INTERNSHIP REPORT

ON

ASHUGANJ POWER STATION COMPANY LTD

By

Humayra Chowdhury (2008-2-80-033)
Tuhin Afroz (2008-2-80-048)
Subeh Us Sama Authaye (2008-2-80-067)

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, 2012]
Approved By

_____

Academic Adviser
Sohana Tanzeem

_____

Chairperson of The Department
Dr. Khairul Alam

APPROVAL LETTERS

ASHUGANJ POWER STATION COMPANY LTD. (APSCL)
(An Enterprise of Bangladesh Power Development Board)

APSCL

CIRIFICATION FOR INDUSTRIAL ATTACHMENT TRAINING PROGRAMME

Certified that Humayra Chowdury, Student. ID No- 2008-2-80-033 of Electrical & Electronic Engineering Départements of East- West University, Dhaka, has participated the Industrial Attachment Training Program from 26-12-2011 to 11-01-2012 and successfully completed the course.

11-01-2012

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

ASHUGANJ POWER STATION COMPANY LTD. (APSCL)
(An Enterprise of Bangladesh Power Development Board)

CIRIFICATION FOR INDUSTRIAL ATTACHMENT TRAINING PROGRAMME

Certified that Tuhin Afroz, Student. ID No- 2008-2-80-048 of Electrical & Electronic Engineering Département of East- West University, Dhaka, has participated the Industrial Attachment Training Program from 26-12-2011 to 11-01-2012 and successfully completed the course.

11-01-2012

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

ASHUGANJ POWER STATION COMPANY LTD. (APSCL)
(An Enterprise of Bangladesh Power Development Board)

CIRIFICATION FOR INDUSTRIAL ATTACHMENT TRAINING PROGRAMME

Certified that Subeh Us Sama Authaye, Student. ID No- 2008-2-80-067 of Electrical & Electronic Engineering Département of East- West University, Dhaka, has participated the Industrial Attachment Training Program from 26-12-2011 to 11-01-2012 and successfully completed the course.

11-01-2012

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

ACKNOWLEDGMENT

First of all, we'd like to thank almighty Allah for letting us complete our internship work successfully.

We'd like to express our gratitude to the Ashuganj Power Station Company Limited (APSCL) management for allowing us to complete our industrial training at this company. We'd also like to thank Mr. Md. Karuzzaman, Senior Engineer (Generator, Switchgear & Protection), Mr. Anwar Hossain, Manager (Operation), Mr. Bikash Ranjan Roy, Manager (I&C), Mr. Md. Mizanur Rahman, Senior Engineer (CCPP) and Mr. Noor Mohammed, Manager (Sub-Station) who had given us their precious time during our internship program to supervise us.

We'd also like to thank our academic advisors Sohana Tanzeem, Lecturer, Mohammad Zakir Alam, Lecturer and Rizvi Ahmed, Research Lecturer, Department of Electrical & Electronic Engineering, East West University, Bangladesh.

Finally, we'd like to mention our thanks to Dr. Khairul Alam, Chairperson & Professor of the Department of Electrical & Electronic Engineering for being very supportive throughout our academic life in EWU.

EXECUTIVE SUMMARY

The power sector in Bangladesh is going through numerous problems characterized by lack of supply capacity, frequent power cuts, unacceptable quality of supply, and poor financial and operational performance of the sector entities We did our internship at Ashuganj Power Station Company Ltd (APSCL) located at 90 km North-East of Dhaka on the left bank of the river Meghna from 26th of December to 11th of January and this internship report is the result of those 15 days attachment with the APSCL. During our internship period we gathered practical experiences over the topics related power generation switchgear protection and power distribution which we have learned inside the class room or from books. In this report we have focused on the processes which are used in APSCL. For power generation, steam and gas turbine power plants are used in APSCL. So we observed the process of power generation by steam and gas turbine power plant. During our internship period unit 1 and 4 of steam turbine power plant were under overhauling situation. So we had the opportunity to observe the inside part of the generator (rotor and stator) and turbine chamber which helped us to collect more knowledge about these topics.

Protection and controlling of the equipments of the power station is a very important and complicated task. With the help of the plant engineers we observed the control room and protective equipments such as: relays (digital and electrical), circuit breakers etc very closely and understood the functions and controlling system of those equipments. Substation is an important part of a power station to distribute power and protection purpose. We acquired knowledge about various types of transformers, bus-bars, circuit breakers (SF6 and Oil), lightning arresters, CT, PT and other equipments of the substation which were clearly taught and shown by the senior engineers of the substation of APSCL. There we saw how the generated power is transformed by transformer and distributed. We observed the protection schemes taken to protect transmission lines and related equipment. Through our internship we have came to know how a power station runs. On the completion of our internship we can relate theoretical knowledge with practical experience.

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DAILY ACTIVITY REPORTS

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:	APSCL
Name of the student:	Tuhin Afrooz
ID:	2008-2-80-048

Date:	26.12.2011
Start time/End time	8.00 am to 4.00 P.m
Location:	Mechanical Department
Mentor:	Achinta Kumar Sarkar (DGM, Mech)

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 objectives of today's activities were to know about the history, current situation and future plans of Ashugonj Power station co Ltd (APSCL). We also visited the power station as an introductory lesson.

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.

APSCL was established in 1970 and currently, it has 9 units in total: 6 of them are run by steam turbine, 2 of them by gas turbine and 1 combined cycle. Unit 1 and 2 are of capacity 64MW each, while unit 3, 4 and 5 are 150MW each. These units are all run by steam turbine. The gas turbine units GT1 and GT2 has capacity of 53MW each. The combined cycle has capacity of 34MW. APSCL plans to make a 225MW unit and a 450MW unit in the future.

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

Our visit to the power plant and the brief introduction was similar to the theoretical knowledge we got from the power related courses.

26.12.2011

Signature of the mentor with date
Name: ACHINTA KUMER SHAKER
Designation: DGM (MM)
Contact Phone #: 01711-425460,

26.12.11

Signature of academic supervisor with date
Name: MOHAMMAD ZAKER ALAM
Designation: LECTURER

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East West University
EEE 499
Industrial Training
Daily Activity Report

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Name of the company:	APSCL
Name of the student:	Tuhin Afroz
ID:	2008-2-80-048

Date:	29.12.2011
Start time/End time	8.00 am to 4P.m
Location:	Generator and Switch Gear Protection Division
Mentor:	Mohammad Kamruzzaman (Senior Engineer)

General Instructions:

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

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East West University

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

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

The objective of the day was:

i) Construction, principle and maintenance of different types of Generator [AC, DC, Salient Pole, non-salient Pole]

ii] Over current protection, over current with under voltage.

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

i) Construction of salient pole Generator. Non-salient pole is used for higher rpm than salient pole.

ii) Working principle of AC & DC Generator's stator and rotor.

iii) Maintenance
- a) Carbon Brush Check
- b) Slip ring check
- c) Air Filter Checking
- d) Shaft Voltage Measurement (P-T-O)

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

The topics discussed in this section was the related material of Switchgear Protection and Electrical Machine-2 Courses.

29.12.11
Signature of the mentor with date
Name:
Designation: Mohammad Kamruzzam... Senior Engr. (Generator)
Contact Phone #: Ashuganj Power Station Co. Ltd. Ashuganj, B-Bar...

26.1.12
Signature of academic supervisor with date
Name: MOHAMMAD ZAKER ALAM
Designation: LECTURER

iv) Protecting of Generator consists of

a) unit Breaker tripped

b) Unit Auxiliary Power supply

c) Excitation Breaker Tripped

d) Steam supply shut off valve off.

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Name of the company:	APSCL
Name of the student:	Tuhin Afroz
ID:	2008-2-80-048

Date:	31.12.2011
Start time/End time	8a.m to 4P.m
Location:	Generator, Switchgear & Protection Division
Mentor:	Mohammad Kamruzzaman (Senior Engineer)

General Instructions:

a. It is the intern's duty to make sure that all his/her daily activity reports are appropriately signed by both the mentor and the academic supervisor.
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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 was different types of protection of Generators includes:

i) Over voltage protection
ii) Negetive phase sequence
iii) Loss of excitation
iv) Reverse Power
v) Under frequency
vi) Minimum impedence

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.

Over Voltage Protection: When voltage is above rated voltage this fault occures, which occures due to thundering, sudden load reduction or line fault.

Negetive Phase Sequence: For same current there will be +ve phase sequence, for unbalance condition there will be -ve phase sequence and for ground fault there will be zero sequence.

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

The topic was studied in the course switchgear & Protective Relay (EEE 442)

31.12.11
Signature of the mentor with date
Name:
Designation:
Contact Phone #:

Mohammad Kamruzzaman
Senior Engr. (Generator)
Ashuganj Power Station Co. Ltd.
Ashuganj, B-Baria-3402

Zakir 26.1.12
Signature of academic supervisor with date
Name: MOHAMMAD ZAKIR AZAM
Designation: LECTURER

2.

Loss of Excitation: If excitation power is blocked, gene generator will take reactive power from grid, which results a fault known as loss of excitation.

Reverse Power: In this case generators will like motor. For reverse power supply relay will work.

Under Frequency: Frequency is proportional to output voltage. If the output voltage increase frequency decrease, which is known as under frequency.

Minimum Impedence: In this case fault is detected by calculating the impedence of the line.

Distance Protection: In this system, it measure the impedance and phase voltage, for what fault protection can be given to the specific direction.

Winding Differential Protection: For fault occurance there is a current through operating coil this activate the protective system.

Stator Earth Fault: A Xformer is used for fault protection.

Rotor Earth Fault: For this fault there will be no exciton of field in the rotor.

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Name of the company:	APSCL
Name of the student:	Humayra Chowdhury
ID:	2008-2-80-083

Date:	29.12.2011
Start time/End time:	8:00am ~ 4:00pm
Location:	Operation Department
Mentor:	Anwar Hossain (Manager, Operation)

General Instructions:

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

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

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

The objective of today's training was to learn about the operation and the control system.

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

Total no. of units in APSCL : 9
→ Steam turbine : 5
→ Gas turbine : 2
→ IC engine (16 gas engine) : 1

Dimineralized water system : Raw water $\xrightarrow[\text{treatment}]{}$ Demineralized water

Condenser System : Demineralized water $\xrightarrow[\text{treatment}]{}$ Condenser

3. Relate your practical activity with the theoretical knowledge you gained in the respective academic course. (P.T.O.)

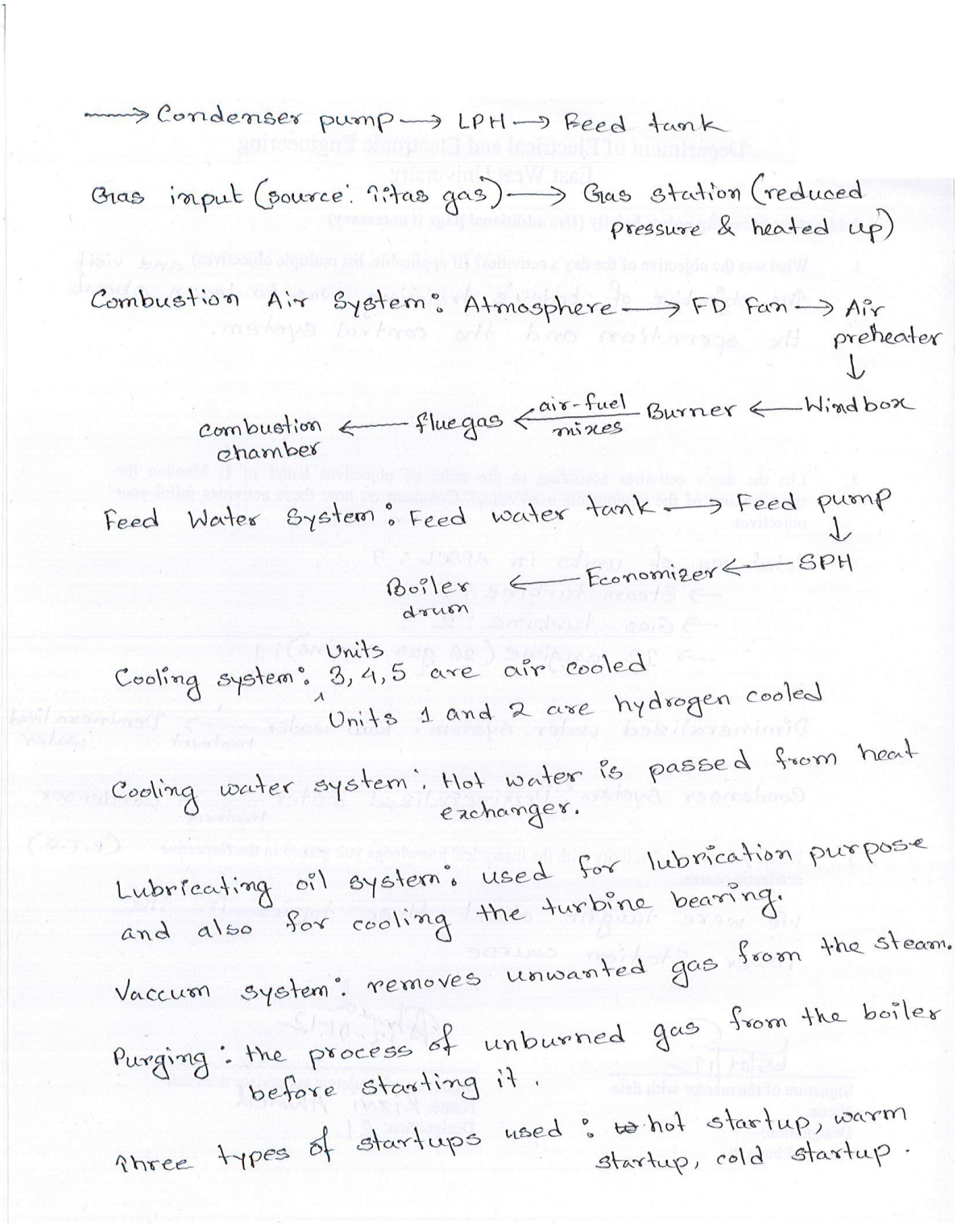
We were taught about these topics in the Power Station course.

05/01/12

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

Ahmed 23-01-12

Signature of academic supervisor with date
Name: Rizvi Ahmed
Designation: RL


Condenser pump → LPH → Feed tank
Gas input (source: Titas gas) → Gas station (reduced pressure & heated up)
Combustion Air System: Atmosphere → FD Fan → Air preheater
Windbox → Burner → air-fuel mixes → fluegas → combustion chamber
Feed Water System: Feed water tank → Feed pump → SPH → Economizer → Boiler drum
Cooling system: Units 3, 4, 5 are air cooled
Units 1 and 2 are hydrogen cooled
Cooling water system: Hot water is passed from heat exchanger.
Lubricating oil system: used for lubrication purpose and also for cooling the turbine bearing.
Vaccum system: removes unwanted gas from the steam.
Purging: the process of unburned gas from the boiler before starting it.
Three types of startups used: hot startup, warm startup, cold startup.

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Name of the company:	APSCL
Name of the student:	Humayra Chowdhury
ID:	2008-2-80-083

Date:	31.12.2011
Start time/End time	8:00 am ~ 4:00 pm
Location:	Operation Department
Mentor:	Anwar Hossain (Manager, Operation)

General Instructions:

a. It is the intern's duty to make sure that all his/her daily activity reports are appropriately signed by both the mentor and the academic supervisor.
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d. In case of any confusion, interns are strongly recommended to consult their respective academic supervisors.

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East West University

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

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

The objective of today's activity was to visit the Control Room of Unit-5.

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.

Unit-5 Control Room is fully computer operated. The system is POS operated which is a Linux based operating system.

We have observed the following systems:

1) Water & Steam Cycle Unit #5
2) Super Heaters
3) Burner Overview
4) Boiler & Flue gas System
5) Feedwater System & Boiler Feed Pump

(P.T.O.)

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

We studied the above topics in the Power Station course.

5/1/12

Signature of the mentor with date
Name: Md Jawad Hasan
Designation: Manager
Contact Phone #: 01241001627

23-01-12

Signature of academic supervisor with date
Name: Rizvi Ahmed
Designation: RL

6) Lube Oil System
7) Temperature & Vibration Monitoring
8) TurbotrolG CONTR CH1 (turbines)
9) Synchronization
10) Bearing Temperatures
11) Shaft Turning Gear
12) Gland Steam System
13) Vibrations / Expansions
14) Generator Measurements
15) Purge & Leak Test
16) Sequence of Events.

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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:	APSCL
Name of the student:	Humayra Chowdhory
ID:	2008-2-80-033

Date:	01.01.2012
Start time/End time	8:00 am ~ 4:00 pm
Location:	Operation Department
Mentor:	Anwar Hossain (Manager, Operation)

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 were to learn about the Network Control Room

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.

Here we learned about switching, busbar and instrument transformers.

Two types of materials are used for the bus-bar: reinforced aluminium core steel and aluminium tube. There are three types of bus bars used in APSCL: 33KV, 230 kV and 132 KV. Aluminium tube busbar is used for 33kV..

The busbar construction can be categorized as Single Busbar, Single Busbar with Sectionalization and Duplicate Busbar. In APSCL, Duplicate Busbar

3. Relate your practical activity with the theoretical knowledge you gained in the respective academic course. (P.T.O.)

We were taught about these topics in Electrical Machine - II and Power Station courses.

23-01-12

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

Signature of academic supervisor with date
Name: Rizvi Ahmed
Designation: RL

system is used. The busbar ratings depends on its current carrying capacity.

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Industrial Training
Daily Activity Report

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Name of the company:	APSCL
Name of the student:	Humayra Chowdhury
ID:	2008-2-80-083

Date:	02.01.2012
Start time/End time	8:00 am ~ 4:00 pm (1 hour gap)
Location:	Instrumentation, Information & Control (I&C)
Mentor:	Bikash Ranjan Roy (Manager, I&C)

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 were to learn about and visit the steam generation and control of the system and ~~to~~ tracing faults in the system.

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

We observed the following equipments in the steam generation and control of the system:
1) Waste Drain valve
2) Control valve (supply pressure 1.4 bar)
3) Binary control
4) Level switch
5) Temperature valve
6) Air heater
7) Voith Gear Control valve
8) Condenser Ventilation valve (P.T.O.)

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

We were taught about these equipments visited today in the Power Station course.

07-01-2012
Signature of the mentor with date
Name: Bikash Ranjan Roy
Designation: Manager (I&C)
Contact Phone #: 01712887349

23-01-12
Signature of academic supervisor with date
Name: Rizvi Ahmed
Designation: RL

9) Shut off valve
10) Control valve

Control valve :

The control valve can open between 0~100%. There are two relays ~~motors~~ C_1 and C_2 connected in 3-ϕ (RYB) that are used to operate the control valve. To open the control valve, C_1 relay ~~motors~~ rotates with RYB in anti-clockwise direction. To close the control valve, the C_2 relay ~~motor~~ rotates with BYR in clockwise direction. When the control valve is 100% open, a signal is sent to the control room and the limit switch (LS) ~~receiv~~ disconnects the motor connection. If the Limit switch fails to operate, then the torque switch operates.

To trace the faults, the cubicles are used. Each of these cubicles have cards with ~~it~~ individual serial number and design. The connections ~~of~~ to the card can be interpreted from the design manual. When a fault has to be detected, first the particular cubicle is selected; then the row is selected, followed by the column and then finally the pin number. The input and output voltages to the card are measured using a measuring lead. ~~and~~ For normal condition, the voltage should be ~~around~~ ~24V.

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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:	APSCL
Name of the student:	Subah VS Sama Authaye
ID:	2008-2-80-067

Date:	03.01.2012
Start time/End time	8:00 am – 4:00 pm (1 hour gap)
Location:	~~Information~~ & Control (I&C)
Mentor:	Bikash Ranjan Roy (Manager, I&C)

Instrumentation

General Instructions:

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

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

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

The objectives of today's activity was to learn about and visit the boiler and related equipments and visit the control room(Unit-4) and how the system is operated from the control room.

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 observed the following equipments in the unit-4 site:

1) Junction Box
2) Air flow Transmitter (rang: 0~8.1mbar)
3) Pressure switch (binary)
4) Live steam flow Transmitter. (operates at 220v ac)
5) Feed water flow Transmitter.
6) Photo receiver
7) Ignitor.

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

We were taught about these equipments visited today in the Power Station Course.

09-01-12

Signature of the mentor with date
Name: Bikash Ranjan Roy.
Designation: Manager (I&C)
Contact Phone #: 01712887349

Signature of academic supervisor with date
Name:
Designation:

8) Nonge valve
9) Feedwater Bypass Control valve

Photo Receiver: detects flame in the burner and sends signal to the control room.

Turbine Protection:
based on
1) Vibration
2) Positioning.

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Daily Activity Report

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Name of the company:	APSCL
Name of the student:	Subeh Us Sama Authaye
ID:	2008-2-80-067

Date:	04.01.2012
Start time/End time	8:00 am ~ 4:00pm (1 hour gap)
Location:	~~Information~~ & control (I&C) → Instrumentation
Mentor:	Bikash Ranjan Roy (Manager, I&C).

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 were to visit and learn about turbine, condenser and the burner control from the control room.

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 visited the following equipments:

1) IP turbine fixed blade
2) Turbine load control Panel.
3) Solenoid valve
4) Emergency trip switch.
5) Vaccum trip circuit
6) Turbine operating device. (Comoll → signal converter)

P.T.O

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

We were taught about some of these equipments in the Power station Course.

07-01-2012

Signature of the mentor with date
Name: Bikash Ranjan Roy.
Designation: Manager (I+E).
Contact Phone #: 01712887349

Signature of academic supervisor with date
Name:
Designation:

7) Main Stop valve left (based on binary control)
8) Lube oil Controller.
9) Overspeed sensor
10) Pedestal bearing Vibration.
11) Impulse line of temperature sensor.
12) Turbo Max (IP Turbo Max, HP Turbo Max)
13) Turbine Drain valve.
14) Isolating valve
15) Suction valve
16) Strainer (used for filtering purpose)
17) condenser Ventillation Valve. (sucks out the ~~water~~ air ~~component~~ from the condenser)
18) Gland Steam Exhaust Valve
19) Turbine Load Control device (controls the load on the turbine)

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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:	APSCL
Name of the student:	Sudeh Us Sama Authaye
ID:	2008-2-80-067

Date:	5.01.2012
Start time/End time	08:00 - 04:00 PM
Location:	CCPP
Mentor:	Mohammad Mizanur 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 the day's activity were to learn about CCPP (gas turbine) and visit the gas turbine of CCPP

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.

Here we learned about combined cycle power plant

* two gas turbine each 25.67 MW of 35°c temperature.
* Present → GT1 - 37 MW, GT2 - 42MW.
* for gas turbine - 150 - 70MW at 15°c temperature.
  exhaust temp. - 500°c (old 569°c)
  turbine inlet temperature - 1010°c.
  Natural gas. fuel system (to burner)
  compressor ratio (1:8) axial flow system types.
* 60% relative humidity and ambient pressure at sea level in gas turbine.

P-T-O.

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

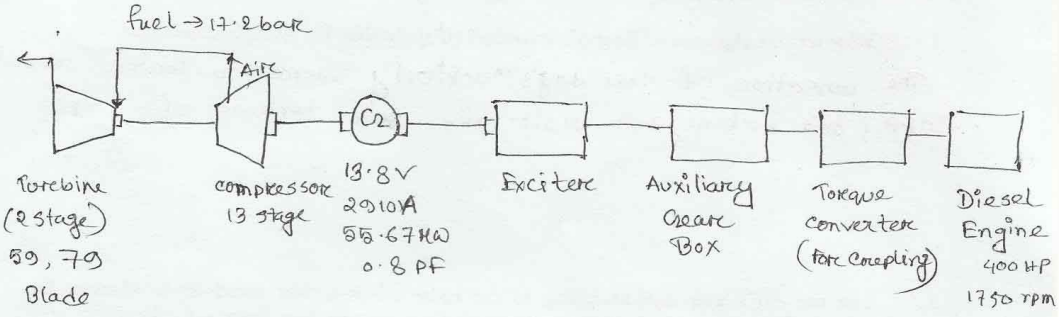
09.1.2017

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

Signature of academic supervisor with date
Name:
Designation:

* lowere temperature of aire inlet in gas turebine will give higher efficiency.

* Gas turebine:



* Gas flows in Gas turebine — 0.464 – 0.466 m3.
* WHRU – waste heat recovery unit
* knock out Pot → Remove condense from gas.

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Daily Activity Report

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Name of the company:	APSCL
Name of the student:	Sabeh Us Sama Authaye
ID:	2008-2-80-067

Date:	17.01.2012
Start time/End time	08:00 am – 04:00 PM
Location:	CCPP
Mentor:	Mohammad Mizanur 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 objectives of today's activity were to know about the main systems of gas turbine.

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

The main system of gas turbine includes:

1) Starting system
2) Fuel system
3) Air inlet system
4) Exhaust system
5) Lube oil system
6) Cooling System
7) Auxiliary Power system
8) control protection.

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

We studied about these systems in the Powere Station course

9.1.2012

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

Signature of academic supervisor with date
Name:
Designation:

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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:	APSCL
Name of the student:	Sudeh Us Sama Authaye
ID:	2008-2-80-067

Date:	08.01.2012
Start time/End time	08:00-04:00pm
Location:	CCPP
Mentor:	Mohammad Mizanur Rahman

General Instructions:

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

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

Steam turbine consists of following parts:

1. Condenser
2. Dump valve
3. Turbine
4. Vaccum pump
5. Condensate extraction pump
6. Deaereator
7. Deaereator storage vessel.
8. Make-up tank
9. LP evaporator

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

We studied about this system in the Power Station course.

9.1.2012

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

Signature of academic supervisor with date
Name:
Designation:

10. HP evaporator
11. Forced flow section
12. Superheater
13. Steam drum
14. Feed pump.
15. HP circulating pump
16. CIES (Combined Isolating & Emegency Stop) valve

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Daily Activity Report

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Name of the company:	APSCL
Name of the student:	Tuhin Afroz
ID:	2008-2-80-048

Date:	27.12.2011
Start time/End time	8a.m to 4p.m
Location:	substation
Mentor:	Md. Nur Mohammad

General Instructions:

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

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

The objective of the day's activities is:

a) Over description of substation
b) Substation and Bus bar protection
c) Transmission of the system.

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

i) Brief discussion on single line Transmission of APSCL
ii) Description of total no of power station of APSCL and Rental power station.
iii) Theoretical analysis of Transformer, Protection of transformer etc.
iv) Bus bar protection includes CT, PT, Relay, Isolation etc.
v) We also visit the substation of APSCL

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

We discussed and visited substation which was related with course material of power station, switchgear and Protective Relay and Electrical machine-1 course.

27/12/2011
Signature of the mentor with date
Name: Noor Mohammed
Designation: Manager (O&S)
Contact Phone #: 01712-191803

26.1.12
Signature of academic supervisor with date
Name: MOHAMMAD ZAKIR ALAM
Designation: LECTURER

Department of Electrical and Electronic Engineering
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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:	APSCL
Name of the student:	Tuhin Afroz
ID:	2008-2-80-048

Date:	28.12.2011
Start time/End time	8a.m to 4.P.m
Location:	Substation
Mentor:	~~Md.~~ Noor Mohammad

General Instructions:

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

Department of Electrical and Electronic Engineering
East West University

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

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

1. Fault MVA
2. Grounding including [Equipment grounding and Transformer grounding]
3. Protection of Transformers
4. Relay [Over current Relay, Differential Relay, Bukholz Relay]

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.

a) Fault MVA is the multiplication of fault current and voltage, fault MVA = $\sqrt{3}$KV X fault current. It depends on how large the system is.

b) There are two types of Grounding includes transformers, grounding and Equipment grounding.
To neutralize the fault portion of the transformers.
Transformers grounding is used

P.T.O

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

The topic discussed and observed are related with the course materials of switch gear & protective Relay.

28/12/2011
Signature of the mentor with date
Name:
Designation:
Contact Phone #:

26.1.12
Signature of academic supervisor with date
Name: MOHAMMAD ZAKIR ALAM
Designation: LECTURER

②

For safety purpose of human & equipement

D. Relay Protection

i) Differential Relay : when there is a current in the operating coil of the Differential Relay it operates

ii) Over Current Relay : It gives the over current protection

iii) Earth fault Protection: There are two parameters in the earth fault relay, time and fault current.

iv) Bukholz Relay: when there is a fault in the transformer, oil is decomposed and there will be gas which is collected by bukholz relay. Because of temperature increase more then the alarm ring, as more as temperature rise then the relay trip.

Department of Electrical and Electronic Engineering
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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:	APSCL
Name of the student:	Humayra Chowdhury
ID:	2008-2-80-033

Date:	11.01.2012
Start time/End time	8:00 am ~ 4:00 pm
Location:	Substation
Mentor:	Noor Mohammad (Manager, Substation)

General Instructions:

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

Department of Electrical and Electronic Engineering
East West University

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

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

The objective of today's activity was to learn about transformer protection.

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.

Transformer Protection

1) Mechanical protection:
   * Bukholz Relay
   * Oil Temperature Indicator
   * Winding Temperature Indicator
   * Pressure Relief Device (PRD)
   * Oil Level Indicator

(P.T.O.)

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

We studied about protection a in Switchgear and Power System Protection course.

11/1/2012
Signature of the mentor with date
Name: Noor Mohammad
Designation:
Contact Phone #:

23-01-12
Signature of academic supervisor with date
Name: Rizvi Ahmed
Designation: RL

2) Electrical Protection :

* Differential Relay
* Overcurrent Relay
* Earth fault Relay
* Restricted Earth fault Relay

Different types of Circuit Breakers

* MCB
* MCCB
* ACB
* ABCB
* SF_6 CB
* Vaccum CB
* Oil CB
  - → Minimum Oil CB
  - → Bulk Oil CB

CHAPTER-01

1. INTRODUCTION

The following chapter is based on our training program in APSCL on 26.12.2011 under Achinta Kumer Sarkar, DGM, Mechanical Department.

1.1 The Objective of APSCL

To enhance the station's dependable capacity to comply with the government's target to provide electricity for all by 2021 and increase overall thermal efficiency of the station by installing new plant in order to generate more power consuming the amount of gas. [1]

1.2 Company Profile

Name of the Company : Ashuganj Power Station Company Ltd.
Date of Incorporation : 28 June 2000.
Registration No : C-40630 (2328)/2000 dt. 28.06.2000.
Location : 90 km North-East of Dhaka on the left bank of the river Meghna.
Land : 311.22 Acres
Installed Capacity : 724 MW
Total number of plants : 3
Total Number of Units : 9
Fuel used: Natural Gas Supplied by Titas Gas Transmission & Distribution Co. Ltd., Bangladesh

Plant 1: Thermal Power Plant (TPP)

Two Steam Units of 64MW- Unit # 1 & 2 each-commissioned in 1970.

Plant 2: Combined Cycle Power Plant (CCPP)

Gas Turbine Units-GT1 and GT2 of capacity 56MW each-commissioned in 1982 and 1986 respectively

One Steam Turbine (ST) of capacity 34MW with waste heat recovery Boiler commissioned in 1984

Plant 3: Thermal Power Plant (TPP)

Unit # 3 of 150MW capacity was commissioned in 1986

Unit # 4 of 150MW capacity was commissioned in 1987.

Unit # 5 of 150MW capacity was commissioned in 1988.

Table 1.1: Availibility & efficiency of APSCL units

SL No.	PARTICULARS	GT#1	GT#2	ST (cc)	Unit#1	Unit#2	Unit#3	Unit#4	Unit#5
1	Model & Capacity of Turbo-Generator	GEC, UK, 69.6MVA 13.8 KV	GEC, UK, 69.6MVA 13.8 KV	GEC, UK, 43MVA 13.8 kV	BBC, Germany, 80MVA 11.0 kV	BBC, Germany, 80MVA 11.0 kV	ABB, Germany, 190MVA 15.75 kV	ABB, Germany, 190MVA 15.75 kV	ABB , Germany, 190MVA 15.75 kV
2	Installed Capacity (MW)	56	56	34	64	64	150	150	150
3	Present De-rated Capacity, MW	40	40	18	64	64	105	140	140
4	Date of Commissioning	15/11/1982	23/03/1986	28/03/1984	17/08/1970	8/7/1970	17/12/1986	4/5/1987	21/03/1988
5	Total hours run since Installation	150,516	114,768	87,034	231,011	204,371	186,821	183,865	164,933
6	Total Energy Generation to date , GWh	5,936.68	6,607.73	1,734.07	10,575.44	9,744.33	22,328.50	21,306.43	29,767.39
7	Plant Factor %, 2010	71.77	85.52	31.05	56.15	86.03	81.74	53.45	83.77
8	Availability Factor %, 2010	82.69	96.03	29.54	68.10	95.65	94.75	64.06	95.54
9	Station Thermal Efficiency %	20	20	28	30	31	31	36	36

Table 1.2: Cost of production of existing unit

SL No.	PARTICULARS	GT#1	GT#2	ST (cc)	Unit#1	Unit#2	Unit#3	Unit#4	Unit#5
1	Installed Capacity (M	56	56	34	64	64	150	150	150
2	Present Contracted Capacity, MW	40	40	0	64	64	102	140	140
3	Date of Commissioning	15/11/1982	23/03/1986	28/03/1984	17/08/1970	8/7/1970	17/12/1986	4/5/1987	21/03/1988
4	Cost of fuel per unit G (Tk.)	1.30	1.30	0.00	0.93	0.87	0.90	0.90	0.79

1.3 Resources Availability

GAS &Water: Ashuganj is situated near Titas Gas Field and at the bank of the river Meghna. So it was the most favorable place for power station because of availability of natural resources for power generation. For this purpose about 311 acre land at the 1 kilometer north-east away from the Meghna Railway Bridge was acquired.

1.4 Future Project of APSCL

1) Ashugonj 225 MW Combine Cycle Power Plant:

Capacity:	225MW
EPC Contract Price	USD 61,970,240+EUR60,362,742+ BDT 2,530,772,664
EPC Contractor	The consortium of Hyundai Engineering Co.Ltd. and Daewoo International corporation, korea.
Expected date of completion	April ,2014
Project Duration	25 months
Fuel	Natural Gas

2) Ashugonj 450 MW Combine Cycle Power Plant:

Capacity	450MW
Estimated Cost of Project	BDT 3,333.00 Crore
Project completion time	27 months
Expected date of completion	September 2014
Fuel	Natural gas

3) Ashuganj 450 MW Combine Cycle Power Plant (North) Project:

Capacity:	450MW
Estimated Project Cost:	BDT 3,400.02 Core
Project Finance:	ADB & IDB
Expected Completion:	October, 2015
Fuel:	Natural Gas

1.5 Objective of the Internship

The first objective of the internship is fulfilling the partial requirement of EEE program. In this intern report, we have attempted to give an overview of Ashuganj Power Station Company Ltd in power generating, substation and protection schemes. The study aims at some objectives, which are as follows

1. Understanding the power generation process
2. Understanding protection techniques
3. Understanding how to control power generation unit
4. Idea about sub-station equipments and maintenance
5. Finding out the every risk related to APSCL Ltd
6. Recommending how it can be improved to fulfill the loads of the country

1.6 Internship Group Members

For this internship program, our group members are: Humayra Chowdhury, Tuhin Afroz and Subeh Us Sama Authaye.

1.7 Scope and Methodology

At present, 48.5% of the total population of Bangladesh is enjoying the electric facilities. As of April 2010, the total numbers of transmission and distribution lines are recorded to 8,359 km and 266,460 km respectively. In Bangladesh per capita generation is 220 KW hr which is comparatively lower than other developed countries in the world. A recent Status about Bangladesh power generation is stated below:

Table 1.3: A recent status about Bangladesh power generation and consumption

Installed capacity (April 2012)	6693.00 MW
De rated generation capacity(April 2012)	6061.00 MW
Generation	3,900 - 4,300 MW
Maximum generation (March 2012)	6066.00 MW
Peak demand	5,800 MW
Access to electricity	47%
Per capita generation	220 KW-hr

This report focuses on generation process which includes plant equipments, protection, control and maintenance in APSCL. Primarily, the data is collected during the internship period. The discussions with the superintendent engineer was effective and this report is based on these information. Some information is also taken from the company website (www.apscl.com) as a secondary source of information.

1.8 Training Schedule

Table 1.4: Our Training Schedule in APSCL

Date	Division	Time(1st session)	Time (2nd session)	Mentor
26-12-2011	Total Plant Overview	08am to 01pm	02pm to 05pm	Engr.Achinta Kumer Sarker
27-12-2011	Generator	08am to 01pm	02pm to 05pm	Engr. Md. Kamruzzaman
28-12-2011	Generator	08am to 01pm	02pm to 05pm	Engr. Md. Kamruzzaman
29-12-2011	Operation	08am to 01pm	02pm to 05pm	Engr. Anwar Hossain
31-12-2011	Operation	08am to 01pm	02pm to 05pm	Engr. Anwar Hossain
01-01-2012	Operation	08am to 01pm	02pm to 05pm	Engr. Anwar Hossain
02-01-2012	I&C	08am to 01pm	02pm to 05pm	Engr. Bikash Ranjan Roy
03-01-2012	I&C	08am to 01pm	02pm to 05pm	Engr. Bikash Ranjan Roy
04-01-2012	I&C	08am to 01pm	02pm to 05pm	Engr. Bikash Ranjan Roy
05-01-2012	CCPP	08am to 01pm	02pm to 05pm	Engr.Md. FazleHassan Siddiqui
07-01-2012	CCPP	08am to 01pm	02pm to 05pm	Engr.Md. FazleHassan Siddiqui
08-01-2012	CCPP	08am to 01pm	02pm to 05pm	Engr.Kh. Nazmul Amin
09-01-2012	Substation	08am to 01pm	02pm to 05pm	Engr.Noor Mohammad
10-01-2012	Substation	08am to 01pm	02pm to 05pm	Engr.Noor Mohammad
11-01-2012	Substation	08am to 01pm	02pm to 05pm	Engr.Noor Mohammad

CHAPTER-02

2. POWER GENERATION

In APSCL, generators are run by steam turbine, gas turbine and IC engine. The plant uses natural gas from Titas Gas Transmission and Distribution Company Ltd (TGTDCL) as its fuel source for steam generation in the steam turbine and fuel injection in the gas turbine.

The following sections are based on our training program in APSCL from 27-28 Dec, 2011 and 29-31 Dec, 2011 under Md. Kamruzzaman, Senior Engineer, Generator, Switchgear & Protection Division.

2.1 Generator

Based on the type of output, there are two types of generator:

1. AC generator: generates alternating current. Also known as alternator.
2. DC generator: generates direct current.

Based on the construction, generator can be:

1. Single-phase generator
2. Three-phase generator

Figure 2.1: Steam Turbine Generator in APSCL

Based on rotor type, generator can be:

1. Salient pole generator: This type of generator rotor is used for slow speed machines which have large diameters and small axial lengths [2].
2. Non-salient pole generator: It is used for steam turbine-driven alternator. Such rotors are designed mostly for 2-pole (or 4-pole) turbo generators running at very high speed [3].

In APSCL, there are 5 steam generators in the steam plant section, 2 gas turbine generators, 1 combined cycle generator and 1 IC engine generator in the combined cycle plant section. These are all three-phase synchronous AC generators.

Table 2.1: Important information about APSCL generators

Category	Steam power plant section		Combined cycle power plant section	
	Unit 1,2	Unit 3,4,5	Gas turbin 1 & 2	Steam turbine
Name of the maker company	BBC,Germany	ABB,Germany	GEC,UK	GEC,UK
Rated terminal output	64 MW	150 MW	55.67 MW	34.33 MW
Rated terminal voltage	11 KV	15.75 KV	38.8 KV	13.8 KV
Rated power factor	0.8	0.8	0.8	0.8
Rated current	4200/4690 A	6965 A	2911 A	1799 A
Rated frequency	50 Hz	50 Hz	50 Hz	50 Hz
Number of poles	2	2	2	2

2.1.1 Excitation System of Generator

In APSCL, the following generator excitation systems are used:

1. AC Excitation System
2. Brushless Thyristor Excitation System
3. Static Excitation System

2.1.2 Synchronization of Generator

When synchronizing the generator, there are conditions that must be met:

1. Synchronization of Frequency
2. Synchronization of Voltage
3. Synchronization of Phase sequence
4. Synchronization of Phase angle

This means that the parameters of generated power should match those of the grid power.

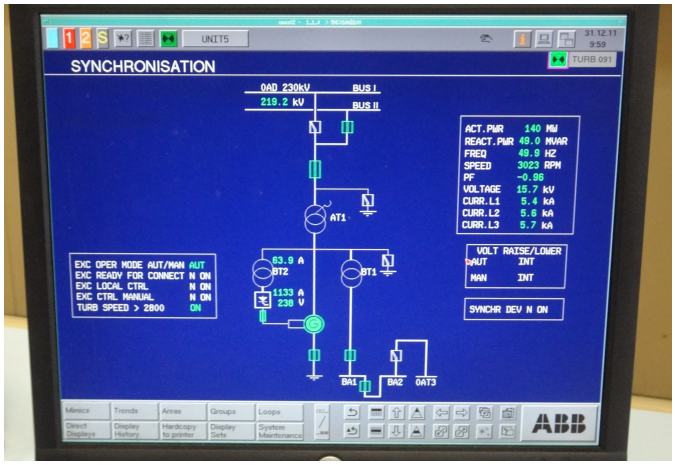

Figure 2.2: Synchronization of Unit-5 generator from Control Room

In APSCL, generators in the steam power plant are synchronized by Synchrotact while the generators in the combined cycle power plant are synchronized by Synchroscope.

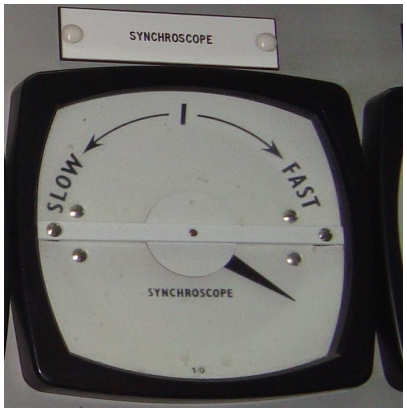

Figure 2.3: Synchroscope in APSCL

Figure 2.4: BBC Synchrotact in APSCL

When all the four conditions is fulfilled then a command signal is sent from the synchronizing panel to the relay of the connecting breaker which will connect the generator to the national grid.

2.1.3 Generator Cooling System

Efficiency of a generator is strongly related to the cooling system of the generator. In APSCL, the following cooling systems are used:

1. Air Cooling: Cooling is done by circulating air through the generator to absorb heat and then exhausting the air to another area outside the generator.
2. Hydrogen Cooling: Hydrogen is circulated through the generator and the rotor for cooling. It is more preferred since hydrogen can carry seven to ten times more heat than air

The following sections are based on our training program in APSCL from 29-31 Dec, 2011 and 01 Jan, 2012 and 02-04 Jan, 2012 under Anwar Hossain, Manager, Operation.

2.2 Turbine

In APSCL, two type of turbines are used:

1. Steam Turbine
2. Gas Turbine

2.3 Steam Turbine Power Plant

In APSCL, Unit 1 to Unit 5 are steam turbine plant.

Among the two types of steam turbines, APSCL uses Impulse Turbine in unit 1-5.

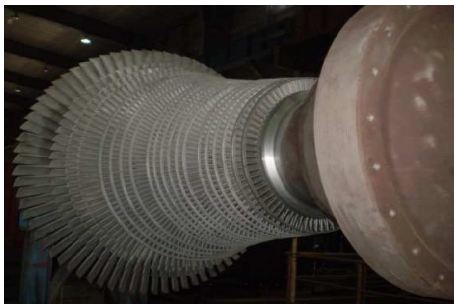

Figure 2.5: Impulse Turbine in APSCL

Table 2.2: Information about APSCL steam turbine plant

Chracteristics	Steam power plant section	
	Unit 1,2	Unit 3,4,5
Name of the maker company	BBC,Germany	ABB,Germany
Rated terminal output	64 MW	150 MW
Live steam pressure(Pabs)	890 bar	135 bar
Live steam temperature	520°C	520°C
Exhaust pressure	0.0742 bar abs	0.08 bar abs
Number of stages	30/12/5	21/16/5
Rated speed	3000rpm	3000rpm
Direction of rotation	Clockwise	Clockwise

2.3.1 Sections of Steam Turbine

The steam turbine in APSCL consists of three sections:

1. High Pressure (HP) Turbine: the blades here are the smallest of all turbine blades; very high energy steam enters the turbine super heaters and occupies a low volume.
2. Intermediate Pressure (IP) Turbine: steam enters here from the boiler re-heater; the steam has less energy, so the turbine blades are bigger than those in HP turbine.

3. Low Pressure (LP) Turbine: steam enters here from the IP turbine and continues to expand; the blades are larger but the energy of steam is lesser than the previous two sections.

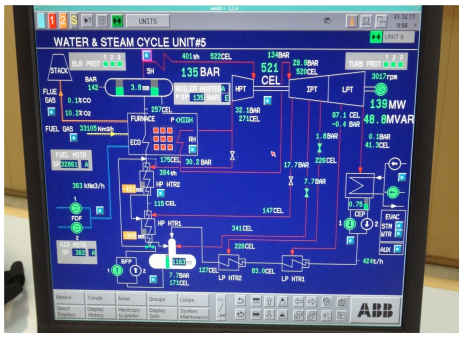

Figure 2.6: Water & Steam Cycle of Unit-5

Figure 2.7: Turbine assembly in Unit-5 zoomed in from the Water & Steam Cycle

2.3.2 Steam Generation

2.3.2.1 Boiler

In APSCL steam power plants, water tube boilers are used.

Table 2.3: Information about the boilers in APSCL steam power plant

Chracteristics	Steam power plant section	
	Unit 1,2	Unit 3,4,5
Type	Natural circulation, Radiant boiler(pressurized)	IHI-FWSR-504 Single drum, Natural circulation, single re-heat
Make	Babcock, Germany	IHI, Japan
Maximum evaporation Capacity	270 t/hr	500.4 t/hr
Efficiency(MCR)	90%	86.8%

2.3.2.2 Furnace/Burner

Furnace or Burner is a chamber where a mixture of air and fuel is used to produce hot flue gas. In the steam turbine power plant of APSCL, each furnace chamber has nine furnaces. The temperature inside the chamber is maintained at 1200-1500°C.

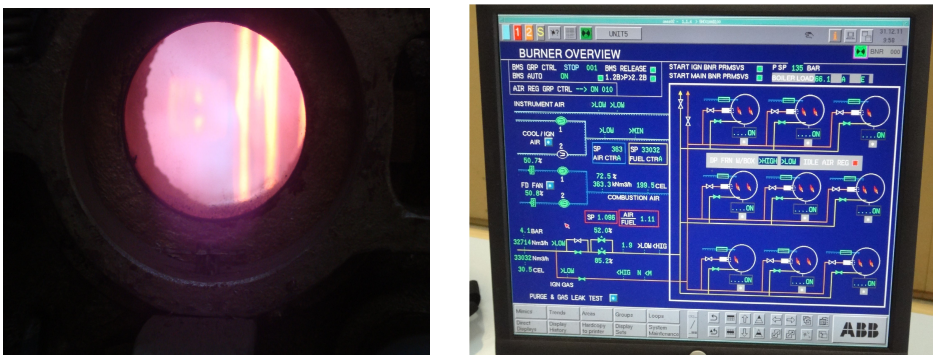

Figure 2.8: Burner in the Steam power plant & Burner system observation from Control Room 5

2.3.2.3 Boiler Drum

It is the storage tank in the boiler where generated saturated steam is stored. It is very important to control the level of the saturated steam. This is done by an automatic system.

2.3.2.4 Super Heater (SH)

Here the saturated steam from boiler drum is converted into super heated steam. Super heater removes moisture from the saturated steam, thus producing dry high temperature steam.

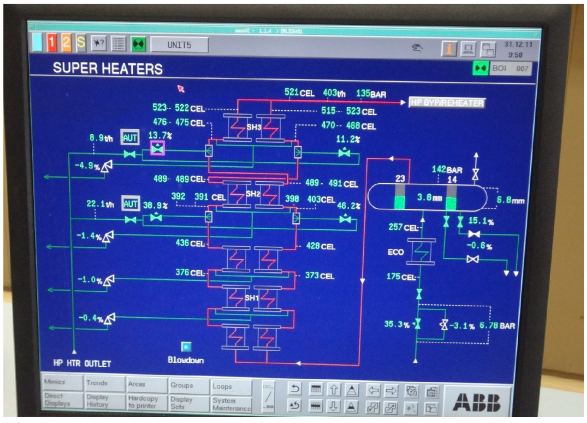

Figure 2.9: Super Heater observation from Control Room 5

Table 2.4: Information about Super Heaters in APSCL

Chracteristics	Steam power plant section	
	Unit 1,2	Unit 3,4,5
Max allowable steam pressure,SH/RH	110 bar abs	171/50 bar abs
Normal working pressure, SH/I	93 bar abs	138.5/36.6 bar abs
Normal working temperature, SH/RH	525°C	523°C

2.3.2.5 Flue Gas

Flue gas is the hot gas produced inside the burner or furnace of the boiler by burning fuel in the presence of air.

2.3.2.6 Re-heater (RH)

This section of the boiler system re-heats the steam that comes from the HP turbine. The re-heated steam is known as the exhaust gas. Each boiler in APSCL has two re-heaters inside.

Table 2.5: Information about the Re-Heaters in APSCL

Chracteristics	Steam power plant section	
	Unit 1,2	Unit 3,4,5
Max allowable steam pressure,SH/RH	110 bar abs	171/50 bar abs
Normal working pressure, SH/RH	93 bar abs	138.5/36.6 bar abs
Normal working temperature, SH/RH	525°C	523°C

The difference between a re-heater and a super heater is that the super heater can raise both the temperature and pressure of the steam, but re-heater can only raise the temperature.

2.3.2.7 Condenser

A condenser is a closed vessel in which steam is condensed by abstraction of heat. Also, the condensed steam can be used as feed water to the boiler.

APSCL steam power plant uses surface condenser.

2.3.2.8 Hot Well

From the condenser the condensed water is reserved into hot-well. Water from the hot well goes into the LP heaters through condensate extension pump (CEP).

2.3.2.9 Feed Water Heater

A feed-water heater is a component used to pre-heat the water that is delivered to a steam generating boiler. Preheating the feed-water reduces the irreversibility involved in steam generation and therefore improves the thermodynamic efficiency of the system.

In steam and combined cycle power plant of APSCL, two types of feed water heater are present:

1. Low Pressure (LP) Heater
2. High Pressure (HP) Heater

Table 2.6: Information about the Feed Water Heaters in APSCL

Characteristics	Steam power plant section	
	Unit 1,2	Unit 3,4,5
Feed water temperature	229°C	246°C

Figure 02.10: LP Heater-1 in APSCL steam power plant

There are two LP heaters and two HP heaters in the steam power plant of APSCL. Steam from IP turbine flows through LP Heater2 and steam from LP turbine flows through LP Heater1, whereas steam from HP turbine flows through HP Heater2 and steam from IP turbine flows through HP Heater1.

2.3.2.10 Feed Water Tank

Feed Water tank is used to store the Feed water that comes from the LP Heaters. Fee water is transferred from the LP heater to the HP heater through this tank and the Boiler Feed Pump (BFP).

Figure 2.11: Feed Water tank in APSCL

2.3.2.11 Economizer

The economizer serves to recover some of the heat being carried by the exhaust flue gases. The heat recovered is utilized in raising the temperature of feed water being supplied to the boiler.

Figure 2.12: Economizer

Advantages of using Economizer:

1. Improvement in the thermal efficiency of the steam plant. It has been estimated that for each 5.5 to 6°C rise in the temperature of feed water, there is a gain of about 10% in the plant efficiency.
2. Reduction in the losses of heat with flue gases.
3. Increase in the steaming capacity of the boiler.
4. Less thermal stresses in the boiler parts and consequently long life of the boiler.

For efficient heat transfer, the surface of the tubes has to be kept clean from the soot and volatile ash deposits.

2.3.2.12 Deaerator

The deaerator is used to remove dissolved gases from the feed water to the steam generating boilers.

In APSCL, the spray-type deaerator is used. It consists of only a horizontal or vertical cylindrical vessel which serves as both the deaeration section and the boiler feed water storage tank.

2.3.2.13 Air Pre-heater

Air pre-heater is used in the steam power plant in APSCL. Its purpose is to extract the heat from flue gases to the air being supplied to the furnace, thus increasing the efficiency of the plant.

2.3.2.14 Stack (Chimney)

Stack or chimney is the passage way through which smoke or gases can escape from a furnace.

2.3.2.15 Water Treatment Plant

The source of boiler feed water is usually a lake or river which may contain suspended and dissolved gases. The water treatment plant removes the suspended impurities and dissolved gases by various methods such as sedimentation, coagulation, filtration, aeration and degasification.

2.3.2.16 Pumps and Fans used in Steam Generation Process

Various pumps and fans are used in the steam generation process, which are run by the plants auxiliary supply. The following pumps and fans are used in the APSCL steam generation plant:

1. Condensate Extension Pump (CEP): transfers condensed water from the hot well to the LP heater. In APSCL steam power plant, there are two CEPs in each boiler; one is running and the other is standby.
2. Boiler Feed Pump (BEP): transfers feed water from the feed water tank to the HP heater
3. Forced Draft (FD) Fan: feeds air from nature to the furnace for the burning of natural gases.
4. Circulating Water (CW) Pump: sends cooling water to the condenser. In APSCL, CW pump is used for both cooling and condensing purpose.

Figure 2.13: FD fan in APSCL

The following sections are based on our training program in APSCL from 05-08 Jan, 2012 and 09-11 Jan, 2012 under Mohammad Mizanur Rahman, Senior Engineer, CCPP.

2.4 Combine Cycle Power Plant (CCPP)

In a combined cycle power plant (CCPP), a gas turbine generator generates electricity and the waste heat is used to make steam to generate additional electricity through a steam turbine.

In Combined Cycle plant of APSCL, the raw material is Gas which comes from Titas Gas.

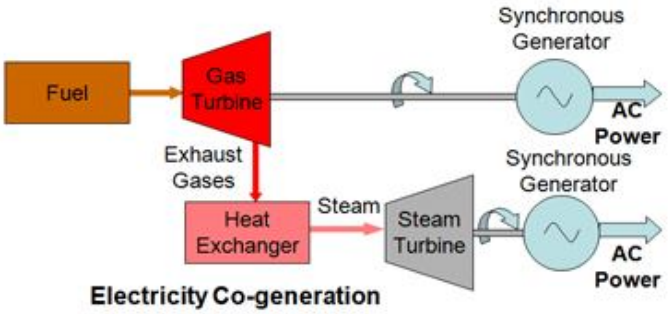

Figure 2.14: Combined cycle power generation system [4]

Table 2.7: Information of combined cycle power plant of APSCL

Category	Combined cycle power plant section	
	Gas turbine 1 & 2	Steam turbine
Name of the manufacturer	GEC,UK	GEC,UK
Rated terminal output	55.67 MW	34.33 MW
Live steam pressure(Pabs)	Flue gas	39 bar
Live steam temperature	1010°C	490°C
Exhaust pressure	-	-0.8 bar-g
Number of stages	-	17
Rated speed	3000rpm	3000rpm
Direction of rotation	Clockwise	Clockwise

Table 2.8: Power generation of combined cycle power plant of APSCL

Units	Date of Commission	Year of last Overhauling	Capacity(MW)		Generation (Kw.h.)	Fuel Consumption	
			Commissioned	De-rated (present)		MCF	m^3/kwh
GT-1	15.11.1982	2008	56	35	846774	14007.69	0.4684
GT-2	23.03.1986	2004	56	40	774542	12812.798	0.4684
CC-ST	28.03.1984	2000	34	16	400525	-	CC0.3180

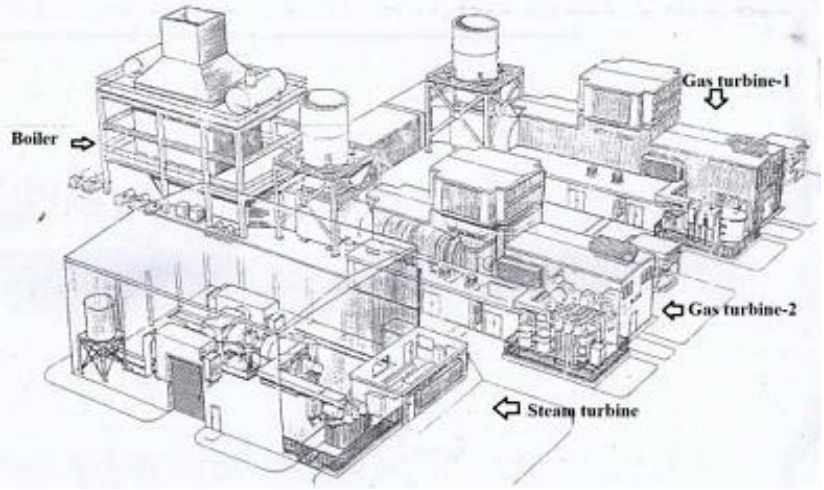

Figure 2.15: Top view of combined cycle power plant of APSCL

2.4.1 Gas Turbine Section

The gas turbine section consists of:

1. Compressor.
2. Combustion chamber.
3. Turbine.

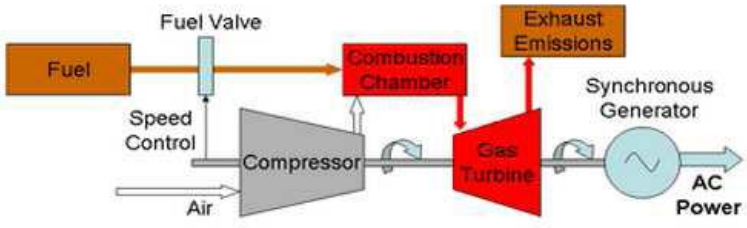

Figure 2.16: Gas turbine power generation system [4]

2.4.1.1 Compressor

Compressor is a device in the gas turbine section which is used to compress the air which is needed to expand by the help of combustion of fuel to create mechanical energy to rotate the turbine [5]. In gas turbine section of APSCL, centrifugal compressor is used.

Figure 2.17: Centrifugal compressor used in APSCL

2.4.1.2 Combustion Chamber

The combustion chamber consists of a vessel where fuel is injected to ignite the compressed air from compressor. The air fuel ratio in the area is maintained at about 15:1.

Figure 2.18: Combustion Chamber of Gas Turbine Plant of APSCL

2.4.1.3 Gas Turbine

The products of combustion consisting of a mixture of gases at high temperature and pressure are passed to the gas turbine, thus rotating it to generate mechanical energy. In gas turbine section of APSCL, shaft type gas turbine is used. They are often referred to as turbo-shaft engines.

Figure 2.19: Gas turbine of APSCL

2.4.1.4 Diesel Engine

The diesel engine is coupled with the turbine to rotate the turbine at the beginning to help the compressor suck air. The diesel engine is turned off when the turbine is at 1800 rpm.

Figure 2.20: Diesel engine used in the gas turbine

Table 2.9: Situation of the gas turbine with respect to the turbine speed

rpm of turbine	Situation
0 rpm	Diesel start
750 rpm	Fire or ignition inside combustion chamber
1800 rpm	Diesel off
2300 rpm	Excitation on
3000 rpm	At no load condition

2.4.2 Steam Turbine Section

The steam turbine section of CCPP is similar to the steam turbine in unit 1-5. The main difference is that in the steam power plant there is a furnace which produces the heat or flue gas but in the combined cycle there is no furnace, steam is produced by the heat of exhaust gas.

The following sections are based on our training program in APSCL from 02-04 Jan, 2012 and 05-08 Jan, 2012 under Bikash Ranjan Roy, Manager, I&C.

2.4.3 Valves used in the Plant

A valve is a mechanical or electromechanical device by which the flow of a gas, liquid can be started, stopped and/or regulated. Valves can be of two types:

2.4.3.1 Isolation valve

It is an on/off valve that typically operates in two positions; the fully open and fully closed position. In APSCL, the following types of isolation valves are used:

1. Manual valve

Figure 2.21: Manual valve used in combined cycle power plant of APSCL

2.4.3.2 Control valve

It can be controlled. This valve can regulate the fluid flow in a piping system. In APSCL, the following types of control valves are used:

1. Pneumatic valve
2. Hydraulic valve

3. Motorized valve
4. Electro-hydraulic valve
5. Servo valve

Figure 2.22: Pneumatic valve

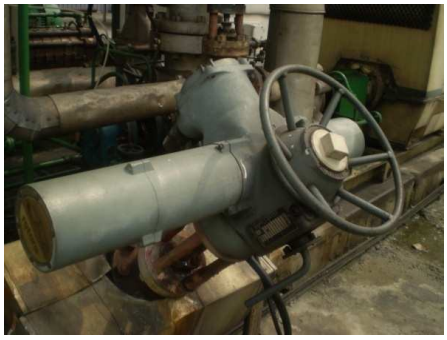

Figure 2.23: Hydraulic valve

Figure 2.24: Servo valve

CHAPTER-03

The following chapter is based on our training program in APSCL from 27-28 Dec, 2011 and 29-31 Dec, 2011 under Md. Kamruzzaman, Senior Engineer, Generator, Switchgear & Protection Division.

3. SWITCHGEAR & PROTECTION

The apparatus used for switching, controlling and protecting the electrical equipments is known as switchgear. Switchgear is used to de-energize equipments to clear faults as well to allow maintenance work to be done.

We learned about several electrical equipment protection, but the main focus was on generator protection.

3.1. Generator Protection

APSCL generators are provided with the following protections:

3.1.1 Overcurrent Protection

For Overcurrent protection, the relay is triggered when the magnitude of current exceeds the pickup level [6]. For generators above 1 MW, overcurrent protection is used as a backup protection.

Figure 3.1: Overcurrent relay in APSCL

3.1.2 Overcurrent Undervoltage Protection

This protection is triggered when multiple generators supply load to a system and if one of the generators trips due to a fault, the other generators try to make up for the tripped generator and try to supply the additional load. As a result, each of the running generators will experience a sudden increase in current and consequently, a drop in the generator terminal voltage.

3.1.3 Overvoltage Protection

Overvoltage may occur from several factors such as lightning strokes, switching surges, arching grounds, etc. Overvoltage can also occur from overfrequency as a result of severe system disturbance.

3.1.4 Negative Phase Sequence Protection

Negative phase sequence protection is provided to protect the system from the effects of negative sequence component of unbalanced currents due to unbalanced loads or phase-phase faults [6]. The unbalanced currents are dangerous from generators and motors point of view as these currents can cause overheating.

A negative sequence relay has a filter circuit which is operative only for negative sequence components.

3.1.5 Reverse Power Relay

Reverse power relaying is provided to protect against the motoring of generators. Such protection is incorporated in the generator protection scheme by directional power relays.

3.1.6 Underfrequency Protection

Under frequency is another result of a severe system disturbance.

3.1.7 Winding Differential Relay

It is one of the important protections to protect generator winding against internal faults such as phase-to-phase and three phase-to-ground faults.

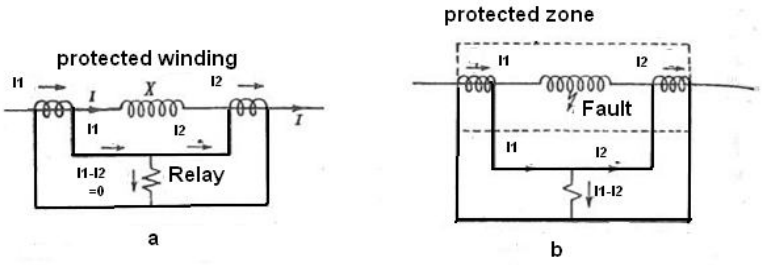

Figure 3.2: Differential protection [7]

In this scheme, the relay is triggered when there is a difference between current values I1 and I2 and the differential current (I1-I2) flows through the relay operation coil as shown in Fig.3.4.(b).

3.1.8 Distance Protection

Distance protection works based on line impedance calculation. During a fault, the current increases and the voltage at the fault point reduces. The ratio V/I is measured at the location of the CTs and PTs to locate the fault at a distance. When distance protection is provided between a generator and a transformer, the relay is designed to operate within the 100% zone on the generator side but within 80% zone on the transformer side.

3.1.9 Stator Earth Fault Protection

Normally the generator stator neutral operates at a potential close to ground. Although a single ground fault will not necessarily cause immediate damage, the presence of one increases the probability of a second. A second fault even if detected by differential relay, may cause serious damage. Protection again such a fault is provided by Stator Earth fault relaying which incorporates measuring the voltage across the secondary of neutral grounding transformer (NGT).

Figure 3.3: Stator Earth Fault relay

3.1.10 Loss of Excitation Protection

The loss of excitation of the generator results from the loss of synchronism. The protection is provided using directional distance type relay with the generator terminals.

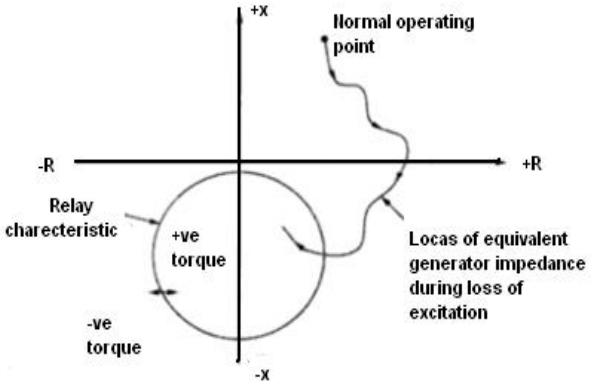

Figure 3.4: Loss of excitation principle [7]

When there is loss of excitation, the equivalent generator impedance varies and traces a curve as shown in the R-X diagram in Fig. 3.6.

3.1.12 Rotor Earth Fault Protection

The rotor circuit of the alternator is not earthed and d.c. voltage is imposed on it. Hence single ground fault in rotor does not cause any damage to it. But it causes an increase in the stress to ground at other points in the field winding when voltage is induced in the rotor due to transients. Thus the probability of more ground faults increases.

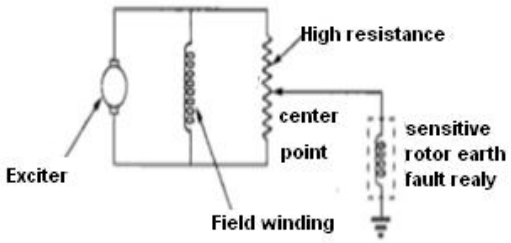

Figure 3.5: Rotor earth fault protection

In this protection scheme, a high resistance is connected across the rotor circuit. It is provided with centre tap and the centre tap point is connected to the ground through a sensitive earth fault relay.

CHAPTER-04

The following chapter is based on our training program in APSCL on 31 Dec, 2011 and 03 Jan, 2012 under Anwar Hossain, Manager, Operation and 07 Jan, 2011 and 10 Jan, 2011 under Mohammad Mizanur Rahman, Senior Engineer, CCPP.

4. CONTROL UNIT

Under normal conditions, most of the monitoring and operations of the power station equipments are done from the control room of the power station, although the equipments can also be monitored and operated directly from the equipments control system.

In APSCL, there are five control rooms for different units.

4.1 Control Room of Unit-1&2

Control system of these two units is analog and manually operated. From staring moment of APSCL this control room is unchanged.

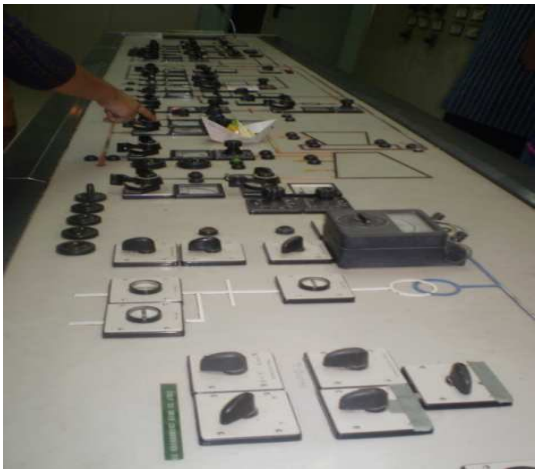

Figure 4.1: Operation unit of control unit 1 & 2

Figure 4.2: Control Unit 1

Figure 4.3: Control Unit 2

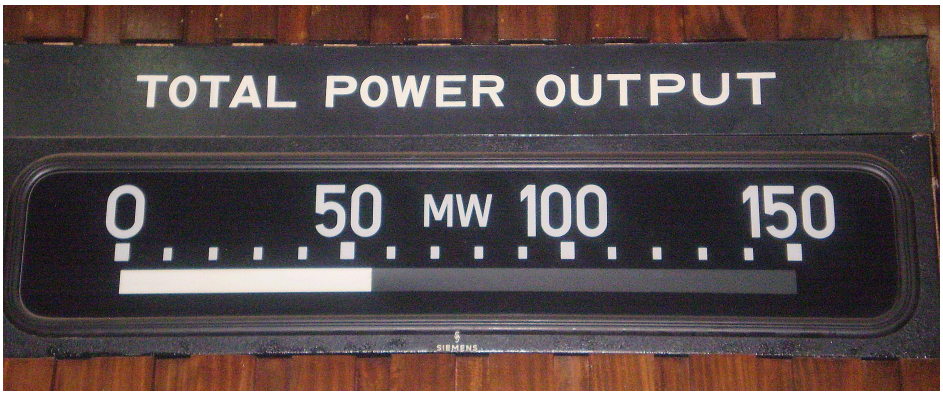

Figure 4.4: Total power output (Unit 1& 2)

4.2 Control Room of Unit-3&4

This control room has some analog and some digital controls. This control unit is also manually operated.

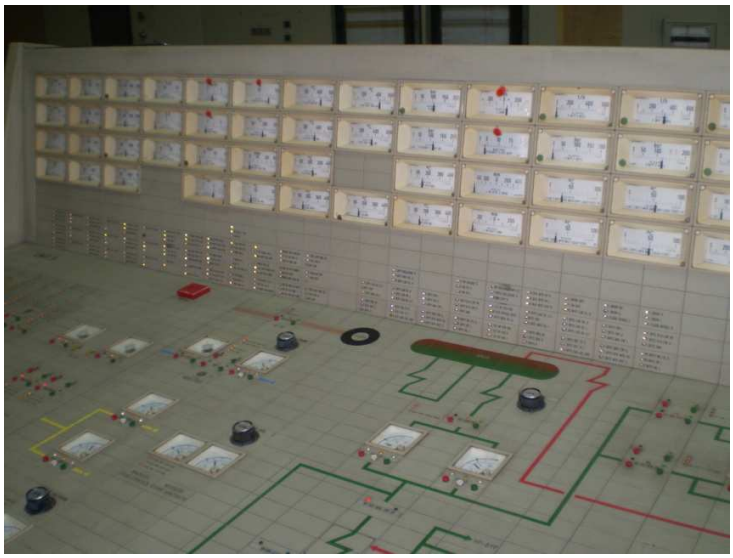

Figure 4.5: Control Room of unit 3&4

4.3 Control Room of Unit-5

Here all equipments are operated by software.

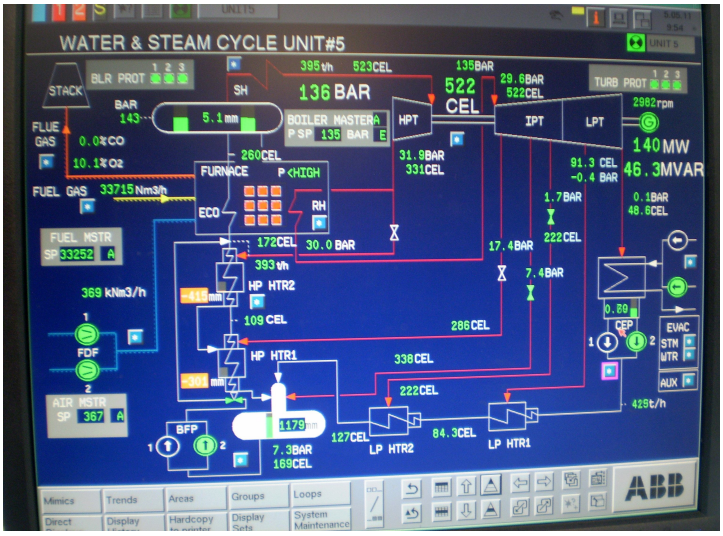

Figure 4.6: Control System of unit 5 (on computer)

Due to its advance technology and availability of devices, less problems are faced to operate this unit. And in digital control system, it is easy to upgrade the system according to requirements.

4.4 Combine Cycle Control

Combined cycle control system is analog and manually operated. Due to having a very backdated controlling technology its efficiency started going down.

Figure 4.7: Control unit of combined cycle plant.

Figure 4.8: Switchgear unit of combine cycle plant.

4.5 Control Unit of Sub-Station

Sub-station's control system is analog. Due to having a very backdated controlling technology its efficiency started going down.

Figure 4.9: Control unit of sub-station

Figure 4.10: Monitoring unit of Sub-station.

CHAPTER-05

The following sections are based on our training program in APSCL from 27-28 Dec, 2011 and 09-11 Jan, 2012 under Noor Mohammad, Manager, Substation.

5. SUBSTATION

5.1 Introduction

A Substation is interconnected to generators, transformers, transmission and distribution lines and all other protecting and maintenance equipment's. In APSCL, generated electricity is transformed from 15.6 KV to 132 KV, 230 KV and 440V as well. 440 V line is used to transmit electricity in local area like inside of Asuganj Power Station for their resident. 132 KV line is used for medium distance transmission such as power transmission to Brahmanbaria. Whereas, 230 KV line is used for long transmission like to transmit power to Dhaka or Sirajganj.

5.2 Substation Elements:

Some of the major substation equipments include:

5.2.1 Transformer

In substation two types of transformers are mainly used:

a. Power Transformer
b. Instrument Transformer

5.2.1.1 Power Transformer

Power transformers can be single phase or three phases. The step up transformer primary side are DELTA connected and secondary side are STAR connected .The voltage of step up transformer are 15.6/132kv and 15.6/230kV. For rating up to 10 MVA, naturally cooled, oil immersed transformers are used.

Figure 5.1: Power Transformer in APSCL

Breather: Breather controls the level of moisture entering into conservator tank during the change in volume of the cooling medium. It is filled up with silica gel.

Figure 5.2: Transformer Breather

5.2.1.2 Instrument Transformers

In APSCL substation, we've observed both types of instrument transformer:

1. Current Transformer (CT): usually connected to the bus bar protection system and circuit breakers trip unit. For the safety of the system, current transformer's secondary winding should be checked regularly.
2. Potential Transformer (PT): mainly used for protective relaying purpose and operation of other instruments such as ammeter, voltmeter and watt meter etc. In APSCL, we learnt that KV (Kilovolts) voltage cannot be measured without PT as it is too high to damage any meter.

Figure 5.3: Current Transformer in APSCL

Figure 5.4: Potential Transformer in APSCL

Figure 5.5: Nameplate Data of a Potential Transformer

5.2.2 Bus Bar

The standard rms value of current and voltage which the bus-bar can carry continuously with temperature rise within specified limits are given below.

Table 5.1: Standard rms value of current & voltage carried by bus-bar in APSCL

Voltage (KV rms)	Current (Amperes)
0.415	220
11	800
33	1600
132	2000
220	2400
400	3000

5.2.2.1 Bus-Bar arrangement

There are several Bus-bar arrangements that can be used in substation:

- Single Bus-bar
- Double Bus-bar
- Sectionalization of Bus
- Ring Bus.
- One and half scam Bus-bar.

We came to know that APSCL uses double bus bar arrangement.

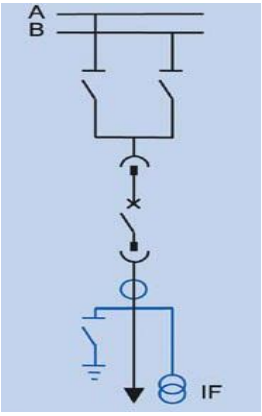

Figure 5.6: Double Bus-Bar Arrangement

Advantages of Double Bus Bar arrangement [8]:

- Cost of equipment is less
- Cost of maintenance and spares holding is less
- Easy to use.
- Requires less space.
- Cost of installation is less.

This scheme has minor disadvantages as well.

5.2.3 Isolator

An isolator switch is used to make sure that an electrical circuit can be completely de-energized for service or maintenance.

Figure 5.7: An Isolator in APSCL

5.2.4 Insulator

Insulators provide insulating supports that attach electric power transmission wires to utility poles. There are several types of insulators:

1. Pin Type Insulator: used for transmission and distribution voltages upto 33kV.
2. Shackle Type Insulator: used for low voltage distribution line.
3. Suspension Type Insulatorused for voltages beyond 33kV.

5.2.5 Circuit Breaker

APSCL uses two of these following circuit breakers in the substation:

5.2.5.1 Oil Circuit Breaker (OCB)

The oil in OCB serves two purposes; it provides the medium for the arc extinction, as well as insulation between the phases and also between the phase and the ground,

Figure 5.8: Oil Circuit Breaker in APSCL

Table 5.2: APSCL OCB Ratings

Particulars	Ratings
Manufacturer	Siemens
Rated voltage	132kV
Rated normal current	1250A
Breaking capacity	5000MVA

5.2.5.2 SF6 Circuit Breaker

SF6 circuit breaker is highly preferred due to it's high dielectric strength.

Figure 5.9: SF6 Circuit Breaker in APSCL

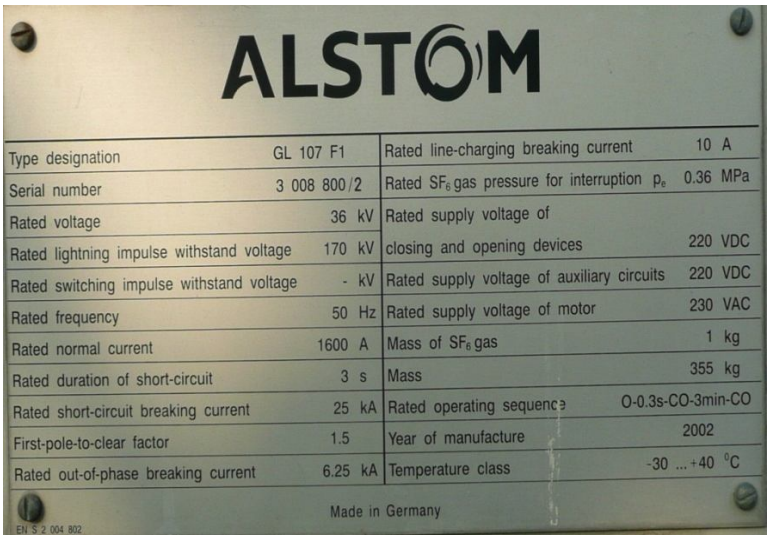

Figure 5.10: SF6 Circuit Breaker rating in APSCL

5.2.6 Protective relays

At APSCL substation, they use following types of protective relays:

1. Buchholz relay: a gas operated relay used for large oil-filled transformers.
2. Percentage differential relay: used in APSCL for power transformer protection.
3. Overcurrent relay
4. Distance relay
5. Pilot relay: APSCL uses microwave type and power line carrier type pilot relay for transmission line protection.

6. Classical relay: APSCL uses electromagnetic attraction type double quantity classical relay with instantaneous operation characteristics.
7. Induction type relay

5.2.7 Lighting Arrester

Lightning arrester is also known as surge arrester. It has a high voltage terminal and a ground terminal. One end of the arrester is connected to the terminal of equipment to be protected and the other end is grounded. When a high voltage or thunder strike occurs, air insulation of the spark gap breaks and the excess charge is channeled to the ground without damaging the protected equipment [6].

Figure 5.11: Lightning Arrester in APSCL

5.2.8 Transmission & Distribution

Transmission and distribution requires several components, the most prominent being:

1. Conductors
2. Line Supporters, such as poles or towers

5.2.8.1 Incoming & Outgoing Feeder

These data are taken from single line diagram of Ashuganj 132kv sub-station.

Incoming feeder:

1. United 50MW Rental
2. AGRECO 80MW Rental
3. Comilla-1
4. Comilla-2

5. Ghorashal-1
6. Ghorashal-2

Outgoing feeder:

1. Shajibazar-3
2. Shajibazar-1
3. Shajibazar-2
4. Ghorashal-1
5. Ghorashal-2
6. Kishoregonj-1
7. Kishoregonj-2

Data collected from Ashuganj 230kv system is given below:

1. United 50MW Rental
2. AGRECO 80MW Rental
3. Comilla-I
4. Comilla-II

5.2.9 Cable

At APSCL substation, following types of cable they are using as transmission line:

1. Twisted pair cable
2. Shielded pair cable
3. Coaxial cable
4. Underground cable

Figure 5.12: Underground cables at APSCL

5.2.10 Fuse

High voltage fuses are used to protect the electrical system in a substation from power transformer faults. They are switched for maintenance and safety.

5.2.11 Cooling System

Cooling system is essential in the power plant as the equipments are working at high voltage and high current. Cooling system may include:

1. Cooling Fan
2. Various type of oil
3. Water tank
4. Air conditioner

Figure 5.13: Transformer cooling fans

5.2.12 Power Line Carrier Communication (PLCC)

In APSCL, PLCC is used for their substation to substation communication. We have seen following contents of PLCC:

1. Wave Trap: blocks high carrier frequency
2. Coupling Capacitor: blocks power frequency.

5.2.13 Auxiliary System for Substation

5.2.13.1 AC Auxiliary System

Substation ac auxiliary systems are typically used to supply loads such as:

1. Transformer cooling, oil pumps, and load tap changers
2. Circuit breaker air compressors and charging motors

3. Outdoor device heaters.
4. Outdoor lighting and receptacles
5. Control house
6. Motor-operated disconnecting switches.

5.2.13.2 DC Auxiliary System

Dc power supply heart of the substation. It is needed to run the Relay, Circuit breakers and control System when Fault occurs. 120 Nichel Cadmium batteries are used for the DC supply in APSCL and to check the performance of the batteries, some tests are also done twice in a month. These tests are:

1. Acid leveling test: This test is performed visually.
2. Cell voltage Test: Here voltage level of each batteries are checked
3. Total Output: Here total output of back up section is checked whether it is 220V or not.
4. Gravity test: This test is performed by using a testing tube.

Table 5.3: Test results of some batteries (220V DC) taken in a day in APSCL

Battery No	Cell voltage (V)	Gravity test
61	1.37	1160
62	1.37	1160
63	1.36	1160
64	1.41	1160
65	1.36	1160
66	1.37	1160
67	1.38	1160
68	1.34	1160
69	1.38	1160
70	1.36	1160
71	1.37	1160
72	1.35	1160
73	1.40	1160
74	1.34	1160
75	1.36	1160

Figure 5.14: Battery Arrangement of back-up system in APSCL

5.3 Operation & Maintenance of Substation

Maintenance of the substation equipments are carried out after certain time intervals, such as weekly inspection or monthly inspection and so on. Inspection and maintenance are carried out on equipments such as:

1. Transformers
2. Circuit Breaker
3. Bus Bar
4. Feeder

Table 5.4: Test of Insulating oil in APSCL

Test	Assumptions
Dielectric strength test	Min. 30kV at 2.5 mm gap (12.5mm sphere)
Acidity test	Acid value less than 0.02 mg KOH/g
Moisture content in oil	50-60 ppm
Neutralization number	0.03 mg KOH/gm
Viscosity at 20°C	40 cst
Dissipation factor or Power Factor	0.5% (at 90°c), 0.1% (at 20°c)
Volume resistivity	5.7×10^{14} Ω-cm
Interfacial tension at 27°C	Minimum 0.04 N/m
Dielectric constant	2 to 2.5
Specific gravity	0.895 (at 20 °C)

CHAPTER-06

6. PROBLEMS & RECOMMENDATIONS

6.1 Observations

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

2. Practical participation in different works of Ashuganj Power Station Company Limited would give us more experience, but unfortunately it was not within the policy of APSCL. We were just observer.

3. Because of the company confidentiality, we could not achieve some important information through we were much interested to know these things.

4. The authority of APSCL could not give us sufficient time as that was the time of closing of the year's activity book. This is critical and very busy time for them

6.2 Recommendations

1. Students must complete the related courses before beginning their internship program. This helps the students understand the topics much better.

2. The tenure of our internship program with APSCL was only for two weeks. Even this short period of time gave us exposure to the practical aspects of theoretical issues. Considering the benefits of practical exposure, we would like to recommend the management of Electrical and Electronics Engineering department of East West University to allow students to take internship programs at prospective companies.

CHAPTER-07

7. CONCLUSION

It was a great opportunity to do the internship work in the 2nd largest power station of Bangladesh. From these 15 days internship in APSCL we have gathered lots of practical knowledge over power generation, switchgear protection and power distribution. APSCL could be regarded as the practical ground of the Electrical and Electronic Engineering Department of East West University. The theories that we have learned at the University could be observed at the APSCL. It gave us an opportunity to apply our theoretical knowledge in practice. Our achievements from APSCL are:

1. Industrial training provided by APSCL has enriched our practical knowledge.
2. It has opened our eyes about practical operation of different equipments.
3. It has increased our confidence to face interview in future.
4. APSCL gave us the unique experience of observing the equipment

The authorities in APSCL were very concerned about all kinds of safety. The friendly environment in APSCL encouraged us to co-operate with each other. We learned a lot and obtained practical knowledge from our internship at APSCL, which will help us in our future life.

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