INTERNSHIP REPORT

ON

MAINTENANCE & OPERATION OF 2×120 MW PEAKING POWER PLANT AT SIDDHIRGANJ

By

Kh.Towkir-Ul-Islam

Md. Shoaib Hossain Chowdhury

Mohammad Ibnul Hasan

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, 2013

INTERNSHIP REPORT

ON

MAINTENANCE & OPERATION OF 2×120 MW PEAKING POWER PLANT AT SIDDHIRGANJ

By

Kh.Towkir-Ul-Islam

Md. Shoaib Hossain Chowdhury

Mohammad Ibnul Hasan

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, 2013

Approved By

_____	_____
Sohana Tanzeem	Fakir Mashuque Alamgir
Lecturer	Lecturer
Dept. of Electrical & Electronic Engineering	Dept. of Electrical & Electronic Engineering

_____

Dr.Mohammad Mojammel Al Hakim

Department Chairperson

Dept. of Electrical & Electronic Engineering

Authorization Letter

We declare that we are the sole authors of this internship report. We authorize East West University to make any part of this report be reproduced, stored in a retrieval system, or transmitted in any form by any means, electronic, mechanical, photocopying, recording or otherwise for the purpose of industrial attachment.

Kh.Towkir-Ul-Islam	Md.Shoaib Hossain Chowdhury	Mohammad Ibnul Hasan
_____	_____	_____

Approval Letter

ELECTRICITY GENERATION COMPANY OF BANGLADESH LIMITED

(An Enterprise of Bangladesh Power Development Board)
Siddhirganj 2x120 MW Peaking Power Plant Project, Siddhirganj, Narayanganj
Tel: 880-2-7692013, Fax: 880-2-7691280, E-mail: pd2x120@egcb.com.bd

Office of the
General Manager

Ref No.: 324/DGM (Op)/2x120MW /EGCB/2012. Date: 15.9.2012

CERTIFICATE

This is to certify that **Khandaker Towkir-Ul-Islam** son of Khandaker Tariqul Islam, **Student ID.2009-1-80-047**; Department of Electrical & Electoronic Engineering, East West University have successfully completed Industrial Training (105 hours) at **Siddhirgong 2x120MW Peaking Power Plant** of Electricity Generation Company Of Bangladesh Ltd from **12.08.2012 to 08.09.2012.** During his training period he was familiarized with operation and maintenance of GE Frame 9E Gas Turbine, Gas Booster Compressor, Instrument Air Compressor, Water Treatment plant, Switch-Gear, Transformer, Sub-station, etc.

We wish him all success in life.

(Md. Atiar Rahman)
Deputy General Manager (Operation)
Siddhirgong 2x120MW Peaking Power Plant,
Electricity Generation Company of Bangladesh Ltd.,
Siddhirgong, Narayangong.

ELECTRICITY GENERATION COMPANY OF BANGLADESH LIMITED
(An Enterprise of Bangladesh Power Development Board)
Siddhirganj 2x120 MW Peaking Power Plant Project, Siddhirganj, Narayanganj
Tel: 880-2-7692013, Fax: 880-2-7691280, E-mail: pd2x120@egcb.com.bd
Office of the General Manager

Ref No.: 323/DGM (Op)/2x120MW /EGCB/2012. Date: 15.9.2012

CERTIFICATE

This is to certify that **Md. Shoaib Hossain Chowdhury** son of Md. Zahangir Alam Chowdhury, **Student ID.2009-1-80-022**; Department of Electrical & Electoronic Engineering, East West University have successfully completed Industrial Training (105 hours) at **Siddhirgong 2x120MW Peaking Power Plant** of Electricity Generation Company Of Bangladesh Ltd from **12.08.2012 to 08.09.2012.** During his training period he was familiarized with operation and maintenance of GE Frame 9E Gas Turbine, Gas Booster Compressor, Instrument Air Compressor, Water Treatment plant, Switch-Gear, Transformer, Sub-station, etc.

We wish him all success in life.

(Md. Atiar Rahman)
Deputy General Manager (Operation)
Siddhirgong 2x120MW Peaking Power Plant,
Electricity Generation Company of Bangladesh Ltd.,
Siddhirgong, Narayangong.

ELECTRICITY GENERATION COMPANY OF BANGLADESH LIMITED
(An Enterprise of Bangladesh Power Development Board)
Siddhirganj 2x120 MW Peaking Power Plant Project, Siddhirganj, Narayanganj
Tel: 880-2-7692013, Fax: 880-2-7691280, E-mail: pd2x120@egcb.com.bd
Office of the General Manager

Ref No.: 318/DGM (Op)/2x120MW /EGCB/2012. Date: 15.9.2012

CERTIFICATE

This is to certify that **Mohammad Ibnul hasan** son of G.M Rafiqul Islam**, Student ID.2009-2-80-063**; Department of Electrical & Electoronic Engineering, East West University have successfully completed Industrial Training (105 hours) at **Siddhirgong 2x120MW Peaking Power Plant** of Electricity Generation Company Of Bangladesh Ltd from **12.08.2012 to 08.09.2012.** During his training period he was familiarized with operation and maintenance of GE Frame 9E Gas Turbine, Gas Booster Compressor, Instrument Air Compressor, Water Treatment plant, Switch-Gear, Transformer, Sub-station, etc.

We wish him all success in life.

(Md. Atiar Rahman)
Deputy General Manager (Operation)
Siddhirgong 2x120MW Peaking Power Plant,
Electricity Generation Company of Bangladesh Ltd.,
Siddhirgong, Narayangong.

Acknowledgment

We would like to start our acknowledgement by conveying our heartfelt gratitude towards Almighty Allah. Then we would like to thank our supervising advisor Sohana Tanzeem and Fakir Mashuque Alamgir for their constant support, cooperation and generosity. We would also like to thank Dr. Anisul Haque, ex-Chairperson and Professor of the Department of Electrical & Electronics Engineering, Dr. Khairul Alam, ex-Chairperson & Associate Professor of the Department of Electrical & Electronics Engineering and Dr.Mohammad Mojammel Al Hakim, Chairperson and Associate Professor of the Department of Electrical & Electronics Engineering for being helpful during the time of our internship.

We would like to thank Electricity Generation Company of Bangladesh Ltd. for giving us the opportunity to work in the field of Power Plant Maintenance and Operation. A big thanks to its engineers whose guidance and training came handy in obtaining the perfect knowledge and experience about the Gas Turbine Power Plant and it will definitely be useful in our future.

On the submission of our intern report on Maintenance & Operation of 2X120 MW Peaking Power Plant at Siddhirganj, we would like to extend our gratitude and sincere thanks to Engr. Atiar Rahman (DGM, Maintenance), Engr. Md. Saiful Islam (Manager, Electrical) and Engr. Md. Anisur Rahman (Manager, Operationional & Mechanical Maintenance) for being a source of guidance and inspiration during this period. Their wonderful style of mentoring has surely made our training period a great learning experience. We express our heartiest thanks to Engr. Ashis Kumar Biswas (Asst. Manager, Technical), Engr. Nandhipan Das (Asst. Manager, Technical), Engr. A.K.M. Zillur Rahman (Asst. Manager, Technical) and Engr. Nadir Chowdhury (Asst. Manager, Technical) for their technical guidance and encouragement which has been of great help in carrying out the internship work.

We express our sincere thanks to all the members of Siddhirganj 2X120 MW Peaking Power Plant for their friendly and helpful attitude.

And last but not the least, our cordial thanks to our parents whose continuous support was a genuine source of motivation behind making this report a fruitful one.

Executive Summary

Bangladesh is a country with very high demand of electricity. It has ever growing large population to be provided with electricity. Therefore, the necessity of electricity is growing day by day. But unfortunately, there are certain drawbacks in the power sector that has pulled down the growth of electricity generation. Main reasons off course are poor financial and operational performance, scarcity of fuel (for those plant which runs by natural gas as fuel). Even though there has been a lot of reformatting initiatives made since our independence, but still the Government lag behind to provide required power to its people.

In Bangladesh, the present maximum demand of electricity varies from 4,500 MW to 5,600 MW and it is expected to rise more in coming years. But currently maximum generation of power available is not up to the mark. It is because of old set up and inefficiency of the maximum power plant.

In EGCB (Electricity Generation Company Bangladesh Ltd.), there are two units each of which has capacity of generating 120 MW electricity. The fuel that is used here is natural gas taken from Titas Gas Company Ltd. But due to insufficient gas supply, the plant's present maximum production capacity is 220 MW (if fuel supply is adequate enough) and regular production is 170-180 MW.

During our internship in EGCB (Electricity Generation Company Bangladesh Ltd.), we worked on the generation and distribution of power in practical field. Here we worked as a team and was involved in generator section, transformer section, gas turbine, substation and control room. In all of these sections, we were demonstrated how these systems work and what protective measures are taken for them. The on duty engineer showed us how each of the unit works (as a whole) with proper synchronization of gas booster, combustion chamber and turbine. Then the generated power is transmitted through substation to grid by various step-up and step-down transformers. We got to learn the importance of protection and switch gear system for the plant and how do they work. At the end, the whole internship was a proper combination of our theoretical and practical knowledge which will help and guide us to deal real life problems in power sector.

Training Schedule

The following table contains our training schedule at EGCB Siddhirganj Power Station. Our internship started on 12th of August 2012 and ended on 8th of September 2012.

Date	Division	Time	Instructor
12-08-2012	Electrical	9am to 4pm	Engr. Nandhipan Das Asst. Manager (Technical)
14-08-2012 25-08-2012 26-08-2012	Control unit	9am to 4pm	Engr. Nadir Chowdhury Asst. Manager (Operation) Engr. Siddiqur Rahman Asst. Manager (Operation)
27-08-2012	Operation	9am to 4pm	Engr. A.K.M Zillur Rahman Asst. Manager (I&C)
28-08-2012	Fire fighting	9am to 4pm	Engr. K.M.H Kabir Manager (Environment & Safety)
29-08-2012 30-08-2012 01-09-2012	Electrical	9am to 4pm	Engr. Nandhipan Das Asst. Manager (Technical) Engr. Ashis Kumar Biswas Asst. Manager (Technical)
02-09-2012 03-09-2012	Mechanical	9am to 4pm	Engr. Yamin Ali Asst. Manager (Technical)

Date	Division	Time	Instructor
04-09-2012 05-09-2012	Electrical	9am to 4pm	Engr. Nandhipan Das Asst. Manager (Technical) Engr. Ashis Kumar Biswas Asst. Manager (Technical)
06-09-2012	Electrical	9am to 4pm	Engr. Saiful Islam Manager (Electrical)
08-09-2012	Mechanical	9am to 4pm	Engr. Yamin Ali Asst. Manager (Technical)

TABLE OF CONTENTS

Page

Authorization Letter 2
Approval Letter 3
Acknowledgment 6
Executive Summary 7
Training Schedule 8

Chapter 1

Introduction 15
1.1 Objective of The Internship 15
1.2 Scope 15
1.3 Methodology 15

Chapter 2

Company Profile 16
2.1 Mission and Vision 16
2.2 History 16
2.3 Plant Details 17
2.4 Future Plan of EGCB 17
2.5 Model of 2×120MW Siddhirganj Power Plant 17

Chapter 3

Generation of Power 19
3.1 Generator 20
3.1.1 Auxiliary Compartment 21
3.1.2 Combustion chamber 21
3.1.3 Gas Turbine Excitation Compartment 22
3.2 Stator & Rotor 23
3.3 Gas Booster Compressor 24
3.4 Gas Valve Modules 24
3.5 Modes of Operation 26
3.6 Gas Skid 26

Chapter 4

Protection System and Switchgear 27
4.1 Protection of Generator 27

4.1.1 Differential Protection 27
4.1.2 Loss of Field Excitation 28
4.1.3 Current Unbalance Protection 28
4.1.4 Over Current Protection 28
4.1.5 Restricted Earth Fault Protection 28
4.1.6 Reverse Power Protection 29
4.1.7 Under Voltage Trip 29
4.2 Protection of Transformer 29
4.2.1 Unit Transformer Protection Scheme 29
4.3 Transmission Line Protection 30
4.3.1 Distance Relay 30
4.4 Fire Safety Measures 30
4.5 Circuit Breakers 31
4.5.1 Sulpher hexafluoride (SF6) high-voltage circuit-breakers 31
4.5.2 Air Break Circuit Breaker and Air Blast Circuit Breaker 32
4.5.3 Miniature Circuit Breaker and Molded Case Circuit Breaker 33
4.6 Different relay systems 33
4.6.1 Bucholz Relay 33
4.7 Lightning Arrester 34

Chapter 5

Testing & Maintenance 35
5.1 Testing For Transformer 35
5.1.1 Transformer Oil test 35
5.1.1.1 Acid Neutralization Test 35
5.1.1.2 Dielectric Breakdown Test 35
5.1.1.3 Moisture Content Test 36
5.2 Generator Cooling System 37
5.2.1 Air cooling 37
5.2.2 Water cooling 37

Chapter 6

Substation 38
6.1 Transformers 39
6.2 Bus Bars 42

6.3 Single Bus Configuration 42
6.4 Transmission and Distribution..... 42
6.4.1 Insulators 42
6.4.2 Isolators 43
6.5 Auxiliary Systems..... 43
6.6 Underground cable 43
6.7 Single Line Diagram of Siddhirgonj 2×120 MW PPP 44
Chapter 7
Control & Backup System 46
7.1 Manual Control for both unit 1 and 2 46
7.1.1 Generator Transformer panel..... 46
7.1.2 Data Concentrator panel 47
7.1.3 Gas Turbine Auxiliary panel 47
7.1.4 Generator Relay panel (GRP)..... 48
7.1.5 Generator Control Panel 48
7.1.6 Automatic Voltage Regulator (AVR)..... 49
7.1.7 Thyrister Convertor 49
7.1.8 Relay panel 49
7.1.9 Battery charger panel..... 49
7.1.10 Emergency Lighting Charger 50
7.2 Computer based automatic Control 50
7.2.1 Distributed Control System 50
7.2.2 Mark VI control for turbine 50
7.3 Backup System 51
7.3.1 Auxiliary DC power supply..... 51
7.3.2 Battery Voltage Level..... 51
Chapter 8
Conclusion 53
8.1 Problems 53
8.2 Recommendations 53
8.3 Conclusion 53
References..... 55
Appendix.....56

LIST OF FIGURES

Page

Figure 2.1: Model of Siddhirganj 2 X 120 MW Peaking Power Plant 17
Figure 3.1: Generator Unit at the setup time of Siddhirganj 2 X 120 MW PPP 20
Figure 3.2: Combustion Chamber Compartment of EGCB 22
Figure 3.3: An Idealized Brayton Cycle 22
Figure 3.4: Gas Valve Unit of EGCB 25
Figure 4.1: CO_2 fire safety cylinders for internal instrument protection in EGCB 31
Figure 4.2: Air Circuit Breaker used in EGCB 32
Figure 5.1: Dielectric Oil Test Module of EGCB 36
Figure 5.2: Mist Eliminator Pump of EGCB 36
Figure 6.1: The Substation of EGCB 38
Figure 6.2: Power Transformer-1 of EGCB 39
Figure 6.3: Power Transformer-2 of EGCB 39
Figure 6.4: Power Transformer 3 and 4 of EGCB 40
Figure 6.5: Current Transformer of EGCB 41
Figure 6.6: Potential Transformers of EGCB 41
Figure 6.7: Different types of Insulators used in EGCB substation 43
Figure 6.8: Underground Cables of EGCB substation 44
Figure 6.9: Bus and General Specification of Siddhirgonj Power Plant 44
Figure 7.1: Generator Transformer panel 47
Figure 7.2: Data concentrator panel 47
Figure 7.3: Generator Relay Panel 48
Figure 7.4: Generator Control Panel 48
Figure 7.5: Automatic Voltage Regulator 49
Figure 7.6: Battery Charger Panel 50
Figure 7.7: Ni-Cd batteries as DC supply in EGCB 52

LIST OF TABLES

Page

Table 3.1: Ratings of scrubber in EGCB 19
Table 3.2: Ratings of Filter Separator in EGCB 19
Table 3.3: Ratings of Fine Filter in EGCB 19
Table 3.4: Ratings of Generator in EGCB 20
Table 3.5: Gas Turbine Ratings in EGCB 23
Table 3.6: Stator ratings in EGCB 23
Table 3.7: Rotor ratings in EGCB 23
Table 3.8: Ratings of GBC in EGCB 24
Table 4.1: Ratings of SF_6 circuit breaker in EGCB 32
Table 4.2: Complete information of different Circuit Breakers that are used in EGCB 33

Chapter 1
Introduction

As a part of completion of our under graduation, we have to do an internship in any company of electrical field. Therefore, we had the opportunity to do that internship in Electricity Generation Company Bangladesh (EGCB). All three members of our group worked in EGCB as intern during the semester break of Fall 2012 as per University rules. The detail work of what we did there is entirely and thoroughly described in this report.

1.1 Objective of The Internship

The aim of our internship was to get introduced practically with the power generation and transmission process which involves getting a brief idea of all major machineries and systems that are involved in the process. Our objective was very well served because we were given training on certain important sections of the plant such as Gas turbine, Gas booster compressor, Instrument air compressor, Water treatment plant, Switch-gear, Sub-station and Control room.

1.2 Scope

In EGCB, as an intern we had opportunity to visit and gather practical knowledge on Gas turbine, Gas booster compressor, Instrument air compressor, Water treatment plant, Switch-gear, Sub-station and Control room of the plant. This was a great scope for all of us to relate all our theoretical knowledge with practical knowledge and to realize how a power plant runs by all these important sections.

1.3 Methodology

We have designed our report mainly in five major parts. They are Generation, Protection and Switchgear, Testing & Maintenance, Substation, Control & Backup System. And thereafter, these sections are subdivided into subsections as all these sections need multiple things to be described in order to get a whole idea about the operation and maintenance of the plant.

Chapter 2
Company Profile

The continuous changing process of power sector in Bangladesh was started in 1972 when this sector was the responsibility of Bangladesh Power Development Board (BPDB). Later after several changes and subdivision of such a demanding and large sector into rural and urban areas, the distribution of electricity in Dhaka city was bestowed upon Dhaka Electric Supply Authority (DESA) in 1991. Aiming to the development of a single buyer market model ever since mid-1990s, the government allowed a lot of necessary changes that has evolved lots of independent power producing entities in the market. Hence starting from power generation to transmission and distribution, the whole operational responsibility previously rested upon BPDB has been decentralized among all newly formed power generating business units like Electricity Generation Company Bangladesh (EGCB) Ltd.

2.1 Mission and Vision

Just like any power plant, EGCB has its own mission and vision. To excel in electricity business by generating efficient, reliable and cost effective electricity in an environmentally responsible manner to satisfy the customers is the main goal with which the company started its journey in the power generation field. With this mission in mind, EGCB has so far succeeded and kept its pace. The vision of the company is "Generation of Quality Electricity for the Betterment of the Nation."

2.2 History

EGCB has three projects currently on going; one among them is 2×120 MW Peaking Power Plant project in Siddhirganj. The project is situated on the bank of the river Shitalakhya within the Siddhirganj Power Station premises and it was funded by Asian Development Bank (ADB). EGCB signed a contract with Bharat Heavy Electricals Limited (BHEL) as Equipment Procuring Contractor (EPC) for the above project on 31st January, 2007 [1].

2×120 MW Peaking Power Plant at Siddhirganj is an open cycle, double unit plant. The 1st unit of the plant was put on test on 20th November, 2009 and was inagurated by the Honorable Prime Minister of Bangladesh on 14 February, 2010. The 2nd Unit was put on test run on 26 May, 2010. The 2nd Unit was taken over from the EPC on October 14, 2010. Commercially, the operation date of both units was 5th February, 2012 [1].

2.3 Plant Details

The Siddhirganj power station runs by natural gas that is supplied by Titas Gas Company Bangladesh Ltd. Due to the scarcity of gas, actual maximum production is 211.76 MW (2×105.88 MW) off course provided that the gas supply is sufficient enough.

The total land area of Siddhirganj power station is 4.17 acres. This huge area is not owned by the plant but an agreement between EGCB Ltd. and BPDB was made to sanction this area for use on rental basis for 23 years starting from 29th August 2011.

Besides, a Power Purchase Agreement (PPA) for 2x120 MW Peaking Power Plant at Siddhirganj was signed between EGCB Ltd. and BPDB on 29 August, 2011 for the period of 22 years.

2.4 Future Plan of EGCB

To ensure uninterrupted power generation by recruiting skilled and experienced manpower and increasing efficiency of machine is the ultimate plan of EGCB. A very unique future plan of EGCB is to implement corporate culture in the organization. If that can happen, EGCB will be a centre of attraction for many professionals. EGCB also want to strengthen their financial position by earning maximum profit through offering best services to their valued customer.

2.5 Model of 2×120MW Siddhirganj Power Plant

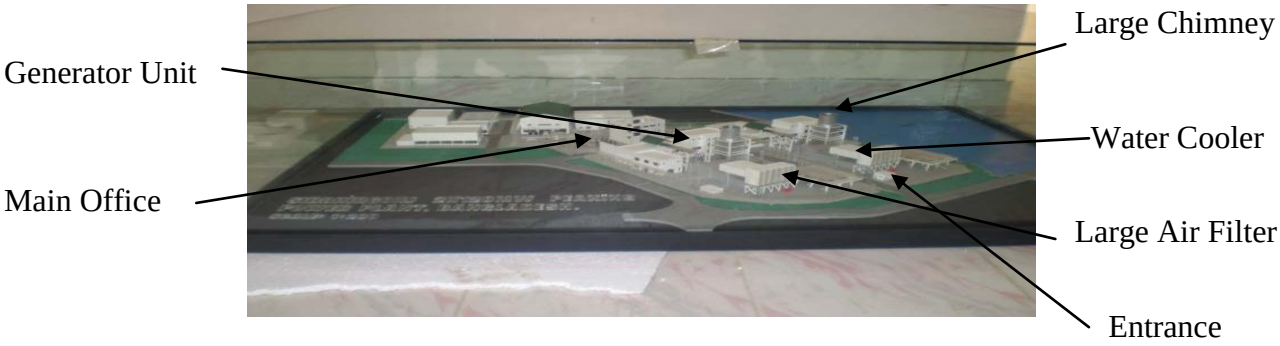

Figure 2.1: Model of Siddhirganj 2 X 120 MW Peaking Power Plant

Figure 2.1 shows the view of the whole Siddhirganj 2 X 120 MW power plant with an architectural model. Now if we look at the figure minutely, we will see that there are two units with same structures. We can see that there are two large air filters, water cooler, and two large chimneys right in front of the entrance. Then there are the two generator units right

after the chimneys. Then there are official buildings that have been pointed. These are the basic structural sights that are visible on the model and discussed. There are also other sections like control room, gas skid section and many more which are discussed in various sections of the report but are not mentioned here as they are not understandable on the picture.

Chapter 3

Generation of Power

In EGCB, the whole electricity generation process works as follows.

At first, gas comes from Titas Gas Company Ltd. Then the gas is passed through scrubber to Gas Booster Compressor. Later on, the gas is filtered with fine filter and filter separator. Next, the gas is sent to gas valve module. Afterwards, the gas is sent into combustion chamber.

In combustion chamber the gas is mixed with air. Then firing is made. When the rotor speed goes 3000 rpm, then it is synchronized. As a result, we get 11KV generator output voltage.

Table 3.1: Ratings of scrubber in EGCB [2]

No. of Unit	2
Capacity	79100 Nm^3/hr
Working Pressure	10.4-14.1 Kg/cm^2
Design Pressure	18.0 Kg/cm^2
Max^m Temperature	$65^\circ c$

Table 3.2: Ratings of Filter Separator in EGCB [2]

No. of Unit	04 Nos (2W+2S)
Capacity	39550 Nm^3/hr
Working Pressure	26.4 Kg/cm^2
Design Pressure	35.0 Kg/cm^2
Design Temperature	$150^\circ c$

Table 3.3: Ratings of Fine Filter in EGCB [2]

No. of Unit	02 Nos (1W+1S)
Capacity	39550 Nm^3/hr
Working Pressure	26.4 Kg/Cm^2
Design Pressure	35 Kg/Cm^2
Design Temperature	$150^\circ c$

3.1 Generator

In EGCB we saw two generators for two units. The rating of those generators is given below.

Table 3.4: Ratings of Generator in EGCB [2]

Manufactured By	Jhansi, BHEL India
KVA	135750
KW	108600
PF (lag)	0.80
Frequency	50 Hz
RPM	3000
Phase	3(AC)
Standard	IEC-60034, IS 5422
Protection	IP-54

In EGCB, there is actually two large generator units each of which produces 120MW power as the plant's name describes. This means that the units consist of various other machines and motors other than only generators. And during our internship, we got to see and told thoroughly about what these units consist of and how they work. We will try to describe that experience here in this section.

Figure 3.1: Generator Unit at the setup time of Siddhirganj 2 X 120 MW PPP

In figure 3.1, we can see three main parts of a Generator unit. The three parts are

1. Auxiliary compartment which contains -
    a. Lube oil Pump
    b. Cranking Motor
    c. GT starting Motor

   d. Turning Gear
2. Combustion Chamber which contains -
   a. 14 Combustion Liners
   b. 3 different nozzles
3. Gas turbine excitation compartment which contains -
   a. 17 stage compressor
   b. Combustion system
   c. 3 stage Turbine

3.1.1 Auxiliary Compartment

In auxiliary compartment the steps of working process is as follows.

- At first after getting starting command, cranking motor starts within 15-30 secs with the help of Lube oil pressure, Hydraulic oil pressure and Lift oil pressure.
- Then the turbine starts to speed-up and reaches 600 RPM. Afterwards, it decreases and reaches up to 360 RPM when firing occurs from Burner.
- Afterwards, the turbine RPM starts increasing again and reaches up to 3000 RPM when the excitation gets on. Thus, the turbine gets synchronized.

3.1.2 Combustion chamber

In combustion chamber compartment, we were told about how the combustion process works. Here the filtered air is mixed with gas and burned with the help of spark plug. Compressed Gas is supplied to each combustion chamber through a nozzle that functions to disperse and mix the compressed gas with proper amount of combustion air. In EGCB, there are in total 14 combustion chambers within a unit. Each combustion chamber has three nozzles attached to it. They are primary nozzles, secondary nozzles and cap-liners. All these nozzles with a combustion chamber are pointed out in figure 3.2.

The main components of combustion chamber are as follows –

- Spark Plug: 14 Nos
- Primary Fuel Nozzle: 14 Nos
- Secondary Fuel Nozzle: 14 Nos

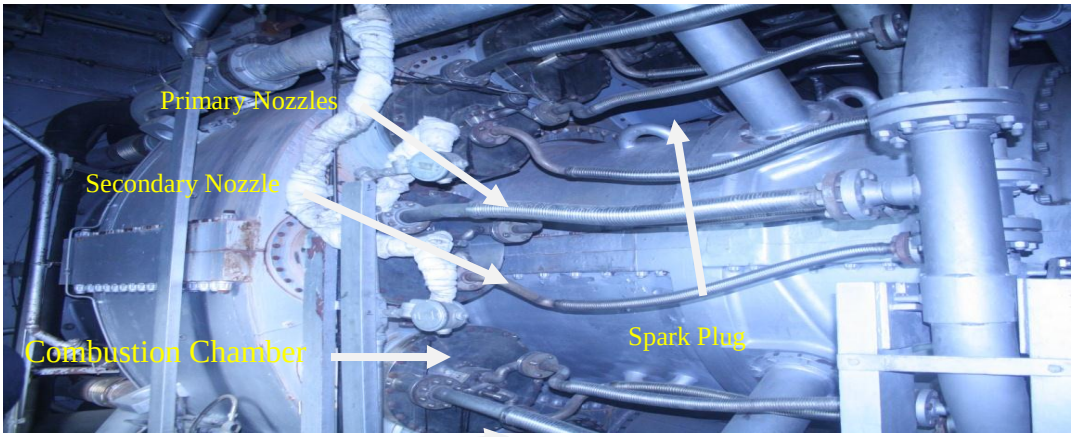

Figure 3.2: Combustion Chamber Compartment of EGCB

3.1.3 Gas Turbine Excitation Compartment

In EGCB, we saw Gas Turbine Excitation compartment. In the gas turbine the gas goes through three thermodynamic processes, compression, combustion and expansion. All together these three steps are known as Brayton cycle. In the gas turbine the gas being fed to the turbine is firstly compressed by the compressor in order to increase the pressure. Then the compressed gas is carried out to the combustion chamber through nozzles (3 different nozzles). In the combustion chamber the gas is being mixed with air and burned in order to increase the internal energy of gas (perfect mixing of air with gas results in better performance of GT). A combustor must maintain stability. To do so, combustors are carefully designed to pre-mix and ignite the air and fuel, and then mix in more air to complete the combustion process. Then the heated high velocity gas is passed through turbine blades. The high velocity gas put pressure on the turbine blades that make turbine to rotate. The air guide blades in the turbine controls the exhaust gas flow and redirect to the turbine blade in order to increase efficiency.

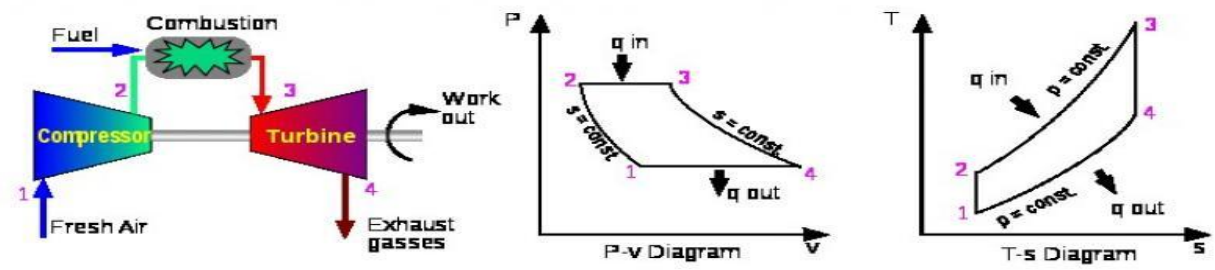

Figure 3.3: An Idealized Brayton Cycle [3]

In figure 3.3, the two method of representation of Brayton cycle is shown. In temperature vs entropy diagram, air is taken from atmosphere at state 1 and compressed to state 2. Then the

compressed air is sent to combustion chamber where fuel is burned in it. Here the fuel and air ratio is kept in a way, so that temperature rises up. In the meantime the pressure is kept constant. Finally when the air is discharged back to the atmosphere again, the temperature falls down. Here is to mention that the high temperature normally used now a days are limited within 650^0 C -815^0 C depending on the properties of the material of the blade of rotor. Here when temperature is raised from point 1 to 2, it is said to be compression state. While again when the temperature falls down from point 3 to 4 in temperature vs entropy plot of Figure 3.3, it is called isentropic. [4]

The ratings of the Gas Turbine of EGCB is as follows

Table 3.5: Gas Turbine Ratings in EGCB [2]

Size	Frame-9Er, 108.66 MW
Manufacturers	Turbine Rotor: GE-France
Accessory Gear Box	GE
No. of Compressor stages	17
No. of Turbine Stages	03
No. of Combustor	14

3.2 Stator & Rotor

Stator and rotor is an indispensible part for any generator unit. During our internship at EGCB, we were told about stator and rotor. The ratings of these parts are given below.

Table 3.6: Stator ratings in EGCB [2]

Volt	11000 Volt
Amperes	7125 Amp

Table 3.7: Rotor ratings in EGCB [2]

Volt	370 Volt
Amp	817 Amp
Cooling Type	CACW
Over Speed	10% Max^m

3.3 Gas Booster Compressor

From the collective perspective it was observed that the gas supplied by the Titas is about 10 kg/m^3 pressure. In order to run the gas turbine it needed about 20 kg/m^3 of pressure and constant gas supply. So in order to provide regular gas supply at a constant pressure it needs a compressor which is known as GBC or gas booster compressor. Gas booster compressor supplies about 20 kg/m^3 pressure of gas to the GT through SRV (speed/stop ratio valve) and gas control valves (GCV). Before gas is boosted up in gas booster compressor the gas is passed through filter for purification and filtered gas is then given as input to the compressor. Then the compressed gas is passed through the GBC to GT.

Table 3.8: Ratings of GBC in EGCB [2]

Type	BCL 406
Normal Capacity	33086 Nm^3/hr
Suction Press	10.73 kg/cm^2
Delivery Press	26.85 kg/cm^2
Power	1562 KW
Normal RPM	11396
Max. Continuous Speed	11396 rpm
First Critical Speed	5800
Casing Design Pressure	29 kg/cm^2
Casing Design Temp	$150^{\circ}C$
Serial No.	C-300
Hyderabad Division Year	2005

3.4 Gas Valve Modules

In EGCB, in front of combustion chamber there is a Gas Valve unit. Several valves are set there which are described below from the collective perspective.

Stop Ratio Valve

The main function of the Stop-Ratio Valve (SRV) is to work as the fuel (gas) stop valve. The flow of gas needed to be controlled when generator changes its operation mode. To do so, SRV is used. The secondary purpose is to regulate the fuel pressure of the Gas Control Valve

(GCV) during starting and acceleration [5]. The gas fuel pressure required in the turbine during starting is much less than the pressure of gas fuel supplied. The SRV let gas flow drop to the pressure of the GCV during starting. Again when the turbine accelerated at its rated speed it needs more gas flow, when SRV let the gas flow to increase. That is why, this valve is also called Speed Ratio Valve.

Gas control valve

A gas control valve is used for the purpose of safety of gas turbine. It controls the amount of gas flowing to combustor. It can maintain a steady flow of gas without any gas leaking. The control valve adjusts the pressure of gas that is supplied to the unit. It also regulates the amount of gas that is supplied to combustor. The pressure control is important because too much pressure can result in explosion. On the other hand low pressure of fuel will not let the turbine to run.

Servo valve

Servo valves are used to control fuel flow, combustor bypass, compressor bleed valves, NOx control, as well as the position of inlet guide vanes. This means they are important to turbines performance and safe operation. Figure 3.4 shows the Gas Valve unit of EGCB plant. Here, there are several Stop Ratio Valves (SRV), Gas Control Valves and Servo Valves. This unit was more mechanical concept based explanation for us while we were shown and explained about this unit.

Figure 3.4: Gas Valve Unit of EGCB

3.5 Modes of Operation

In EGCB we were introduced to a completely new topic. We were introduced to three modes of operation. Actually every power plant runs in different modes of operation with respect to different technical condition of the plant. So do EGCB. In EGCB, the plant follows three modes of operations. They are

- Primary mode
- Lean-Lean mode
- Premix mode

Primary mode

The system in operated in primary mode when the gas supply is low or gas pressure is low. Usually the plant needs 40 MW power in this mode. In fact 40MW is the base load. If the plant is running in this mode for a long time it can be harmful for the turbine. This mode also increases the production cost. As a result profit goes down during this mode of operation.

Lean-Lean Mode

The plant is operated in Lean-Lean mode when the gas supply is medium or gas pressure is medium. Usually the plant gets 60 to 65 MW power in this mode.

Premix Mode

The plant operates in premix mode when the gas supply is high or gas pressure is high. Usually in this mode, the plant gets 110 to 115 MW power. In fact 115MW is the full load. In this mode the turbine efficiency becomes maximum, as it produces the maximum output power. In Premix mode the production cost decreases. As a result, the company earns more revenue on their investment during this mode of operation.

3.6 Gas Skid

The main purpose of Gas skid is to purify natural gas. In EGCB, we were taken in to Gas skid section. There we were told what gas skid does. It actually works to remove liquid droplets and solid contains from incoming natural gas supply. Various kinds of filter constitutes of Gas Skid.

Chapter 4

Protection System and Switchgear

EGCB is a Gas Turbine Power Plant with turbine, boiler, compressor, combustion chamber, gas booster, water treatment plant and various pipes, valves and fans. And these are the major part of the electricity generation process. Hence, EGCB authority has the necessary and proper Protection System for the safety of this equipments and apparatus. In this chapter, a brief overview and discussion on the Protection system of EGCB will be made.

4.1 Protection of Generator

Just like any other power plants, EGCB has many generator protections included among which some major and important ones that we were told about are discussed below. Here to mention that the description of the mentioned protections will be made based on collective perspective and theoretical knowledge as this is impossible to see these protection systems live because of their internal connections.

- Differential Protection**.**
- Loss of Field or Excitation Protection.
- Current Unbalance Protection.
- Over Current Protection**.**
- Restricted Earth Fault Protection.
- Over Voltage Protection.
- Reverse Power Trip.
- Under Voltage Trip.

Basically these all are various kinds of relays. Now some of these relays are briefly discussed in the following segments of the chapter as below.

4.1.1 Differential Protection

From the collective perspective, we saw several differential protections for generator. It is actually a relay. It is used here in EGCB to protect generator winding against internal faults

such as phase-to-phase and three phase-to-ground faults [6]. We were told that the differential relay that has been used in the generator is actually current differential relay.

4.1.2 Loss of Field Excitation

Loss of field excitation is a protective measure taken against the failure of AVR or field open circuit or short circuit. Due to these failure generator acts as an induction motor. So protection against Loss of Field Excitation is very important.

4.1.3 Current Unbalance Protection

From the collective perspective we know that current unbalance occurs due to difference in three phase voltage. In EGCB, there is protection against this in generator. This is used because due to current imbalance, high current is induced in the rotor of generator which leads to overheating of motor and burning of windings. In fact this is a switchgear relay that is used in EGCB. This relay has also been used in EGCB so as to compare the loads of various circuits.

4.1.4 Over Current Protection

In EGCB, generator is designed to operate continuously at rated KVA, frequency and power factor over a range of 95% to 105% of rated value. Now, operating of the generator beyond rated KVA may result in harmful stator over current. This leads to overheating of stator and failure of insulation. This is very a risky condition for people working in the unit. Hence, such a protection is taken in EGCB generator unit.

4.1.5 Restricted Earth Fault Protection

The working function of it is similar to generator differential protection. It protects the high voltage winding of power transformer against internal faults. One set current transformer on neutral and phase side of the power transformer are exclusively used for this protection. The protection cannot detect turn-to-turn fault within one winding. Upon the detection of a phase to phase or phase to ground fault in the winding, the unit is tripped automatically from control unit in EGCB.

4.1.6 Reverse Power Protection

Our intern advisor introduced us to a new type of protection for generator called Reverse Power Protection. This is actually a protection for the Prime mover of the generator rather than for the whole generator. It describes a condition where the prime mover of a generator is not supplying sufficient torque to keep the generator rotor spinning at the same frequency as the grid to which the generator is connected. In other words, the generator will actually become a motor and will draw current from the grid and will be supplying torque to the prime mover which is supposed to be supplying torque to the generator. Hence a protection relay is set up by EGCB within the generator prime mover [7].

4.1.7 Under Voltage Trip

In EGCB, there is also protection relay for under voltage occurrence. This method is used to prevent closing of the breaker by mistake. In this system tripping is generally delayed. This is done so that the voltage drop is caused by fault and time is allowed for the appropriate fuse or breaker to operate and the voltage to be recovered without the loss of power supply.

4.2 Protection of Transformer

In EGCB just like any other plant, it has got different types of transformers like Power transformer, Current transformer, many Step-up and Step-down transformers for transmission of current to grid and others. And therefore, lots of protection has been taken care of for the safety purpose here in EGCB. Actually, the EGCB authority installed a protection scheme as a whole for the transformer protection ever since the plant was built for easy monitoring and protection purpose. And that protection scheme is described down here briefly based on the collective perspective.

4.2.1 Unit Transformer Protection Scheme

EGCB has a very advanced Transformer Protection Unit designed for use on 3-phase power transformers as we observed. It provides sensitive high-speed differential protection for internal phase and ground faults as well as time and instantaneous over current protection for auto, winded transformers. The user-selectable harmonic restraint setting prevents false tripping on magnetizing inrush and over excitation. So whenever any faults occur, protection unit trips down and take necessary steps to protect the transformers.

4.3 Transmission Line Protection

Transmission Line protection systems are designed to identify the location of faults on the transmission line and to isolate only the faulted section. The key challenge to the transmission line protection lies in reliably detecting and isolating faults compromising the security of the system. As we were only showed the Distance relay, it is discussed below.

4.3.1 Distance Relay

From the collective perspective, distance relay work on the basis that the impedance of a transmission line is proportional to its length. For distance measurement it is appropriate to use a relay capable of measuring the impedance of a line up to a predetermined point. Such a relay is described as a distance relay and is designed to operate only for faults occurring between the relay location and the selected reach point, thus giving protection for faults that may occur in different line sections [6].

4.4 Fire Safety Measures

During our working period in EGCB, we attained a whole day training session about Fire Fighting and Safety Procedure by a senior specialist Kazi M H Kabir,PhD on this field. In EGCB, there is a section where large cylinders containing Carbon-Di-Oxide gas are set that are made inter connected by pipes with all internal sections as in Combustion chamber, Gas booster etc. The capacity of CO_2 in these cylinders at EGCB is 6000 Kg per tank. They are programmed such that where ever any burning or combustion occurs internally in the system; CO_2 directly reaches there and handle the situation automatically. For that, there are sensors used everywhere in the system off course to find out any combustion. Apart from that, routine workshop is hold for the workers and stuffs to keep them aware and cautious about dealing fire. Figure 4.1 shows the compartment where the large CO_2 cylinders are made connected. This compartment branches out and expands to various sections of the plant where there is the need of fire safety. It is to mention that these cylinders are changed on routine basis as they need to be refilled.

Figure 4.1: CO_2 fire safety cylinders for internal instrument protection in EGCB

4.5 Circuit Breakers

A circuit breaker is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit. Its basic function is to detect a fault condition and to immediately discontinue electrical flow. Unlike a fuse, which operates once and then has to be replaced, a circuit breaker can be reset to resume normal operation. The circuit breakers that are commonly used in different sections of the plant are as follows,

- SF6 circuit breaker
- Air Blast Circuit Breaker (ABCB)
- Air break Circuit Breaker (ACB)
- Miniature Circuit Breaker (MCB)
- Molded Case Circuit Breaker (MCCB)

Engr. Nandhipan Das showed us different types of circuit breakers that are used in the plant and the working function of them in different sections is discussed below.

4.5.1 Sulpher hexafluoride (SF6) high-voltage circuit-breakers

We were told about SF_6 circuit breakers that were mentioned to be used in each of the three phases with rated voltage of 11KV. As it is very renowned for extinguishing arc in short times, hence it has been incorporated in three phase. So that while over voltage occurs, the

breaker can trip to discontinue the system. But due to its high cost, it is not something that is used in many parts of the system.

Table 4.1: Ratings of SF_6 circuit breaker in EGCB [2]

Model	HECS-100M
Rated Frequency	50Hz
Max. Operating Voltage	13.2 KV
Max. Operating Current at $40^{\circ}C$	10500A
Rated power-frequency withstand voltage	60Kv
Rated Lighting Impulse Withstand Peak Voltage	125Kv
Rated Voltage for unitary drives	$3\times400VAC$
Capacitors on transformer/generator side	1300nF/130nF
Total weight of the system	3880Kg
Instruction 600/part list number	1HC0020305

4.5.2 Air Break Circuit Breaker and Air Blast Circuit Breaker

In EGCB we saw both Air Break Circuit Breaker and Air Blast Circuit Breaker that has been used in bus bar and motor feeders and its rated voltage is 400 Volt AC and 230 Volt AC respectively. It has been mainly used here for its fast operation actually. These circuit breakers have panels that are installed in switchgear panel room of EGCB. So when these circuit breakers are tripped, light flickers in those panels which indicate that the breaker is tripped. Figure 4.2 is the apparent look of the breaker. It cannot be made work externally except just pulling up the lever as we can see in the figure to trigger down the breaker manually in case of any emergency need.

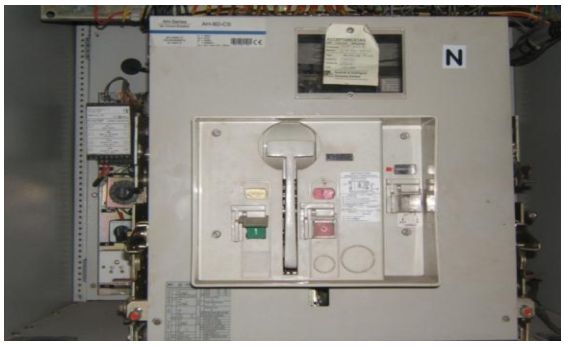

Figure 4.2: Air Circuit Breaker used in EGCB

4.5.3 Miniature Circuit Breaker and Molded Case Circuit Breaker

Both of these circuit breakers are rated at 230 Volt AC and have been used in each single phase of the three phase line. They are basically used to protect each phase individually rather than using fuse which needs to be replaced.

A table at a glance of the circuit breakers that are used in the plant with their rating is given below.

Table 4.2: Complete information of different Circuit Breakers that are used in EGCB [2]

Breaker's Name	Rating	Where used
SF_6 Circuit Breaker	11KV	Three Phase Line
Air Break Circuit Breaker	400VAC	Bus Bar and Motor Feeders
Air Blast Circuit Breaker	400VAC	Bus Bar and Motor Feeders
Miniature Circuit Breaker	230VAC	Each single phase of Three Phase Line
Molded Case Circuit Breaker	230VAC	Each single phase of Three Phase line

4.6 Different relay systems

Even though several protection relays for generators and transformers have already been discussed previously but there were certain completely new relays that were shown to us in EGCB. Actually these are very familiar to power plant engineers but for us as an intern, these are totally new.

4.6.1 Bucholz Relay

An important relay for transformer is a Buchholz relay which is found to be located in an inclined pipe between the transformer itself and its oil conservation tank (located above the transformer). It is a mechanical phenomenon. It is used to monitor large transformers for oil loss or insulation breakdown. Whenever there will be a minor internal fault in the transformer, the transformer insulating oil will be decomposed in different hydrocarbon gases, CO_2 and CO. The gases produced due to decomposition of transformer insulating oil will accumulate in the upper part of the transformer oil container which causes fall of oil level in it. Thus whenever the oil level will fall, the alarm circuit will be energized which

means the relay will be tripped. Then by collecting the accumulated gases from the gas release pockets on the top of the relay and by analyzing them, plant engineers can predict the type of fault in the transformer. Just like any other plants, EGCB have this relay used as well and our intern advisor for that day mentioned that it is a very necessary and important part of oil transformer [8].

4.7 Lightning Arrester

We have seen many lightning arresters to be used near power transformer section in EGCB where they are used to bypass current to the ground when high voltage or thunder strike occurs.

In this chapter, the protection system in EGCB has been discussed which includes protection against abnormalities in Generator, Transformer, Transmission line and Turbine. These are the major parts that need to be protected all the time. All of these protections are automatically programmed to trigger as per situation and they are controlled and monitored from control room. The Fire Fighting and Safety procedure is also discussed that is a vital issue not only for the safety of plant but also for many lives. The different circuit breakers which are an indispensible part of power plant and relays of different types that has been particularly used in EGCB has been mentioned and discussed briefly as well. Hence the protection system chapter ends here.

Chapter 5

Testing & Maintenance

In every plant there are lots of elements that need to be tested in a routine basis. Moreover, electrical elements need to be maintenance properly in order to make lasted for a long time. So in EGCB, there are certain testing and maintenance procedures that we were told about. A brief discussion of them is in below.

5.1 Testing For Transformer

In practical it is very important to determine the transformer reaction for different loads. The performance depending on parameters can be obtained by solving the equivalent circuit for any load conditions. Although when a transformer is rewind with different primary and secondary windings the equivalent circuit also changes. In order to get the equivalent circuit parameters, test methods are first choice. From the analysis of the equivalent circuit one can determine the electrical parameters. On the other hand if the temperature rise of the transformer is required, then test method is the most dependable way. There are several tests that are done on the transformer in EGCB. A few common ones are discussed here.

5.1.1 Transformer Oil test

An oil sample will identify many things on a transformer. The following tests can be performed with the oil sample.

5.1.1.1 Acid Neutralization Test

The Acid Neutralization test is a test of the fluid that declares of how much it has oxidized. Oxidization decreases its dielectric property. Acidity shows chemical reaction with organic insulation. Oxidized fluid will allow interior components to rust.

5.1.1.2 Dielectric Breakdown Test

Dielectric strength of insulating oil is measured in this test. In EGCB, they have Dielectric strength measuring machine manufactured by Megger to test the oil. A diagram of the machine is shown in Figure 5.1. In the figure within the transparent glass part, there are two electrodes placed at a distance. The test is done by applying an AC voltage between the

electrodes. The gap between the electrodes is specified. There is a digital keypad with a display on the right side of the machine. This keypad is used to apply the voltage right before the insulation breaks down, so that a conducting path is formed. Then the dielectric strength is calibrated from the specified distance and the applied voltage. If the dielectric strength is decreased then the arc extinguishing capacity will be decreased. Here it is important to mention that the module shown in Figure 5.1 is strictly monitored and controlled by engineers due to its delicacy.

Figure 5.1: Dielectric Oil Test Module of EGCB

5.1.1.3 Moisture Content Test

Water decreases the power of insulation of oil. Moist can be formed from two sources. One of them is by the breathing process or from oil degradation. Now to absorb the moisture in the air sucked in by the transformer during the breathing process, silica gel breather is used. Now a question may rise that what is transformer breathing. Well when load on transformer increases the insulating oil of the transformer gets heated up, expands and gets expel out in to the conservator tank present at the top of the power transformer and subsequently pushes the dry air out of the conservator tank through the silica gel breather [9]. This process is called breathing out of the transformer. Oil degradation also produces moisture. In Figure 5.2, we can see the Mist Eliminator Pump which is an auxiliary appliance of the plant as it is run by auxiliary power supply.

Figure 5.2: Mist Eliminator Pump of EGCB

5.2 Generator Cooling System

Generator is heated up while running. Too much heat built in generator is not allowed. Excessive heat reduces the performance and its lifetime. In EGCB there is cooling system installed with generator. In the following section, generator cooing system will be discussed.

5.2.1 Air cooling

In EGCB, air cooling method is used to cool the generator. Air is passed through the generator to dissipate the heat. The air around the generator is hot. So passing cool air replaces the hot air around generator and eventually the temperature falls down.

5.2.2 Water cooling

Water fins are surrounded by the generator to absorb heat and then carrying the heat away. Water is being flown continuously by a motor and the heat is being dissipated away. At the EGCB they use water cooling system to cool down the generator.

Chapter 6

Substation

Substation is an indispensible part of Power Plant. Substation is used for different purposes. Mainly substation is used for transmission of power. Usually at EGCB, generator produces 11KV output voltage which is then increased up to 132KV by step-up transformer for transmitting and reducing I^2R loss purpose. Substation is also used for the maintenance of auxiliary equipment of the plant. In this chapter, we will discuss the main parts of a substation used in EGCB.

Figure 6.1: The Substation of EGCB

Figure 6.1 shows the partial part of the substation at EGCB where the Current Transformers (CT), Power Transformers (PT), Isolators, Insulators are connected and arranged. Below, different equipment of the substation is described from the collective perspective.

At EGCB we visited the substation; there we saw different types of equipment to obtain our desired voltage levels. Mainly substation is used for transmission of power. The equipment that are used in the substation of EGCB is as follows.

- Power Transformer
- Instrument Transformer
    - Current Transformer (CT)
    - Potential Transformer (PT)
- Bus bar

- Transmission and Distribution
- Insulators
- Isolators
- Auxiliary Systems
- Underground Cables

6.1 Transformers

In EGCB we saw two types of transformers. They are described below.

Power Transformer

In EGCB, we closely observed power transformers and they are generally installed for step up or step down the voltage. For long line transmission high voltage in needed. In EGCB, there are total four power transformers in each unit.

Figure 6.2 shows Transformer-1 of the substation which is used for stepping up the generated voltage from 11KV to 132 KV. This is a Δ-Y connected transformer.

Figure 6.2: Power Transformer-1 of EGCB

Figure 6.3 is Transformer-2 which is tapped from transformer 1. This is a step down transformer. Here, the voltage level is stepped down from 132KV to 11KV.

Figure 6.3: Power Transformer-2 of EGCB

Figure 6.4 is showing both Transformer 3 and 4. They are also step down transformers tapped from transformer 2. Here, the voltage level is stepped down from 11KV to 6.6KV. Those transformers are used for auxiliary purpose of the plant. This 6.6KV high voltage is not directly used for auxiliary purpose but is made change as per demand to lowest nominal voltage need.

Figure 6.4: Power Transformer 3 and 4 of EGCB

Instrument Transformer

During our internship we saw instrument transformers. There were two kinds of Instrument Transformers. They are Current Transformer and Potential Transformer. Instrument transformers are used for measuring and protection purposes. These transformers are discussed below.

i) Current Transformers (CT)

In EGCB during our intern period, we saw several current transformers. Current transformers are mainly used for metering and protection. Usually we cannot use high current for metering purpose. So we need to step down the current to a convenient value. Normally in CT, primary side current is very high and secondary side is low. At EGCB, the ratio is 800/1. Current Transformers are always connected in series with the 132 KV line. These transformers are made in India by BHEL (Bharat Heavy Electricals Ltd.). Figure 6.5 shows the CT at EGCB substation. Apparently CT looks like wide circular cylinder and it is connected in series with the transmission line we observe carefully.

Figure 6.5: Current Transformer of EGCB

ii) Potential Transformers (PT)

In EGCB, we saw several potential transformers. These transformers are used for measuring and protection purpose. Usually protective relays need low voltage to operate. So we need to convert the high voltage to low voltage. In fact, potential transformer is a step down transformer. It indicates primary side voltage is high and secondary side voltage is low. PT is used in parallel with the line. The ratio is 1200/1 of 132KV line. Potential transformers used in EGCB are made in India by BHEL. Figure 6.6 is the PT. It sometimes creates confusion about which one is PT in between CT and PT as both looks more or less same. But PT is connected in parallel with the transmission line. Besides PT is a little narrow at the top side as we can see in Figure 6.6.

Figure 6.6: Potential Transformers of EGCB

6.2 Bus Bars

During our internship in EGCB we observed Bus Bars. Bus bar is a bar or line where different types of lines such as transmission line, distribution line etc. operates at the same voltage level. Bus bar is used as the common electrical bar. The incoming and outgoing lines in a substation are connected to the bus bar. In EGCB they used single bus bar.

6.3 Single Bus Configuration

As the name suggests, it consist of a single bus bar and all the incoming and outgoing lines are connected to it. At EGCB, the reason why they have used Single Bus Configuration is due to the fact that it has low initial cost, less maintenance needed and simple operation. However, the disadvantage of single bus bar system is that if repair is to be done on the bus bar or a fault occurs on the bus, there is a complete interruption of the power supply as we were told.

6.4 Transmission and Distribution

During our internship we saw the transmission and distribution system of EGCB. A substation receives electrical power from generating station via incoming transmission lines and delivers electrical power via the outgoing transmission lines. Overhead lines are used for transmission and distribution. Some components are used in EGCB which are given below.

6.4.1 Insulators

We saw different types of insulators in the substation of EGCB which are used in power lines. There are three types of insulators. Figure 6.7 shows these insulators which are pointed for identification purpose. And they are -

- Suspension type insulator.
- Pin type insulator.
- Strain Insulator.

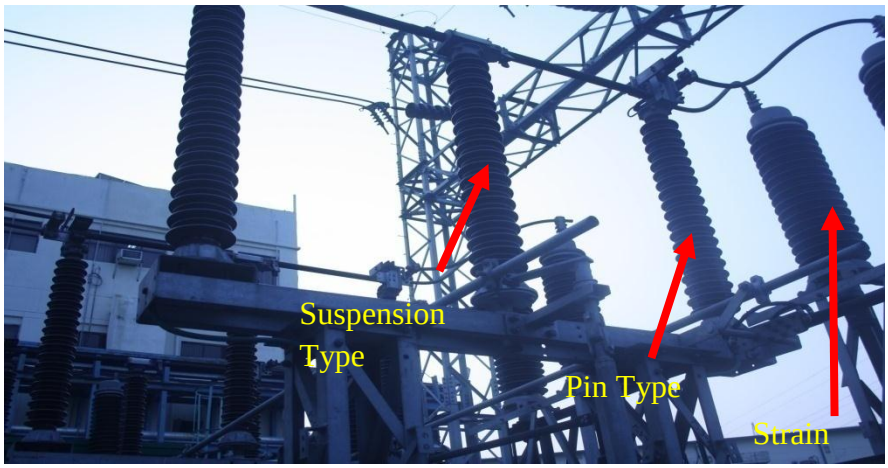

Figure 6.7: Different types of Insulators used in EGCB substation

6.4.2 Isolators

In substation we also saw the Isolators. It is the extra protection part of the system. It is often desired to disconnect a part of the system for general maintenance and repairs. It is accomplished by an isolator. Isolator does not have the arc extinction capacity. It operates under no load condition. It does not have any specified current breaking capacity or current making capacity. Isolator not even used for breaking load currents. While opening a circuit we have to open the circuit breaker first, and then we can open the isolator. While closing circuit, the isolator is closed first, then circuit breakers.

6.5 Auxiliary Systems

During our intern period we saw different types of auxiliary systems used in EGCB. The systems are Lube Oil pumps, Outdoor lighting and receptacles, Control house, Heating and ventilation, Chiller Air conditioning, Battery charger input and Motor-operated switches etc. For these auxiliary purposes, EGCB take power from Grid and Transformer 3, 4.

6.6 Underground cable

An underground cable essentially consists of one or more conductors covered with suitable insulation and surrounded by a protecting cover. In EGCB's substation, we saw these cables for the grounding, metering and internal connection purpose.

Figure 6.8: Underground Cables of EGCB substation

The cable shown in figure 6.8 is actually an XLPE cable ranges from 6.6kV to 33kV in voltage rating. XLPE cables use cross linked polyethylene as insulator and this equalizes the electrical stress of the cables [10].

6.7 Single Line Diagram of Siddhirgonj 2×120 MW PPP

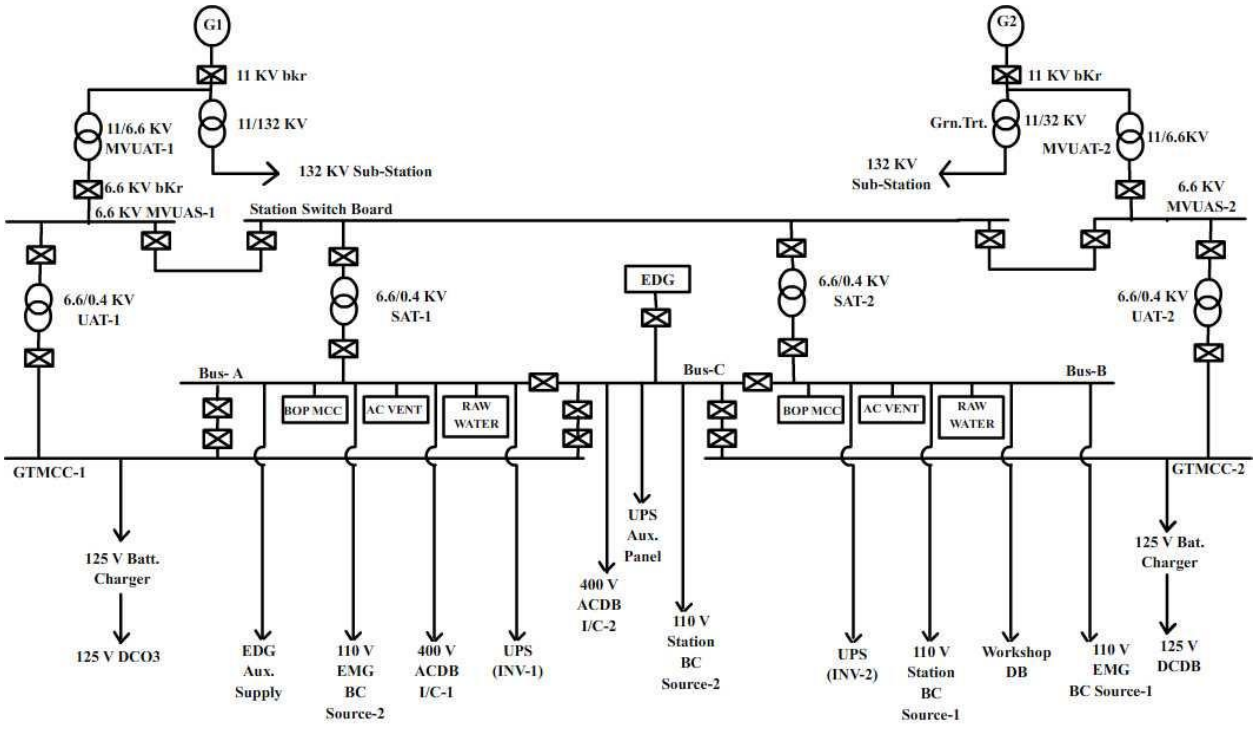

Figure 6.9: Bus and General Specification of Siddhirgonj Power Plant [2]

Figure 6.9 is a single line representation of EGCB plant in terms of bus and general specifications. The whole plant constitute of two units. For the purpose of discussion and understanding, only one unit's work flow is going to be described briefly here.

11KV current is generated at first in generator unit of the plant. This current is then stepped up to 132KV and sent to the substation. A portion of this high voltage current is bypassed right after generation in to Medium Voltage Unit Auxiliary Transformer (MVUAT-1) for the auxiliary usage within the plant. For the auxiliary purpose of the plant, this transformer step down the 11KV current into 6.6KV current. Then it goes to Medium Voltage Unit Auxiliary Station (MVUAS-1). This station again is connected with the switching board of the plant through circuit breakers. Now this 6.6KV voltage is stepped down in to 0.4 KV through Unit Auxiliary Transformer (UAT-1) and sent to Gas Turbine Motor Control Circuit (GTMCC-1). Similarly through Station Auxiliary Transformer (SAT-1) the voltage is reduced down to 0.4KV. Finally this 0.4KV current from UAT-1 and SAT-1 respectively is reduced as per need and used in all necessary auxiliary units such as Balance Of Plant Motor Control Circuit (BOP MCC), BUS A, Battery charger, Emergency Diesel Engine (EDG) etc of the plant. Similar work flow occurs in the other unit.

Chapter 7
Control & Backup System

At EGCB they use 2 types of Control system.

- Manual Control for both unit 1 and 2.
- Computer Based Automatic Control.

Again, Computer Based Automatic Control has two parts. They are

- Distributed Control System (DCS) for the Balance of plant (BOP).
- Mark six controls for turbines.

We can also divide the Control System of the whole plant in two ways in terms of control management as follows

- Local Control room for Gas Turbine (GT).
- Central Control room for the whole system.

7.1 Manual Control for both unit 1 and 2

At EGCB during our training period we saw the manual control room. This room contains different types of manual controlling equipment like Data Concentrator panel, Field Suppressor panel, Thyristor Convertor panel, Automatic Voltage Regulator panel, Generator Transformer panel, GT Auxiliary panel, GT Control panel , Generator- Relay panel, 2×120 MW Generator Control panel, 110/200 A-H Battery Charger panel, 110V Emergency Lighting Charger panel, 125V/150Amp Dual FCBF panel. We will discuss these in next section.

7.1.1 Generator Transformer panel

In EGCB at Local control room, we saw generator transformer panel. The rating of this panel is as follows

Power = 170MVA

Voltage = 132/11KV

Frequency = 50Hz

Figure 7.1: Generator Transformer panel

7.1.2 Data Concentrator panel

Figure 7.2 shows the Data Concentrator Panel in EGCB. It is used if the plant system fails at worst case scenario. Then it concentrates all necessary data at one place. In fact, it is a switch gear and manufactured by AREVA.

Figure 7.2: Data concentrator panel

7.1.3 Gas Turbine Auxiliary panel

In EGCB, we saw Gas Turbine Auxiliary Panel. It contains UV fire monitor, Hazardous Gas Monitor 1&2 and Water Wash System. This panel is used for controlling the auxiliary equipment of the gas turbine. It is manufactured by PROCON.

7.1.4 Generator Relay panel (GRP)

At EGCB we saw GRP. Figure 7.3 shows it. Here all the Controlling equipment is serially arranged in a panel. We can manually control the generator and relay from this panel. Different types of controlling wires from generator and relays are connected to this panel. There are different types of meter indicates the present condition of generator and relays. This panel is made by Siemens.

Figure 7.3: Generator Relay Panel

7.1.5 Generator Control Panel

Figure 7.4 shows Generator Control Panel in EGCB. This panel contains ammeter, voltmeter, PF meter, Frequency meter, Null voltmeter, MW meter, MVAR meter, Synchroscope, Excitation Field Ammeter, Excitation Field Voltmeter, Double Frequency Meter, and Double Voltmeter. It also contains push button switches, Different indicating lights, Trivector meter and various relays. In fact, this panel manually controls the whole Generator unit.

Figure 7.4: Generator Control Panel

7.1.6 Automatic Voltage Regulator (AVR)

In Figure 7.5 we can see AVR of EGCB. When the rotor speed of generator goes 2000 rpm, DC supply goes off and excitation system turns on. Then the output voltage is regulated by AVR. We can manually control the generator output voltage by AVR. It is made in India by BHEL.

Figure 7.5: Automatic Voltage Regulator

7.1.7 Thyrister Convertor

We saw thyrister at EGCB. It is a rectifier deals with high DC voltage. We need high DC voltage to operate big size DC motors. We can manually control the firing angle by thyrister.

7.1.8 Relay panel

At EGCB we observed relay panel. All the relay panels are automated in EGCB. This relay panel includes protective relays, control switches, temperature sensor, energy meters and auxiliary relays.

7.1.9 Battery charger panel

This panel is used for charging the batteries of the plant. Actually it is a Float Cum Boost Charger. Normally the DC Power is supplied to the load by the Float Charger. It also supplies trickle current to the battery to keep it healthy. If the charging current under Float Mode exceeds a set level, boost charger is switched ON. It supplies quick charging current to the battery. On battery reaching the set value, the Boost Charger is switched OFF. Rating of this panel is 110/200 A-H as it can be seen from Figure 7.6. This charger is manufactured by

CHHABI. From the figure we can see three flickering lights. They flicker when Trickle current, Charging current and set voltages are provided in to it.

Figure 7.6: Battery Charger Panel

7.1.10 Emergency Lighting Charger

In EGCB, we saw Emergency Lighting charger. The charger is used for emergency lighting of the plant when any abnormal case occurs. Its rated output voltage is 110Volt.

7.2 Computer based automatic Control

At EGCB they use Distributed Control System (DCS) as their main controlling system. More specifically we use DDCMIS system. This system operates with Max DNA software. They also use Mark six control systems for turbine only.

7.2.1 Distributed Control System

During our training period we saw DCS. Mainly it is the combination of PID controllers**.** DCS is a computerized control system used to control the Balance of Plant. DCS is a very broad term used in a variety of industries, to monitor and control distributed equipment.

7.2.2 Mark VI control for turbine

We saw Mark six controls for Frame 9E Gas Turbine at EGCB. Mark six is a flexible control system for multiple applications. It features high speed, networked I/O for simplex, dual, and triple redundant systems.

7.3 Backup System

Like any other power plant, the backup system of EGCB power plant provides the continuous DC power supply to the control equipment. Here it is provided by Nickel Cadmium batteries. This section will deal with the auxiliary power supply using DC batteries for the plant and the voltage level that is provided by these batteries will also be discussed.

7.3.1 Auxiliary DC power supply

We have seen the auxiliary power supply which is provided by the DC supply. The inverter is used to convert the DC supply to the AC. In the battery backup panel the batteries are interconnected. Battery ensures an uninterrupted power supply. In EGCB lead acid or nickel cadmium batteries are used to get 220V dc supply. In the control room there are two rectifiers. One is for supplying the DC to the control panel from the input AC source and the other rectifier (Rectifier-2) is used for the backup rectifier of Rectifier-1.

The batteries are charging and discharging continuously. When charge is needed, the batteries are being charged, but when there is AC power supply, the batteries are in floating condition. In this state neither they get charged nor do they supply power. The rectifier itself supplies the DC to the control board from the input AC.

7.3.2 Battery Voltage Level

In the battery backup room we have seen Ni-Cd batteries are connected in series to add the voltage. The voltage level of all the batteries is same (1.2V). The battery capacity is denoted by the Ampere-Hour (A-H). These batteries are also connected to the system. The batteries are charging continuously and when needed, these batteries will behave like a backup system. The steady condition at which the constant voltage will be given is called the floating position. These batteries are charged once a month in a higher voltage (1.6V) to enhance the battery performance. Figure 7.7 shows the view of the Battery room where Ni-Cd batteries are connected in series to provide DC supply.

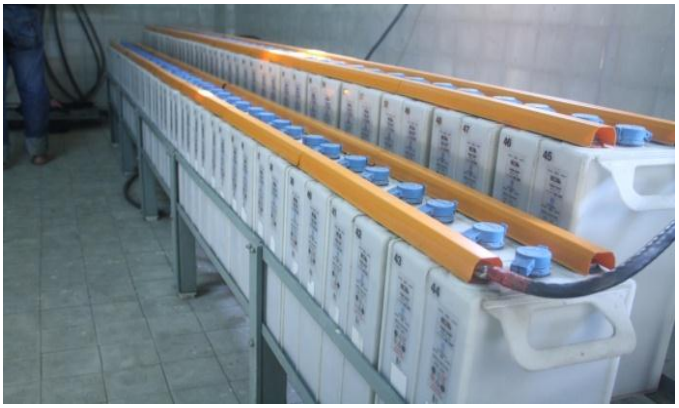

Figure 7.7: Ni-Cd batteries as DC supply in EGCB

Chapter 8
Conclusion

8.1 Problems

In our internship program we faced some problems. Those are as follows:

• During our internship one generator unit was turned off for low gas pressure. This is why we could not observe full load of the power station.

• The time of the internship was too short for which we could not learn all the sections thoroughly.

• Before the internship we did not have any academic knowledge about the mechanical section of the power plant, for which we faced some problems in our internship.

8.2 Recommendations

• The length of the internship duration should be increased. We think the duration should be spare for at least three months.

• Students should complete power station related courses such as power station and switchgear before internship.

• University authority should offer at least one course related to mechanical engineering to understand the mechanical parts of the power station.

• Substation is a high voltage area. So everyone should be aware of the precautions of power station.

8.3 Conclusion

Power sector is a very important and sensitive issue for any country for its industrial thus economic growth. But, from the beginning Bangladesh is facing numerous problems in power sector. Among them the main problem is its inadequate generation of electricity. Day by day the demand is increasing but the generation of power is not enlarged in the same manner. As a result, load-shedding is occurring frequently.

Through this internship we got the opportunity to work as a member of a professional team which was involved in the I&C (Instrumentation and Control) section, electrical section, mechanical section and the maintenance section. The generation of electricity is one of the most complex processes among all these sections. Electricity is generated after a lot of complex steps and then supplied to the grid.

We have gathered some practical experience in generation of electricity. We also have gained practical knowledge in controlling a large power plant from the control room with the assistance of our superintendent engineers. With the experience of this internship we can relate the practical understanding with the theoretical knowledge of power generation. In this internship we also have encountered some real life problems in electricity generation. We believe that, the practical experience that we have gathered in EGCB will help us in our professional life.

References

[1] Electricity Generation Company Bangladesh (2012, February 5) [Online].
Available: http://www.egcb.com.bd/120mw.php.
[2] Siddhirganj 2×120 MW Power Plant Authority.
[3] Idealized Brayton Cycle [Online].
Available: www.braytonenergy.net
[4] Professor M.V.Deshpande, "Gas Turbine Stations and Combined Cycles", in *Elements of Electrical Power Station Design*, 3rd ed. Allahabad, India: A.H.Wheeler, 1986.
[5] G.R.Nagpal, "Gas Turbine Power Plant", in *Power Plant Engineering*, 4th ed. Delhi, India: Khanna, 2001.
[6] C.Russell Mason, "Current, Voltage, Directional, Current (or Voltage)- Balance, And Differential Relays", in *The Art & Science of Protective Relaying*, New Jersey: Wiley, 1956.
[7] Reverse Current Protection of an Alternator [Online].
Available:http://www.projecttopics.info/Electronics/Reverse_Power_Protection_of_An_Alternator.php
[8] Bucholz Relay [Online].
Available:http://www.electrical4u.com/electrical-transformer/buchholz-relay-in transformer.php
[9] MAHA Trading Co. [Online].
Available: http://www.silicagelpacks.com/Silica-gel-breather-function.htm
[10] Hideo Tanaka, Hiroshi Niinobe, Takehiko Mizuno, Satoru Maruyama, "Underground Power Cable, Distribution Cable, Overhead Transmission Line, Industrial Cable and Their Accessories," Furukawa Electric, Tokyo, Japan, Furukawa Review, No. 32, 2007.
Available: www.furukawa.co.jp/review/fr032/fr32_02.pdf

Appendix

EGCB - Electricity Generation Company Bangladesh

BPDB - Bangladesh Power Development Board

DESA - Dhaka Electric Supply Authority

ADB - Asian Development Bank

BHEL - Bharat Heavy Electricals Limited

MVUAT -Medium Voltage Unit Auxiliary Transformer

MVUAS - Medium Voltage Unit Auxiliary Station

UAT - Unit Auxiliary Transformer

GTMCC - Gas Turbine Motor Control Circuit

BOP MCC - Balance of Plant Motor Control Circuit

EDG - Emergency Diesel Engine

SAT - Station Auxiliary Transformer

GCV - Gas Control Valve

SRV - Speed Ratio Valve

PT - Potential Transformer

CT - Current Transformer

GT - Gas Turbine

GBC - Gas Booster Compressor

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:	EGCB
Name of the student:	Kh Towkir-Ul-Islam
ID:	2009-1-80-047

Date:	12/8/12
Start time/End time	9.00 am to 4.00 p.m
Location:	Siddirganj power station, Narayanganj
Mentor:	Nandhipan Das

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 today's activity was to get a basic idea of the total electrical system of this plant.

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

We were shown how the step-up transformer (11KV/132 KV) were connected to two stepdown transformers of respectively 11/6.6 KV and 6.6/0.4 KV. From there what is the need of 6.6KV and how the generated power is transmitted to the grid We also had an brief discussion on the purpose CT, PT and circuit breakers, and relays use as protection system.

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

As this was our first day as an intern and we were told about CT, PT, relays and circuit breakers, we were very much able to relate the practical knowledge with theoretical ideas.

Nandhipan Das 12.8.2012
Signature of the mentor with date
Name: Nandhipan Das
Designation: Assistant Manager (Technical)
Contact Phone #: 01717676873

Signature of academic supervisor with date
Name:
Designation: 10/12

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

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

Name of the company:	EGCB
Name of the student:	Kh. Towkir - Ul - Islam
ID:	2009 - 1 - 80 - 047

Date:	14/8/12
Start time/End time	9.00 am to 4.00 pm
Location:	Siddirganj ~~Ner~~ Power Station, ~~Narsingdi~~ Narayanganj
Mentor:	Nadir Chowdhury

General Instructions:

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

Department of Electrical and Electronic Engineering
East West University

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

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

The objective of the day's activities was to relate the mechanical part with the main controlling system of the power station, thus to get an idea on how through the control room, the whole system can be conducted.

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.

As per the objective firstly we were briefly taught about how air compresion and combustion chamber works to activates generators work function. We were taught about Brayton Cycle and showed the P-V diagram as well as T-S diagram. Later we were introduced to the Mark-VI software that was the day's prime objective. By this we were briefly showed HMI to understand how control room work softwere. And in the end, we were taken to the switchgear control room where we saw the protection system of the whole plant.

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

We got to relate various protection relays and CB Circuit breakers that we learnt in our switch gear courses.

14/8/12

Signature of the mentor with date
Name: Nadir Chowdhury
Designation: Asst. Manager
Contact Phone #: 01722-020360

Signature of academic supervisor with date
Name:
Designation: 10/12

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

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

Name of the company:	EGCB
Name of the student:	Kh. Towkir - Ul- Islam
ID:	2009 - 1 - 80 - 047

Date:	25/8/12
Start time/End time	9.00 am to 4 p.m
Location:	Siddirganj power station, Narayanganj
Mentor:	SIDDIQUR 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.
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)

Today's main goal was to familiarize/get acquainted with the basic work function system of this company through a single line diagram. For this, we also got to learn about the demands, generation and distribution as in like auxillary units, and generation unit etc.

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 went to the central control room where we were explained a single line diagram of the whole plant. Here, we saw how what are the internal/auxillary demand from the generation unit. And how the connections were made.

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

Through today's class we got to learn about different power consumption of the whole power plant and I got to relate them with my power station course.

Signature of the mentor with date
Name: Md. Sikdar Rahman
Designation: Assistant Manager (Tech.)
Contact Phone #: 01717283322

Signature of academic supervisor with date
Name:
Designation:

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

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

Name of the company:	EGCB
Name of the student:	Kh. Towkir - Ul- Islam
ID:	2009 - 1 - 80 - 047

Date:	26/8/12
Start time/End time	9.00 am to 4 p.m
Location:	Siddirganj x power station, Narayanganj
Mentor:	Siddiqur 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.
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 today's activities was to give a complete idea on the ~~Distributed~~ Mark VI Control system of the plant.

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

On that day we specifically learnt
- about balanced of plant
- a brief idea on its gas booster compressor & electrical connection.
- got to know about the conditions i.e. start permissive of Gas compressor
- and last but not the least about a brief idea on the trip logic of gas compressor.

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

Even though majority of ~~this~~ these ~~topics~~ activities were practical application of our theoretical knowledge and they were comparatively new yet we could relate the practical and theoretical knowledge.

29/8/12

Signature of the mentor with date
Name: Siddiqur Rahman
Designation: Asst. Manager (operation)
Contact Phone #: 01717283380

Signature of academic supervisor with date
Name:
Designation:

10/12

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

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

Name of the company:	EGCB
Name of the student:	Kh. Towkir - Ul- Islam
ID:	2009 - 1 - 80 - 047

Date:	27/8/12
Start time/End time	9.00 am to 4 p.m
Location:	Siddirganj power station, Narayanganj
Mentor:	A.K.M Zillur 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.
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)

Knowing ~~about~~ different modes of operation of generator and the various valves associated with them was the main objective of today's activities.

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.

As per our objectives today we were shown three different valves known as IGV, SRV and GRV which controls the different modes of operation of the plant. We saw their functions as well as the connections of various other valves and their positions.

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

In our academic courses we learnt about different valves which were matched with our practical knowledge.

27/02/2012

Signature of the mentor with date
Name: A.K.M. Zillur Rahman
Designation: Asstt. Manager (I&C)
Contact Phone #: 01739664236

Signature of academic supervisor with date
Name:
Designation:

10/12

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

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

Name of the company:	EGCB
Name of the student:	MD. SHOAIB HOSSAIN CHOWDHURY
ID:	2009-1-80-022

Date:	28-08-2012
Start time/End time	9AM to 4P.M
Location:	SIDDHIRGANJ, NARAYANGANJ
Mentor:	KAZI M H KABIR

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 main objective of the day is to understand and acquire practical knowledge about fire fighing.

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

① First we give a pre-Training exam.
② Then we read fire-fighting handout and listen the discussion carefully.
③ Then we give a post treaning examination.
④ Then we do ~~written~~ wrap up discussion and gives our opinion about the topic.

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

On academic course EEE-442 we learn different types of protection. Here we practically learn how to handle those kind of fire hazard.

23/8/12
Signature of the mentor with date
Name: Kazi M. H. Kaiser, PhD
Designation: Manager Environment
Contact Phone #: 8124197 - 110

16/9/12
Signature of academic supervisor with date
Name: FMA
Designation: Lecturer

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

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

Name of the company:	E.G.C.B
Name of the student:	MD SHOAIB HOSSAIN CHOWDHURY
ID:	2009-1-80-022

Date:	29-08-2012
Start time/End time	9AM to 4PM
Location:	SIDDHIRGANJ, NARAYANGANJ
Mentor:	Engr. ASHIS KUMAR 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.
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 main objective of the day is to learn and observe the gas conditioning skid.

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

1. First we go to go conditioning skid learned
2. Then we saw how CH4 gas purified before use.
3. Then we saw how to increase gas pressure using gas booster.
4. Then we observe how we measure the gas pressure.
5. After all the purification gas are supplied to generator.

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

In our theoretical course EEE 491 we learn about conditioning gas skid. Here we practically observe that.

29/08/12
Signature of the mentor with date
Name:
Designation: ?
Contact Phone #:

16/9/12
Signature of academic supervisor with date
Name: FMA
Designation: Lecturer.

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

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

Name of the company:	E. G. C. B
Name of the student:	MD. SHOAIB HOSSAIN CHOWDHURY
ID:	2009-1-80-022

Date:	30-08-2012
Start time/End time	
Location:	SIDDHIRGANJ, NARAYAN GANG
Mentor:	NANDHIPAN DAS

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)

Todays objective was to get an overview of the transformers present in the plant.

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

1. Practical knowledge about all the transformers.
2. Practical knowledge about the protection system.
3. Then we saw how those instruments are connected with each other.

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

In our theoretical course EEE 442 we know those things. Here we practically observe those things.

Signature of the mentor with date
Name: Nandhipan Das
Designation: Assistant manager
Contact Phone #: 01717 676873

30.08.2012

Signature of academic supervisor with date
Name: FMA
Designation: Lecturer

16/9/12

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

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

Name of the company:	MD. SHOAIB HOSSAIN CHOWDHURY
Name of the student:	E. G. C. B
ID:	2009-1-80-022

Date:	01-09-2012
Start time/End time	9A.M to 4 P.M
Location:	SIDDHIRGANJ, NARAYANGANJ
Mentor:	NANDHIPAN DAS

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)

Todays objective was to know about excitation system and a field view of the generator unit.

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

1. First we were given an assignment on excitation system.
2. Then we go to generator unit where excitation system exists.
3. Then we practically observe how it works.

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

In our theoretical course EEE 442 we read about excitation systems. Here we practically observe that.

1.7.2012
Signature of the mentor with date
Name: Nandhipan DAS
Designation: Assistant Manager
Contact Phone #: 01717676873

Mahmud. 16/9/12
Signature of academic supervisor with date
Name: FMA
Designation: Lecturer.

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

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

Name of the company:	EGCB
Name of the student:	MD. SHOAIB HOSSAIN CHOWDHURY
ID:	2009-1-80-022

Date:	02-09-2012
Start time/End time	9AM to 4 P.M
Location:	SIDDHIRGANG, NARAYAN GANJ
Mentor:	MD YAMIN 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 mein objective of the day is to understa the mechanical part of the 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.

1. First we came to know the mechenical Construction of gas turbine, Compressor etc.
2. Then we know about 3 modes of operation of the gas turbine.

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

We know about this theoretically in EEE-4 Curee. Here we practically relate the theoretical and practical knowledge.

02.09.12
Signature of the mentor with date
Name: Md. Yamin Ali
Designation: Assistant manager
Contact Phone #: 01929 301768

16/9/12
Signature of academic supervisor with date
Name: RMA
Designation: Lecturer

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

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

Name of the company:	EGCB
Name of the student:	MOHAMMAD IBNUL HASAN
ID:	2009-2-80-063

Date:	03.09.2012
Start time/End time	9:00 am to 4:00 pm
Location:	Field trip
Mentor:	MD. YAMIN 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 this day was to know the Gass cotroll system, different types of valve & pump used in powerstation, Diessel cycle, Gass compresson Turbine learning etc.

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.

The topic covered was,
↳ Gass booster compresson,
↳ Air filtering system,
↳ Generator colling system / process
↳ Different types of valves, amp pumps
↳ Gass booster compresson,
↳ Anti surge controll / protetion etc.
↳ diffrent types of pump ↳ magnetic pick up.

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

The practical knowledge was covered ~~in~~ or related ~~to~~ in course powerstation. (EEE-441)

09.09.12

Signature of the mentor with date
Name: Md. Yamin Ali
Designation: Asst. Manager
Contact Phone #: 01929301768

Signature of academic supervisor with date
Name:
Designation: 10/12

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

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

Name of the company:	EGCB
Name of the student:	Mohammad Ibnul Hasan
ID:	2009-2-80-063

Date:	04.09.2012
Start time/End time	9.00 — 4:00 PM
Location:	central control room
Mentor:	Engr. Ashis kumar 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.
b. The daily report should be a brief narration of the activities during the internship period in the eyes of the intern and should be completed and submitted by every intern irrespective of the number of partners s/he might have for the presentation and final report writing purpose.
c. The report should not be a compilation of lectures notes taken during the internship, rather it should depict what the intern has learned on a particular day.
d. In case of any confusion, interns are strongly recommended to consult their respective academic supervisors.

Department of Electrical and Electronic Engineering
East West University

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

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

The objective of this days activity was to know how turbine and generators are controlled from central controll pannel

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.

At the controll pannel we have watched boow GT, and generators and other auxilary motor, pumps, compressor etc are controlled which is know as DCS Distributed controll system
DCS is made by metsoautomation software, Max Dynamic networking access (DNA)
* ONAF, ONAN, OFAN
* tap principle, tap position,
* winding connection (vector group)
* principal of transformer
* paralleling
* OLTC

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

The practical knoledge gained today was related to EEE-402 (controll system)

4/9/12

Signature of the mentor with date
Name: Ashis Kumar Biswas
Designation: Asst. Manager
Contact Phone #: 01912598109

Signature of academic supervisor with date
Name:
Designation:

10/12

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

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

Name of the company:	EGCB
Name of the student:	Mohammad Ibnul Hasan
ID:	2009-2-80-063

Date:	05.09.2012
Start time/End time	9:00 to 4:00 PM
Location:	Switch gear control room.
Mentor:	~~Md. Saiful Islam~~ Nandhipan Das

General Instructions:

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

Department of Electrical and Electronic Engineering
East West University

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

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

The objective of this day's activity was to learn ~~AVP~~ principal of mechanism of AVR, Thyristor, GRP-M, GRP-R, GRP (Generator relay pannel)

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 to day's activity we get to learn AVR (Automatic voltage regulation), Thyristor and generator relay pannel. We watched the readings of different types of protection relay and CB's. Generator excitor (pilot excitor, Brush less excitor) generator shaft coupling with turbine shaft, diode wheel etc.

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

The topics discussed to-day was related to course EEE-442, EEE 304, EEE-307

Signature of the mentor with date
Name: Dandhipan Das
Designation: Asst. Manager
Contact Phone #: 01717676873

Signature of academic supervisor with date
Name:
Designation:

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

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

Name of the company:	EGCB
Name of the student:	Mohammad Ibnul Hasan
ID:	2009-2-80-063

Date:	06.09.2012
Start time/End time	9.00 to 4:00 PM
Location:	Switch gear room
Mentor:	Md. Saiful Islam

General Instructions:

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

Department of Electrical and Electronic Engineering
East West University

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

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

The objective of this day's activity was to visit and gain the knowledge about the switchgear room, generator relay pannel and Battery room. PMCC,

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.

↳ switchgear room
↳ Diffrent types of circuit Breaker
↳ Generator relay pannel
↳ Battery room.
↳ 86 - master trip.

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

The theoritical/practical knowledge is quite related to the cource switchgear (EEE-442)

Signature of the mentor with date
Name: Md. Saiful Islam
Designation: Manager (Electrical)
Contact Phone #: 01730359532

Signature of academic supervisor with date
Name:
Designation:

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

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

Name of the company:	EGCB
Name of the student:	Mahammad Ibnul Hasan
ID:	2009-2-80-063

Date:	08.09.2012
Start time/End time	9:00 am to 4:00 pm
Location:	Field Trip
Mentor:	MD. Yamin Ali

General Instructions:

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

Department of Electrical and Electronic Engineering
East West University

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

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

The objective of this days activity was know how different types of compresson, GBC etc woorking principle.

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.

↳ IAPA (Instrument air, Plant air compresson)
↳ Reciprocating Air compresson
↳ GBC, air filter, N_2 filter
↳ anti surge tank
↳ Pneumatic valve
↳ pressure switch. etc.

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

The topic of this days is related to EEE-441 (power station) course.

08.05.12
Signature of the mentor with date
Name: Md. Yamin Ali
Designation: Asst. Manager (Tech)
Contact Phone #: 01929301768

Signature of academic supervisor with date
Name:
Designation: 10/12