acquision.)
iv) Special type of Relay (Buchholz Relay)
By doing this activities I have learned operation of GAS Engine

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

I have studied different types of Relay in EEE442 (switch gear and protection Relays) and I knew the generators Principle

25/8/12

Signature of the mentor with date
Name:
Designation:
Contact Phone #: 01728061063

Engr. Golam Rabbani
Assistant Engineer
Combined Cycle Power Plant
APSCL, Ashugang
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10.09.2012

Signature of academic supervisor with date
Name: Dr. Anisul Haque
Designation: Professor
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Dhaka, Bangladesh

Department of Electrical and Electronic Engineering
East West University
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Daily Activity Report

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| | |
|---|---|
| Name of the company: | Ashugang Power Station Company Limited. |
| Name of the student: | Mahafuzur Rahman |
| ID: | 2009-1-80-008 |

| | |
|---|---|
| Date: | 26/08/2012 |
| Start time/End time | 8am – 4pm , (1pm – 2pm) Break |
| Location: | Switchyard |
| Mentor: | Golam Rabbani |

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)

The objective of the day's was to
i) learn about the substation
ii) and Equipment used on substation.

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) Visited the substation
(ii) Visited the control room of substation.
Equipment ~~use~~ visited :
(i) Circuit Breakers ($SF_6$, MOCB)
(ii) Current Transformers
(iii) Potential Transformers.
(iv) Lightening Arrester. (v) insulators (vi) wave trapper
(vii) 33 KV, 132 KV, 230KV transmission Line.
By knowing the placement of different equipment's I have learned about the substation.

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

I knew most the equipments characteristics from the course EEE442 ( switch gear and Protection Relays).

26/8/12
Signature of the mentor with date
Name:
Designation:
Contact Phone #: 01720061063

Engr. Golam Rabbani
Assistant Engineer
Combined Cycle Power Plant
APSCL, Ashuganj
B-Baria

10.09.2012
Signature of academic supervisor with date
Name: Dr. Anisul Haque
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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: | Ashugang Power Station Company Limited |
| Name of the student: | Mahafuzur Rahman |
| ID: | 2009-1-80-008 |

| | |
|---|---|
| Date: | 27.08.12 |
| Start time/End time | 8am to 4pm Break (1-2pm) |
| Location: | Combined Cycle Power Plant, (Control Room). |
| Mentor: | Golam Rabbani |

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)

The objective of the day's was to -
(i) understand the operation of GAS turbine
(ii) understand different system of GAS Turbine.

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 about various condition to turn the unit (combine cycle power plant)
(ii) Different types of valves to pressure and flow Contr
(iii) Fluid coupling
(iv) Auxilary gear box.
(v) lub oil System.
(vi) DC exitor, filter, compressor, Bearing.

These are part of the system. so By knowing all about this equipment I have developed my knowledge about GAS Turbine power plant.

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

There are many electronics application. Most of them are used for signaling purpose. I have learned from EEE 205 (Digital logic gate

27/8/12

Signature of the mentor with date
Name:
Designation:
Contact Phone #: 01X20061063

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B-Baria

10.09.2012

Signature of academic supervisor with date
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Department of Electrical and Electronic Engineering
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Industrial Training
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| | |
|---|---|
| Name of the company: | Ashuganj Power Plant Company Limited |
| Name of the student: | Mahafuzur Rahman. |
| ID: | 2009-1-80-008 |

| | |
|---|---|
| Date: | 28.08.12 |
| Start time/End time | 8am to 4pm Break (1-2pm) |
| Location: | Water cycle |
| Mentor: | Golam Rabbani |

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)

(i) Water cycle of the plant.
(ii) physical view of the water circulation.

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 Water Cycle.
(ii) Discussion on Condenser (steam to water conversion)
(iii) visited water pumps, (2.5 MW, Three Pumps) two Active
(iv) water Filters
(v) Pipelines.
(vi) Discussion on Dam water (De-mineralized)

By doing these activities I have learned the water circulation system.

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

These activity related with the course PHY101 (Fundamentals of Physics) and I knew about different types of pumps from EEE304.

28/8/12

Signature of the mentor with date
Name:
Designation:
Contact Phone #: 01720061063

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Assistant Engineer
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Signature of academic supervisor with date
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Department of Electrical and Electronic Engineering
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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: | Ashuganj Power Station Company Limited |
| Name of the student: | Mahafuzur Rahman |
| ID: | 2009-1-80-008 |

| | |
|---|---|
| Date: | 29.08.12 |
| Start time/End time | 8am to 4pm Break (1-2 pm) |
| Location: | Control Room of CCPP (Unit-6,7,8) |
| Mentor: | Golam Rabbani |

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)

The objective of the days was to understand the operation of steam Turbine Unit, which is a part of Combine Cycle power plant.

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 stam turbine with the help of schematice Diagream.
(ii) Steam flow on turbine
(iii) low pressure and hiegh pressure evaporator.
(iv) supper Heater, Generator
(v) feed water tank, Make up tank
(vi) Condenser, Different types of pump.

By knowing Differents parts of stem turbine unit I known Steam turbine unit.

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

From the course EEE 304 I know about Generator and pumps. The pressre control By using oil is related to PHY 102.

29/8/12
Signature of the mentor with date
Name:
Designation:
Contact Phone #: 01720061063

Engr. Golam Rabbani
Assistant Engineer
Combined Cycle Power Plant
APSCL, Ashugang
B-Baria

10.09.2012
Signature of academic supervisor with date
Name: Dr. Anisul Haque
Designation: Professor
EEE Department
East West University
Dhaka, Bangladesh

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: | Ashuganj Power Station Company Limited |
| Name of the student: | Mahafuzur Rahman |
| ID: | 2009-1-80-008 |

| | |
|---|---|
| Date: | 30.08.12 |
| Start time/End time | 8am to 4pm Break (1-2pm) |
| Location: | CCPP (combind cycle Power Plant) |
| Mentor: | Golam Rabbani |

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)

The objective of the day's was to
(i) understand of combustion chamber of GAS
(ii) Protection of Circuit Breaker (SF6)
(iii) maintanance of Circuit Breaker

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) Operation of combustion chamber.
(ii) ignator and flame detector.
(iii) Thermo couple
(iv) Exusht GAS temperature Differential Relay
(v) PI test (SF6 circuit Breaker) & Protections.

By doing these I know about how a combustion chamber of GAS turbine work and Protection of Current Transformer and Circuit Break

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

I knew about SF6 circuit Breaker and it's protection from EEE 442 (Switchgear and Protective Relays).

30/8/12

Signature of the mentor with date
Name:
Designation:
Contact Phone #: 01720061063

Engr. Golam Rabbani
Assistant Engineer
Combined Cycle Power Plant
APSCL, Ashugang
B-Baria.

10.09.2012

Signature of academic supervisor with date
Name: Dr. Anisul Haque
Designation: Professor
EEE Department
East West University
Dhaka, Bangladesh

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: | Ashuganj Power station Company limited |
| Name of the student: | 2009-1-80-008 |
| ID: | ~~31.08.12~~ 2009-1-80-008 |

| | |
|---|---|
| Date: | 31.08.12 |
| Start time/End time | 8am to 4pm Break (1-2pm) |
| Location: | 53 MW GAS Engine (Unit-9) |
| Mentor: | Golam Rabbani |

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)

The objective of this days was to
(i) Visit the GAS Engine Room
(ii) Control Room
(iv) Substation of 50MW GAS Engine unit.

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) Visit the GAS Engine Room. visited different equipments such as - water pressure vasel, Colling fan, Exusthut Outlet, Turbo charger, Exahust header, Ventilation fan, DC power storage, LENOX (Combustion chamber) Control panel.
(ii) Visit to Control Room and Substation.
By doing these I have understand the GAS Engine Unit.

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

On this Unit there are conversion of energy in different ways which are related to PHY102. And the control Unit is (PLC based) related to EEE402.

31/8/12

Signature of the mentor with date
Name:
Designation:
Contact Phone #: 01720061063

Engr. Golam Rabbani
Assistant Engineer
Combined Cycle Power Plant
APSCL, Ashuganj
B-Baria

10.09.2012

Signature of academic supervisor with date
Name: Dr. Anisul Haque
Designation: Professor
EEE Department
East West University
Dhaka, Bangladesh

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: | Ashuganj Power Station Company Limited |
| Name of the student: | Mahafuzur Rahman |
| ID: | 2009-1-80-008 |

| | |
|---|---|
| Date: | 1.09.12 |
| Start time/End time | 8am to 4 pm , Break (1-2pm) |
| Location: | CCPP |
| Mentor: | Golam Rabbani |

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)

The objective of the day's was to visit the combined cycle power plant.

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 combined cycle power pla
(ii) visit to cepp. Eaipments. —
(a) Diesel Engine, (b) Auxiliary gear box,
(c) Exciter (d) Compressor (e) Filter (f) Combustio
(g) turbine (h) Accumulator (i) steam dram
(j) Emergency Exhaust (j) Feed pump. etc.

By visiting these equipment I known about the equipments used in cepp.

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

I know about DC exciter from EEE 301. and EEE 304.

11/9/12

Signature of the mentor with date
Name:
Designation:
Contact Phone #: 01720061063

Engr. Golam Rabbani
Assistant Engineer
Combined Cycle Power Plant
APSCL, Ashugang
B-Baria.

10.09.2012

Signature of academic supervisor with date
Name: Dr. Anisul Haque
Designation: Professor
EEE Department
East West University
Dhaka, Bangladesh

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: | Ashuganj Power Station Company Limited |
| Name of the student: | Mahafuzur Rahman |
| ID: | 2009-1-80-008 |

| | |
|---|---|
| Date: | 2.09.12 |
| Start time/End time | 8am to 4pm , (1-2 pm) |
| Location: | Thermal Power plant (unit- 3.) |
| Mentor: | Golam Rabbani |

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.
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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)

The objective of the day's was to understand the activities of thermal power plant (unit 3- 150 MW).

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 thermal plant.
(ii) Procedure to start plant.
(iii) Fuzing System
(iv) Burners, Economizer
(v) condenser
(vi) Carrier water pump. (4.5 MW)
(vii) HP, IP and LP turbine.

There idea developed my concept on thermal power plant.

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

There activity related with EEE205.

12/9/12

Signature of the mentor with date
Name:
Designation:
Contact Phone #: 01720061063

Engr. Golam Rabbani
Assistant Engineer
Combined Cycle Power Plant
APSCL, Ashugang
B-Baria.

10.09.2012

Signature of academic supervisor with date
Name: Dr. Anisul Haque
Designation: Professor
EEE Department
East West University
Dhaka, Bangladesh

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: | Ashugans Power Station Company Limited |
| Name of the student: | Mahafuza Rahman |
| ID: | 2009-1-80-008 |

| | |
|---|---|
| Date: | 3.09.12 |
| Start time/End time | 8am to 4pm, Break (1-2pm) |
| Location: | Combaind Cycle powr Plant (CCPP) |
| Mentor: | Golam Rabbani |

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)

The objective of the day's activities is to learn about Generator (Motor) maintenance and other maintenance of combind cycle power plant.

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 Megger test (Insulation test)
(ii) Stator winding Resistance test.
(iii) Gas flow meter
(iv) Cycloconverter
(v) Rotor Eccentricity.
(vi) Discussion on Fuse Protection.
(vi) Discussion on Governor control.

All these activities are related to plant maintenance and to keep system healthy

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

These activities are related with EEE 311 (Measurement and Instrumentation).

3/9/12

Signature of the mentor with date
Name:
Designation:
Contact Phone #: 01720061063

Engr. Golam Rabbani
Assistant Engineer
mbined Cycle Power Plant
PSCL, Ashugang
B-Baria

10.09.2012

Signature of academic supervisor with date
Name: Dr. Anisul Haque
Designation: Professor
EEE Department
East West University
Dhaka, Bangladesh

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: | Ashuganj Power Station Company Limited |
| Name of the student: | Mahafuzur Rahman |
| ID: | 2009-1-50-008 |

| | |
|---|---|
| Date: | 4.09.12 |
| Start time/End time | 8am to 4pm ; Break (1-2pm) |
| Location: | CEPP |
| Mentor: | Golam Rabbani |

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)

The objective of the days was to
(i) Roto Alignment with respect to Turbine / Pumps.
(ii) learn about allignment.

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 Allignment.
(ii) Different methods of allignment
- Dial Indicator method
- Reverse indicator method
- laser beam method.
(iii) Discussion on allignment problems.

By knowing these we can make a proper allignment with the help of any method

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

There are related to MAT 102. We can use software for these calculations.

4/9/12
Signature of the mentor with date
Name:
Designation:
Contact Phone #: 01820061063

Engr. Golam Rabbani
Assistant Engineer
Combined Cycle Power Plant
APSCL, Ashugang
B-Baria

10.09.2012
Signature of academic supervisor with date
Name: Dr. Anisul Haque
Designation: Professor
EEE Department
East West University
Dhaka, Bangladesh

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: | Ashuganj Power Station Company Limited |
| Name of the student: | Mahafuzur Rahman |
| ID: | 2009-180-008 |

| | |
|---|---|
| Date: | 5.09.12 |
| Start time/End time | 8am to 4pm . Break (12-2)pm |
| Location: | CCPP |
| Mentor: | Golam Rabbani |

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)

The objective of this days was to
(i) Understand the procurement system of the Ashuganj power Station Company limited.

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 Equipment Imports
(ii) Tendering Methods.
- OTM (Open Tendering Protocol.
- LTM (Limited Tendering Protocol
(iii) Direct Procurement
(iv) Higher Authority for procurement Entity.
These gives me ~~ab~~ knowledged about Procurement Methods.

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

These activity are related with SAT 102 (Approximate need with respect to stock graph).
And ~~BUS~~ MGT 102.

5/9/12

Signature of the mentor with date
Name:
Designation:
Contact Phone #: 01720061063

Engr. Golam Rabbani
Assistant Engineer
Combined Cycle Power Plant
APSCL, Ashuganj
B-Baria

10.09.2012

Signature of academic supervisor with date
Name: Dr. Anisul Haque
Designation: Professor
EEE Department
East West University
Dhaka, Bangladesh

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: | Ashuganj Power Station Company Limited |
| Name of the student: | Mahafuzur Rahman |
| ID: | 2009-1-80-008 |

| | |
|---|---|
| Date: | 06.09.12 |
| Start time/End time | 8am to 4 pm. Break (1-2pm) |
| Location: | Control Room of CCPP |
| Mentor: | Golam Rabbani |

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)

The objective of the day's activities was to understand the CCPP starting procedure

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 different signals and their states.
(2) Discussion on plant starting procedure with the help of block diagram.
(3) Drawing of the Interlock system block diagram.
(4) Video show on How GAS Turbine Works).

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

Related with EEE402 (Signals and System).
and EEE205 (Digital logic)

6/9/12

Signature of the mentor with date
Name: Engr. Golam Rabbani
Designation: Assistant Engineer
Combined Cycle Power Plant
APSCL, Ashugang
B-Baria
Contact Phone #: 01720061063

10.09.2012

Signature of academic supervisor with date
Name: Dr. Anisul Haque
Designation: Professor
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Dhaka, Bangladesh

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: | Ashuganj Power Station Company Limited |
| Name of the student: | Mahafuzur Rahman |
| ID: | 2009-1-80-002 |

| | |
|---|---|
| Date: | 07-09-2012 |
| Start time/End time | 8am to 4pm (Break 1-2 pm) |
| Location: | CCPP and Unit 5 (Control Room & plant) |
| Mentor: | Golam Rabbani |

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)

The objective of the days activities was
(i) to understand the Pressure flow management of Combined cycle power plant
(ii) Visit to Unit-5 (thermal power plant) and the Boiler processing Area.

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. lecture on Pressure flow management.
2. Discussion on Boiler starting procedure and conditions.
3. Discussion on Economizer.
4. Discussion on Flue gas management.
5. Discussion on Heat Recovery processes.
6. Visit to Unit 5

By knowing them I know about the Boiler starting condition and Pressure flow controling.

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

these are related to Engineering Physics-I (PHY 102).

7/9/12

Signature of the mentor with date
Name:
Designation:
Contact Phone #: 01720861663

Engr. Golam Rabbani
Assistant Engineer
Combined Cycle Power Plant
APSCL, Ashuganj
Brahmanbaria

10.09.2012

Signature of academic supervisor with date
Name: Dr. Anisul Haque
Designation: Professor
EEE Department
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Dhaka, Bangladesh