INTERNSHIP REPORT

ON

[POWER GENERATION, CONTROL AND PROTECTION SYSTEM OF GHORASHAL POWER STATION]

By

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Submitted to the

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, 2017]

Approved By

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Approval Letter

Bangladesh Power Development Board
Ghorashal Training Center, BPDB, Palash, Narsingdi.

Certificate

This is to certify that

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Successfully completed the training program for
Industrial Attachment Training Course
Held on 20th August 2016 to 3rd September 2016

at
Ghorashal Training Center
Bangladesh Power Development Board

Date of Issue:
3rd September 2016

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Acknowledgment

We are grateful to the almighty Allah for help to let us complete this internship. This training would not be possible without the direct and indirect help of several persons who made our internship easy and successful.

First, we would like to express our gratitude to our respected Supervisor Dr. Anisul Haque, Dean, FSE and Professor, EEE for giving us opportunity to do our internship under his supervision and providing us his assistance.

We would like to thank the Bangladesh Power development board for giving us permission to do our intern at Ghorashal power plant. We also thank the Ghorashal power plant management and power station training center authority for providing us necessary facilities to complete this training.

Last but not the least, we would like to express cordial thank to Dr. Muhammed Mazharul Islam, Chairperson and Assistant Professor of the Department of Electrical & Electronic Engineering, East West University, for his help and support not only in academic purposes but also in real life.

Executive Summary

We have chosen the industrial training to fulfill the partial requirements of B.Sc. in EEE. We have completed our internship at Ghorashal Power Station (GPS) from 20/08/2016 to 03/09/2016. During this time, we have gathered practical knowledge about power generation, transmission process and power distribution process of GPS. GPS covers all the processes from power generation to power supply to the national grid. The aim of this report is to give a brief description of what we have learnt at GPS. At GPS, there are 6 units with an installed capacity of 950 MW. The present de-rated capacity is 740 MW, but now present generation is 650 MW.

We have seen boiler where steam is generated at 350^{o}C temperature. We also have seen furnace where fuel burning process is done at 1800^{o} C. We have seen the turbine, which is coupled with the generator. The two pole generator rotates with the turbine at a speed of 3000 rpm. We have learned about cooling system of generator and also seen different types of pumps which are used in GPS. In the substation part, we have learned about different types of transformers such as power transformer, auto transformer, instrument transformer and auxiliary transformer and their cooling system. We have observed the protection equipment and switchgear equipment of GPS. We have seen how to control and maintain the particular units of power generation from control room. We have gathered practical knowledge from GPS during our internship period, which will play a vital role to build our career.

Authorization Letter

We hereby declare that, we are the sole author of this internship report. We authorize East West University to lend this internship report to other institutions or individuals for the purpose of industrial requirements.

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Training Schedule

The training schedule of Ghorashal Power Station is given below.

Date	Division	Time	Trainer
20-08-16	Generators of six unit	09 am to 05 pm	Engr. Md. Monir Masrum
21-08-16	Boiler (maintenance)	09 am to 05 pm	Engr. Md. Aminul Huq
22-08-16	Sub-station	09 am to 05 pm	Engr. Abdullah Bin Aziz
23-08-16	Boiler	09 am to 05 pm	Engr. Md. Shafiqul Alam
24-08-16	Switchgear control room	09 am to 05 pm	Engr. Md. Zahurul Islam
25-08-16	GPS Lab	09 am to 05 pm	Md. Abu Baker
26-08-16	Control room and Boiler	09 am to 05 pm	Engr. Khirod Mohan Bose
27-08-16	Generator	09 am to 05 pm	Engr. Md. Akter Hossain
28-08-16	Different Pumps	09 am to 05 pm	Engr. Suman Kumer kunda
29-08-16	Control room	09 am to 05 pm	Mr. Prokash kumer Ghosh
30-08-16	Turbine, Boiler and Generator	09 am to 05 pm	Engr. Md. Mahabubur Rahman
31-08-16	Water treatment plant	09 am to 05 pm	Mr. Md. Abdul Mannan
01-09-16	Control room for grid failure purpose	09 am to 05 pm	Engr. Md. Mokammel Hossain
02-09-16	Turbine	09 am to 05 pm	Engr. Md. Achher Ali
03-09-16	Boiler	09 am to 05 pm	Engr. Dilip Biswas

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Chapter 1: Introduction

Electricity is one of the most important criteria for the development of a country. Electricity plays a vital role in the economy of Bangladesh. The increase of industries in Bangladesh has created a huge demand of electric power. Power generation is a very important sector in Bangladesh. Ghorashal Power Station (GPS) is the largest power station in Bangladesh with installed capacity 950 MW. We got opportunity to do our intern at Ghorashal Power Station (GPS) from 20th August to 3rd September 2016. During this internship, we have visited and observed different parts of this power station. In this chapter we present Company Profile, Mission and Vision of GPS, Future Plan of GPS, Objective of the internship, Scope and methodology and an overall discussion about GPS.

1.1 Company Profile

GPS is situated on the bank of the Shitalakshya River, North East of Dhaka under Palash Upazilla, in Narsingdhi district. It is one of the oldest and the largest power stations in Bangladesh. At first, it started generation in 1974. Its installed capacity is 950 MW with six units. Ghorashal Power Station is a thermal power station and the turbines of the six units are steam turbines. In GPS, natural gas (Mithene-CH_4) is used as fuel, supplied by Titas Gas Transmission and Distribution Company. Table 1.1 shows the profile of GPS and Table 1.2 describes the information on power generating units of GPS.

Table 1.1: Profile of GPS.

Name	**Ghorashal Power Station**
Year of establishment	1974
Corporate Office	Bangladesh Power Development Board (BPDB)
Supplier	M/S Technopromexport, Russia
Main Work	Power Generation
Number of Generation Units	6 (Steam Turbines)
Running Units	5 (1-5 units)
Installed Capacity	950 MW
Present de-rated capacity	740 MW
Present generation	620 MW

Table 1.2: Power generating unit description of GPS.

Unit no.	Date of Commissioning	Age (Years)	Installed Capacity (MW)	Running Capacity (MW)	Current Condition
Unit-1	16th June, 1974	41	55	40	Running
Unit-2	13th February, 1976	39	55	40	Running
Unit-3	14th September, 1986	29	210	170	Running
Unit-4	14th March, 1989	26	210	180	Running
Unit-5	14th January ,1994	21	210	190	Running
Unit-6	30th January, 1999	16	210	0	Under tendering process for repairing since 18-07-2010

1.2 Mission and Vision of Ghorashal Power Station

GPS is a Sub-division of Bangladesh Power Development Board (BPDB). So, the vision and mission of BPDB are carried out by GPS. The mission and vision of BPDB are as follows.

Vision Statement

BPDB's vision is to provide quality and reliable electricity to the people of Bangladesh for desired economic, social and human development of the country undertaking institutional and structural reforms leading to the creation of a holding company.

Mission Statement

- To deliver quality electricity at reasonable and affordable prices with professional service excellence.
- To make electricity available to all citizens on demand by the year 2020.
- To provide specialized skilled services in Operation and Maintenance with outstanding performance in Generation, Transmission and Distribution for promoting competition among various power sector entities.
- To follow international standard and adopt modern technology and practices in power generation activities.
- To ensure improved and satisfactory services to the consumers.
- To develop new mindset for all of its employees congruent with the corporate culture.
- To reach self-sufficiency by increasing of its income and reduction of expenditure [1].

1.3 Future Plan of Ghorashal Power Station

To deliver electricity at a reasonable price BPDB has taken a plan to add a combined cycle power plant of 365 MW in GPS. BPDB signed turnkey Engineering Procurement Construction (EPC) contract with China National Technical Import and Export Corporation and China National Machinery Import and Export Corporation (CMC). A warranty period of 24 months is given by this company that will start with the installation of the combined cycle power plant. It will take at least 900 days or around two years and five months to complete the construction of the combined cycle power plant. This contract was signed on 25 May 2013 and the construction is still going on.

1.4 Objective of Internship

The main objective of this internship is to gain practical knowledge of power generation, transmission and distribution process of GPS. In this internship, we have observed and gathered practical knowledge about different equipment and machines that we have studied in our academic courses. We have completed our internship in fifteen days. Based on the experiences of this internship and our academic knowledge we have prepared this report that will represent the overall generation, transmission and distribution system of GPS.

1.5 Scope and Methodology

This report is prepared based on the daily practical activities that we have performed in GPS. In this report we have covered the total process of generation of electricity, power transmission and power distribution system of GPS. This report contains the description of the equipment and machines used for power generation, transmission and distribution. This report also contains other relevant information about GPS that we have gathered during our internship.

To prepare this report, we have used the information and knowledge that we have gathered during internship through lectures, practical visits, sketches, diagrams and presentation slides. However, secondary sources are also used in some places. The secondary information is based on internet search, reference books etc.

Chapter 2: Water Treatment

2.1 Introduction

GPS is a thermal power station, where steam is used as the main fluid to rotate the steam turbine. To run the power plant, huge amount of water is needed. The water is also used for various cooling systems and general purposes in the power plant. In GPS, the river water of Shitalakshya is the main source of water. The natural water of the river cannot be used directly in the boiler because it contains many minerals and suspended substances, which are harmful for the boiler and turbine. So the purification of natural water is needed to remove harmful substances from the water. The plant where the raw water is purified and the degree of quality of the purified water is maintained is called "Water Treatment Plant". The purified water is called "Demi-water or Demineralized water". The quality of demi-water is maintained very carefully. On the other hand, the natural water or mineral water has bad effect of "Scale Decomposition" which can block the pipeline of water of the boiler. In this chapter, we will discuss the mechanical and chemical processes of water treatment in water treatment plant. Figure 2.1 shows the water treatment plant of GPS.

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Figure 2.1: Water treatment plant of GPS.

2.2 Water Collection

GPS requires around 670 tons/hour water for each 210 MW unit. From the ratio of needed water and capacity of generating unit, we can see that generating 1 MW requires 3.19 tons/hour of water. The plant is situated on the bank of Shitalakshya. The flow of water remains almost the same throughout the whole year. At GPS, the river water is collected by the "River Water Pump" and collected to the "River Water Tank". Water is collected from the river, and then it is distributed in different areas of the plant for different purpose. A portion of raw water is supplied to the condenser of different plants. Another portion of water is supplied to the water treatment plant. The water treatment plant produces de-mineralized water, and this water is supplied to the boiler for the steam generating purpose in all the thermal power plants.

2.3 Treatment Steps

In GPS, a portion of raw water supplied to the water treatment plan to get purified demi-water. The dissolved and solid particles and mineral of river water are removed by taking 6 steps in water treatment plant. The steps are discussed below.

2.3.1 Clarifier

The clarification process is a pre-treatment of water. The clarifier is a device, which is used to remove the suspended matter from the mineral water. In clarifier, the chemical process is done to remove the suspended matter. This chemical process is called coagulation. In this process, Aluminum Sulfate Polyacrylamide, Calcium Hydroxide, Ferrous Sulfate, Ferric Chloride etc. are used as coagulants. The coagulants react with the river water and we get partially clear water. This partially clear water is known as coagulated water and contains some floating coagulated and other substances. Figure 2.2 shows the clarifier of GPS. The chemical reaction of clarifier is given below,

$$Al_2(SO_4)_3 + \text{Clay}(H_2O) \rightarrow Al(OH)_3\,(\text{sludge}) + H_2SO_4$$

Figure 2.2: Clarifier of GPS.

2.3.2 Sand Filter

Sand filter is a mechanical device, which is used to filter the coagulated water. This mechanical filter contains anthracite or sandstone to filter the water. When coagulated water passes through the filter than all the floating particles are absorbed by the sandstone. We get very clear and transparent water after mechanical filtering and this water is known as filtered water.

2.3.3 Cation Exchanger

Filtered water or clarified water contains many mineral ions like Na^+, Ca^{++}, Mg^{++}, Fe^{3+}, and $Al3^+$ etc. Dissolved solid means various kinds mineral ions, which may react to various parts of the boiler. So it is required to remove ions. First the clarified water treated in a cation exchanger resin column. The

cation exchanger contains cation resin, the resin is an organic substance capable of exchanging ion. Here cation resin catches these cations by the reaction given below. Figure 2.3 shows the physical view of the resin of GPS.

Cation exchange resin

Formula: R-H

The reaction of resins

$R\text{-}H^{+} + NaCl \longrightarrow R\text{-}Na + HCl$

Figure 2.3: Physical view of Resin.

2.3.4 Degasifier

Water contains some dissolved gases. To remove those gases degasifier or decarbonizer is used. The degasifier or decarbonizer is a device where a gaseous substance, especially carbon dioxide is removed mechanically and chemically. The chemical reaction in the degasefier is given below

$H_2CO_3 \longrightarrow H_2O + CO_2$

Here dissolved carbon dioxide (CO_2) is removed after cation exchanger.

2.3.5 Anion Exchanger

The cation and dissolved carbon dioxide (CO_2) free water is treated in anion exchanger resin column. The anion exchanger contains anion resin. It consists of polymeric cation with active anions. Here the anion resin catches all the anions like SO_4^{2-}, NO_3^{-}, Cl^{-} in water from the reaction given below.

Anion- Exchange resin

Formula: R-OH

The reaction of resins

$R\text{-}OH + HCl \longrightarrow R\text{-}Cl + H_2O$

After this process the water is known as semi de-mineralized water. This water is used for cooling and for the production of de-mineralized water.

2.3.6 Mixed Bed Exchanger

After ion exchanger process, the semi de-mineralized water contains a small amount of cation and anion. This semi de-mineralized water passes through the mixed bed exchanger. Mixed bed exchanger contains cation and anion resin mixture, which absorbs the ions. After this process, the water is called De-mineralized water. This water conductivity is less than 1 µS/cm, it's approximately 0.2-0.3 µS/cm. Figure 2.4 shows the mixed bed exchanger in GPS.

Figure2.4: Mixed bed exchanger.

Chapter 3: Boiler

3.1 Introduction

The equipment, which is used for producing steam at predetermined temperature and pressure is called boiler. The boiler is also called the steam generator. The GPS is a thermal power station and the prime mover is steam turbine. Therefore, steam is the most essential substance for the plant to generate electricity. In this boiler section, we have discussed different kinds of boiler equipment and boiler auxiliaries of GPS.

The boiler, which is used in GPS is a water tube boiler. The water of the boiler passes through the tubes, which is surrounded by the hot flue gas. The heat of the flue gas transfers to the water through the tube and the steam is produced inside of the tubes. The boiler of GPS is an externally fired boiler. The furnace chamber is located outside of the boiler drum. In this boiler, the natural circulation of water is needed to produce the steam and no force is applied for water flow in the water tubes.

The six generator units of GPS have individual boilers to produce steam and these are outdoor type boilers. The efficiency of unit 1 and 2 is 90.5% and unit 3, 4, 5 have 93% efficiency. Table 3.1 shows the brief characteristics of a boiler of 55 MW and 210 MW units at GPS.

Table 3.1: Pressure and temperature rating of boiler (55MW and 210MW units).

Unit capacity	55MW unit	210MW unit
Steam generating capacity (Ton/hr.)	230	670
Steam pressure at boiler out let (Kgf/cm^2)	100	140
Rated live steam temperature (°C)	540	540
Secondary steam temperature (°C)	-	540
Efficiency (in %)	90.5	93
Exhaust flue gas temperature (°C)	120	132

3.2 Main Components of Boiler

The components of boiler are used for producing and delivering steam safely to the desired location. These components also maintain the desired pressure, temperature and quality. The main components of boiler are,

1. Boiler drum
2. Furnace or combustion chamber
3. Burners

3.2.1 Boiler Drum

One of the most important components of boiler is boiler drum. It is a horizontal drum and the water is coming from water treatment plant. There are actually three sections in boiler drum and these are, left salt section, clean section and right salt section. Each section has different tasks. Salt section has another section that is called wind section, which flows air like wind and then the minerals become

cool at the bottom of the section. After that, the minerals will be removed from the bottom of the boiler drum. In every 18-20 hours, the salty water is removed by opening the bottom valve.

3.2.2 Furnace or Combustion Chamber

The main design and operation of the boiler furnace is to obtain combustion with minimum smoke. Smokeless combustion is preferred for mainly two reasons:

1. The smoke is a main cause of air pollution.
2. Smoke is the indication of incomplete combustion. The unburned visible gases are shown in the form of smoke.

In a furnace chamber, heat is necessary to generate steam and the heat is generated by a combustion process which is basically a chemical reaction. Every boiler has a furnace chamber and it is located outside boiler chamber. Figure 3.1 shows the furnace of unit-3 at GPS.

Figure 3.1: Furnace of unit-3 at GPS.

3.2.3 Burners

There are 12 burners in every 210 MW power plants of GPS. At the beginning of firing, two burners are in service. Then gradually all burners join in the action.

3.3 Boiler Auxiliaries

Auxiliaries of steam boiler are devices that are installed in the steam boiler and can make it operate efficiently. These devices should be maintained and controlled. Therefore, that steam boiler can run in good condition. Some of these auxiliaries, which are installed in steam boiler, are given below.

1. Super Heater
2. Economizer
3. Regenerative Air Heater
4. Forced Draught fan (FD fan)

5. Induced Draught fan (ID fan)
6. Deaerator
7. Boiler Condenser

In the following sub-sections, these auxiliaries are discussed in brief.

3.3.1 Super Heaters

Super heater is an essential part of boiler. Super heaters are placed in the path of hot flue gas from the furnace. Hot flue gas makes the steam heated inside the super heaters, before entering the High Pressure Cylinder (HPC). So the efficiency of the system is increased. In GPS, the super heaters increase steam temperature from 350^0C to 540^0C. There are three types of super heaters. These are given below.

3.3.1.1 Radiant Super Heater

Radiant super heater is placed around the water tubes of the boiler. It is located at the bottom of the furnace. Furnace temperature is 1500^0C during working and this heat turns the water into steam inside the water tubes. The steam goes to the boiler drum and from the boiler drum, steam of 350^0C temperature first enters the radiant super heater. Flue gas from the furnace makes the steam inside the radiant super heater more heated. After this step, steam temperature increases to 365^0C.

3.3.1.2 Platen Super Heater

From radiant super heater steam enters the platen super heater and temperature increases to 405^0C. In this step, steam gets heat mainly from radiation.

3.3.1.3 High Pressure Conductive Super Heater

Steam goes to high pressure super heater from platen super heater. It is divided into two parts. In this section steam temperature is increased to 540^0C and this steam is injected into HPC.

3.3.1.4 Re-Heater

From the HPC steam of 336^0C temperature enters re-heaters and again the temperature becomes 540^0C. This steam enters the Intermediate Pressure Cylinder (IPC).

3.3.2 Economizer

The economizer is a device which serves to recover some of the heat being carried by exhaust flue gas. The heat thus recovered is utilized in raising the temperature of feed water being supplied to the boiler. If the feed water at raised temperature is supplied to the boiler, it needs less heat for its conversion into steam and thus there is a saving in the consumption of fuel. As a result, the boiler efficiency is raised. Figure 3.2 shows the economizer of unit-6 at GPS. 6

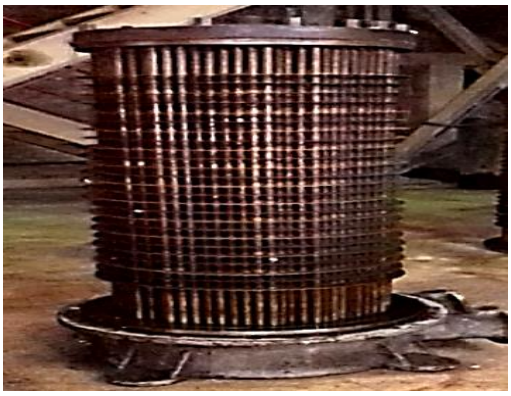

Figure 3.2: Economizer of unit-6 at GPS.

3.3.3 Regenerative Air Heater (RAH)

Regenerative air heater captures the heat of boiler exhaust gas as it is made of heat-absorbing metallic elements. Air from the Forced Draught (FD) fan is passed through the RAH and inside the RAH, there are pipes containing flue gas. So air becomes hot and flue gas releases heat when air comes in contact with the pipes of flue gas. The captured heat is released into the cooler air and this air is entered to the furnace.

3.3.4 Forced Draught Fan (FD fan)

The main function of FD fan is to create positive pressure. It is installed near or at the base of the boiler to supply air to the boiler furnace chamber and force the flue gas to pass through the super heaters, re-heater and economizer. It also sucks the air and delivers it to the combustion chamber. The fan motor rotates at 600 rpm up to 750 rpm.

3.3.5 Induced Draught Fan (ID fan)

The main function of ID fan is to create negative pressure. It is installed near or at the base of the chimney to suck hot gas from boiler side and discharge to the atmosphere. The rotating speed of ID fan is 595 rpm to 744 rpm.

3.3.6 Deaerator

The main function of deaerator is to remove the dissolved oxygen from the water. To remove dissolved oxygen, hydrogen or ammonia is entered in the deaerator. During operation, condensate comes to feed water tank through deaerator and make-up water is added to feed water tank from demi-water tank. In deaerator the working pressure is 6 kg/cm^2, temperature is 164ºC, volume of feed water tank is 100 m^3 and deaerator capacity is 1000 tons/hour.

3.3.7 Boiler Condenser

Boiler condenser is used for condensing the overheated steam. In GPS, boiler condenser is an auxiliary component of boiler. Steam comes to boiler condenser from two sides. One from boiler drum and other from high pressure heater (HPH). Temperature and pressure in the boiler drum is maintained 350ºC and 158 kg/cm^2. Excess steam in the boiler drum goes to the condenser and temperature is reduced. This water from the boiler condenser is used to maintain the temperature of the super heaters. Another part of water from feed water pump enters HPH. If the temperature of the

HPH water is very high before entering economizer then water goes to boiler condenser. After that, water enters economizer and then boiler drum.

3.4 Boiler Protection

For boiler protection, some necessary parameters are maintained. Those parameters are given in table 3.2.

Table 3.2: Protection parameters of boiler.

No.	Description	Parameter settings	Time settings
1	Decrease of gas pressure before burners	0.1 kg force/cm^2	------
2	Drum level decrease	-160 mm	------
3	Drum level increase	200 mm	------
4	Decrease of steam flow through reheat lines	0.1 kg/cm^2	20 seconds
5	Tripping of both ID fan, FD fan and RAH	By interlock mechanism of switches	9 seconds (only for RAH)
6	Pressure drop of air, supplied to burners	40 kg force/m^2	9 seconds
7	All three feed pumps tripe	By inter locking contacts of switches	9 seconds

Chapter 4: Turbine

4.1 Introduction

In this chapter the mechanism and operation of the turbine is described. Here we have included the types of turbines, their working principle and protection that we have observed in GPS.

4.2 Stem Turbine

The prime mover at GPS is a steam turbine. In steam turbine, the thermal energy of the fluid is converted to mechanical energy. Pressurized hot steam is injected into the turbines. In GPS, all units have steam turbine. At full load, the turbines rotate at 3000 rpm (Rotation per Minute). Turbines have two parts. Fixed blades and moving blades.

4.2.1 Moving Blades

Moving blades are fixed with the rotor shaft. According to shape moving blades are reacting type or impulse type. In GPS the reaction type, impulse type and a combination of both type blades are used. The conversion of energy depends on the shape of the blades. The moving blades are attached to the wheels of the shaft. Wheels are round rings around the rotor shaft. The moving blades of High Pressure Cylinder (HPC), Intermediate Pressure Cylinder (IPC) and Low pressure Cylinder (LPC) are different. Figure 4.1 shows the moving blades of HPC, figure 4.2 shows moving blades of IPC and figure 4.3 shows the moving blades of LPC of unit 6 at GPS.

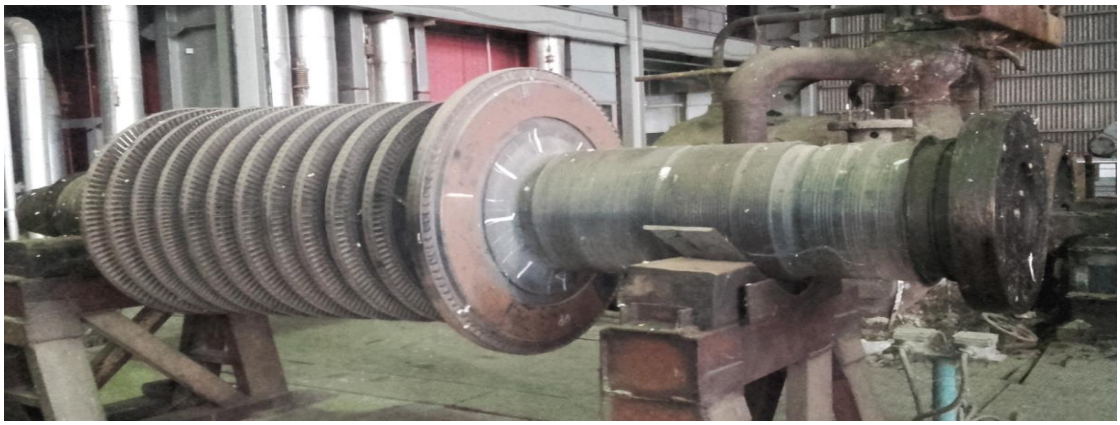

Figure 4.1: Moving blades of high pressure cylinder.

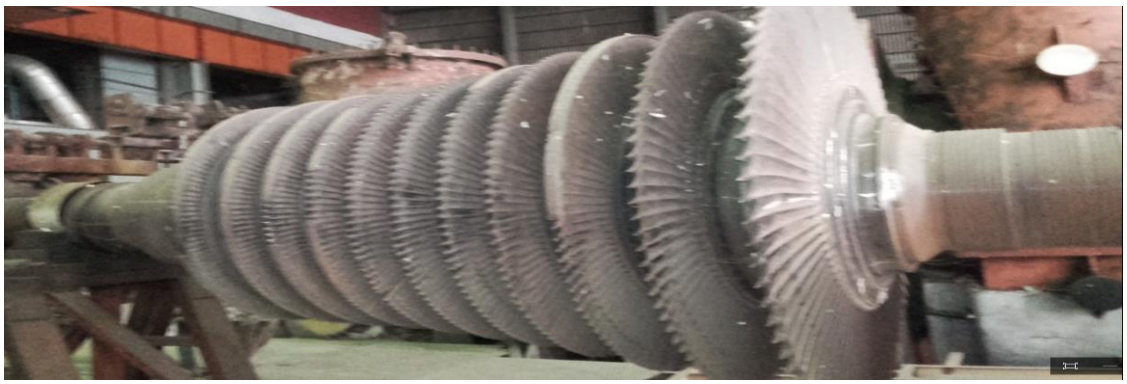

Figure 4.2: Moving blades of intermediate pressure cylinder.

Figure 4.3: Moving blades of low pressure cylinder.

4.2.2 Fixed Blades

Fixed blades are attached with the cylinders in round shaped diaphragms. Those blades are used as nozzles when steam passes from one stage to another. The fixed blades in each cylinder are distributed in stages. When the steam passes through each stage, pressure is released and velocity is increased. Half of the fixed blades are attached to the upper portion of the casing of cylinder and other half is attached to the bottom of the casing of the cylinder. Figure 4.4 shows the fixed blades of turbine.

Figure 4.4: Fixed blades of turbine.

4.3 Cylinder

In GPS, there are three cylinders according to pressure.

1. High pressure cylinder (HPC)
2. Intermediate pressure cylinder (IPC)
3. Low pressure cylinder (LPC)

Figure 4.5 shows the turbine layout of GPS.

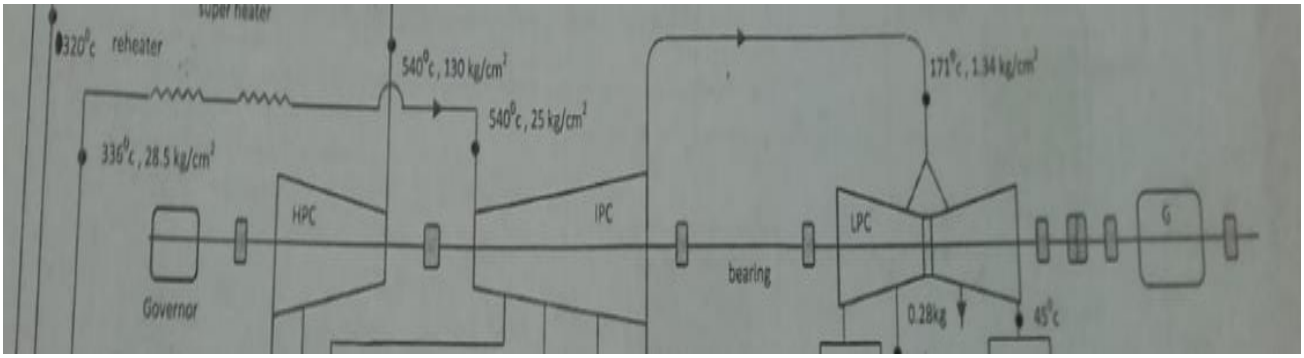

Figure 4.5: Turbine layout.

4.3.1 High Pressure Cylinder (HPC)

Steam first enters the HPC turbine from the super heaters at a pressure of 130 kg/cm^2 and temperature of 540^{0}C. HPC has twelve stages. After completing these stages, temperature falls to 330^{0}C and steam enters the re-heater to regain temperature and the temperature becomes close to 540^{0}C but pressure falls to 25 kg/cm^2.

4.3.2 Intermediate Pressure Cylinder (IPC)

Steam goes to the IPC at 25 kg/cm^2 pressure and 540^{0}C temperature. This cylinder has eleven stages. Blades of this cylinder are bigger than HPC turbine blades. After completing these eleven stages steam loses most of the energy and enters LPC at 1.34 kg/cm^2 pressure.

4.3.3 Low Pressure Cylinder (LPC)

Steam enters LPC at 171^{0}C temperature and 1.34 kg/cm^2 pressure. This section is divided into two parts. One part has three stages and the other part has four stages. Figure 4.6 shows the HPC, IPC and LPC of unit-4 at GPS.

Figure 4.6: HPC, IPC and LPC of unit-4 at GPS.

4.4 Condenser

The steam enters the condenser from LPC. At GPS, the condenser is a surface contact condenser. Inside the condenser, there are thousands of water tubes. Water from the Shitalakshya river flows inside the condenser tubes and the steam from the LPC is flowed through the condenser, touching the condenser tubes. Therefore, the steam temperature decreases and the condenser water temperature rises up to almost 45^0C after heat exchange. At GPS, the condenser is divided into two parts. These two parts of condenser are supplied steam from each LPC parts above them. Figure 4.7 shows the surface contact condenser.

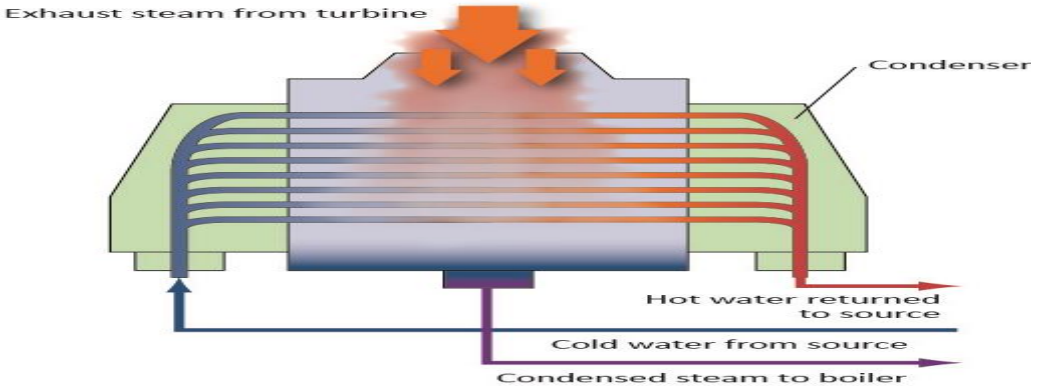

Figure 4.7: Surface contact condenser [2].

4.5 Governing System

Governor is a very important component of turbine. It controls the flow and speed of steam according to load requirement [3], [4].

4.5.1 Throttle Governing

In this system, the pressure of the steam is reduced according to the speed of the rotor shaft. A control valve or throttle valve controls the flow of steam. When the load is reduced, speed of shaft increases. Therefore, the control valve reduces the amount of flow of steam. This system is also called flywheel system. In this system, a flywheel is coupled with the rotor shaft, two flyweight or weight balls are attached to the spindle. The operating valve or throttle valve is connected with operating rod or lever and the lever is attached with the sleeve. Figure 4.8 shows the throttle governing system.

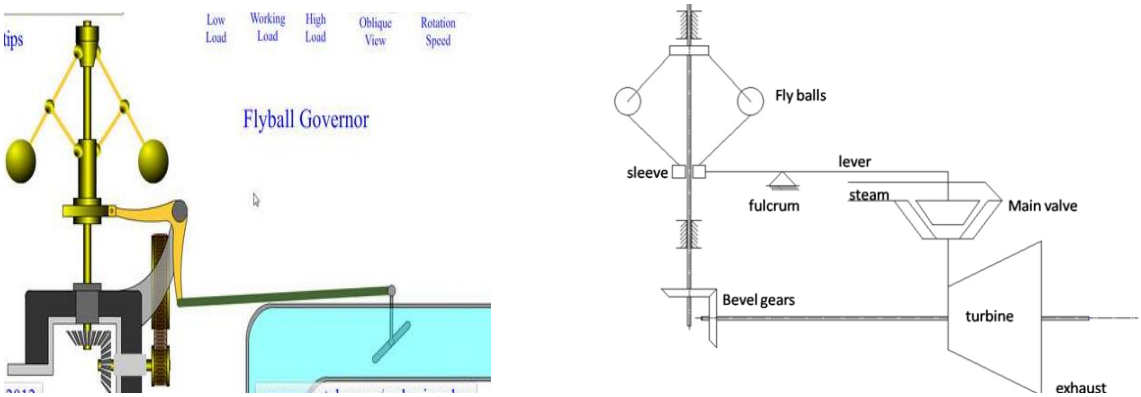

Figure 4.8: Throttle governor.

4.5.2 Nozzle Governing System

In this system, the amount of steam is not controlled, rather the pressure and velocity of the steam is controlled. Steam enters the nozzle at high pressure and low velocity. The nozzles are actuated by independent control mechanism. Depending on the load, some nozzles are made active and some nozzles are closed. Velocity of the steam increases and pressure decreases after the steam has passed the nozzles. Figure 4.9 shows the nozzle governing system.

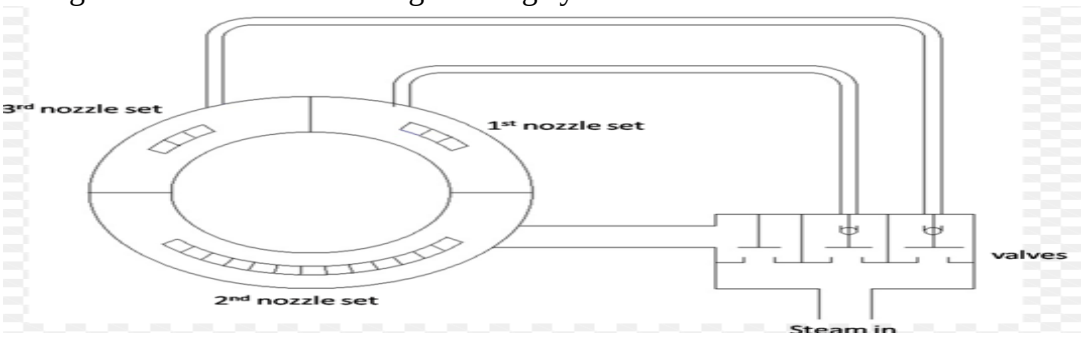

Figure 4.9: Nozzle governor.

4.6 Working Principle

At first, from the boiler steam enters the super heater. After completing five stages of the super heater, steam enters the HPC. Then steam goes to the re-heater, gains temperature and enters IPC. After IPC, steam enters the LPC. The flow of steam is continuous. From LPC steam goes to condenser. Figure 4.10 shows temperature and pressure at different equipments and parts of GPS.

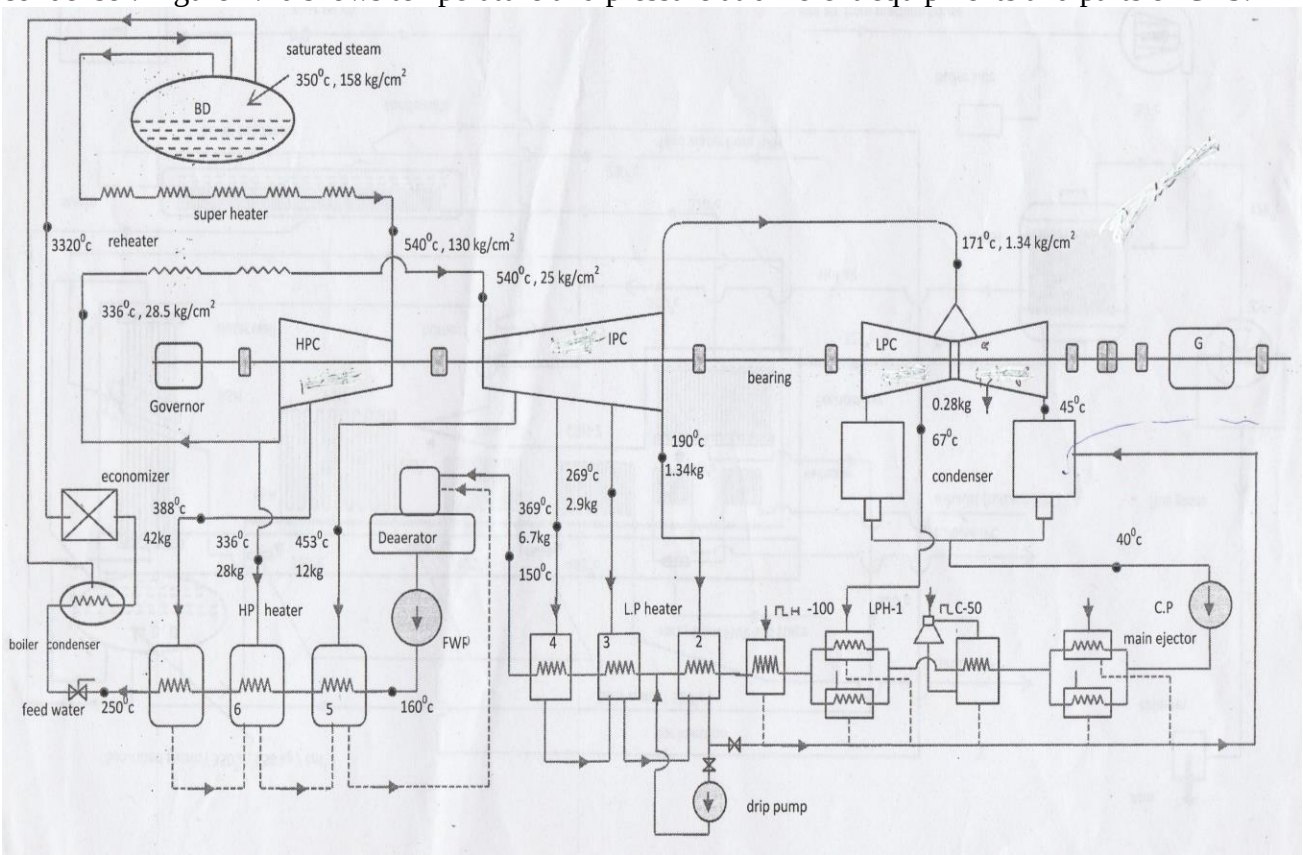

Figure 4.10: Thermal and pressure diagram of GPS.

4.7 Bearings

Bearings are important part for turbine operation. In GPS, there are seven turbine bearings. The turbine shaft is hold by the bearings. Bearings help to rotate the turbines smoothly. Two types of bearings are used in GPS.

1. Journal bearing
2. Thrust bearing

4.7.1 Journal Bearing

It is a round type bearing that holds the turbine shaft on lubricating oil. Lubricating oil is pumped between the shaft and the bearing for preventing damage due to friction. The main purpose of this bearing is to hold the turbine during operation and to provide smooth rotation. In GPS, there are six journal bearings. First one is between governor and HPC. Then two are between IPC and LPC. After that, two are between LPC and generator on both sides of the coupling of rotor and turbine shaft. The last one is located after the generator.

Components of Journal bearing

1. Housing
2. Oil inlet
3. Bearing liner
4. Journal or shaft
5. Drain

Figure 4.11 shows the journal bearing at GPS and figure 4.12 shows the vertical diagram of journal bearing.

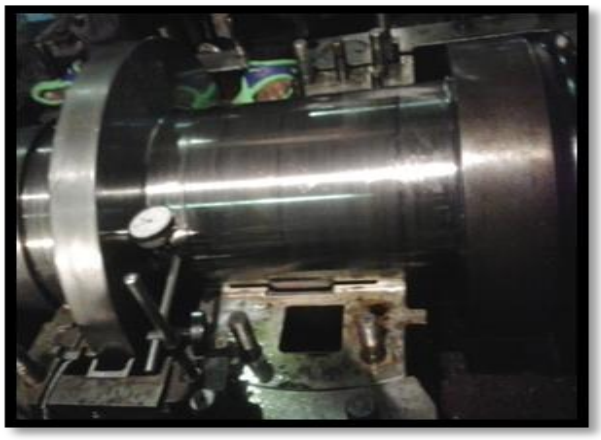

Figure 4.11: Journal bearing at GPS.

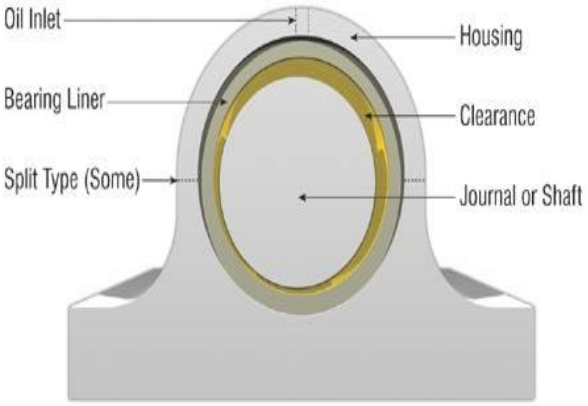

Figure 4.12: Vertical diagram of Journal bearing [5].

4.7.2 Thrust Bearing

Thrust bearing holds the turbine shaft in position. In thrust bearing, a number of rolling materials are mounted in a round ring. Thrust bearing provides positive axial location of the shaft of turbine relative to cylinder. In GPS, thrust bearing is provided to overcome the vibration and thrust created by the pressure of the steam on the turbine blades. In GPS there is only one thrust bearing between HPC and LPC. This bearing holds the shaft in position during critical speed. Except any serious cause or emergency thrust bearing should be free from maintenance [6]. Figure 4.13 shows the different parts of thrust bearing.

Figure 4.13: Different parts of thrust bearing [7].

4.8 Turbine Startup

Before starting the turbine operation following equipments are ensured.

1. Shaft turning gear is in operation
2. Level of vacuum tank is satisfactory
3. Full closing of steam extraction line of high pressure heater (HPH) and low pressure heater (LPH) from Turbine
4. Feed water Pump, Gas cooling Pump and Stator cooling Pump are in operation
5. Live steam temperature before stop valve is 300^0C - 320^0C
6. Live steam pressure is 20-25 kg/cm^2
7. Condenser vacuum not less than - 0.748 kg/cm^2 (550 mm of Hg)
8. Span of rotor bending should not exceed 0.07 mm
9. Rotor axial shift within 0.5 mm to 0 mm
10. Differential expansion of HP rotor is -1.2 mm to + 4 mm
11. Differential expansion of IP rotor is -2.5 to + 3 mm
12. Differential Expansion of LP rotor is -2.5 to + 4.5 mm
13. Difference of temperature of top and bottom HPC is 50 ^{O}C
14. Difference of temperature between top and bottom IPC is 60^{O}C
15. Oil temperature after cooler is 40 ^{O}C - 45^{O}C
16. Condenser level is satisfactory
17. Pressure in Condenser is not higher than 0.3 kg/cm^2
18. Live steam should have the following constituents within the limits.

SiO_2 < 100 µg / kg, Fe < 100 µg / kg, H_2 = 1 µg / liter.

4.8.1 Turbine Rolling

If the parameters are ok, the turbine is pushed by opuihening the regulating valves. The regulating valve is moved by moving the control gear wheel in anti-clockwise direction. Rolling is done in the following process,

1. Turbine speed is increased to 500 rpm. At this speed the turbine is rotated for 10 to 15 minutes and checked if any abnormal noise is heard.
2. Then the speed is increased to 1200 rpm, slowly within 3 to 5 minutes. Turbine is held at this speed for 10 to 15 minutes for heating and listening if any abnormal noise is heard.
3. Then the speed is increased from 1200 rpm to 2850 rpm continuously without stopping for overcoming the vibration of critical speed. At critical speed, the vibration of the machine is most severe and makes high noise. The critical speeds are 1459 rpm, 1862 rpm, 1970 rpm and 2487 rpm.

4. After reaching 2850 rpm, the drain of live steam and pipelines are closed and speed is increased up to 3000 rpm.

4.9 Lubricating System

Lubricating system is important for the smooth rotation of turbine shaft in the bearings. A lube oil pump forces the oil inside the turbine. A lube oil tank holds the oil. If the oil supply is hampered turbine shaft will be damaged. This is why a stand by pump and an emergency pump is used for emergency oil supply, for overcoming accidents. Figure 4.14 shows the oil pumps, figure 4.15 shows the inlet, and outlet pipes of lube oil and figure 4.16 shows lubrication oil supply.

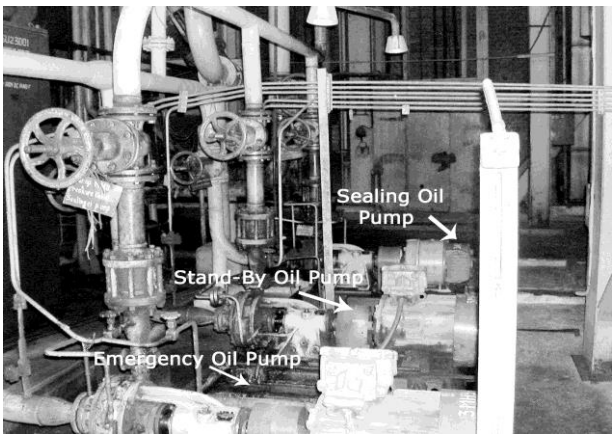

Figure 4.14: Oil Pumps.

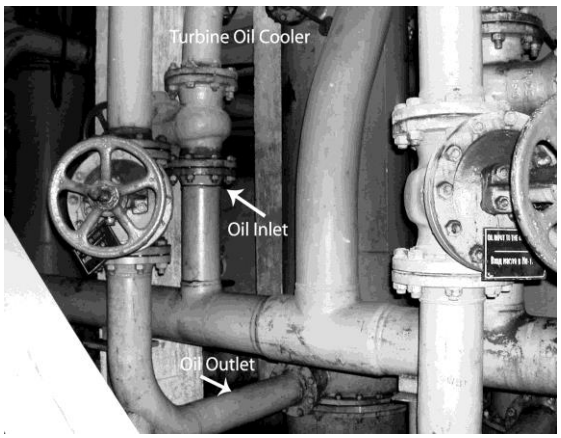

Figure 4.15: Oil inlet and outlet pipes.

Figure 4.16: Lubrication oil supply.

4.10 Shaft Turning Gear

Shaft turning gear is provided for uniform cooling of the shaft, when generator is shut down. When the turbine rotates, the shaft becomes hot. If the turbine is stopped instantly after shutting down of generator then it may be damaged due to an unbalanced cooling. So, the shaft turning gear rotates the shaft at 3 or 4 rpm for 48 to 72 hours after the system is stopped.

4.11 Turbine Protection

Turbine is one of the most important parts of power generation system. Proper protection is needed to secure turbine operation. In GPS, the protection system is designed to avoid different types of unexpected situations.

4.11.1 Speed Protection

If the load decreases, the turbine speed increases. Therefore, nozzle governor and throttle governor is provided to control the shaft speed.

4.11.2 Thrust Protection

When the turbine is starting to roll, at the critical speed the vibration of the shaft is severe. For this vibration, serious damage can happen to the turbines. So, thrust bearing is provided between HPC and IPC. This bearing prevents the effect of axial thrust and keeps the turbine in position.

4.11.3 Axial Shift Protection

Due to excessive heat, if the frame of the thrust bearing is melted or damaged then the shaft can move either toward the generator or toward the governor. Therefore, terrible accidents can occur. Motion sensors are used to measure this shift. In GPS, if the shaft is moved 1.2 mm toward the generator or 1.7 mm toward the governor, then the system is automatically shut down.

4.11.4 Lubrication Oil Protection

In GPS, the lube oil pressure is always kept below 0.3 kg/cm^2. The turbines are supplied oil at a pressure of 1.4 kg/cm^2 to 2.11 kg/cm^2. The oil pressure is measured using pressure gage in the oil inlet tube. The main oil pump supplies oil. If the oil pressure is decreased then required amount of oil will not be carried to turbines. For continuous flow of lube oil, a stand by pump and an emergency oil pump is used.

4.11.5 Protection Parameter

The protection parameters of turbine are given in table 4.1.

Table 4.1: In GPS the following protection parameters are maintained for turbine protection.

No of parameters	Description	Parameter settings
1	Lubricating oil pressure drops in turbine bearing	0.3 Kg/cm^2
2	Vacuum drop in turbine condenser	540 mm of Hg
3	Axial shift of turbine rotor	+1.2 mm (towards generator) -1.7 mm (towards governor)
4	Relative expansion of rotor should be within the range	HP rotor -1.2 to +4 mm, MP rotor -2.5 to +3 mm, LP rotor -2.5 to 4.5 mm.
5	Oil level drop in damping tank	60 mm below from the top of the damper tank
6	Tripping of the sealing oil pump	Signal from circuit breaker
7	Main steam temperature raise	565^oC
8	Main steam temperature drop	450^oC
9	Decrease of cooling water flow through generator	22 T/H (Ton per hour)
10	Level rise of high pressure heater-5 (HPH-5), high pressure heater-6 (HPH-6), high pressure heater-7 (HPH-7)	4900 mm, 4900 mm, 4525 mm

Chapter 5: Generator

5.1 Introduction

Generator is the most important element in power generation process. In this chapter, we have discussed the generator that we have observed in GPS. We have described different parts of generator. Maintenance and protection procedure of generator is also described in this chapter. Generator is a machine that converts the mechanical energy to electrical energy. At GPS, there are six generators. Unit 1 and 2 produces 10.5 KV and unit 3, 4, 5 and 6 produces 15.75 KV. The brief description of the generation process of GPS has given as follows. The frequency of the generators is 50 Hz and speed is 3000 rpm. Figure 5.1 shows the generator of unit-4 at GPS.

Figure 5.1: Generator at GPS (Unit-4).

5.2 Generator Ratings

In GPS, the 210 MW units and the 55 MW units have certain generator ratings. The 55 MW generators of unit 1 and 2 are manufactured by Electrosila, Russia. The 210 MW generators are manufactured by Elektrotyazhmash, Ukraine. The ratings of these generators are given in table 5.1.

Table 5.1: Rating of Generator.

Specification	210MW generator	55MW generator
Model	TGB-200MT3	TB-06-2
Output Power	210 MW	55 MW
Pole	2	2
Phase	3	3
Terminal voltage	15.75 kV	10.5 kV
Stator current	9060 A	3780 A
Rotor excitation current (DC)	1950 A	1445 A
Frequency	50 Hz	50 Hz

5.3 Main Components

Main components of the generator are

1. Stator
2. Rotor
3. Brush and slip rings

Figure 5.2 shows the stator and rotor of unit-6 at GPS.

Figure 5.2: Stator and rotor at GPS (unit-6).

5.3.1 Stator

Stator is the armature of generator. It is the stationary part where three phase electricity is produced. When the magnetic field of the rotor cuts the stator windings, an EMF (Electromotive Force) is produced in the stator windings. In GPS, the stator has 30 slots and 2 windings per slot. The stator windings are designed in such a way that each phase has 20 windings. Figure 5.3 shows the stator of unit-6 at GPS.

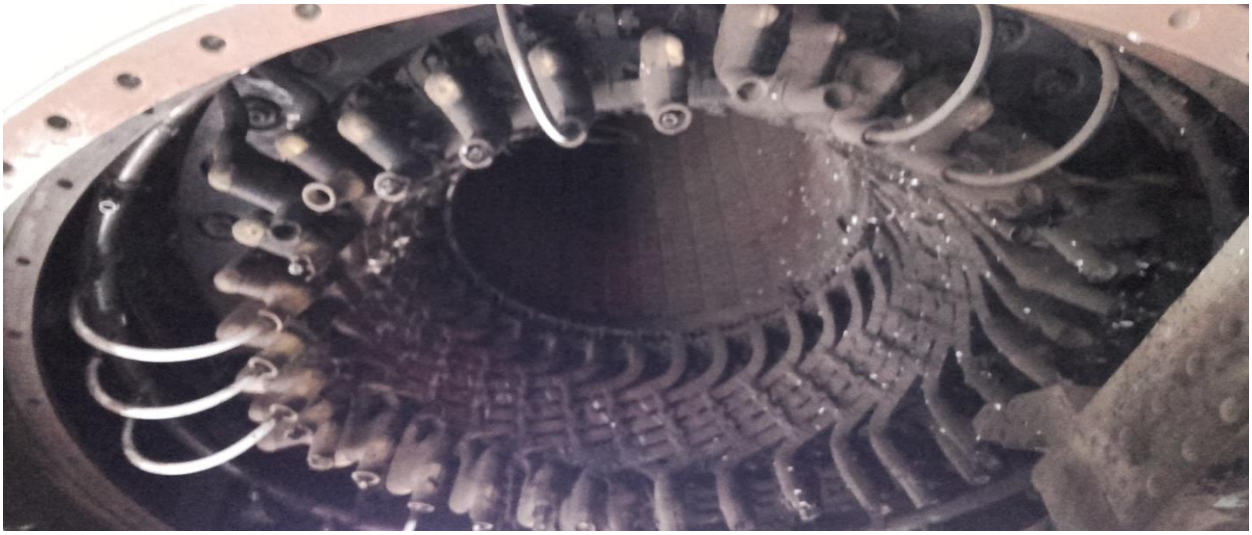

Figure 5.3: Stator of unit-6 at GPS.

5.3.2 Rotor

Rotor is the rotating part of generator. In GPS, the rotor has two poles and it rotates at 3000 rpm. Rotor is coupled with the turbine. Turbine is the prime mover of rotor. DC excitation is provided in the rotor for generating an electric current in the rotor windings. Rotor has 18 slots or bars. Silver soldering (combination of 45% silver, 30% copper and 25% zinc) is used in the rotor windings. Figure 5.4 shows the rotor of unit-6 at GPS.

Figure 5.4: Rotor of unit-6 at GPS.

5.3.3 Carbon Brush and Slip Rings

DC excitation is provided in the rotor by means of carbon brush and slip rings. In GPS, there are total 208 carbon brushes and two slip rings. 104 carbon brushes are connected to positive terminal and 104 brushes for connected to negative terminal of supply. Figure 5.5 shows carbon brush and slip ring chamber of unit-4 at GPS.

Figure 5.5: Carbon brush and slip ring chamber (Unit-4).

5.4 Generator Cooling

Generator cooling is very necessary for safe operation. Due to rotation and dc current supply rotor is heated. Stator is the conducting part of generator and due to continuous flow of electricity stator is heated. In GPS, two types of cooling is used.

5.4.1 Stator Cooling

Water is used for stator cooling in GPS. Water carrying pipes are passed through the stator windings. This water supply removes the heat through heat exchange. Demi water is supplied through the tubes by a pump. After circulating the stator when heat is exchanged this water goes to the cooling chamber. This heat exchanging process is continuous. Figure 5.6 shows the stator water pipes.

Figure 5.6: Stator water pipes.

5.4.2 Rotor Cooling

In GPS, hydrogen (H_2) is used to cool the rotor. H_2 is used in rotor cooling because it has a light weight and is easy to pass during rolling the rotor. H_2 has high dielectric property and absorbs high amount of heat. The H_2 is 97% pure and relative humidity is 25%. A fan is used to circulate the flow of H_2. H_2 is injected in the air gap between stator and rotor.

5.5 Generator Excitation

For creating magnetic fields in the rotor windings DC excitation is provided. Carbon brush and slip rings are used to supply the DC voltage during rolling. This excitation process has two parts.

5.5.1 Initial Excitation

When the generator is started but not synchronized with the grid, excitation is provided by means of batteries. In GPS, a number of electrolytic cells are connected in series and used as a battery bank. This battery bank is placed in the substation. Figure 5.7 shows the battery bank of GPS.

Figure 5.7: Battery bank for initial excitation.

5.5.2 Excitation during Operation

When the generator is synchronized with the grid, the battery is disconnected by a circuit breaker and dc excitation is given from the 15.75 kV line. When the generator is synchronized with the grid, the terminal voltage of the stator is stable. In GPS, for the 210 MW generators this voltage is 15.75 kV. For the 55 MW generators this voltage is 10.5 kV. In GPS, from the 15.75 kV line, voltage is stepped down by a rectifier transformer and the secondary terminal of the rectifier transformer is connected to a thyristor. The rectifier transformer steps down 15.75 kV to 580 V. The thyristor converts the ac current to dc. This dc supply is provided to the rotor carbon brushes.
Voltage regulator is used to control the dc excitation current. The output voltage of the generator is controlled by controlling the excitation current. Disconnecting the battery is done automatically after few seconds of generator synchronization.

5.6 Generator Protection

Generator protection is one of the most important tasks of GPS. Generator of unit-6 was damaged and the blades of low pressure turbine was damaged due to inappropriate protection. So, for safe and long lasting operation, it is necessary to take adequate protection for generator. The protection system in GPS for generator is given below.

5.6.1 Internal Stator Fault Protection

Two types of internal faults can occur in stator.

Phase to Earth Fault Protection

This type of fault occurs if any of the phases meet the ground or body of the generator. In this situation, the phase sequence becomes abnormal. To detect this fault differential protection is provided. A current transformer (CT) is connected in the neutral to earth connection. When the generator is connected directly to the bus bar, an inverse time relay is used across the CT secondary.

Phase to Phase Fault Protection

This type of situation can occur if the phases of the stator come in contact. This type of accident occurs due to insulation breakdown of stator windings. Therefore, huge current will flow through the stator. To avoid this accident differential protection system is used between the phases of the stator. Differential relays are used between the phases. Figure 5.8 shows differential protection scheme for stator protection.

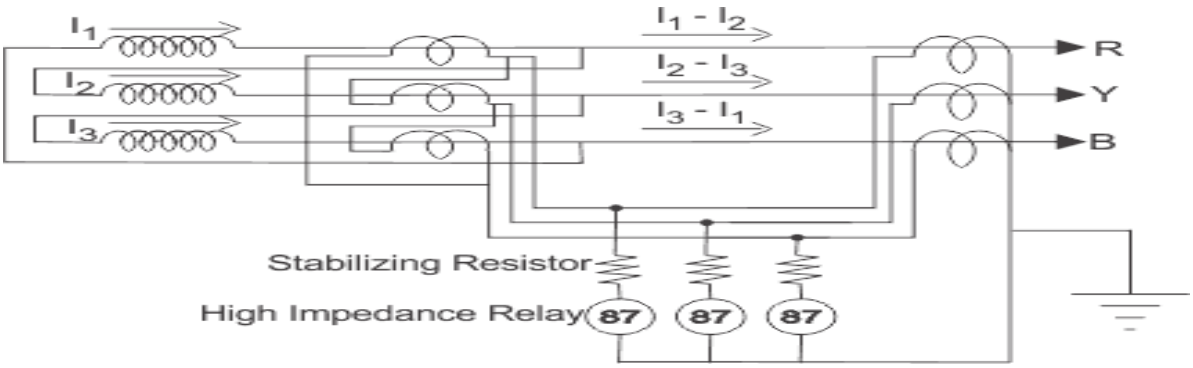

Figure 5.8: Differential protection scheme for stator protection [8].

5.6.2 Rotor Earth Fault Protection

If the insulation of the rotor winding is damaged, then this problem can occur. One earth fault will not create much damage to the circuit, but if the second fault occurs then the magnetic field of the rotor will be unbalanced. To avoid this problem three mechanisms are available. These mechanisms are [11]

1. Potentiometer method
2. AC injection method
3. DC injection method

In GPS, AC injection method is used.

AC Injection Method

In this method, one voltage relay is connected with the field windings and the exciter circuit. This relay is connected to the ground through a capacitor and the secondary winding of an auxiliary transformer. If any fault occurs in the field winding or exciter circuit, the relay contacts will be closed and the voltage of the secondary winding of the auxiliary transformer will appear across the voltage sensitive relay. Thus the relay will operate. Figure 5.9 shows the diagram of ac injection method for rotor earth fault protection.

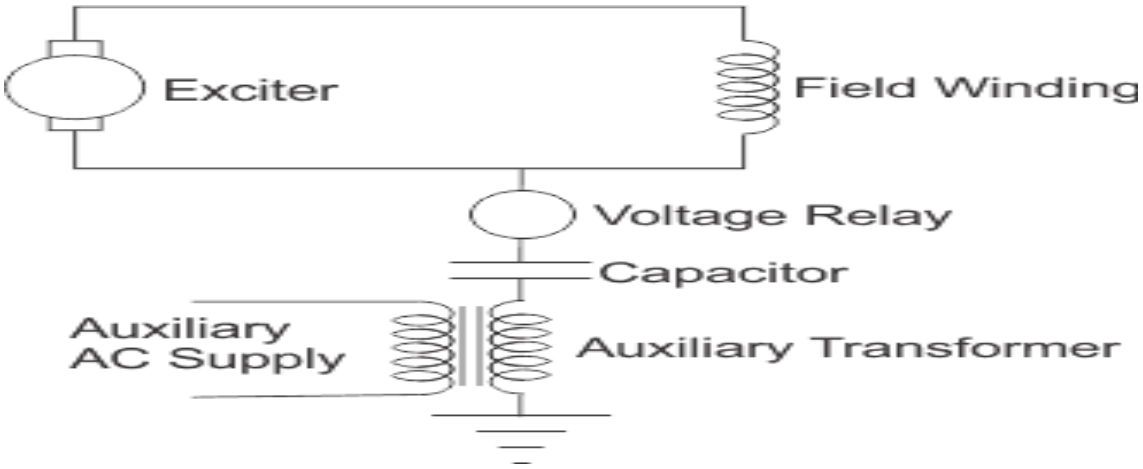

Figure 5.9: AC injection method for rotor earth fault protection.

5.6.3 Unbalanced Loading

If there is unbalance in the stator loading, it can cause serious damage to the generator. Due to unbalance loading, negative current flows towards the generator. If any unbalance occurs due to the fault in the stator windings that would be cleared instantaneously by the differential protection provided in the generator. Unit circuit breakers are used to disconnect the generator from grid if negative current flows. Inverse time over current relay is used to detect negative current during unbalance loading.

5.6.4 Loss of Excitation

If the generator is operating at high load and excitation at the rotor is low, it will produce an insufficient current compared to load. In this situation, the generator will draw high amount of reactive power. Therefore, emergency tripping is necessary. To detect this problem reactive power relay is used.

5.6.5 Thermal Overloading

Temperature is increased due to insufficient cooling of stator and rotor. It also occurs for over loading. To detect thermal overloading temperature detectors are placed in different points of generator, especially near the bearings. In GPS, thermocouple is used to detect temperature rise. A relay triggers an alarm on if the temperature is very high.

5.6.6 Over Speed Protection

Over speed protection or low forward power protection is necessary for generator. If the load is reduced or the unit circuit breaker is tripped but turbine is not stopped then this type of problem is occurred. This is why during emergency purposes if the unit circuit breaker is tripped, turbine must be tripped simultaneously. For over speed protection, governor is used to control the speed according to load demand.

5.6.7 Reverse Power Protection

If the prime mover speed is reduced to critically low speed or the prime mover is stopped but generator is connected to grid, then reverse power will flow to generator from grid. It is called motoring of generator. This type of problem occurred in GPS at unit 6. To prevent this problem unit circuit breaker is used. In GPS, reverse power relay are used to detect reverse power flow.

5.6.8 Under Frequency Protection

If a generator or a group of generators are supplying to a system where the load is higher than the prime mover capability, then it will cause under frequency condition. Generally, this situation is occurred when one generator for a particular region is shut down and another generator tries to fill up the total demand. At this situation, load-shedding scheme is applied to remedy the situation. In GPS, under frequency relay is used to detect under frequency condition. If the load-shedding scheme fails then the generator is forced shut down.

Chapter 6 : Sub-Station

6.1 Introduction

Sub-station is an assembly of machineries used to change some characteristics (e.g. voltage level, ac to dc, power factor etc.) of electric supply. Sub-station is an important part of power system which is used for transmission and distribution of electricity [9]. At the sub-station of GPS, various kinds of equipment are installed that are discussed in this chapter. Figure 6.1 shows the sub-station at GPS.

Figure 6.1: Sub-station of GPS.

The arrangement of the sub-station is made to transmit through 230 kV and 132 kV transmission lines. For the safety of the sub-station, safety equipments are installed. 2.5 MVA transformer is connected from generator which supplies power to generator for excitation. The auxiliary transformer is directly connected with generator to supply the auxiliary equipment. At GPS, two 125 MVA transformers are connected from generator. These transformers step up the voltage from 15.75 kV to 230 kV and supply power to 230 kV grid line. There is a 32 MVA reserve auto transformer which takes power from the grid to supply plant equipment when the generator is not in generating mode. Here, between 230 kV and 132 kV grid line, the autotransformer is implemented. When there is excess power in any grid line, this autotransformer supplies power from one grid to another grid. Figure 6.2 shows the single line diagram of unit-5 at GPS sub-station.

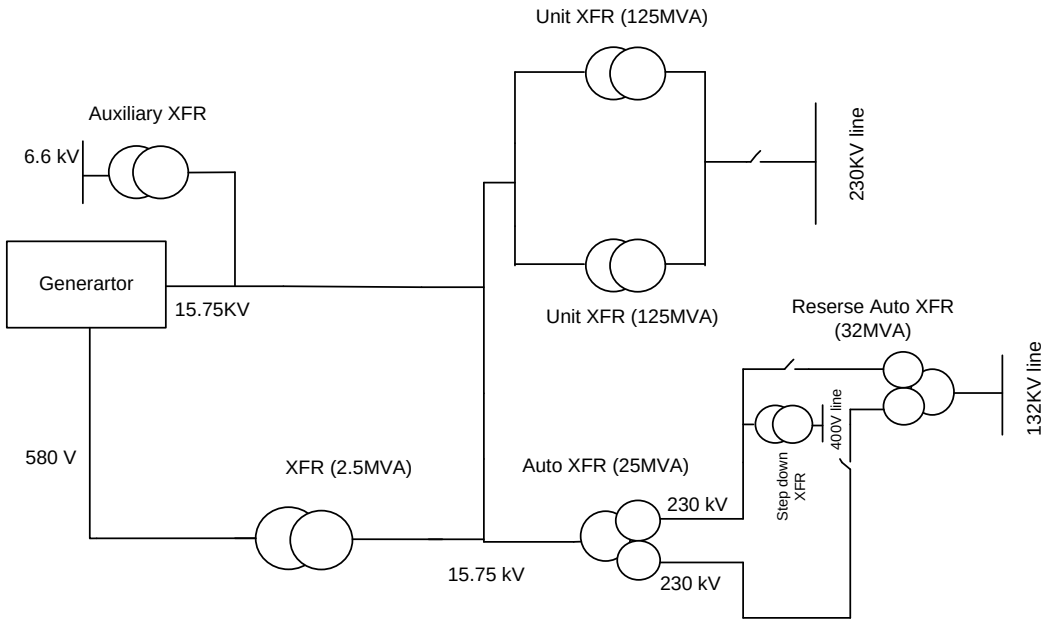

Figure 6.2: Single line diagram at GPS sub-station.

6.2 Transformers

A transformer is a static piece of apparatus that changes ac electric power of one voltage level to ac electric power of another voltage level at constant frequency. Transformers are classified with respect to transformation, arrangement of coils and magnetic circuit, the method employed in cooling, the kind of service, etc. There are different types of transformers like power transformers, auxiliary transformers, coupling transformers, instrument transformers which are used in GPS for different purposes. In this section, we have discussed about different types of transformers in GPS.

6.2.1 Power Transformer

The power transformer in sub-station is employed to change the voltage level. It is also known as unit transformer. It is generally used for stepping up the voltage level. For example, at GPS 55 MW unit and 210 MW unit generators generate 10.5 kV and 15.75 kV respectively. When this power is transferred through a transmission line it requires to reduce the value of current. So, step up transformer generates high voltage up to 132 kV or 230 kV. Here the power and frequency remains constant. Figure 6.3 shows a power transformer of unit-5 at GPS.

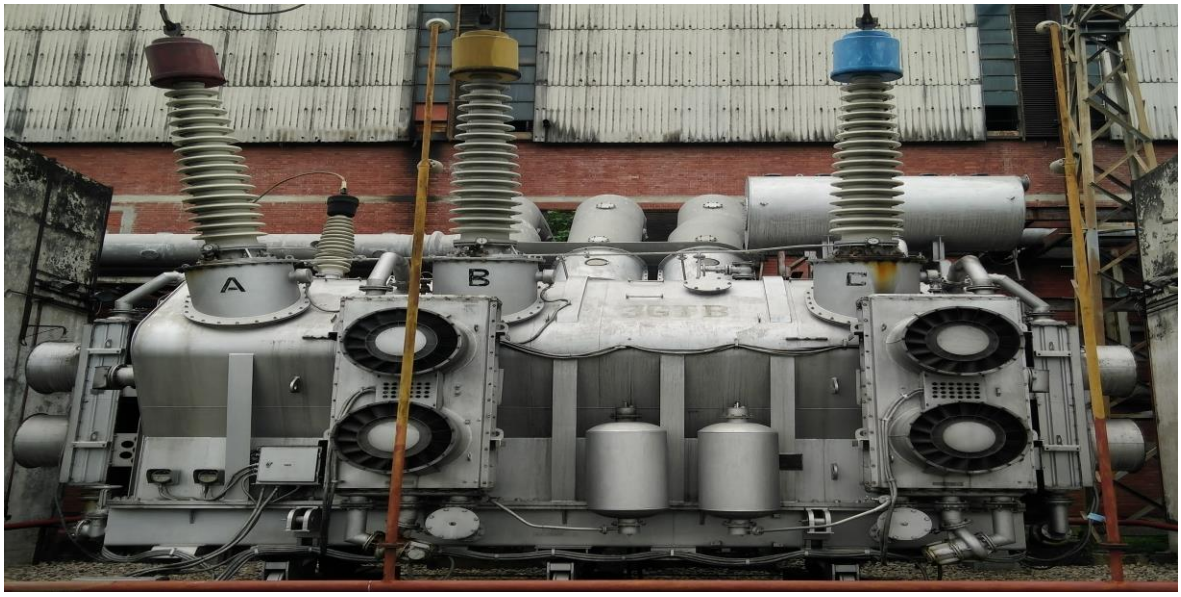

Figure 6.3: Power transformer.

6.2.2 Auxiliary Transformer

The auxiliary equipment of the power generating station need power which are provided by the auxiliary transformer. At GPS, auxiliary transformer is directly connected to the generator and supplies power to the auxiliary equipment such as motors, lights, other plant loads etc. It is a three winding transformer which has one primary and two secondary windings. The primary winding voltage rating is equal to the main generator voltage rating. The secondary winding may have same or different voltage rating. Figure 6.4 shows an auxiliary transformer at GPS, which is made in Korea by Hyosung Heavy Industries Ltd. and the rating of this transformer is given in table 6.1.

Table 6.1: Rating of an auxiliary transformer.

Year of Manufacture	1985
Serial No.	P84-6914
Cooling Type	ONAN / ONAF
Volts	15.75 / 6.6 kV
Apparent Power	18750 / 25000 kVA
Bearable Insulation Level of High Voltage	170 kV
Bearable Insulation Level of Low Voltage	60 kV
Frequency	50 Hz
Winding Temperature Rise	55˚C
Oil Temperature Rise	50˚C
Ambient Temperature	45˚C
Total Weight	38800 kg
Insulating Oil Weight	5000 kg
Standard	IEC 76

Figure 6.4: Auxiliary transformer.

6.2.3 Coupling Transformer

Coupling transformer is used in sub-station to step up or step down the voltage level. At GPS, coupling transformers are situated between the 132 kV and 230 kV bus bars. If any fault occurs for an example, voltage level falls down and 132 kV bus bar is de-energized then it is required to energize. At that time, coupling transformer steps down the voltage taken from 230 kV bus bar to 132 kV bus bar and then 132 kV bus bar will be instantly energized. Similarly, if 230 kV bus bar is de-energized then coupling transformer steps up the voltage taken from 132 kV bus bar to 230 kV bus bar and the 230 kV bus bar will be energized. Figure 6.5 shows the coupling transformer at GPS and the rating of a coupling transformer at GPS given in Table 6.2.

Table 6.2: Ratings of a coupling transformer.

Year of Manufacture	1985
Serial No.	152810
No. of the Specification	IEC76
No. of Phase	3
Type of Cooling	ONAN/ONAF
Rated Frequency	50 Hz
Rated Power	100/150 MVA
Rated Voltage Primary	240 kV
Rated Voltage Secondary	140 kV
Rated Current Primary	240/360 A
Rated Current Secondary	412/618 A
Temp. Rise Oil	50˚C
Temp. Rise Wind	55˚C
Ambient Temperature	45˚C
Conductor Material	Copper
Type of Insulating Oil	IEC 296
Total Mass	220000 kg

Figure 6.5: Coupling transformer.

6.2.4 Instrument Transformer

Instrument transformer is a transformer mostly used for measuring and protection purposes. This transformer steps down the voltage and current. Instrument transformer is classified into two groups.

1. Current Transformer (CT)
2. Potential or Voltage Transformer (PT)

Current Transformer (CT)

Current transformers (CT) are used for stepping down AC current from higher value to lower value for measurement and protection. At GPS, current transformers are used at 132 kV and 230 kV bus bar systems. These transformers are made by Crompton Greaves Limited in India. Ratio of these transformers are 1500-750/1 with rated frequency 50 Hz. Figure 6.6 shows a CT of 230 kV bus bar at GPS.

Figure 6.6 : Current transformer (CT).

Potential Transformer (PT)

Potential transformer is used for measurement and protection by stepping down voltage from higher value to lower value. It is also known as voltage transformer. At GPS, potential transformers are used at 132 kV and 230 kV bus bar systems, which are made by Crompton Greaves Limited in India. At 230 kV bus bar, the PT ratio is 230 kV/100 V and at 132 kV bus bar, PT ratio is 132 kV/100 V. Figure 6.7 shows a PT of 230 kV bus bar at GPS.

Figure 6.7 : Potential transformer (PT).

6.3 Cooling System of Transformer

At GPS, there are two types of cooling system used for transformer cooling.

1. Oil Natural Air Forced (ONAF) cooling system
2. Oil Forced Air Forced (OFAF) cooling system

6.3.1 Oil Natural Air Forced (ONAF) cooling system

Oil Natural Air Forced (ONAF) cooling system is simpler than OFAF cooling system. If dissipating surface of transformer is increased, transformer heat dissipation can be increased. Instead of increasing the dissipition surface, air flow is increased in this system. Fans blowing air on cooling surface is employed. Forced air flow is better than natural air flow because here fans are mounted near the raditor and the forced air takes away the heat from the surface of radiator [11]. Figure 6.8 shows the ONAF cooling system.

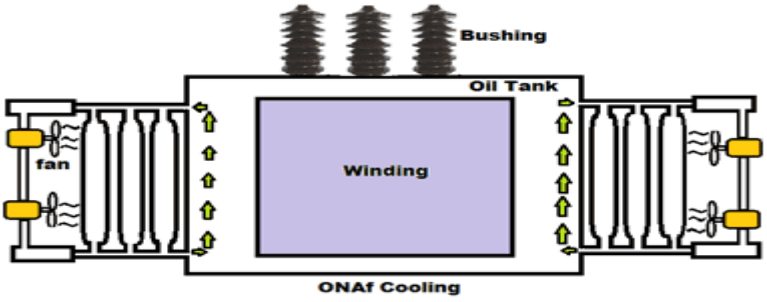

Figure 6.8: Oil Natural Air Forced (ONAF) cooling system [10].

6.3.2 Oil Forced Air Forced (OFAF) cooling system

In Oil Forced Air Forced (OFAF) cooling system oil is forced to circulate within the closed loop transformer tank and forced oil exchange heats. Here, a pump does oil circulation and cooling fans give forced air. Figure 6.9 shows the OFAF cooling system.

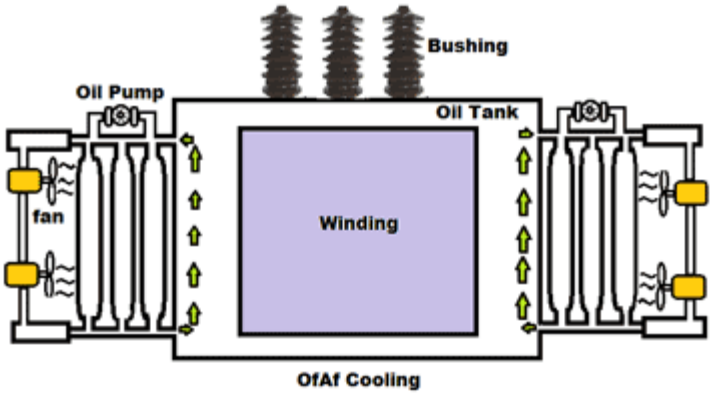

Figure 6.9: Oil Forced Air Forced (OFAF) cooling system [10].

6.4 Transformer Tap Changer

A tap changer is a connection point selecting mechanism, which is used in distribution transformers to regulate the output voltage to the required levels. To keep the supply voltage within the limits it deals variable control by allowing a variable number of turns to be selective in discrete steps. Figure 6.10 shows a tap changer of distribution transformer at GPS.

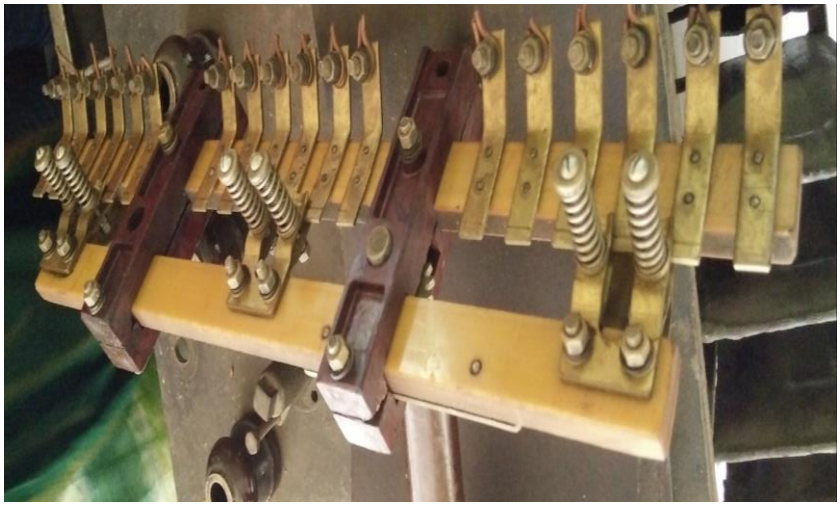

Figure 6.10 : Transformer Tap Changer.

6.5 Megger Test

Testing of transformer is classified into two groups. One is type test which is performed in the factory and another one is routine test. Routine tests are made on each and every transformer. Megger test is a type of routine test. It is also known as insulation resistance test. This is done to check the insulation of winding of the transformer. Insulation resistance is measured by megger. To perform this test the primary and secondary terminals are connected with the megger and the voltage is applied from an external dc source.

6.6 Transmission Equipments

At GPS, there are different types of transmission equipment that are described below.

6.6.1 Bus Bar

Bus bar is a very important component in sub-station, which is used as the common electrical component. It is used when a number of lines operating at the same voltage have to be electrically connected. There are two types of bus bars used in GPS. At GPS, all incoming feeders are connected to single bus bar system and double bus bar system is used between 132 kV and 230 kV bus bar system. These are described in this section [10].

Single Bus bar System

A single bus bar system consists of a single bus bar and here all the incoming and outgoing lines are connected. The advantages of single bus bar system include low initial cost, less maintenance and simple operation. However, the disadvantage is when repairing has to be done on the bus bar or a fault occurs at the bus bar the supply will be completely interrupted. Figure 6.11 shows the single bus bar system.

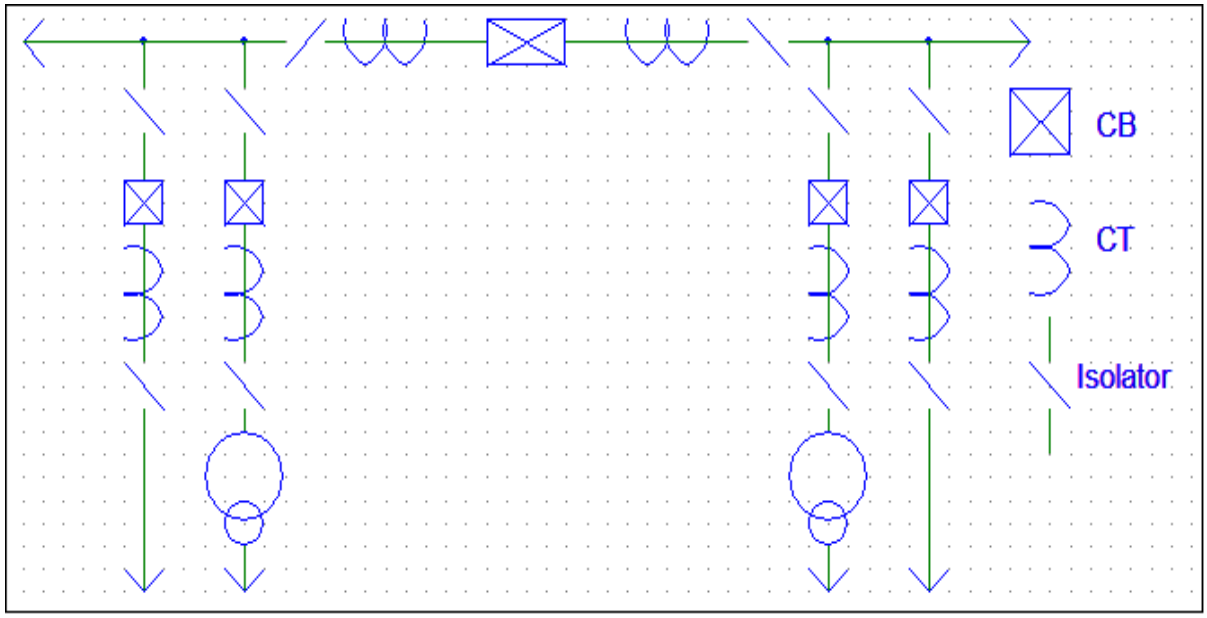

Figure 6.11: Single bus bar system.

Double Bus bar System

A double bus bar system consists of two bus bars. One is a main bus bar and another is a spare bus bar. Each bus bar has capacity to carry the entire sub-station load. The incoming and outgoing lines are connected to either of the bus bars by a bus bar coupler. At the GPS, the incoming and outgoing lines are connected to main bus bar. Figure 6.12 shows the double bus bar system.

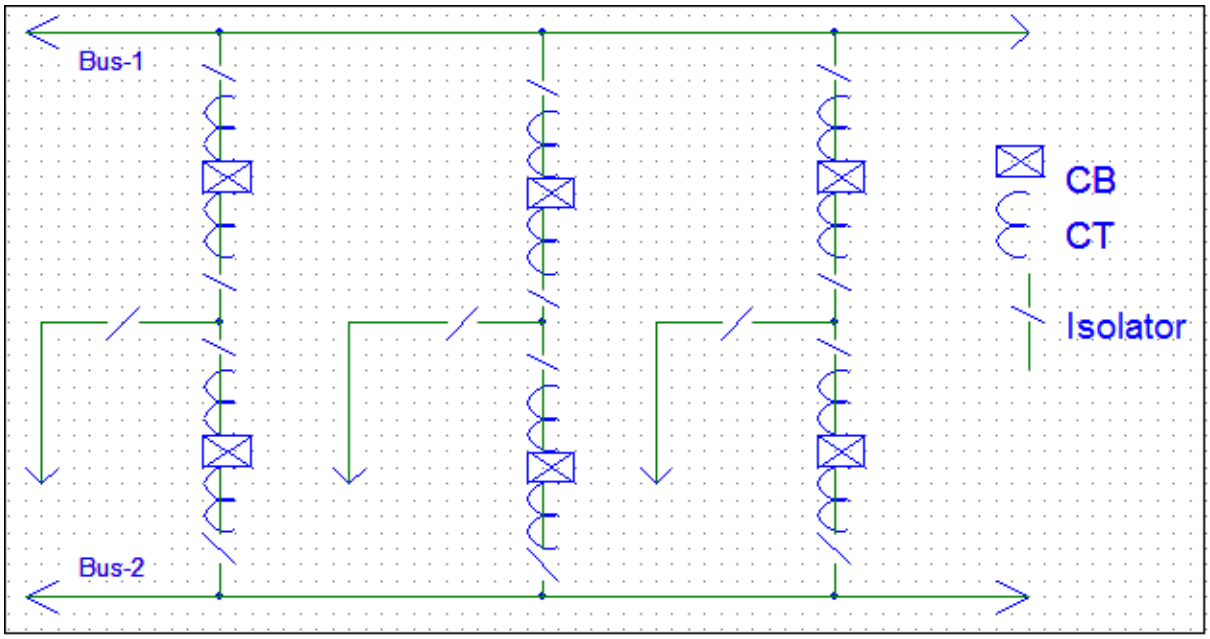

Figure 6.12: Double bus bar system.

6.6.2 Wave Trapper

Wave trappers are parallel tuned inductor-capacitor tank circuit, which are used at sub-stations using Power Line Carrier Communication (PLCC). It operates at high frequency and the frequency acts as harmonics towards the electrical equipments. The wave trapper allows the power signal to flow and traps the communication signal to protect electrical equipments. Figure 6.13 shows the wave trapper at GPS.

Figure 6.13: Wave trapper at GPS.

6.6.3 Transmission System

Transmitting the power from generation station to different load centers is known as an electrical transmission system. For transmitting the power, transmission lines are used which are generally three types. These are given below.

- Short transmission line which is less than 80 km
- Medium transmission line which is greater than 80 km and less than 160 km
- Long transmission line which is greater than 160 km

Figure 6.14 shows 230 kV transmission line at GPS.

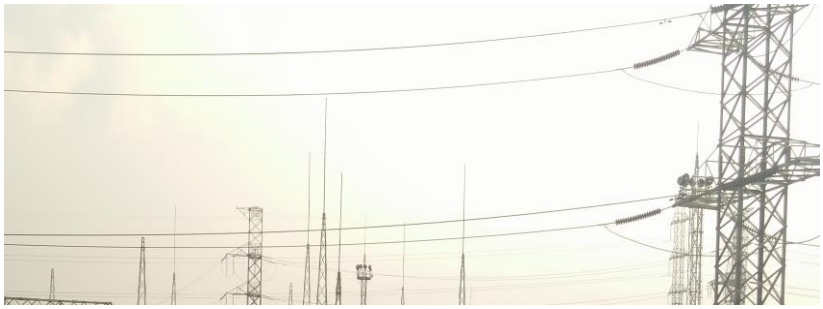

Figure 6.14: 230 kV Transmission Line.

6.7 Bay

A bay is the interconnection of the following equipment, such as, potential transformer (PT), lightning arrester, isolator, current transformer (CT) and circuit breaker. There are three types of bay.

1. Incoming feeder bay
2. Outgoing feeder bay
3. Transformer bay

An incoming feeder bay at GPS, is shown in figure 6.15.

Figure 6.15: Incoming feeder bay at GPS.

6.8 Protection System

Protection system deals with the protection of electrical power system from faults and isolates the faulty parts. It is very important to save electrical equipment and human lives. At the GPS, many protective devices like circuit breaker, isolator, insulator, lightning arrester, relay etc. are used to operate and maintain the power system. In this section, we have discussed about protection system of GPS.

6.8.1 Circuit Breaker

Circuit breaker is a switching device that can be operated manually or automatically for control and protection of electrical power system [11]. At the GPS, there are different types of circuit breakers. These are discussed below.

Air Blast Circuit Breaker (ABCB)

Air blast circuit breaker is the fastest high voltage circuit breaker. It operates in microseconds. In the air blast circuit breaker, compressed air at pressure of 20 kg/cm^2 to 30 kg/cm^2 is employed as an arc-quenching medium. The main advantage of using ABCB is that, there is no chance of fire hazard caused by oil and it requires less maintenance. Figure 6.16 shows air blast circuit breaker at GPS.

Figure 6.16: Air blast circuit breaker (ABCB).

SF_6 Circuit Breaker

SF_6 circuit breaker has very short arcing time and operates without noise. In this circuit breaker sulfur hexafluoride (SF_6) gas is used as the arc-quenching medium. SF_6 gas is an inert, non-toxic and heavy gas with good dielectric strength and excellent arc quenching property. Therefore, it is very popular. Figure 6.17 shows SF_6 circuit breaker of GPS.

Figure 6.17: SF_6 circuit breaker.

Vacuum Circuit Breaker (VCB)

Vacuum circuit breaker is a metal enclosed switchgear where the arc quenching takes place in vacuum. VCB is smaller than other breakers and it requires small place. The lifetime of a vacuum CB is much longer than other breakers. It is user friendly and pollution free CB. Figure 6.18 shows the vacuum circuit breaker at GPS.

Figure 6.18: Vacuum circuit breaker.

6.8.2 Insulator

Insulator is very useful for a sub-station. It actually serves two purposes. It supports the conductors and confines the current to the conductors. Porcelain is used for the manufacture of insulators. Insulators are known as bushing. At GPS, strain type insulator are used which are employed at the dead end of the transmission line.

6.8.3 Isolator

At GPS sub-station, isolator is used to disconnect a part of the system for general maintenance purposes and repairs under no load. It is manually operated. Figure 6.19 shows isolator at GPS.

Figure 6.19: Isolator at GPS.

6.8.4 Lightning Arrester

Lightning arrester is a protective device. It is used for limiting surge voltages due to lightning strikes or equipment faults or other events. It is also known as surge arresters. It prevents damage of

equipment and disturbance of service. Lightning arrester has a high voltage terminal and a ground terminal. When any high voltage or thunderstorm occurs, air insulation of the gap breaks. Then arc is formed for providing a low resistance path for the surge to the ground. As a result, the extra charges are grounded by the lightning arrester. The lightning arrester does not work under normal condition. Figure 6.20 shows lightning arrester at GPS.

Figure 6.20: Lightning arrester at GPS.

6.8.5 Sky Wire

Sky wires are overhead ground wires, which are used for lightning protection. It is used in transmission lines to protect the lines by providing a ground path.

6.8.6 Relay

Relay is a sensing device, which senses an abnormal condition of electrical circuit and operates its contact automatically. There are different types of relays used at GPS for different purposes, which are discussed below.

Differential Relay

Differential relay is a very commonly used relay for protecting transformers and generators. In transformer this relay compares between primary current and secondary current of a transformer. If any unbalance is found the relay will be active and it will trip the circuit breaker of the transformer.

Buchholz Relay

Buchholz relay is a safety device, which is used specially in power transformer. In power transformer, there are many internal faults such as impulse breakdown of the insulating oil, insulation failure of turns and buchholz relay protects the transformer from these faults. Figure 6.21 shows a buchholz relay at GPS.

Figure 6.21: Buchholz relay at GPS.

Distance Relay

Distance relay protection is specially used in transmission lines. If any fault occurs in the transmission line then this relay begins to work. The operation of this relay depends on the ratio of voltage and current. So, it is also known as impedance relay.

Chapter 7: Control Room

7.1 Introduction

Control room of a power station is basically a place, from where all the working units of a power station are maintained. It is very important for a power station. It consists of different control units. Each of the units is controlled and maintained by a group of engineers. At GPS, there are three control rooms. Generally, there are two controlling units in a control room. Control room 1 is used for operating unit 1 and 2. Control room 2 is used for operating unit 3 and 4 and control room 3 is used for operating unit 5 and 6.

7.2 Control Desks

At GPS, there are different types of control desks. The desks are boiler desk, turbine desk and generator desk. Always engineers are monitoring the desks. The different types of desks are described below.

7.2.1 Boiler Desk

Boiler of a power station is controlled from boiler desk. From here engineers can control demineralized water level, gas pressure, temperature of boiler etc. Here all switches are operated manually. Figure 7.1 shows a boiler desk of unit-3 at GPS.

Figure 7.1: Boiler Desk.

7.2.2 Turbine Desk

Turbine desk is a desk where turbine is controlled. All the work is done manually from here. From turbine desk, the engineers control the temperature of the steam turbine. The lubrication pressure in the steam turbine, as well as the oil level of that turbine is also controlled from here. These works are done for the protection of the turbine and for controlling the turbine speed. Figure 7.2 shows a turbine desk of unit-3 at GPS.

Figure 7.2: Turbine Desk.

7.2.3 Generator Desk

From the generator desk generator is controlled. All the controlling tasks, which are related to the generator, such as controlling the hydrogen pressure, excitation voltage, synchronous speed etc. are done from here. The engineers do all of the controls manually. Figure 7.3 shows a generator desk of unit-3 at GPS.

Figure 7.3: Generator Desk.

Chapter 8: Conclusion

GPS is the largest power station in Bangladesh for generating electricity. We have gathered experience and practical knowledge of generation and distribution of power from our internship. The engineers of GPS are highly experienced and capable. Their helpful behavior helped us and encouraged us to learn better and gather as much knowledge as possible in these fifteen days of internship. It was a great opportunity for us to have an experience of power generation process at GPS and see the practical work, which we learned theoretically at our university.
During our internship, we have observed the generation, distribution and protection system of the six units at GPS. The total experience that we have from GPS is helpful to understand the working procedure of power sector. This experience will provide us confidence to face interview and build our future carrier in power sector.

8.1 Problem

We have faced some problems during the period of our internship. Such as,

- 15 days are not sufficient time to understand the whole process of GPS.
- At GPS, we cannot participate in any practical work. We have just observed the system and working procedure.
- Due to privacy of administration, we could not collect some data or information.
- Due to lack of practical knowledge about mechanical part, we faced some problems to understand this part.

8.2 Recommendation

From the experience of our internship, we have some recommendations. These are as follows

- Before going to intern, students must complete the power station related courses. They should have the knowledge of boiler, turbines, generator and substation. They should also know the working principles of the relays and circuit breakers, which are used in power stations.
- Everyone should know the safety procedures of the power station before entering the boiler and generator sections.
- The period of our internship was 15 days. We have tried our best to learn as much as possible in these 15 days. However, the generation process is a very large operation. It is not enough to understand the total operation. Therefore, the tenure of the internship should be increased.

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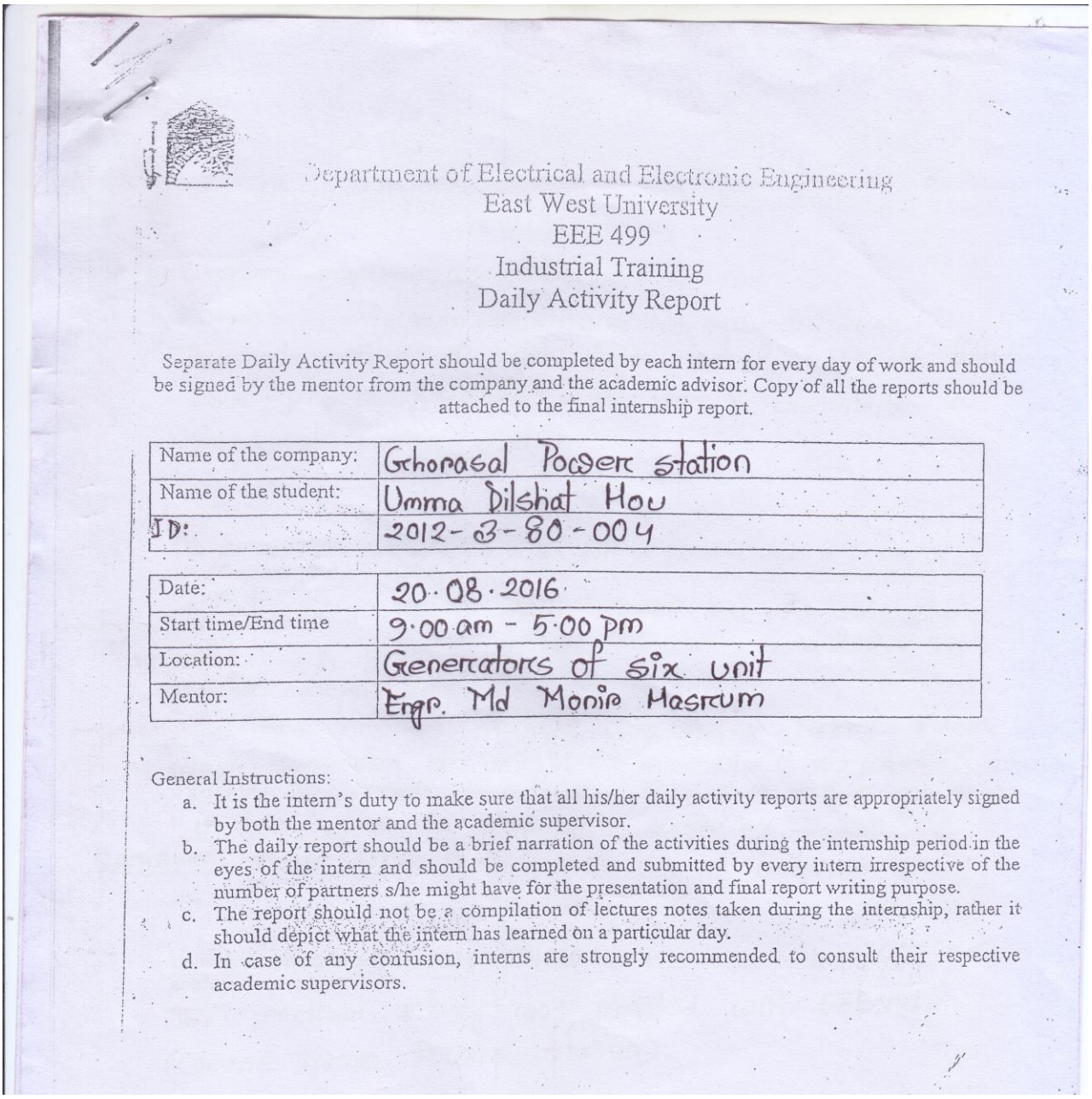
Appendix



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:	Ghorasal Power station
Name of the student:	Umma Dilshat Hou
ID:	2012-3-80-004

Date:	20.08.2016
Start time/End time	9.00 am - 5.00 pm
Location:	Generators of six unit
Mentor:	Engr. Md Monir Hasrum

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 activity was to familiar how power generate, Transmit & distribute in Ghorasal power station.

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

Generation: In Ghorashal power station, there are six units where unit 1 & 2 generate 55 MW individually & unit 3, 4, 5 & 6 generate 210 MW individually.

Transmission: Transmission voltage are 33KV, 132KV, 230KV Line.

Transformer: Generator of unit 1 & 2 generate 10.5KV which is step up 132KV by power transformer & unit 4, 5, 3, 6 generate 15.75KV which is step up by 230KV by transformer.

Comment: From 2010 unit 6 was out of service.

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

The practical activity was related with EEE441. (Course Name: Power Station).

29.09.16
Signature of the mentor with date
Name: Engr. Md Monir Hasnum
Designation: XEN, 1-4-6 unit, GPS.
Contact Phone #:

04.10.2016
Signature of academic supervisor with date
Name: Dr. Anisul Haque
Designation: Professor
EEE Department
East West University
Dhaka, Bangladesh

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East West University
EEE 499
Industrial Training
Daily Activity Report

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Name of the company:	Ghorasal power station
Name of the student:	Umma Dilshat Mou
):	2012-3-80-004

Date:	21.08.2016
Start time/End time	9.00 am - 5.00 pm
Location:	Boiler (Maintenance)
Mentor:	Engr. Md. Aminul Huq

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.

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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 were to know about various purpose of maintanance of boiler.

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.

Boiler maintenance:
Routine: The boiler mountains should check after three years repeatation.
Breakdown: use for replacing any equipments
Overhauling: It is done for save the equipments
Preventive: If more than three tubes of water damages then the plant shut down.
Comment: Here, we visit the maintenance section of the boiler.

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

The practical activity was related with EEE441

21.08.16
Signature of the mentor with date
Name: Engr. Md. Aminul Huq.
Designation: XEN, 5-6unit, Boiler Maint GPS
Contact Phone #:

04.10.2016
Signature of academic supervisor with date
Name: Dr. Anisul Haque
Designation: Professor
EEE Department
East West University
Dhaka, Bangladesh

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EEE 499
Industrial Training
Daily Activity Report

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Name of the company:	Ghorasal power station
Name of the student:	Umma Bikhat Mou
ID:	2012-3-80-004

Date:	22-08-2016
Start time/End time	9.00 am – 5.00 pm
Location:	Sub-Station
Mentor:	Engr. Abdullah Bin Aziz

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.

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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 were to familiar with some parts of substation equipment.

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

list: Transformers, current XFR, Potential XFR, Busbar, Lighting arresters, Relay, circuit breakers, Isolator.

Circuit breaker: It is use for protection.

Relay: It is used for the sense of the fault.

CT: It is used for ~~transmission~~ transformers current.

Isolator: It is used for isolate faulty zone.

Busbar: It is used for transmit power for grid.

PT: It is used to present negligible load to supply.

Comment: In the substation we saw different type of XFR protection.

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

The practical activity was related with EEE 441 (power station) & EEE 442 (switchgear).

22/09/16

Signature of the mentor with date
Name: Engr. Abdullah Bin Aziz
Designation: XEN, 1-4unit, sub-station. GPS.
Contact Phone #:

04.10.2016

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

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Daily Activity Report

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Name of the company:	Ghorasal power station
Name of the student:	Umma Dilshad Mou
ID:	2012-3-80-004

Date:	23.08.2016
Start time/End time	9.00am - 5.00pm
Location:	Boiler
Mentor:	Engr. Md. Shafiqul Alam

General Instructions:

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

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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 were to know about the controller, control loop, control valve, transmitter.

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

Controller: Here we control pressure, temperature etc.
Control loop: Loop is known as closed logic path.
Control valve: Here we control the pressure & level of fuel.
Transmitter: If we give input then we can get output from this device.
Comment: Here, we can understand about the control system.

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

The practical activity was related with EEE441 (power station)

03.8.16
Signature of the mentor with date
Name: Engr. Md. Shafiqul Alam
Designation: SDE, Boiler Maint. 1-4 unit, GPS
Contact Phone #:

04.10.2016
Signature of academic supervisor with date
Name: Dr. Anisul Haque
Designation: Professor
EEE Department
East West University
Dhaka, Bangladesh

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Daily Activity Report

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Name of the company:	Ghorashal power station
Name of the student:	Umma Dilshat Moo
ID:	2012-3-80-004

Date:	24.08.2016
Start time/End time	9.00 am - 5.00 pm
Location:	Switchgear control room
Mentor:	Engr. Md. Zahurul Islam.

General Instructions:

a. It is the intern's duty to make sure that all his/her daily activity reports are appropriately signed by both the mentor and the academic supervisor.
b. The daily report should be a brief narration of the activities during the internship period in the eyes of the intern and should be completed and submitted by every intern irrespective of the number of partners s/he might have for the presentation and final report writing purpose.
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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 were to know about the dc storage & DC powerr station.

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

DC power is use for emergency purpose such as switchgear control, lighting & emergency motors There are 2 types of battery : (i) Load acid & (ii) Ni-Cd battery.

Comment: We visited the DC storage in the station

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

The practical activity was related with EEE441

Zahurul 24/08/16

Signature of the mentor with date
Name: Engr. Md. Zahurul Islam.
Designation: xEN, 1-4 unit, Generator, GPS
Contact Phone #:

AHaque 04.09.2016

Signature of academic supervisor with date
Name:
Designation:

Dr. Anisul Haque
Professor
EEE Department
East West University
Dhaka, Bangladesh

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Name of the company:	Ghorashal Power Plant
Name of the student:	Abid-Al-Mahmud
ID:	2013-1-80-005

Date:	25/09/2016
Start time/End time	9.00 am - 5.00 pm
Location:	Ghorashal Power station Lab
Mentor:	Engr. Md. Abu. Baker

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.

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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 todays activities is to learn the procedure of different types of test of transformer.

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

From today's activities we have observed the following testing procedures of transformers. The tests are 1) Type test 2) Routine test 3) Oil test

comment- type test is done by manufacturers. Routine tests are done in EPS Labs.

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

These activities are related to the course
1. Electrical Machines Fundamentals (EEE-301)
2. Synchronous machines and Systems (EEE-304)

25/08/2016
Signature of the mentor with date
Name: Engr. Md. Abu Baker
Designation: Project Director (RTD)
Contact Phone #:

04.10.2016
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

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Name of the company:	Ghorashal Power Station
Name of the student:	Abid- Al- Mahmud
):	2013- 1- 80- 005

Date:	26/08/2016
Start time/End time	9.00 am - 5.00 pm
Location:	Control room and Boiler
Mentor:	Engr. Khirod Mohan Bose

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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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 todays activity is to observe the boiler operation, purging procedure and shutdown of boilar.

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.

We have visited the boiler and contral room and observed the fallowing phenomena

1. Before unit startup purging is done
2. Unit is started after checking, every thing is ok
3. If any fault occured, then unit is shut down from the contral room.

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

Todays activities are related to the course Power station (EEE-491)

26.8.16

Signature of the mentor with date
Name: Engr. Khirod Mohan Bose
Designation: ACE, (XEN), CPS
Contact Phone #:

04.10.2016

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

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EEE 499
Industrial Training
Daily Activity Report

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Name of the company:	Chorashal Power Station
Name of the student:	Abid-Al-Mahmud
):	2013-1-80-005

Date:	27/09/2016
Start time/End time	9.00 am- 5.00 pm
Location:	Generator
Mentor:	Engr. Md. Akter Hassain

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)

Today's objective is to observe and learn about Generator.

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.

To day we have visited the generators of unit 3, 4, 5 and 6. We have observed the fallowing equipments

Stator - It is the conductor part of generator

Rotar - The rotating part. DC excitation is provided in Rotar

carbon brush and slip ring - DC excitation is provided by these elements

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

To day's activities are related to the course EEE-301 and EEE-304

27/08/16

Signature of the mentor with date
Name: Engr. Md Akter Hossain
Designation: Xen, 5-6 unit, Generator, APS
Contact Phone #:

04.10.2016

Signature of academic supervisor with date
Name:
Designation:

Dr. Anisul Haque
Professor
EEE Department
East West University
Dhaka, Bangladesh

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Industrial Training
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Name of the company:	Ghorashal power station
Name of the student:	Abid- Al- Mahmud
ID:	2013-1-80-005

Date:	28/09/2016
Start time/End time	9.00 am - 5.00 p.m
Location:	Different types of pumps
Mentor:	Engr. Suman Kumer Kunda

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.

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East West University

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

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

To day we have learned about necessary pumps.

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.

To day we have observed the following equipment,

a) Circulating water pump - Used for supplying river water

b) Lube oil Pump - Used for pumping Lubrication oil

c) Feed water Pump - It is used for pumping demi water.

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

To days activities are related to the course EEE-491.

Signature of the mentor with date
Name: Engr. Suman Kumer Kunda
Designation: AE, Gen. 5-6 Unit, CPS
Contact Phone #:

04.10.2016
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

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Name of the company:	Baharashal Power Plant
Name of the student:	Abid-Al-Mahmud
):	2013-1-80-005

Date:	29/08/2016
Start time/End time	9.00am - 5.00pm
Location:	Control room of BPS
Mentor:	Mr. Prokash Kumer Boash

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.

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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 is to observe the control room and learn about the controlling 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.

To day we have observed the following equipments

a) Boiler controlling- There is a desk in GPS control room for controling boiler

b) Terbine controling- In the terbine desk there are control switch of stem pressure, speed, Lubeoil, and temperature

c) Generator Desk- There are control switch for coaling, freaquency, rator speed and excitation

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

29/8/16
Signature of the mentor with date
Name: Mr Proskash Kumer Ghosh
Designation: Manager, OPn, 1-4unit, GPS
Contact Phone #:

04.10.2016
Signature of academic supervisor with date
Name:
Designation:

Dr. Anisul Haque
Professor
EEE Department
East West University
Dhaka, Bangladesh

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Industrial Training
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Name of the company:	Ghorashal Power Station
Name of the student:	Binoy Kanti Paul
ID	2012-3-80-002

Date:	30.08.2016
Start time/End time	9:00 am - 5.00 pm
Location:	Turbine, Boiler and Genenator
Mentor:	Engr. Md. Mahabubur Rahman

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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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 activity is familiar with different types of protection system.

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

Boiler protection:- a) Decrease of gas pressure before burners b) Drums level protection c) Tripping of IDF/FDF/RAH

Turbine protection:- a) Lubricating oil pressure drop to turbine bearing b) Turbine rotor axial shift c) Main steam temperature

Generator protection:- a) Differential protection b) loss of excitation c) Thermal overloading

Comment: We practically visit and understand this.

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

This is related to Power station and Switchgear and Protective relay course which is mention as EEE 441 and EEE 442

30.8.16
Signature of the mentor with date
Name: Engr. Md Mahabubur Rahman
Designation: Manager(main), 5-6 unit, GPS
Contact Phone #:

04.10.2016
Signature of academic supervisor with date
Name:
Designation:

Dr. Anisul Haque
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:	Ghorashal Power Station
Name of the student:	Binoy Kanti Paul
ID:	2012-3-80-002

Date:	31.08.2016
Start time/End time	9.00 am - 5.00 pm
Location:	Water treatment plant
Mentor:	Mr. Md Abdul Mannan

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 activity is visiting water treatment plant and know about how to produce demi water.

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.

Clarifier :- Suspended materials of water removed here
filter :- Floating elements are absorbed by sandstone.
Cation exchanger:- Resin is used for cation exchanger
Degasifier : Here gaseous substances or CO_2 are removed.
Anion exchanger:- Anion resine are used for this
Mixed Bed exchanger:- Its removes anion and cation
Comment:- We visit different steps of water treatment plant

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

This is related to Introduction to Chemistry which is mention as CHE101

31/08/2016

Signature of the mentor with date
Name: Mr. Md Abdul Mannan
Designation: Chief Chemist, Plant 1-4 unit, GPS
Contact Phone #:

04.10.2016

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

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Name of the company:	Ghorashal Power Station
Name of the student:	Binoy Kanti Paul
ID:	2012-3-80-002

Date:	01.09.2016
Start time/End time	9.00 am - 5.00 pm
Location:	Control room for grid failure purpose
Mentor:	Engr. Md. Mokammel Hossain

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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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 activity is to know about grid failure and what should do during grid failure.

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.

There are two types of grid failure. ① Partial failure ② full grid failure.

At the ~~time~~ grid failure DC backup battery power using for emergency lighting and emergency pumps should be started. Isolation also should be done using circuit breaker

Comment :- At the end of the day we learn about Black out of a power station.

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

This is related to Power station and switchgear and protective relay course which is mentioned as EEE 441 and EEE 442

01/09/16
Signature of the mentor with date
Name: Engr. Md. Mokammel Hossain
Designation: SE, System Protection, PDB, Dhaka
Contact Phone #:

04.10.2016
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

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Name of the company:	Ghorashal Power Station
Name of the student:	Binoy Kanti Paul
ID:	2012-3-80-002

Date:	02.09.2016
Start time/End time	9.00 am - 5.00 pm
Location:	Turbine
Mentor:	Engr. Md Akhter Ali

General Instructions:

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

Department of Electrical and Electronic Engineering
East West University

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

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

The objective of the day activity is to learn about turbine and its components

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.

Stages of turbine: There are 12 stages in high pressure cylinder. There are 11 stages in intermediate pressure cylinder and There are 4 stages in low pressure cylinder.
Rotating blades:- Rotating blades are rotate
Stator blades:- Stator blades are fixed.
In turbin also has regulating valves, governor, turning gear
Comment:- We see all of parts of unit six

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

This is related to Power Station course which is mention EEE 441

2/9/16
Signature of the mentor with date
Name: Engr. Md Achhen Ali
Designation: XEN, Tunline, 5-6 unit, GPS
Contact Phone #:

04.10.2016
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
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Name of the company:	Ghorashal Power station
Name of the student:	Binoy Kanti Paul
ID:	2012-3-80-002

Date:	03.09.2016
Start time/End time	9.00 am - 5.00 pm
Location:	Boiler
Mentor:	Engr. Dilip Biswas

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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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 activity is learning about boiler and its equipments.

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.

Burner: It is used for burning Furnace: Here combustion is occured fuel: In GPS natural gas is used. Boiler drum: In boiler drum has steam and demiwater its maintain stem temp and pressure

Demiwater :- It's means deminaralized water

FD fan : It's means force draugh fan it's create positive pressure

ID fan : It's meas Induced draugh fan it's create negative pressure

Comment: We visit boiler section and see its equipments

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

This is related to Power station course which is mention as EEE 441

03/09/16
Signature of the mentor with date
Name: Engr. Dilip Biswas
Designation: XEN, 5-6 Auto control, GPS
Contact Phone #:

04.10.2016
Signature of academic supervisor with date
Name:
Designation:

Dr. Anisul Haque
Professor
EEE Department
East West University
Dhaka, Bangladesh