INTERNSHIP REPORT

ON

Palli Bidyut Samity-1

By

Md. Khalid Hossain

Submitted to the

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Faculty of Sciences and Engineering
East West University

In partial fulfillment of the requirement
for the degree of
Bachelor of Science in Electrical and Electronic Engineering.
(B.Sc. in EEE)

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Approved By

11.4.11

Sharmin Rowshan Ara
Academic Advisor

11.04.2011

Dr. Anisul Haque
Department Chairperson

Approval Letter

This is to certify that Md. Khalid Hossain, SID: 2005-2-80-034 has successfully completed the internship work in Palli Bidyut Samity-1 that was assigned to him as part of the internship program. I, Engineer Md. Amzad Hossian, on behalf of Palli Bidyut Samity-1 (PBS-1) am recommending this work as the fulfillment for the requirement of EEE 499 Industrial Training. I wish him success.

9/4/11

মোঃ আমজাদ হোসেন
এ.জি.এম. ইঞ্জিনিয়ারিং
ঢাকা পবিস-১

Engineer Md. Amzad Hossian

Acknowledgment

At first I thank Almighty Allah. My special thank goes to my supervisor, Md. Amzad Hossain Assistant General Manager of the Palli Bidyut Samity-1, Md. A.Z.M Azad, General Manager of the Palli Bidyut Samity-1 and Safiul Islam, Senior Staff of the Palli Bidyut Samity-1. I also greatly appreciate the support of all the employees of PBS-1. I am grateful to our chairperson, Dr. Anisul Haque, Professor, Department of EEE and my advisor Sharmin Rowshan Ara, Senior Lecturer, Department of Electrical & Electronic Engineering for their constant advice and suggestion. Thanks to my fellow friends and East West University for arranging the internship in a reputed organization like REB.

Executive Summary

Rural Electrification Board (REB) is the pioneer in providing electricity for thousands of villages in Bangladesh. Palli Bidyut Samity's are the co-operative societies of REB which are actually taking the responsibilities of distribution of power. There are total seventy Palli Bidyut Samity under REB and Palli Bidyut Samity-1 is one them. I have completed my internship in Palli Bidyut Samity-1. I started my internship on 30th August, 2010 in Palli Bidyut Samity-1.The duration of this internship was three months (two days a week). During my internship period I visited all the departments of Palli Bidyut Samity-1, their distribution substation (Nobinogor, Savar) and grid substation (Hamannogor, Savar). I also got the opportunity to visit two power plants which generates electricity for PBS-1; these are, Summit Power Limited (Ashulia, Savar) and United Power Generation and distribution Company Limited (EPZ, Savar).

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Chapter 1

1.1. Objective

Internship is a part of fulfillment of the undergraduate degree in EEE department of the East West University. Internship provides an opportunity to apply theoretical skills that we have learned in university and test their application in a particular career before permanent commitments are made. In addition, this is a scope to obtain the perspective of a work environment and benefit from a mentor or supervisor's experience and advice. I have completed my internship in Palli Bidyut Samity-1. Palli Bidyut Samity-1 is the leading electricity distribution company in rural and industrial area around Dhaka city. Palli Bidyut Samity-1 provided me an excellent opportunity to unify my theoretical knowledge with practical knowledge of the production and distribution of power sector.

1.2. Company Profile

With a Presidential Ordinance in October 1977, The Bangladesh Rural Electrification (RE) Program was founded & established the Rural Electrification Board (REB).It is a semi-autonomous government agency which is responsible for providing electricity in rural area of Bangladesh. From the very beginning, the programme's motto was to use electricity as a means of creating opportunities for improving agricultural production and enhancing socio-economic development in rural areas as well as the improvement of the living standard and quality of rural people. PBS is a consumer owned organization. Their basic principle is to serve as a co-operative organization for distributing electric power to its members. It is an independent corporate body subject to all applicable laws and prescribed Bye-Laws and is responsible for the efficient and effective management of its affairs including proper and successful construction, operation and maintenance of its electric distribution.

Today there are 70 operating rural electric cooperatives called 'Palli Bidyuit Samity (PBS)' which bring service to approximately 79,00,000 new connection being made and more than 14,000 kms of line being constructed each year. Electricity is now available to operate 86,766 irrigation pumps, 62,875 small and cottage industry units, 373,119 commercial setups and 8,733 other establishments in the rural areas. The total number of the member of Palli Bidyut Samity-1 are 2, 94,000(two lacks ninety four thousand). Palli Bidyut Samity-1 is one of the four Samity

among 70 which are making profit. PBS-1 has been subdivided into five departments and these are given below:

- Member service
- Consult Service
- NIPOR Service
- Finance Section
- Engineering Section

The programme of REB is listed in table 1.1 (as on October, 2010):

Number of Approved Projects	45
Number of Approved PBSs	70
Number of REB organized	70
Number of PBSs electrified	70
Number of district under the REB programme	61
Number of Up-Zillas under the programme	433
Number of villages electrified	48,380
Total distribution line constructed	2,22,780 Km
Total 33/11 KV sub-stations constructed and commissioned	426
Installed Capacity of Sub-stations	2825 MVA
Number of population in Programme Area	9,25,13,296
System Loss	14.85%

Table 1.1: The Programme of REB

The features of Palli Bidyut Samity-1 in table 1.2:

Number of Up-Zillas under the program	4
Number of grid substations	6
Number of distribution substations	19
Total number of the consumers	1, 71,768
Domestic consumers	1, 42,959
Commercial consumers	18,769
General power	4489
Large power	83
Street lights	138
Resale to other PBS	69
Total demand	260 MW
Present system loss	8.76%

Table 1.2: The features of Palli Bidyut Samity-1

1.3. Generation scenario

The Rural Electrification Board (REB) has an endless vision which comprises financial support, technical oversight, and long-term direction to the rural electrification program in Bangladesh. Throughout its 32 years history, REB has performed very well and contributed to the continual development of this program. REB has sponsored the foundation of 70 PBSs connecting nearly 8 million electric services, representing slightly over 45% of the rural population of Bangladesh. The power crisis in Bangladesh faces a serious challenge in rural areas and REB has been preparing itself to provide technical leadership to overcome the challenges. In the aim of alleviating the power shortage problem of the country, the Ministry of Energy, decided to go for small scale power generation on B.O.O. (Build, Owned, Operate) basis under the support of REB and accordingly gave directives to REB in 1998 for the construction of 10 MW power stations in financially viable PBSs.

REB, accordingly, selected three sites, namely Dhaka PBS-1, Narsingdi PBS-1 and Comilla PBS-1 for implementing its 1st phase of Small Scale Power Generation as Pilot Project.

Guaranteed Net Plant Capacity of each of the power station is 11 MW. The Palli Bidyut Samities (Rural Electric Societies) are the non government electric co-operative institution in the power sector distributes power in the rural areas of the country through their network. To fulfill the demand, Summit Power Limited and United Power Generation are established with help of financial aid and guidance of Palli Bidyut Samity-1 (PBS-1).

1.4. Socio-economic impact

Before our liberation in the year 1971, PBS little facilities created for the rural people. In 1972, Rural Electrification Directorate (under Power Development Board) was established to get ready efforts for electrifying rural areas. In 1976 NRECA performed a probability study for reaching electricity to each and every rural home and other rural establishments. As a result Rural Electrification Board was formed to start efforts at bringing down changes in rural living patterns. Over the last 28 years, the program has reached about 433 thanas of the country, thus making it a center development program. The program has brought light to many families, until now remaining in complete darkness. It has given them the clarification towards modern lining, freedom from poverty, malnutrition and hunger. Electricity has brought many families close to the rural homes. Some of them are thinking of taking new plans in industrial and agricultural sectors.

Palli Bidyut Samity has provided jobs to rural families. In addition, a total of 8000 persons are employed in the construction firms and consulting offices working for the program. Rural people now have much better work-habits and an improved sense of discipline and social security.

Literacy rate in the rural areas has improved radically due to the development of mass education program. Poor workers can attend the night schools at the end of the day's business. They can also sit beside the children to supervise their education. Living pattern in rural areas have changed due to introduction of new consumer items and like refrigerator, television, radio, cassette players, fans etc. By dint of TV, people are now keeping informed about the latest state of sports, culture and political developments. Villages are experiencing a kind of urbanization in the form of public services, regular education, sanitation and health care and economic activities.

RE program have speeded the other development activities in the rural areas. Many new infrastructure development NGOs (non government organizations) and human development bodies have extended their activities in remote rural areas to help at poverty mitigation and human development. By dint of electricity, NGOs are encouraging mixed human activities in the form of handicraft development and cross-cultural interchanges.

Figure 1.1: Social Development by PBS

Women as well as men of the rural areas are enjoying the benefits of electricity. They can do extra work after household job which is added to family earnings. Women are getting self-dependent, making small groups of income generating purposes, specially rearing poultry and cattle, making vegetable farms and opening small shops. The use of light during evening ensures women's safe movement from one place to another. Increase in overall years of schooling for both boys and girls, preference to send girls to schools, awareness of legal issues and awareness about negative impact of dowry.

These things ultimately reduce migration towards cities. On the other hand, it ensures effective and maximum utilization of human and other properties. Speedy electrification of our rural homesteads & other consumers have sped timely utilization of natural and other resources.

1.5. Field of Rural Electrification Board

REB already covered almost all part of our country and covered all most 2, 22,608 Km line. The map of REB is given below:

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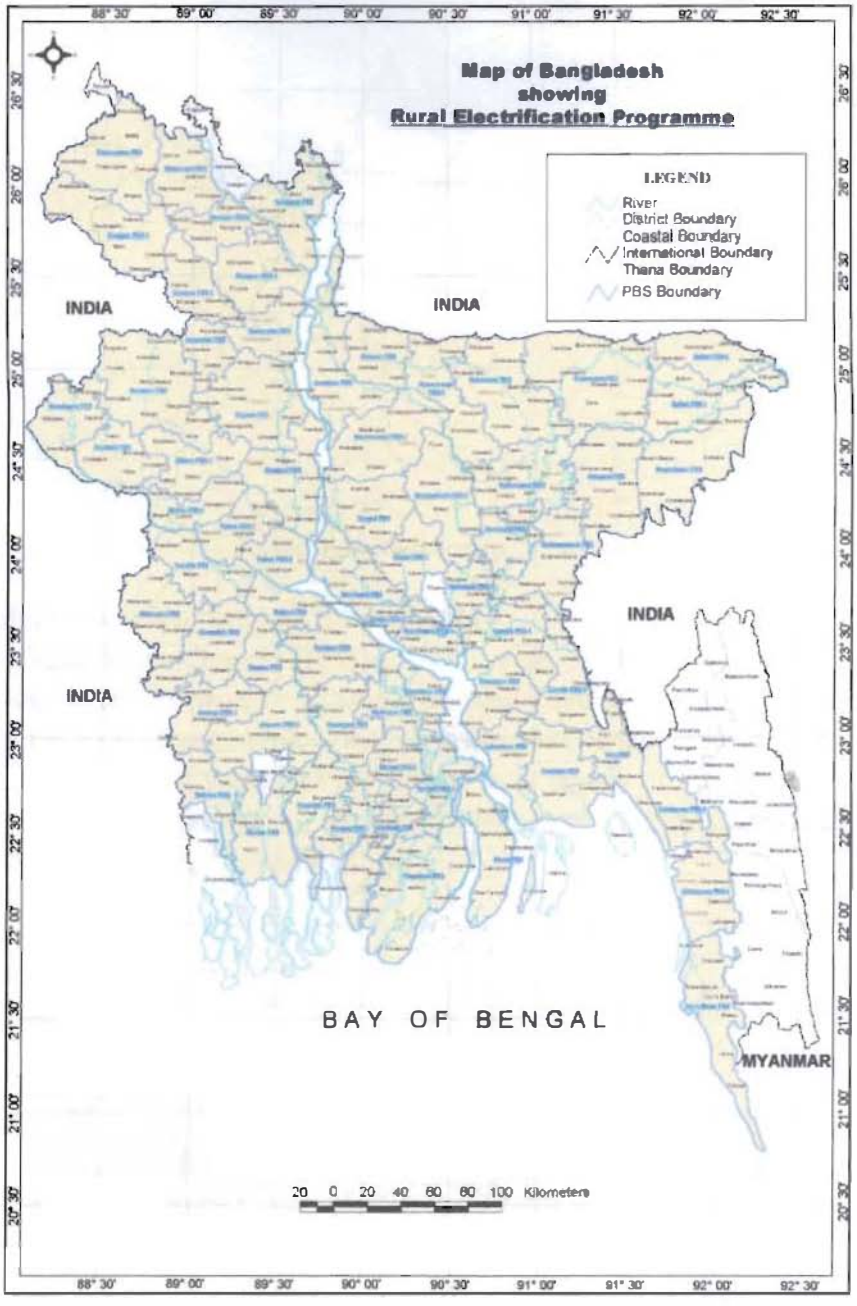

Figure 1.2: REB map

Palli Bidyut Samity-1 has covered four Up-Zillas and these are Savar, Dhamray, Kaliakor and Gazipur. The map of the PBS-1 is given below:

Figure 1.3: PBS-1 map

1.6. Rural Electrification through Solar Energy

PBS provided Solar Home System (SHS) in rural areas of Bangladesh where possibility of running grid line is non- permeable because of financial and technical limitations. Harnessing solar energy in the form of useable electricity is sustainable, environment friendly, which would be used for household and commercial use for the rural people of remote area. About 80,000 people will get benefit of electricity by the implementation of the project. Total 603 no of SHSs have been installed which are given below:

Barisal PBS-1	164
Nator PBS-2	97
Pabna PBS-2	71
Serajganj PBS	30
Cox's bazar PBS	191
Sunamganj PBS	50

Table 1.3: List of Solar Home System (SHSs) in different area

1.7. The Internship Schedule

During my Internship the places to which I paid visit were related to the PBS-1. These are Summit Power Limited, United Power Generation and Distribution Company Limited, grid substation (Hamannogor, Savar), distribution substation (Nobinogor, Savar). I also saw activities of other department of PBS-1 which are Member Services, General Services, Nipor, Engineering, staking design and supervision department. The internship schedule is given below:

	Location	Date	Supervisors	Designations
Member Service	Nobinogor, Savar	30th August, 2010	N/A	AGM Member Service(MS)
Distribution Substation	Nobinogor, Savar	8th September	Safiul Islam	Senior Staff
Grid Substation	Hamannogor, Savar	18th September	Safiul Islam	Senior Staff
Power Generation in Summit Power Limited	Ashulia, Savar, Dhaka	25th September, 2010	Engineer Habib	Plant Manager
Consult Service	Nobinogor, Savar	4th October, 2010	N/A	AGM Consultant
United Power Generation and Distribution Company Limited	EPZ Savar, Dhaka	09th October, 2010	A.S.M. Ahsan Habib	Plant Manager
Nipor Service	Nobinogor, Savar	16th October, 2010	Safiul Islam	Senior Staff
Engineering Section	Nobinogor, Savar	23th October, 2010	Engineer Shushanto	Engineer COM
Staking, Design and Supervision	Nobinogor, Savar	6th November, 2010	Engineer Shushanto	Engineer COM
Finance Section	Nobinogor, Savar	27th November, 2010	N/A	AGM Consultant

Table 1.4: Internship schedule

Chapter 2

Working Overview Of PBS-1

2.1. Member service

Member service is one of the most important part in PBS-1. Member service department provide quality customer service and communicate effectively with customer. Member service department is also called one point service. One point service is responsible to solve any kind of problem of customer. Responsibilities of member service department are described below:

- Establish new connection
- Establish old connection
- Answer customer's request
- Establish new meter
- Meter disconnection and replacement
- Meter checking
- Collection and investigation of meter reading
- Collection of monthly bill
- Single phase meter test
- Monitoring line distribution
- Maintenance of transformer
- Maintenance of yearly grid substation
- Repairing over loaded transformer
- Solve customer's complain
- Monitor system loss

2.2. Consult Service

Consultant department provides many kinds of service to the PBS-1. Consultants are carrying study and load survey for PBSs. On the basis of the load survey and load growth, consultants calculate the future load and plan and design the power distribution system. The work of consultant department is given below:

- Consultants design the distribution line to cover the entire area for electrification for PBS-1.
- To maintain better construction quality, local consultants are also involved in supervision and energization of the line.
- Consultant department performs the field survey and design master plan.
- Consultants are studying load growth of each PBS separately by collecting various data such as maximum demand KVAR, Voltages Amperes of Voltage drop at different points of sub-station, meter connection, line construction data in each month.
- Consultant department also provide maintenance operation by changing poles, voltage regulator or capacitor.

PBS provides both classroom session and on job training for the local consultants (owners, managers, engineers, workers). Until now there are 19 consulting firms, over 1000 engineers are working in 67 PBSs in RE program.

2.3. Nipor Service

Nipor Service is also called complain center of PBS-1. Responsibilities of nipor service department are described below:

- The main activities of nipor service are operation, maintenance and construction of the line.
- If any kind of fault occurs in transmission line then nipor section addresses the problem.
- Nipor service also solve the consumer complain related to the distribution line and take initiative to solve it.
- Faulty transformers from distribution line and substations are repaired by this section.
- Regular maintenance of these transformers are also responsibility of nipor service.

The view of nipor section in PBS-1 is given below:

Figure 2.1: View of nipor service in PBS-1

2.4. Engineering Section

The engineering section is responsible for overall planning and execution of these plans. Loads arrange center also works under the engineering section. The work of engineering section is given below:

- Engineering section provides estimate for new transmission line and send the estimate to the higher authority for approval.
- Engineering section also takes necessary steps in case of sudden fault in transmission line.
- This section records all necessary information regarding total receiving power from grid substations, system loss, peak demand etc.
- Distribution transformer, poles, circuit breakers, wire and other equipments for establishing a new transmission line are provided by engineering section.

2.5. Finance section

The Finance Department is responsible for the effective financial management. Responsibilities of a finance department in PBS-1 are to collect the bill from the consumer and record the total coming revenue from the consumer. Percentage of the total Revenue on September, 2010 in PBS-1 is given below in a tabular form:

Class of Service	Number of the Connections	Amount of the Revenue	Percentage of the total Revenue
Domestic	1, 42,959	77,513,781	29.63%
Commercial	18,769	26,158,667	10%
Irrigation	3823	803,727	0.31%
Charity Organization	1507	1,057,405	0.404%
General Power	4489	91,690,070	35.05%
Large Power	83	32,551,135	12.44%
Street Lights	183	40,094	0.02%
Resale to other PBS	0	31,787,119	12.15%
Total	1, 71,768	261,601,998	100.004%

Table 2.1: Total revenue collection on September, 2010

2.6. Staking, Design and Supervision

Staking, design and supervision is another department in PBS-1 and play an important role to provide the suitable service. Responsibilities of staking, design and supervision department is given below:

- This department designs and constructs the new line in a new area.
- Sectionaling of the transmission line and design the road map for the new consumer is also performed by this department.
- This department calculates the voltage drop and ensures same voltage in transmission line.
- They also study the system loss of PBSs.

The bar chart of system los from 1981 to 2009 is given below:

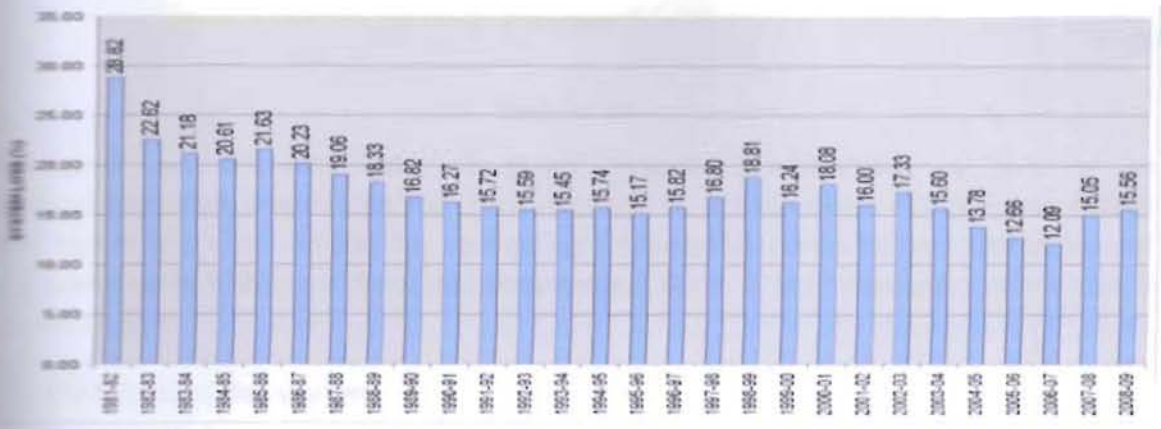

Figure 2.2: Bar chart of system loss

2.7. Load shedding

Load shedding is a common scenario in our country. When supply of electricity can not fulfill the maximum demand then load shedding occurs. The load shedding scenario of September, 2010 in PBS-1 is given below:

Time	Maximum Demand	Total Supply
1.00 AM	3846 MW	2856 MW
5.00 AM	3269 MW	3021 MW
10.00 AM	4852 MW	2432 MW
17.00 PM	5186 MW	2652 MW
20.00 PM	5436 MW	2272 MW
23.00 PM	4267 MW	2382 MW

Table 2.2: Load shedding scenario of September, 2010 in PBS-1

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Chapter 3

Substation

Substations are important part of power system. A substation is a part of an electrical generation, transmission and distribution system. In a substation voltage is transformed from high to low, or the reverse. My visit during the internship period includes distribution and grid substation in Nobinogor, Savar and Hamannogor, Savar. A brief description of this visit is provided below:

3.1. Distribution Substation

3.1.1. Introduction

A distribution substation transfers power from the transmission system to the distribution system of an area. The distribution station reduces voltage to a value suitable for local distribution. The input for a distribution substation is typically at least two transmission or sub transmission lines. There are 19 distribution substations in PBS-1 and I have visited a distribution substation which is placed in the main area of the Palli Bidyut Samity-1. In this distribution substation, 33KV voltages come from the national grid to step-down transformer, which decreases the voltage to 230V while increasing the current for domestic and commercial distribution. There are two distribution units and the capacity of these units is 20MW and10MW. In PBS-1the whole distribution system is established in Y connection and used double bus-bar.

Figure 3.1: Distribution substation of PBS-1

Substations generally have Potential Transformer (PT), Current Transformer (CT), circuit breakers, voltage regulators, feeders, lighting arrestor, transformers and switches.

3.1.2. Switching

Switching is an intermediate station between two other substations or between substation at load end and generating station. At switching station incoming power line and outgoing power lines have same level of voltage, i.e. there is no transformer to step down the voltage to connect the load. Switching stations are created just for purpose of controlling important parameters in power system and control of voltage due to capacitive effect.

3.1.3. PT and CT

A PT and CT works on the same principle as that of a simple transformer. PT steps up or steps down voltage and CT steps down the high current into a low level so that it can be measured in a suitable range. PT rating of this substation is 33KV:240V which is fixed and the CT rating 150:5 which is variable. There are six numbers of transformers which are single phase and power transformer.

3.1.4. Circuit breaker

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 discontinue electrical flow by interrupting continuity. Unlike a fuse, which operates once and then has to be replaced, a circuit breaker can be reset after fault detection (to resume normal operation). In a distribution substation, circuit breakers are used to interrupt any short-circuits or overload currents that may occur on the substation. PBS-1 substation use SF6 circuit breaker.

3.1.5. Voltage regulator

A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level and also increase the voltage. It can regulate the voltage level $\pm 10\%$ to maintain a constant voltage level.

3.1.6. Feeders

The output of substation is a Number of feeders. The feeders will run overhead, along streets or under streets, in a city and eventually power the distribution transformers at or near the customer location. In this substation there are six feeders in total.

3.1.7. Lightning arresters

Lightning arresters are protective devices for limiting surge voltages due to lightning strikes or equipment faults or other events, for preventing damage to equipment and disruption of service. These are also known as surge arresters. Lightning arresters are installed on many different kinds of equipment such as power poles and towers, power transformers, circuit

breakers, bus structures, and steel superstructures in substations. Horn type lighting arrestors is used in this substation.

3.2. Grid Substation

3.2.1. Introduction

A Grid substation is a large installation where 132kV power lines are transformed to 33 kV for distribution to distribution substation. Grid substation can be a hundred meters or more across and is surrounded by a metal fence. The metal fence surrounding the substation ensures that almost no electric fields emerge from the substation itself.

I have visited Hamannogor grid substation which is placed in Savar. This grid substation established in 2003. The capacity of the transformer is 50(fifty) MVA without cooling and 75(seventy five) MVA with cooling. Delta connections are established in this substation. This substation is capable of supplying 44 MW but at present is supplying only 14 to 15 MW because PGCB (Power Grid Company of Bangladesh) unable to supply enough power to this grid substation. For this reason PBS-1can not fulfill the demand of their customer during peak hour. There are 16 feeders in total. At present only two feeders are being used. All feeders can handle same amount of load coming from national grid. Feeder number L-37 and L-39 are now used for supplying power to the distribution substation.

Figure 3.2: View of Grid Substation, Hamannogor, Savar

The grid substation includes a battery room which plays a vital role in a substation. This dc supply provides dc power for protection, supervision and control of substation and line equipment. Frequently, transmission or distribution power will be lost or reduced in magnitude during system disturbances (faults). To provide an uninterrupted power, most substation use dc power from batteries. In this grid substation there are 92 batteries in series connected (each of 1.2V).

A grid substation also contains Bus-bar, Isolating Switches, Insulators, Instrument Transformation, Metering and Indicating Instrument which are described below.

3.2.2. Load Distribution of Grid substations in PBS-1

There are another four grid substations under Palli Bidyut Samity-1. The total demand, supply and Percentage of the Supply of other grid substation in September, 2010 are given below:

Name of the Grid	Demand in MW	Supply in MW
Kobirpur Grid	3565	1572
Kollanpur Grid	346	234
Savar Grid	588	487
Joydebpur Grid	127	85
Total	4626	2378

Table 3.1: Load distribution of grid substation under PBS-1

3.2.3. Bus-bar

A bus-bar is a thick strip of copper or aluminium that conducts electricity within a switchboard, distribution board, substation or other electrical apparatus. Bus-bars are used to carry very large currents, or to distribute current to multiple devices within switchgear or other equipment. When a number of lines operating at the same voltages need to be directly connected electrically, bus-bars are used as the common electrical component. The incoming and outgoing lines are connected to the bus-bars. There are three types of bus-bar used in substation. They are:

- Single bus-bar arrangement
- Single bus-bar system with sectionalization
- Double bus-bar arrangement

3.2.3.1. Single bus-bar arrangement

In a single bus-bar switchboard the bus-bar can be split into sections and lines and transformers are connected to one bus-bar only. The advantage of single bus-bar is low cost. The main disadvantage is that there is a complete interruption of the supply during routine maintenance or repairment. Single bus-bar diagram is given below:

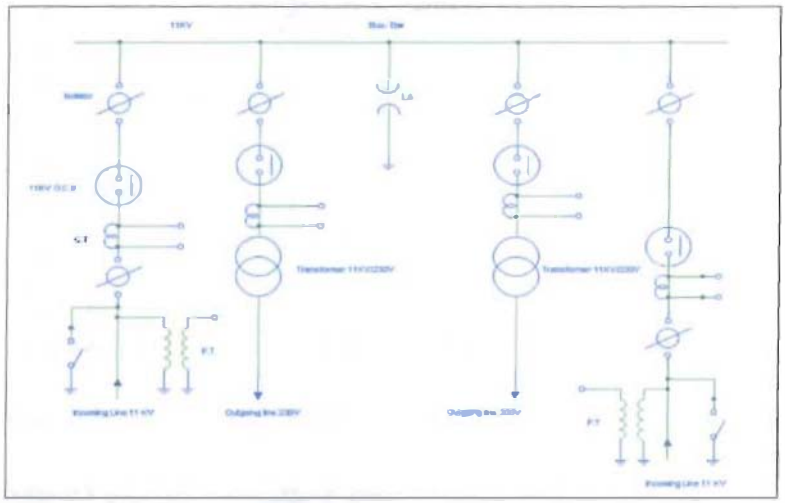

Figure 3.3: Diagram of bus-bar arrangement in substation

3.2.3.2. Single bus-bar system with sectionalization

In this arrangement, the single bus-bar arrangement is divided into section and load is equally distributed among all the sections. Any two sections get connected by a circuit breaker and isolators. The advantage of this arrangement is that if a fault occurs on any section of the bus-bar, that section can be isolated without affecting the supply from the other section and repair and maintenance of any section of the bus-bar can be carried out by de-energizing that section only, eliminating the possibility of complete shutdown. The diagram of Single bus-bar system with sectionalization is given below:

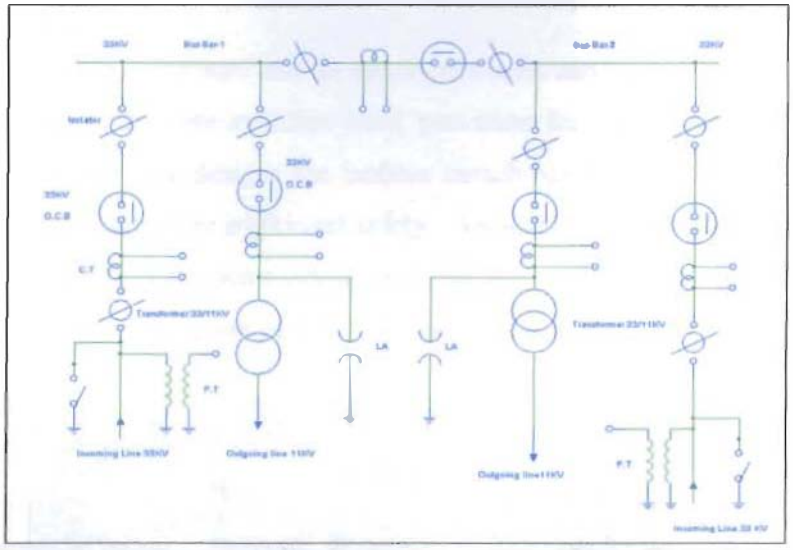

Figure 3.4: Diagram of Single bus-bar system with sectionalization

3.2.3.3. Double bus-bar arrangement

This system consists of two bus-bars, a main bus-bar and a spare bus-bar. The incoming and outgoing lines are connected to either bus-bar with the help of a bus-bar coupler which consists of a circuit breaker and isolators. The advantage of this bus-bar is that in case of repairment on the main bus-bar, the continuity of supply to the circuit can be maintained by transferring the load to the spare bus-bur. The diagram of Double bus-bar arrangement is given below:

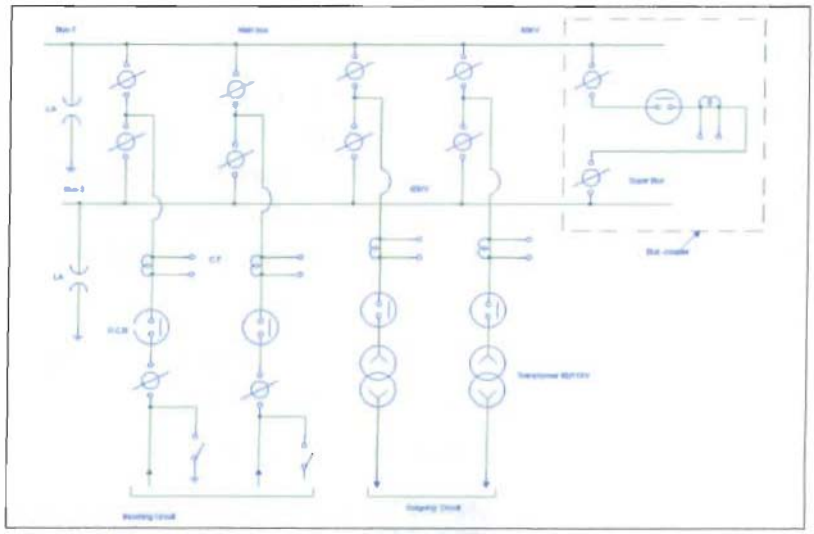

Figure 3.5: Diagram of Double bus-bar arrangement

3.2.4. Isolating Switches

Isolator switch is used to make sure that an electrical circuit can be completely de-energized for service or maintenance. Isolator switches have provision for a padlock which prevents from unplanned operation. In some designs the isolator switch has the additional ability to earth the isolated circuit thereby providing additional safety. An isolator is essentially a knife switch in a substation which is designed to open a circuit under no load and switches are operated only when the lines carry no current. The figure of Isolating Switches is given below:

Figure 3.6: Isolating switches

3.2.5. Insulators

Insulator is a material that resists the flow of electric charge. An insulator is something that inhibits the transmission of heat, light, mechanical, electrical, or other energies from one place to another. An insulator is used to isolate current carrying components from conductive noncurrent carrying components. There are many types of insulators, pin type, suspension type, post insulator etc. For example, post insulator is used for bus-bars. In grid substation porcelain insulator is used.

3.2.6. Instrument Transformer

Instruments transformers are potential or voltage transformer or current transformer. These are used in the substation to supply the instruments with voltages and currents exactly proportional to the main circuits. The function of instrument transformers is to transfer voltage or currents in the power lines to values which are convenient for the operation of measuring instruments. The advantages of instruments transformer are to avoid direct contact to high voltages and currents for the control purpose. Insulators ensure the safety of operators. It can be categorized as potential transformer and current transformer.

3.2.6.1. Potential or voltage transformer

A voltage transformer is used to reduce voltage to a standard value and step down the voltage to a known ratio. Voltage or potential transformers (PT) are used for metering and protection in high-voltage circuits. They are designed to present small load to the supply being measured and to have an exact voltage ratio to accurately step down high voltages so that metering and protective relay equipment can be operated at a lower potential. The primary of this transformer consists of one or more turns of thick wire connected in series with the line. The secondary consists of a large number of turns of fine wire which provides for measuring instruments and voltage which represents a fraction of original line voltage of transmission line.

3.2.6.2. Current transformer

Current transformers are commonly used in metering and protective relays in the electrical power industry where they allow safe measurement of large currents, often in the presence of high voltages. The current transformer safely isolates measurement and control circuitry from the high voltages, typically present on the circuit being measured. The current transformer is typically described by its current ratio from primary to secondary.

3.2.7. Metering and Indicating Instrument

The grid substation consists of a number of metering and monitoring equipments. These are ammeters, voltmeters and energy meters, which are installed in a sub-station to monitor the circuit parameters.

Chapter 4

Power Generation

4.1. Introduction

There are various types of power plants, these are, water power plant, diesel power plant, gas power plant etc. I have visited UPGD (United Power Generation and Distribution Company Limited) and Summit Power Limited during my internship period. Both power plants are gas power plants and included in the generation part of PBS-1. UPGD (United Power Generation and Distribution Company Limited) and Summit Power use Lean burn gas engine and natural gas as a fuel to produce electricity.

Energy conversion is the main principle of power generation in an electrical power plant. Mainly the potential energy is converted in to electrical energy. The potential energy for example coal, diesel, fossil converted into electrical energy. The energy resulted by burning fuels are used to turn fan-like blades inside a turbine. These blades are attached to a pole-like shaft. When the blades inside the turbine begin to turn, the shaft begins to turn. This causes coils located inside a magnetic field within the generator to turn. Change of electromagnetic field results in electricity. More or less electricity can be created by varying certain factors. These are: type of materials used in the wire, the speed at which the turbine rotates, the size of the magnetic field, and the number of wire coils inside the magnetic field, etc. Wires coming from the generator are used to conduct the flow of electricity convert to a neighboring switchyard, where the voltage is stepped up for the purpose of transmission.

4.1.1. United Power Generation and Distribution Company Limited

UPGD was established in 2007 at Export Processing Zones (EPZ), Dhaka for providing power supply to the factories within the boundary of EPZ and residential area outside of EPZ. UPGD Currently operating a 35 megawatt unit in Dhaka EPZ and a 44 megawatt unit in Chittagong EPZ. The total project cost of the plants was at Tk. 3750 million and is powered by the latest Wartsila gas engines. Each engine's production capacity is 8.73 megawatts. Thus UPGD has constructed multidisciplinary infrastructures like power generation, high voltage transmissions and distribution and high or low pressure gas pipelines for the project. On top of this unique

achievement, UPGD has been regularly providing its surplus energy to the PBS-1 of Bangladesh, thus lighting up thousands of residences in Nobinogor, Savar.

Generator Facts of UPGD

Generator Manufacturer: Wartsila (Finland) and Mtube

Generation Capacity per Generator: 8.7 Megawatts and 1.95 Megawatts

Fuel: Natural Gas

Location: Dhaka Export Processing Zone (DEPZ) Plant

Number of Generators: 7

Number of Battery: 184

Capacities: 41 Megawatts

Commercial Operation Date: 26th December 2008

Clientele: Bangladesh Export Processing Zone, Palli Bidyut Samity-1

4.1.2. Summit Power Limited

Summit Power Limited (SPL), sponsored by Summit Group, set up power plants on Build, Own and Operate (BOO) basis for generation of electricity and to sell power to PBS-1 at Nobinogor, Savar. The company is generating electricity from March, 2001 and selling toPBS-1 at an agreed tariff under power purchase agreement. The plants started commercial production on 8 February 2001. Summit Power capacity is 35 megawatt. The view of the Summit Power Limited is given below:

Figure 4.1: View of Summit power plant

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Generator Facts of Summit Power

Generator Manufacturer: Caterpillar (USA) and Wartsila (Finland)

Generation Capacity per Generator: 3.73 Megawatts and 8.73 Megawatts

Fuel: Natural Gas

Location: Ashulia, Dhaka

Number of Generators: 7

Capacity: 46 Megawatts

Number of Battery: 110

Commercial Operation Date: February, 2001 and January, 2008

Clientele: Palli Bidyut Samity-1

4.2. Engine room

Each power plant consists of an engine room and it plays an important role in power plant. I also visited the engine room in both power plants. UPGD (United Power Generation and Distribution Company Limited) and Summit Power both use Lean burn gas engine.

Summit power plant's gas engines are product of Caterpillar (America) and Wartsila (Finland). Each engine consists of total twenty cylinders, ten on each side, which are V type. Capacity of Wartsila's is 8.73MW for each generators and Caterpillar's capacity 3.73MW for each generators. The total number of generator is seven and total capacity is 46MW.

In United Power Generation and Distribution Company Limited's gas engines are product of Wartsila (Finland) and Mtube. These engines also consists total twenty cylinders, ten on each side, which are V type. Each Wartsila's capacity is 8.7MW for each generators and Mtube's capacity 1.95MW for each generators. The total number of generator is seven and total capacity is 41MW. The views of engine room are given below:

Figure: 4.2: Views of engine room

Figure 4.2: Views of engine room

Engine room has plenty of pipelines which are properly color coded for proper identification. These pipelines are used to cool the engine and these lines are connected to the radiator. Engine room also consist 20 exhaust lines, 2 tube chargers, 5 water lines, 4 engine control panel.

4.3. Control room

Control Room is very important part of power station. Control Room is usually placed center of the power plant. The plant operating supervisor and senior operating personnel operate and monitor plant equipments through the control room. Summit Power Limited and United Power Generation and Distribution Company Limited both use automatic control system. Both power plants are using programmable logic control (PLC) unit in their operating system. Programmable logic control (PLC) unit can be operated in two different ways, one is automatic and the other is manual. UPGD and Summit power use automatic PLC unit. PLC unit is essential for the protection purpose and PLC automatically controls most of the electrical equipment. Picture of Programmable logic control (PLC) unit in a power station is given below:

Figure 4.3: Programmable logic control (PLC) unit of UPGD

In UPGD and Summit power plants, alarm panels are located on the upper part of the programmable logic control (PLC) unit. In power plants alarm lights are included within the

system flow path. Usually, alarm lights are mounted separately in massive arrays. The Mimic diagram sketches of major plant systems provided on the middle panels which are shown in figure 4.4. Below Mimic diagram panel has a number of red and green lights. In power plants green light indicates a valve is closed or a breaker is open. Red light indicates valve open or a breaker is closed. Below the mimic panel, meters and computer monitors are located to inform the operator, operating conditions. The last panel contains protective relays.

4.4. The Mimic diagram of power plant

Every power plant has a mimic diagram. Mimic diagram represents bus-bar arrangement, total number of feeder and their arrangement, X formers, circuit breakers, generators. The plant manager of the UPGD provided me the mimic diagram which is given below:

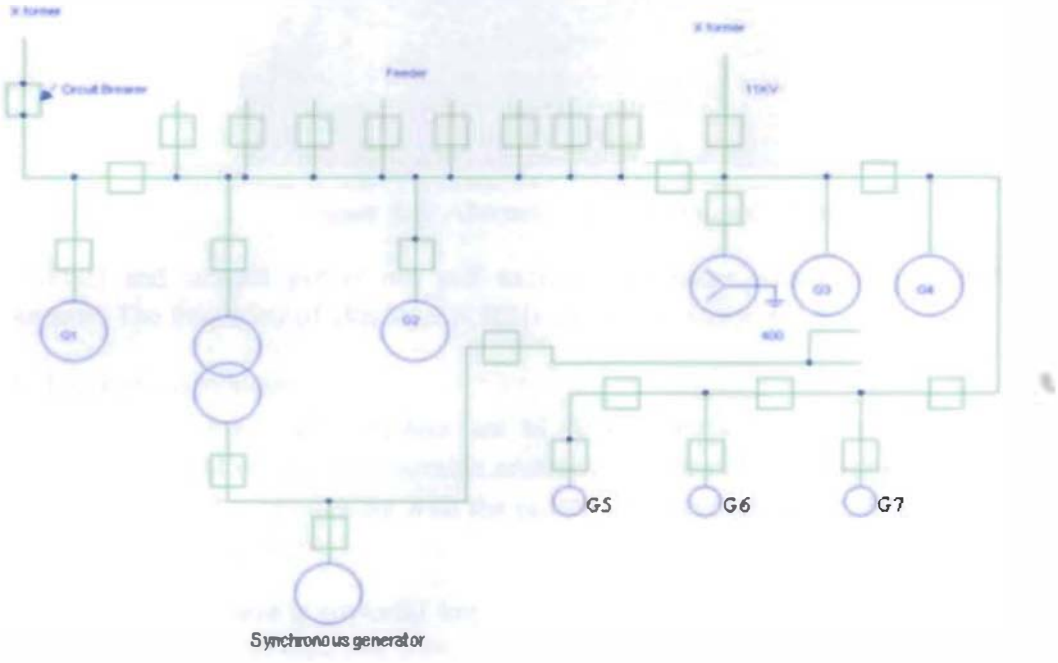

Figure 4.4: The mimic diagram of UPGD power plant

4.5. Alternator

An alternator is an electromechanical device that converts mechanical energy to electrical energy in the form of alternating current. Most alternators use a rotating magnetic field. Any AC electrical generator can be called an alternator. Alternators generate electricity by the same principle as DC generators, namely, when the magnetic field around a conductor changes, a current is induced in the conductor. Typically, a rotating magnet called the rotor turns within a stationary set of conductors wound in coils on an iron core, called the stator. The field cuts

across the conductors, generating an induced EMF, as the mechanical input causes the rotor to turn. The figure of alternator is given below:

Figure 4.5: Alternator of UPGD power plant

In UPGD and summit power use self excited Alternators which are provided from ABB Company. The frequency of alternator is 50Hz and power factor is 0.8.

4.6. Excitation system

Main functions of excitation system are to provide variable DC current in a short time, controlling terminal voltage with suitable accuracy, ensure stable operation with network and or other machines and communicate with the power plant control system to keep machine within permissible operating range.

Excitation systems have a powerful impact on generator dynamic performance and it ensures quality of generator voltage and reactive power. Following excitation system are commonly used.

- Brushless excitation systems, with rotating exciter machines and Automatic Voltage Regulator (AVR).
- Static excitation systems (SES), feeding rotor directly from thyristor bridges via brushes.
- Self excitation system is another kind of excitation systems in which harmonic power developed in a generator. This power is captured by separate stator winding which is controlled and rectified with magnetic amplifier.

4.7. Synchronous generator

Synchronous generators are the primary source of all electrical energy and commonly used to convert the mechanical power, output of steam turbines, gas turbines, reciprocating engines, hydro turbines and wind turbines into electrical power for the grid. They are known as synchronous generators because they operate at synchronous speed, which is the same principle of operation as a synchronous motor. The reasons for using Synchronous Generators in power plant:

- They are more stable and secure during normal operation and they do not require an additional D.C supply for the excitation circuit.
- The permanent magnet synchronous generators avoid the use of slip rings, hence it is simpler and maintenance free.
- Higher power coefficient and efficiency.
- Synchronous generators are suitable for high capacities and asynchronous generators which consume more reactive power are suitable for smaller capacities.
- Voltage regulation is possible in synchronous generators where it is not possible in induction types.
- Condensers are not required for maintaining the power factor in Synchronous generators, as it is required in induction generators.

4.8. Synchronizing condition

The process of connecting an AC generator (alternator) to other AC generators is known as synchronization. When the generator is synchronized, the frequency of the system will change depending on load and the average characteristics of all the generating units connected to the grid. Greater changes in system frequency can cause the generator to fall out of synchronism with the system.

There are five conditions that must be met before the synchronization process takes place. The alternator must have equal line voltage, frequency, phase sequence, phase angle and waveform to that of the system to which it is being synchronized. Waveform and phase sequence are fixed by the construction of the generator and its connections to the system, but voltage, frequency and phase angle must be controlled each time a generator needs to be connected to a grid.

4.9. Radiator

Radiators are heat exchangers used to transfer thermal energy from one medium to another for the purpose of cooling. Radiators are paired with a fan that blows air through the radiator. Air is an important part of the heat transfer process because it takes the heat away from the radiator. Air heats up relatively quickly and as a result radiator's heat can be transferred to the surrounding air effectively. Heated air must continuously be replaced by cool air so that the heat transfer process can continue.

Radiators are very important part of power station to cool engine. During my internship I saw the radiators in UPGD. In UPGD there are in total 24 fans are in radiators. These 24 fans are arranged in three columns and each column consists of 8 fans to. The figure of radiator in UPGD is given below:

Figure 4.6: Radiators in UPGD power plant

Chapter 5

Future Plan

cording to the 1991 survey, there are 86038 numbers of villages in Bangladesh. Seventy five ıusand villages have been planned to be brought under RE programme. The Remaining lages and Chittagong Hill Tract covered by BPDB or DESA where RE programme have not : been considered for implementation.

: programmed was started in 1980. About 45% villages have already been brought under :ctrification by 2005 and the mid-term plan was to cover further 20% villages by 2005. The :ure plan is to cover remaining villages by 2020 under the long term-plan. It is the final goal to t all the villages of Bangladesh under electrification by the year 2020.

ıe number of PBSs up to December, 2006 is 70 which cover more than 90% of effective area r rural electrification. This number is expected to rise up to 72 during the mid-term plan period d up to 75 during the long-term plan period. The PBS map of Bangladesh given below:

Figure 5.1: PBS maps of Bangladesh

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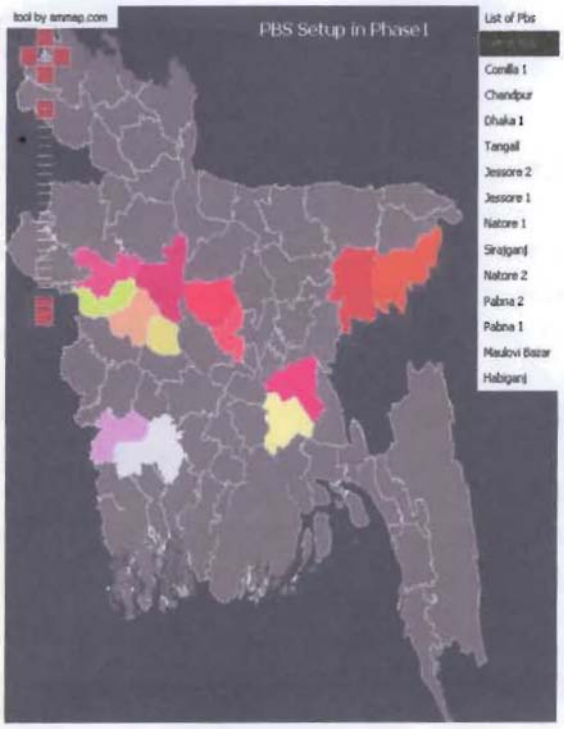

Figure 5.2: PBS setup in Phase1

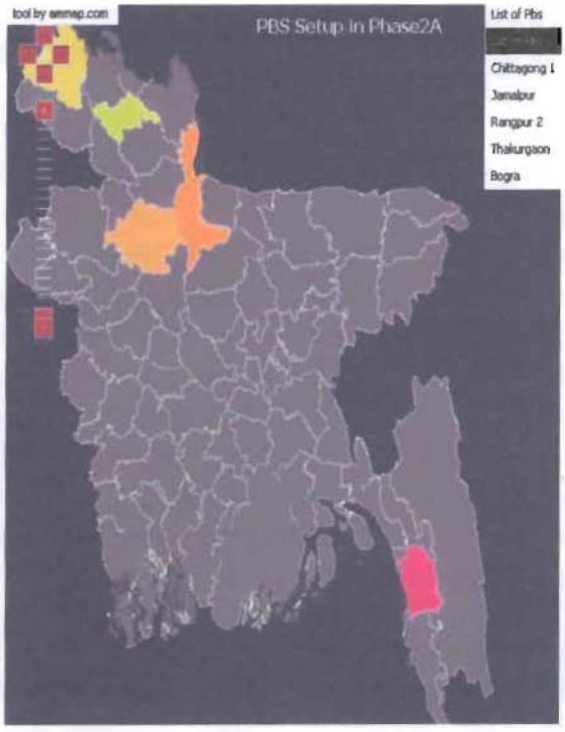

Figure 5.3: PBS setup in Phase 2A

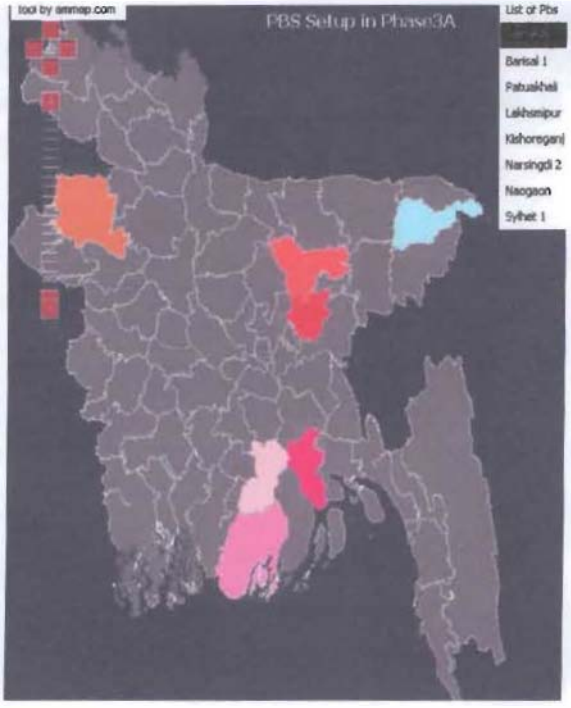

Figure 5.4: PBS setup in Phase 3A

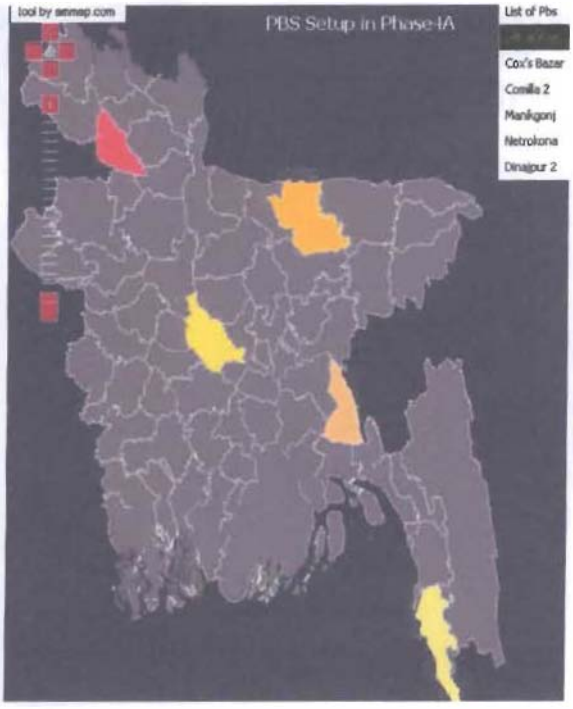

Figure 5.5: PBS setup in phase 4A

Chapter 6

Conclusion

According to this internship report, it is evident that Bangladesh is one of those countries which faces severe power crisis. The three major reasons are scarcity of resources, high population density and insufficient investment in power sector. As a result the supply of electricity lags the demand by huge margin. Though majority population of this country resides in villages, a greater portion was not facilitated for electricity due to the lack of infrastructure. This hampered not only the quality of their life but also the agricultural production. REB took initiative to resolve this issue through PBS. In real hot summer on an average the villages don't get electricity for more than six hours while Dhaka, the capital city of Bangladesh experience load shedding of more than ten hours a day. REB is trying to solve this scarcity of supply by implementing small power plants as in PBS-1. The Ministry of Power and Energy has taken several steps to accelerate the generation of electricity .As a part of this project the targeted production of electricity in next four years is approximately 5000MW.

The other vital issues which are hampering the production and distribution of power sector are: corruption in administration, high system losses and delays in completion of new plants, low plant efficiencies, erratic power supply and shortages of funds for power plant maintenance.

As an autonomous organization Rural Electrification board is sharing the responsibility of distributing electricity to the villages of Bangladesh since 1980 and promising to continue its journey in future, there by contributing to the development of Bangladesh, socially and economically.

Appendix A

Acronyms

REB	Rural Electrification Board
PBS	Palli Biddut Samity
PBS-I	Palli Bidyut Samity-I
PDB	Power Development Board
PGCB	Power Grid Company Bangladesh
UPGD	United Power Generation and Distribution Company Limited
EPZ	Export Processing Zones
PT	Potential Transformer
CT	Current Transformer
GDP	Gross Domestic Product
GOB	Government of Bangladesh
KWh	Kilo-Watt-Hour
KV	Kilo-Volt
MW	Mega Watt
LD	Load Division
LA	Lighting Arrestor
IGA	Income Generating Activities

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