INTERNSHIP REPORT

ON

Polli Bidyut Somity-1

By

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Submitted to the

Department of Electrical and Electronic Engineering
Faculty of Sciences and Engineering
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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

Dr. Md. Ishfaqur Raza	Sohana Tanzeem	Dr. Anisul Haque
Academic Advisor	Academic Advisor	Department Chairperson

APPROVAL LETTER

To whom it may concern

s to certify that Md.Rashedunnabi Badhun, (2007-2-80-003) and Md. Ibrahim Khalil, 2-80-036) has successfully completed their internship program at Polli Bidyut Somity-1. I, eer Md. Amzad Hossian, on behalf of Polli Bidyut Somity-1(PBS-1) recommended this le which fulfills the requirement for EEE 499 Industrial Training, as per the course outline department of electrical and electronic engineering at East West University. I wish them uccess in their professional career.

15/12/11

eer Md. Amzad Hossian

মোঃ আমজাদ হোসেন
এক্সিকিউটিভ, ইঞ্জিনিয়ারিং
ঢাকা পবিস-১

ACKNOWLEDGMENT

rst we wish to convey our heartfelt gratitude to almighty Allah for giving us the strength to plete our internship and also for giving us the strength to work hard and also obtain the eration of all those people with whom we had to work with. Without their assistance we l not have completed our internship and the report.

rst we would like to express our deep gratitude to Mr. Md. A.Z.M Azad, the General ager of the Polli Bidyut Somity-1. Our special thanks to Engineer Md. Amzad Hossain, the stant General Manager of the Polli Bidyut Somity-1. We worked under his supervision. We would like to thank Dr. Md. Ishfaqur Raza, Associate Professor, department of Electrical & ronic Engineering (EEE) and Miss Sohana Tanzeem, Lecturer in the EEE department at West University.

lso would like to thank all the respected officers and employees of Polli Bidyut Somity-1 heir endless support during our training program. We are also very grateful to all our ers for their encouragement and cooperation throughout our internship and academic life.

e end we are very much grateful to our parents for their encouragement and patience.

EXECUTIVE SUMMARY

Bidyut Somity-1 (PBS-1) is one of the best electricity distribution companies in adesh. The site we visited is situated in Nobinogor, Savar. We started our internship on ugust 2010. Before starting our internship in PBS-1, an internship schedule and a group re provided with the internship approval letter by PBS-1. During our internship we have several places such as Summit Power Limited, United Power Generation and distribution any Limited, Power Grid Company Bangladesh and their own distribution substation etc. our internship we have learned about their power generation, power distribution, staking, and supervision and many other things. The experience of our internship was enjoyable ucational.

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INTRODUCTION

Motivation for Internship

ship is part of the undergraduate degree in EEE department of the East West University. eveloping the practical knowledge we wanted to do internship. Internship links theoretical ractical knowledge in our area of interest, which is important for the success of our ssional life. Our area of major for our undergraduate degree is Power Engineering.

Electrification Board or Polli Bidyut Somity is the leading electricity distribution company ral and industrial consumers in Bangladesh. That is why we believe Polli Bidyut Somity-1 ve us the best opportunity to obtain practical knowledge with the help of our understanding ory. During our internship we have learned how power plant generate power, what is the bution system or process for Power Distribution Company and other relevant topics.

nternship supervisors are Dr. Md. Ishfaqur Raza, Associate Professor in the Electrical & onic Engineering department and Miss Sohana Tanzeem, Lecturer Electrical & Electronic eering department, who supported us enabling us to complete the internship and prepare nal internship report. We hope that the internship report will be an important resource and de encouragement to those who want to work in the power sector or power distribution n. At the end of this report we will give a short summary of our industrial training.

Company Profile

a Presidential Ordinance in October 1977, Bangladesh Rural Electrification (RE) Program ounded and Rural Electrification Board (REB) was established as the semi-autonomous nment agency reporting to the Ministry of Power Energy and Minerals Resources. In 1978 electrification board created the Polli Bidyut Board. Each member of the Polli Bidyut y is the owner and servant of the Polli Bidyut Somity. REB is responsible for electrifying and industrial Bangladesh. The purpose of the program has been to use electricity as a s of creating opportunities for improving agricultural production and enhancing socio- mic development in rural areas. Today the number of Polli Bidyuit Somity (PBS) is ty (70). It has provided approximately 79, 00,000 new connections and adds more than

00 kilometers of line each year. Electricity now helps operate 86,766 IRRIGATION pumps, 75 small and COTTAGE INDUSTRY units, 373,119 commercial setups and 8,733 other lishments in the rural areas. Polli Bidyut Somity-1 has 2,94,000 members. The number of somity is 66. However, Polli Bidyut Somity-1 is a profitable organization. This somity has ections, namely: Member Service, General Service, NIPOR Service, Finance Department , nue Department, and Engineering Section.

main features of rural electrification in Bangladesh as on May, 2010 are summarized in e 1. It shows the number of the somitys, in districts and villages, total distribution lines, total ber of distribution transformers, total consumers, etc [1]. It is given below.

ber of REB organized	70
ber of REB operating commercially	70
ber of district under the program	61
ber of Up-Zillas under the program	433
ber of villages electrified	48,380
distribution line constructed	2,22,608 Km
distribution line energized	2,22,796 Km
33/11 KV sub-stations constructed and missioned	426 (343 Constructed by REB, 83 taken over from PDB/DPDC/OTHERS)
lled Capacity of Sub-stations	2825 MVA
number of consumers	81,56,382
number of irrigation pumps connected	2,28,292
em Loss	14.59% (cumulative),16.97% (May'10)

Table 1: Main Feature of REB

we show the main features of the Polli Bidyut Somity-1 in Table 2 which consists of the number of the consumers according to class of service, types, total demand, number of the substations, etc. It is given next.

umber of Up-Zillas under the program	4
umber of grid substations	6
umber of distribution substations	19
tal number of the consumers	1, 71,768
mestic consumers	1, 42,959
mmercial consumers	18,769
igation	3,823
aritable organization	1507
eneral power	4489
rge power	83
reet lights	138
sale to other PBS	69
tal demand	260 MW
esent system loss	8.76%

Table 2: Main Feature of PBS-1

3. Territory of REB

EB covers most of our country. It primarily provides electricity to rural people; however, it also pports distribution in industrial areas. They have established almost 2,22,608 km of electric stribution lines. The territorial map is given in Figure 1:

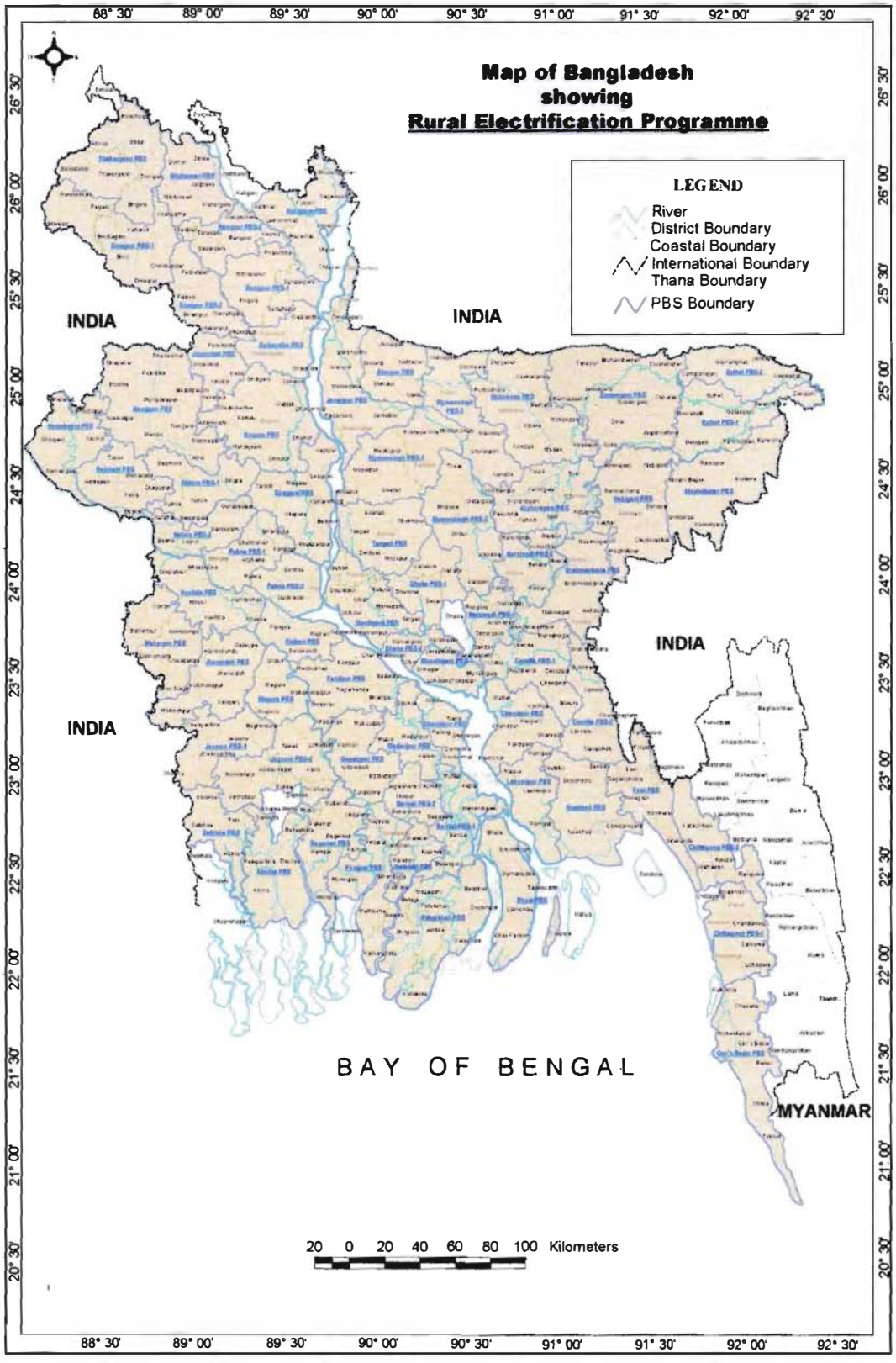


Figure 1: Territorial map of REB

The REB site we visited, Polli Bidyut Somity-1, covers four Upazillas, which are Savar, Dhamray, Kaliakor and Gazipur. The territorial figure of the PBS-1 is given in Figure 2.

Figure 2: Territorial map of PBS-1

1.4. Role of PBS-1 in Socio Economic Development

During our internship we met a few consumers. We discussed with them issues related with their socio-economic development. The mission of the Polli Bidyut Somity is to help develop the rural areas and support its people. In our country, we mainly depend on agriculture. Most of the rural people are either involved in farming or in small business. Extension of infrastructure in rural areas is essential for bringing up any meaningful change in the rural living patterns. Before our liberation in 1971, we had very few facilities available in the rural areas. In 1972, Rural Electrification Directorate (under Power Development Board) was established to gear up efforts towards formation of a separate body responsible for electrifying rural areas. In 1976 NRECA conducted a feasibility study on taking electricity to every rural home and establishments. As a result Rural Electrification Board was formed to take initiatives for bringing changes in rural living patterns. As a result, rural electric societies have provided jobs to rural families and youths. In addition, a total of 8000 persons are employed in the construction firms and consulting offices who are working for the REB projects. Rural people now have much better work-habits and an improved sense of discipline and social security, which comes as a result of the assurances of basic amenities in life. Women of the rural areas are also enjoying the benefits of electricity very well. They can do extra work after household job and add to family earnings.

nen are becoming independent. They are making small groups to support income generation, cially in poultry and cattle. They are creating vegetable farms and some have taken-up ving and sewing projects and while others are opening small shops.

electricity, light during evening ensures women's safe movement from one place to ner. Electricity has had a profound impact on women's mobility, participation in income rating activities (IGAs), decision-making, and freedom of using income and saving. It has ved for better utilization of credit, knowledge about gender inequality issues, household plan according to convenience, changes in attitude in terms of reducing health care rities, increase in years of schooling for boys and girls, encouraging girls to go to schools, eness of legal issues (such as minimum age of marriage, for girls: 18 and boys: 21) and eness about negative impact of dowry.

rural population is gaining extensive knowledge in different areas using information minated through radio and TV, promoting the values of the following:

Value of education, good health, and education

Utility of family planning

Development of knowledge-base through news

Improvement in agriculture practice

Knowledge of modern fishing and pest management

Govt. program for the distribution of Khas land

Prohibition of dowry and their relevant laws

Legal tools to combat violence against women

Local governance, Women right issues, and Human rights issues.

l Electricity has contributed significantly to the development of commercial activities in Bangladesh. Out of the total shops in Bangladesh an estimate 24% are using rural ricity. Electrified commercial establishments are more attached to market.

griculture, rural electricity program (REP) has worked significantly in attaining food self-ciency through the use of productive and efficient irrigation equipments. Both land use

tensity and cropping intensity with electrified pumps (DTW/STW/LLP) are higher than diesel erated pumps. Average yield per acre using electrified pumps is 24% higher than there with of esel operated ones. Electrified pumps contribute one-third of the food self-sufficiency in angladesh. REP through its electrified irrigation pumps covers 4.1 million acres of land for YV Boro and Aman. REP irrigated land produces 6.43 million tons of HYV Boro and Aman, hich is about 29% of all similar types of rice, produced in Bangladesh. 20% rebate to the ectric bill to the irrigation pumps sanctioned by government induces the farmer to enhance ricultural growth. As agricultural productivity has increased, availability of rice & other food ems in villages have helped rural people maintain better food habits.

recent USAID study's findings and assessments about impact of the rural electrification ogram in Bangladesh are as follows:

Presently 55.41% villages and 5.08 million rural households (HH) are electrified and no. beneficiaries is 30.5 million.

Literacy rate in the electrified HHs is 71%, where 54% in the un-electrified HHs.

In the electrified HHs students study 23 minutes more than the non-electrified HHs daily.

78.2% HHs reported an increase on working house.

62.0 % HHs reported an increase in HHs income.

81% HHs reported an increase in reading habits.

93.7% reported an increase in children's study time.

92.0% reported an increase in amusement as well as standard of living.

About 68% of married women in electrified HHs reported using contraceptive methods, here in the non-electrified HHs the rate is 63%.

61% electrified HHs use hygiene latrine, only 29% non-electrified HHs use the same.

53% women of electrified HHs reported allowing young women to work outside village.

71% women of the electrified HHs reported that a couple should have two children.

Annual energy cost (diesel) saving with electric pumps is $2.41 million (in diesel cost).

Creates 5.06 million direct employment opportunities in industries and shops.

l on the findings shown above it is easy to conclude that rural electricity has far-reaching omic, socio-cultural and demographic impact on life and standard of living of rural people ngladesh. It has significant and sustainable impact on agricultural growth, industrialization usiness and commercial activities. In order to accelerate the process of economic growth, gthen public role in the growth process and boost human development in Bangladesh, s of electricity to the households and social and economic institutions should be expanded n shortest time.

Internship Schedule:

ur internship we visited power plants, grid substation, distribution substation, distribution staking design and supervision department. We were shown the activities of other relevant tments such as Nipor, Engineering, Member Services, General Services, Economics rtment and activities of the Councilors. The internship schedule is given in Table 3, with the s of the supervisors, and the visit date and time.

	Location	Date
r Generation in Summit Power Limited	Ashulia, Savar, Dhaka	25th September, 2010
d Power Generation and Distribution pany Limited	EPZ Savar, Dhaka	09th October, 2010
Substation	Hamannogor, Savar	18th September, 2010
bution Substation	Nobinogor, Savar	8th September, 2010
ng, Design and Supervision	Nobinogor, Savar	6th November, 2010
ruction, Operation and Maintenance	Nobinogor, Savar	2th October, 2010
Service	Nobinogor, Savar	16th October, 2010
neer service	Nobinogor, Savar	23th October, 2010
per Service	Nobinogor, Savar	30th August, 2010
ce Section	Nobinogor, Savar	27th November, 2010
ult Service	Nobinogor, Savar	4th October, 2010

Table 3: Internship Schedule

2. POWER GENERATION

. PBS-1 Power Generation:

observed that the generation part of PBS-1 is covered by UPGD (United Power Generation Distribution Company Limited) and Summit Power Limited [2].

ere are various types of alternator that can be used such as water, coal, diesel, with fuel and hout fuel etc. Normally gas, steam, diesel, petrol engine is used in UPGD (United Power neration and Distribution Company Limited) [3]. There are two power plant of PBS-1 for erating power, UPGD is one of them. A similar power generation plant is at Summit Power. mmit Power has increased the production capacity by 33.75 MW, to 46 MW. This project was up to provide electricity to Dhaka Palli Bidyut Somity-1 with 100 years Power Purchase reement (PPA), signed between the Government of Bangladesh and Summit Power.

n burn engine is used in UPGD. Using gas from TITAS, UPGD can supply 22MW to 25MW Dhaka EPZ. However, the total generation capacity is 41MW. In January 2007 United Power neration & Distribution Co. Ltd. (formerly known as Malancha Holdings Ltd.) was born out he necessity for uninterrupted and quality power supply to the industries housed within the port Processing Zones (EPZ) of Bangladesh. Natural gas is used because it is more abundantly ilable and costs less than diesel, even though the efficiency of diesels engine is a greater than engine [4]. Diesel engine is big in size while gas engine is smaller. But steam engine is more cient and it also needs low maintenance. In steam turbine, waste energy is reused by nbined cycle. Heat turbine=1/3*capacity of heat turbine.

re we show the main features of UPGD, particularly - total capacity, types of generator used, mmercial start date, number of generators, and their clients.

nerator Facts:

nerator Manufacturer: Wartsila (Finland) and Mtube

neration Capacity per Generator: 8.7 Megawatts and 1.95 Megawatts

uel: Natural Gas

ocation: Dhaka Export Processing Zone (DEPZ) Plant

umber of Generators: 7

apacities: 41 Megawatts

umber of Battery: 184

ommercial Operation Date: 26th December 2008

ientele: Bangladesh Export Processing Zone, Polli Bidyut Somity-1

ow we show the main feature of the Summit Power Limited which consists of the total pacity, types of generator they use, when they start in commercially, number of generators, no their clients are etc:

Figure 3: Summit Power Plant

gure 3 shows the power plant site of the Summit Power Limited. The funding for this ower plant is given by Polli Bidyut Somity-1.

enerator Facts:

enerator Manufacturer: Catter Riller (America) and Wartsila (Finland)

eneration Capacity per Generator: 3.73 Megawatts and 8.73 Megawatts

: Natural Gas

ıtion: Asulia, Dhaka

ıber of Generators: 7

ıcity: 46 Megawatts

ıber of Battery: 110

ımercial Operation Date: February, 2001 and January, 2008

ıtele: Polli Bidyut Somity-1

2.2. Mimic diagram of power Station:

ic diagram is a dummy view of an original structure. It is required for the overall view of the er station with a picture of the bus-bar arrangement. Every power station has a mimic ram of the station and it is used in various ways. It indicates the total feeder number, gement of the feeders, transformers, circuit breakers, current transformers, and potential sformers. The mimic diagram shown in Figure 4 is that of the UPGD plant.

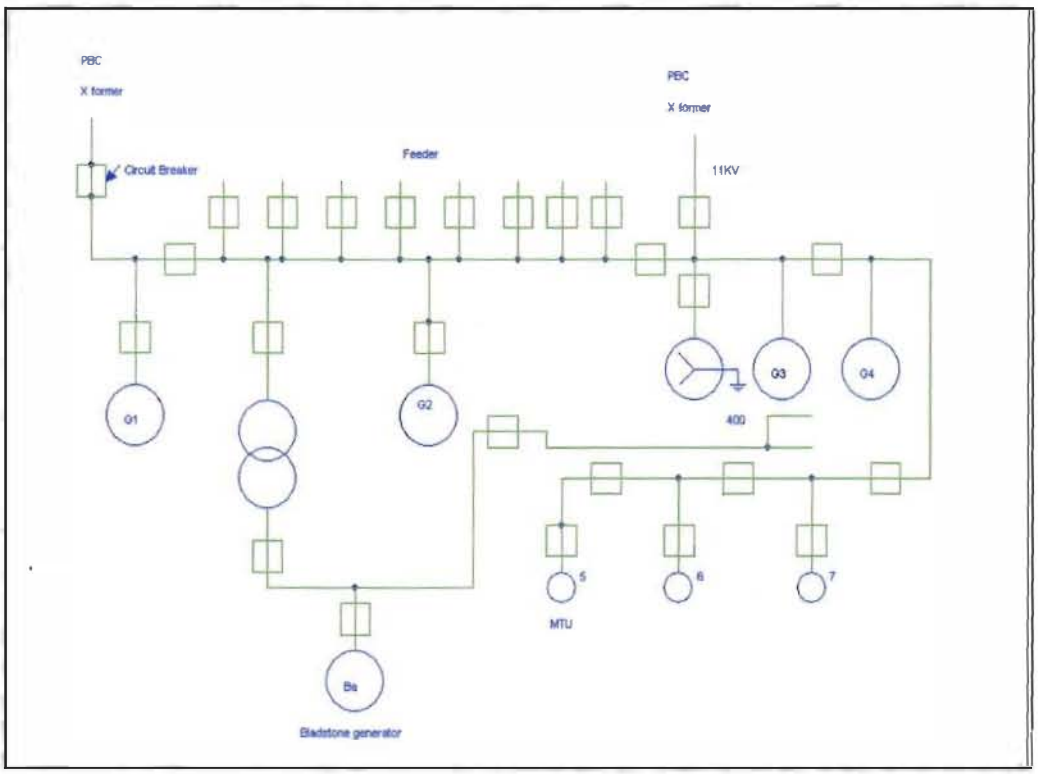


Figure 4: Mimic Diagram of the Power Station

2.3. Requirement of Power Plant:

During our internship, the supervisor of Summit Power Limited told us about the requirement of the power plant and the functions of all these equipments. Electricity is one of our nation's most vital resources, for which Power Plant are essential. Power plant operators control and monitor boilers, turbines, generators, and auxiliary equipment in power-generating plants. They distribute power among generators, regulate the output from generators, and monitor instruments to maintain voltage and regulate electricity flow from the plant. When demand changes, power plant operators communicate with dispatchers at distribution centers to match production with load. On the basis of this communication, they start and stop generators, managing the amount of electricity supplied. They also go on rounds to check that everything in the plant is operating correctly and keep records of switching operations and loads on generators, lines, and transformers. In all of these tasks, they use computers to report unusual incidents, malfunctioning equipment, or maintenance performed during their shifts. Some essential parts of the power plant are listed below.

1. Engine and its accessories.
2. Alternators (generator) which are self excited.
3. Sub –station, where there are transformer, CB, isolator, feeder etc.
4. Switchgear, example - CT (current Transformer) and PT (potential transformer). In figure 5 we show two types of CTs. One is pole mounted single phase CT and another is 11KV CT. We have seen both of them during all our internship periods at the grid substation, distribution substation and in the transmission lines [5].

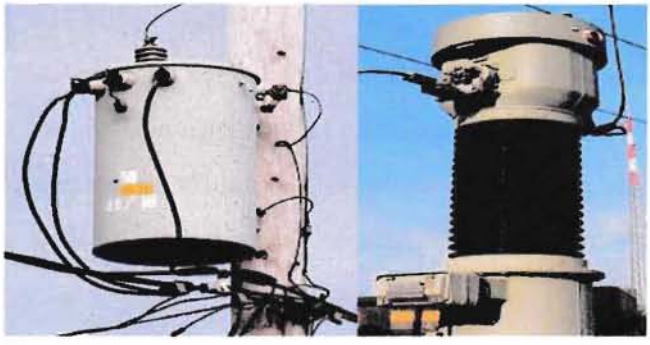


Figure 5: Current Transformer

5. Control panel: Control panel is an essential part of a power plant. This diagram in Figure 6 (given by the plant manager of UPGD) shows the arrangement of the control panel, such as engine, alternator, bus-bar, substation, distribution substation, etc. [6]:

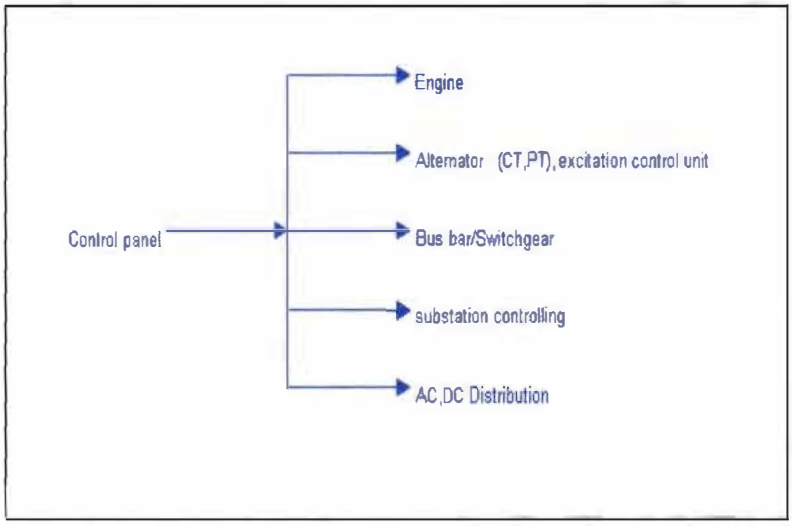


Figure 6: Control Panel

6. DCS - Digital Cross Current Switch. DCS is the scatter system which is used in a power plant. In figure 7 we show the DCS scatter which includes AVR, CT (current transformer) and PT (potential transformer) [7]. These are used in both power plants which we have seen during our internship.

Figure 7: Digital Cross Current Switch

2.4. Controlling of Power Plant:

control a power plant, necessary steps must be taken both from within a control room and m outside the control room. Also equipments are used for measuring and controlling boilers d heat-recovery steam-generators which are often used in land power plant and in process lustries. The practical guide to the design, installation, operation and maintenance of these stems is needed. The guide will start with descriptions of how each area of the plant operates. hen shows how each of the control systems has evolved, how they are implemented in modern stems and how to evaluate the merits of alternative approaches. Developments in control hnology have brought opportunities for the power industry in terms of energy efficiency and fety, but also the risk of a gap between control specialists and power plant engineers.

witching, load control, PLC etc. are also mandatory part of controlling a power plant.

Switching: Auto trip is done so internally start and off occurred in Relay, CB etc.

Load control: Load controlling is done by Fuel where AVR is used to assist.

2.5. Control Room:

ontrol room is needed to maintain the whole system properly. In our internship we were shown e entire programmable logic control unit. The system is automatic however it can be operated anually. User will chose what type of operating system they use. In Summit Power Limited and nited Power Generation and Distribution Company Limited, they use automatic control system d we learn from this internship that automatic control system is user friendly. Now we discuss out the control room.

- PLC: PLC means the programmable logic control unit. PLC meters are used in Summit Power Limited, UPGD and Hamannogor Grid Substation. This is necessary for engine or motor controlling and it is most important part of control room. Zickzuck transformer is used for safety and PLC automatically does tapping. PLC meter is essential for providing protection. Most of the electrical equipment is controlled by the PLC meter. This PLC meter is of two different types, automatic and manual.

UPGD and Summit power we studied the automatic PLC meter. In Figure 8 we show the PLC eter in UPGD which controls the whole power generation unit and the respective feeders.

Figure 8: Programmable Logic Control Unit at UPGD

2.6. Synchronizing condition:

ervisor of UPGD discussed with us the synchronous condition and how synchronizing is e. The process of connecting an AC generator (alternator) to other AC generators is known as chronization. This process is critical for AC power generation. A synchronizer system sists of a sequencer, which is largely embodied in the digital computer as an element of the matic control, and a synchronizer which is external to the automatic control. The sequencer bles the synchronizer to synchronize the three generators in a specific sequence. This depends the startup and loading operation of the turbines, the synchronization operation of the chronizer and the operation of the breakers. Turbine speed changes are initiated by the ed/load control under synchronizer control.

alternator must have equal Line Voltage, Frequency, Phase sequence, Phase angle, and veform to the system to which it is being synchronized. Waveform and phase sequence are d by the construction of the generator and its connections to the system. However, Voltage, quency, and Phase Angle must be controlled each time a generator is connected to a grid.

2.7. Synchronous generator:

ne control room there was synchronizing frequency display, synchronizing voltage display synchronoscope, reset button, plant emergency stop button, and a synchronizing control unit. ing our internship we have learned about the parameter of the control unit of the generator. voltage, phase and frequency will be same between the generator unit and bus-bar. These be shown on the control panel of synchronizing frequency display, synchronizing voltage lay and synchronoscope. Reset button will be needed when the system will face any kind of blem.

t emergency stop is needed for emergency stop of the plant in an emergency case. All this e studied during our internship at Summit Power Limited. In Figure 9 we show the chronous generator control unit which is provided by the internship supervisor of the Summit er Limited:

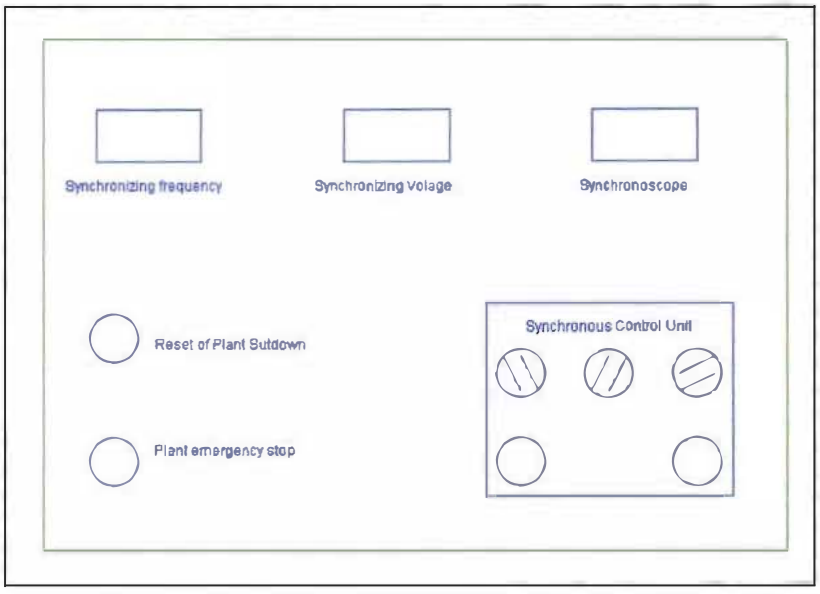


Figure 9: Synchronous Generator Controlling Unit

2.8. Engine Room:

Engine:

In United Power Generation and Distribution Company Limited the engine supervisory system is from CATERPILLAR. Each engine room has three engines, each of which consists of twenty cylinders. Here one side of the engine has ten cylinders while the other side has ten cylinders in a the form of V shape. All engines are from Wartsila (Finland) and Mtube. Each of Wartsila's (Finland) generator capacity is 8.73MW. Each generator uses four engines. Mtubes' capacity is about 1.95MW per each generator and it consists of three generators. So the total capacity is near to 41MW. But it can generate only 22MW to 25MW because of insufficient gas supply. Cylinder type is 20V34G that means 20 cylinders are V type and 34 bore. The total project cost of the plants is Tk. 3750 million. In summary, UPGDC is powered by the latest Wartsila gas engines and Mtube gas engine with the ability to produce 41MW in total. High voltage 33/11 KV substations comprising of two 16/25 MVA, 11/33 KV power transformers along with required length of 11 KV distribution lines have been built by UPGD from each of the two project sites. UPGD has constructed multidisciplinary infrastructures like power generation, high voltage transmissions and distribution and high/low pressure gas pipelines for the project. In Figure 10 we show some figures captured in UPGD. These figures show cylinders, gas pressure meters etc:

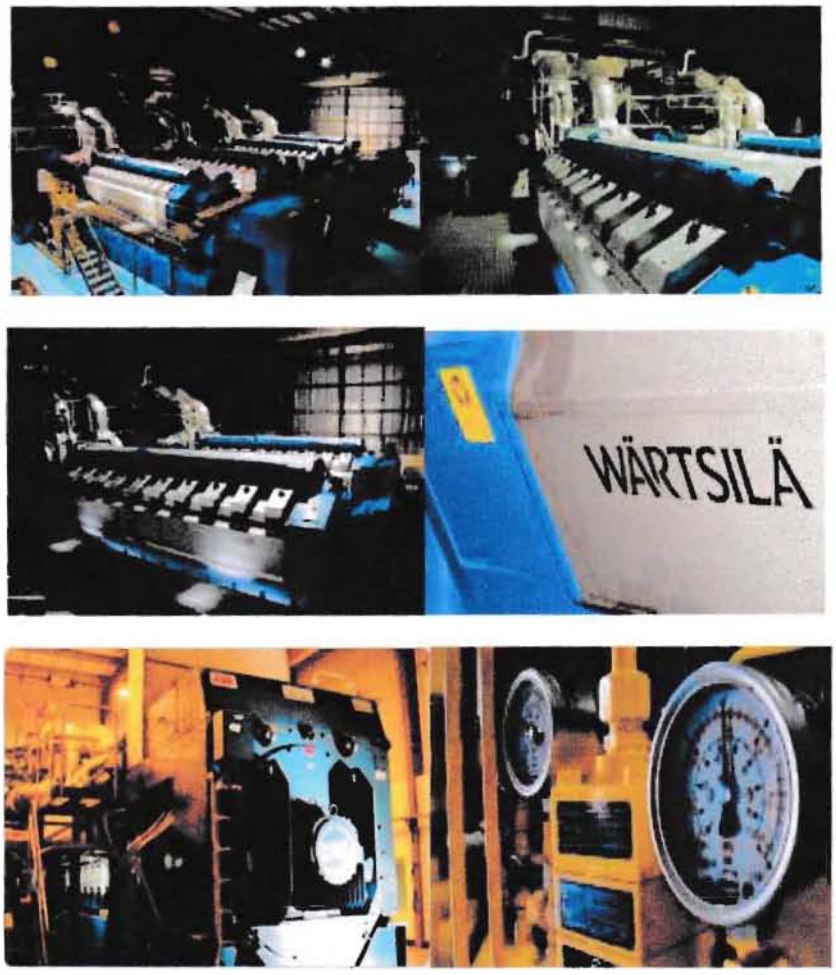


Figure 10: Generator Unit

Summit Power Limited has 20 (twenty) V type cylinders. This supports 7 (seven) generators and all are the gas engine type. It has 20 airs resume tanks. These tanks are used to cool the engine. For cooling the engine it also has the radiator. It also has 20 exhaust lines, 2 tube chargers, 5 water lines, 4 engine control panel etc. and all these information were given to us by our internship supervisor. If energy is the lifeblood that runs through the veins of the economy, the industries are the organs that make up the system itself. By now, no one needs to be told about the crippling effect that load shedding has on daily life. With less power, factories across the nation perform less efficiently. A less efficient factory will be contributing lower to the exchequer than an optimized one. With lower funds, less will be invested towards the Power sector, making the power shortage last longer.

lternator:

ternators that are used in UPGD are self excited generator provided from ABB Company. ternator generated power is defined by frequency of 50Hz, 11kv, 750rpm and PF of 0.8.

ransformer:

o 30MVA transformers which are used in UPGD are auto tap change type and are provided m Energypack of Bangladesh. In the transformers there is a spark plug system which creates h voltage. Also DC voltage is converted into AC voltage by pulse leading DC. PLC tomatically does tapping of transformer.

ontrol Panel:

control panel is a flat, often vertical, area where control or monitoring instruments are played. They are found in places such as nuclear power plants, ships, aircraft and mainframe mputers.

ifferential Relay:

ost differential-relay applications are of the 'current-differential' type.

C:

programmable logic controller (PLC) or programmable controller is a digital computer used automation of electromechanical processes, such as control of machinery on factory assembly es, amusement rides, or lighting fixtures.

entilation Unit:

is is an essential part of the Generator.

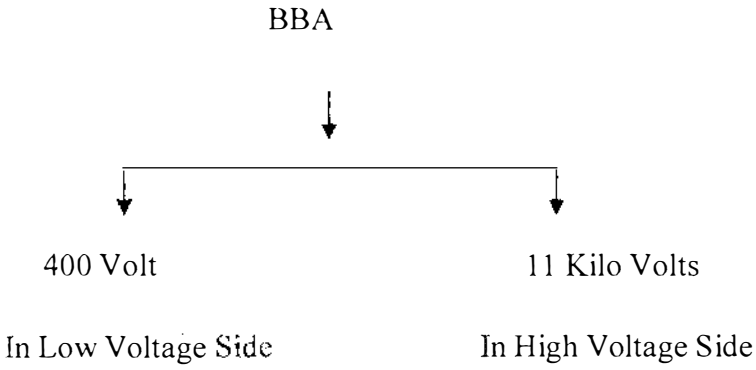
ectifier Unit:

this unit AC is converted into 110volt and 24volt DC. For 110 Volt each of 92 Battery nsumes 1.5 Watt. And for 24 Volt each of 12 batteries consumes 2 Watt. Battery capacity is asured by observing how much time battery will give amp-hour. All battery is VRLA entilation Lead Acid battery) type. For illustration we observed that 400 amp-hours give 24

lt and 120 amp-hours give 110 Volt. In that unit variable frequency diode are used for varying quency to change rpm (rotation per minute). All the information is collected from the pervisor of the UPGD assigned for our internship.

witchgear:

e term switchgear, used in association with the electric power system, or grid, refers to the mbination of electrical disconnects, fuses and/or circuit breakers used to isolate electrical uipment. Switchgear is used both to de-energize equipment to allow work to be done and to ar faults downstream. Load division is shown in the flow chart for Bus-Bar Arrangement BA) in switchgear:



om the flow chart of load division shown above we see that main Bus-Bar Arrangement BA) is divided into two sides, 400 Volt in Low Voltage Side and 11 Kilo Volts in High ltage Side. The different parts of this system are,

- Circuit Breaker (CB): Most of the circuit breaker is vacuum circuit breaker but SF6 circuit breaker is used in Alternator side (Wartsila Finland).
- NGR (Natural Grounding Resistance).
- PPE (Personal Protective Equipment): Such as heal mate, ear-protection, and glass.
- Fire Protection: Fire, water, fire extinguisher.
- MTU: Engine control panel capacity, 548 degree centigrade.
- Auxiliary control panel: Wartsila (Finland) engine.

Radiator:

In Figure 11 we show the radiator which we observed in UPGD. The radiator has 24 fans which are used for cooling the radiator unit. The fans are arranged in three columns and each column has 8 fans to flush out hot air for cooling purpose. Radiators are a must to ensure the optimum means to cool the generator.

Figure 11: Radiator

Both SUMMIT POWER and United Power Generation and Distribution Company Limited (UPGD) cover the generation part of REB (Rural Electrification Board). SUMMIT POWER provides 46 MW for REB. Each of the four engines provide 8.73MW and each of the other three engines provide 3.73MW. Most of the Circuit Breakers (CB) are from Energy Pack. From the early part of the year 2000, SUMMIT POWER provided 11MW for REB, however later in 2008 this supply capacity was extended to 35MW. Diesel engines from Italy are acquired which uses Wartsila (Finland) type equipment. 33KV engines are purchased from Siemens company. In sub-station transformers are also used for tapping 33KV side and 11KV side. If 11KV side reduces to 9KV then tapping is done using a 11KV transformer.

The power plant of UPGD and SUMMIT POWER are same from a construction point of view. In these, radiator units along with 48 fans are used. Those 48 fans are arranged in six columns and each column consumes 8 fans to force out hot air to keep the units sufficiently cool. All the batteries are obtained from Rahimafrooz Company Limited. The batteries are used by engine to control the load shedding condition.

3. SUBSTATIONS:

The assembly of apparatus used to change some characteristics of electric power supply e.g voltage, ac to dc; frequency etc is called a substation, which is an important part of the power system. The continuity of power supply depends to a considerable extent upon the successful operation of substations. It is, therefore, essential to exercise utmost care while designing and building a substation.

3.1. Transformer Substations:

The majority of the substations in the power system are concerned with the changing of the voltage level of electric supply. Transformer substations are four types depending on the use. These are step-up substation, grid substation, secondary substation and distribution substation. In our internship we have been introduced to step-up, grid and distribution substations.

- **Step-up Substation:** Step-up substation is located at the generator side. In our internship we have visited two power stations. Both the stations supply 11KV at the generator side. These substations are used in both power plants and Nobinogor distribution substation.

- **Grid Substation:** From the step-up substation, electric power at 220KV or 132KV etc. is transmitted by 3-phase. 3 wire overhead system to the outskirts of the city. Here electric power is received by the primary grid substation which reduces the voltage level to 66KV or 33 KV or any another type for secondary transmission. Generally grid substation is of outdoor type. We were shown the Hamannogor grid substation in our internship.

- **Distribution Substation:** We visited Nobinogor distribution substation with a supervisor. The electric power from 11 KV lines is delivered to distribution substations. These substations are located near the consumers' localities and which is supplied with 400V or 230V. We use 3-phase or 4-wire for supplying to the consumers. The voltage between any two phases is 400V and between any phase and neutral it is 230V.

3.2. Grid Substation:

In our internship we have seen a grid substation which is situated at Savar, Hamannogor. 132 KV voltages come from the step-up transformer and it is reduced to voltage level of 33 KV. Here we have seen 16 (sixteen) feeders and out of these sixteen feeders they only two feeder are used

because of insufficient supply. We have seen the feeder number L-37 and L-39 is used to supply power to the distribution substation. Though not used, the other feeders are also ready for distribution. The capacity of the transformer is 50(fifty) MVA without cooling and 75(seventy five) MVA with cooling. PGCB (Power Grid Company of Bangladesh) is not able to supply enough power to grid substation. In this grid substation, all the instruments are manufactured in China. With the help of our engineers Chinese engineers have been established this grid substation. We saw that in all this substations all the connections of the transformers are delta type. Here, the peak demand from the grid substation is only 44 (forty four) MW (mega watt) but unfortunately this substation can only supply fourteen to fifteen MW (mega watt). This is why this somity will not be able to fulfill the peak demand or even off peak demand. We also mention that both feeders are receiving the same amount of load which the grid distributed. For our easy explanation we have shown some calculations bellow:

Problems: In internship we have visited Hamannogor Grid Substation, Savar. Here they have used only two feeders among of the sixteen feeders and there has PLC meters to displaying the voltage, current for different monitor. Now we calculated the supply power for two feeders at the same time.

Suppose that for feeder L-37,

Here we calculated the load for both the feeders. For the calculation we need both the value of the current, power factor and bus-bar voltage. For feeder L-37, we see a PLC meter. This meter consists of the three ammeters which provide three different current values. And the value of these current are,

I1= 206.3A

I2= 227.3A

I3= 210.3A and

V=33 kV; this is bus-bar voltage of the grid

Current, $I = \frac{206.3+227.3+210.3}{3} = 215A$

wer factor (pf) = 0.9

wer, $P = 33 * 10^3 * 215 * \sqrt{3} = 11.06MW$

ppose that for feeder L-39,

= 205.7A

= 224.5A

= 205.1A and

33 kV; this is bus-bar voltage of the grid

rrent, $I = \frac{205.7+124.3-205.1}{3} = 212A$

wer factor (pf) = 0.9

wer, $P = 33 * 10^3 * 212 * \sqrt{3} = 10.89MW$

this calculation we have assumed that both transformers have same voltages and it is tributed to the distribution substation.

the protection of this system they use 33/.415 KV transformer. This transformer is used for necessity of the grid substation. In the grid substation we have seen a battery room which is uated beside the control panel room and the voltage of the battery is 110V. This batter room is ded to protect or backup the PLC (programmable logic control) meters. The voltage of each the battery in the battery bank is 1.2V and the number of the batter is 92(ninety two) and the mal capacity of the each batter is 250 Ah. Battery room is too much important for the grid station as it is essential for PLC meters from any kind of accident. In this substation we have n a conservator, which is necessary to collect the heated oil. This is the essential part of a nsformer. In the transformer we have also seen a silica gel tray which is needed to gather the ors or rust. When the silica gel is damaged it turns brown. Every year to ensure performance testing is needed. This oil will be different from transformer oil. The dielectric strength of this is minimum 36KV, as was told to us by the engineers. In this substation we use SF6 vacuums e of breaker. We know that the grounding of the substation is 70(seventy) feet and there they

use solid or effective type of earthlings. In Figure 12 we see the overall view of the grid substation. This substation is situated in Hamannogor, Savar. And this grid substation is the property of the PGCB but the total financial support has been provided by the Polli Bidyut Somity-1 as per an agreement.

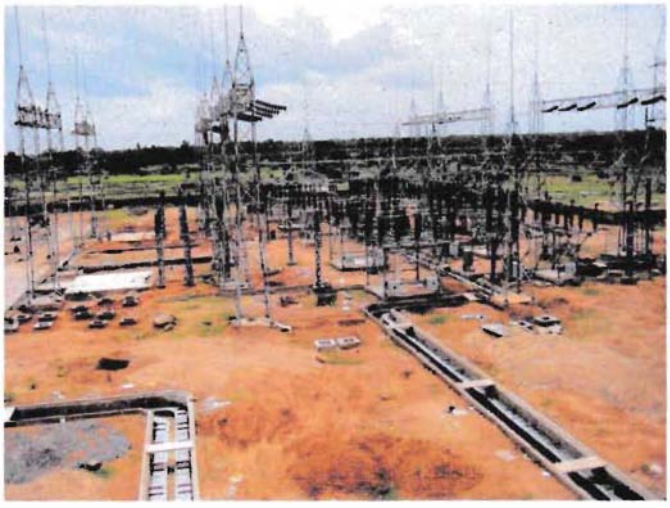


Figure 12: Typical view of a Grid Substation

3.2.1. Equipment of the Grid Substation:

The equipments required for a substation depends on the type of the substation and service requirements. The equipments are described below:

- **Bus-bars:** Bus-bars are necessary when multi lines operating at the same voltage have to be directly connected electrically. Bus-bars are used as the common electrical component. All the bars are copper or aluminum bars. All the incoming and outgoing lines are connected to the bus-bars.

Figure 13: Bus-Bar

In Figure 13 we see the bus-bar, and it consists of incoming line and outgoing line. And it is needed to transmit the electricity from one end to another. According to theory there are 3(three) types of the bus-bars arrangements. These are single bus-bar, single bus-bar with sectionalization and double bus-bar arrangement. But they have used only double bus-bar arrangements in Hamannogor grid substation.

- **Double bus-bar arrangement:** In Figure 14, a double bus-bar arrangement consists of the two bus-bars, a main bus-bars and a spare bus-bar. Incoming and outgoing both have multi-line bus-bars. They are connected in separates lines.

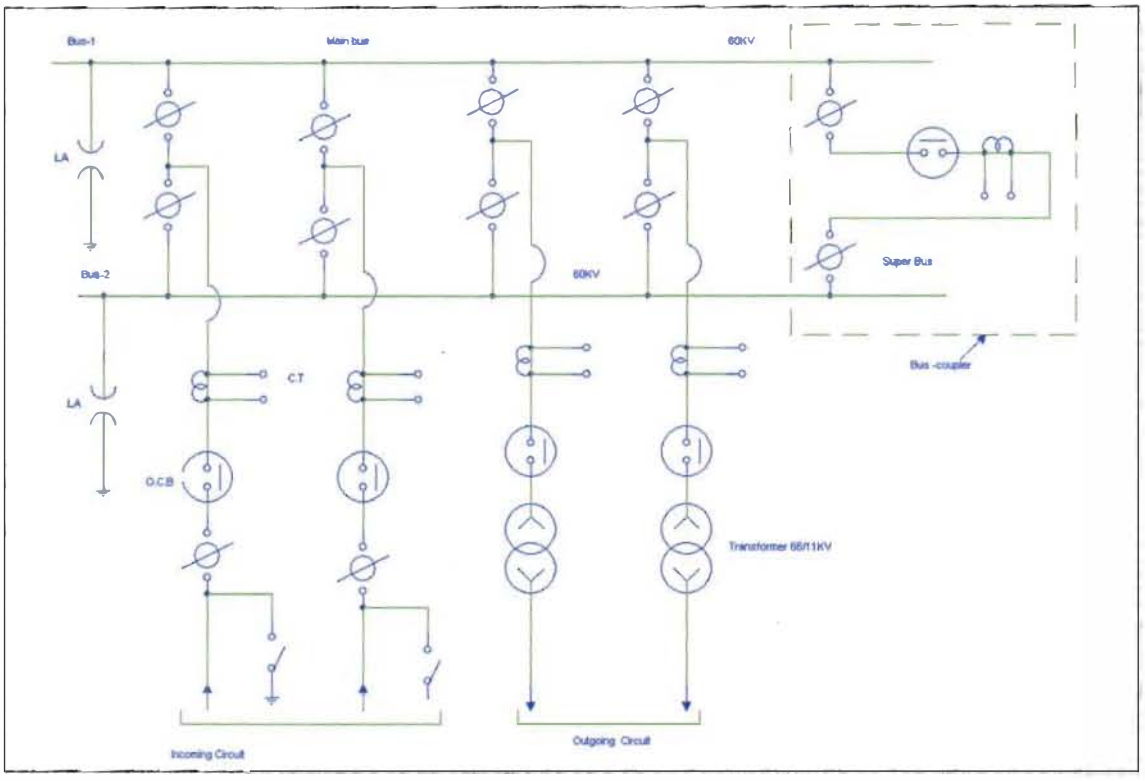


Figure 14: Double Bus-Bar Arrangement

In PBS-1 all kinds of substation are double bus-bars arrangements. Grid substation of the Hamannogor, Savar has also double bus-bars arrangements. The main advantage of Double bus-bar arrangement is that if any of the bus has a fault, then there is no effect on other buses – thus not all the consumer are not affected by the fault.

- **Insulators:** In our internship we have learned about insulators form our internship supervisor. We know that the insulator serves two purposes. One is they support the conductors (or bus-bars) and confine the current to the conductors. We were shown porcelain insulator which is most commonly used. The material for the manufacture of insulators is porcelain. There are several types of insulators (e.g. pin type, suspension type, post insulator etc.). Their use in the substation will depend upon the service requirements. For example, post insulator is used for bus-bars. A post insulator consists of a porcelain body, cast iron cap and flanged cast iron base. The hole in the cap is threaded so that bus- bars can be directly bolted to the cap. In gird substation both types of insulators are used.

- **Isolating Switches:** In grid and distribution substation, it is often desirable to disconnect a section of the system for general maintenance and repairs. This is accomplished by an isolating switch or isolator. An isolator is essentially a knife switch which is designed to open a circuit under no load. In other words, isolator switches are operated only when the lines in which they are connected carry no current. We have observed during internship how insulator switch are working when fault current are occurred.

- **Circuit Breaker:** A circuit breaker is equipment which can open or close a circuit under normal operation as well as fault condition. In Hamannogor grid substation, all the circuit breaker is SF6 type. In closed position of the breaker, the contacts remain surrounded by SF6 gas and the pressure of the gas is 2.8 kg/cm^2. When the breaker operates the pressure of the gas goes to 14kg/cm^2. We know that the high pressure flow of SF6 can absorb the free electron easily. During our internship we saw that the pressure of the SF6 circuit breaker are 2.8 kg/cm^2 in normal condition of the circuit breaker and the abnormal condition this pressure rise to the 14kg/cm^2. If the pressure goes down then the circuit breaker is not able to do work properly and it may be risky for the whole system and will fail to provide system protection. This kind of circuit breaker will be costly because of the high cost of SF6 gas. But it is environment friendly as it does not deposit high amount of carbon. And it also has low maintenances cost and the light foundation requirement. Over all, the grid substation must ensure good protection and it must be user friendly.

Power Transformers: We have seen power transformer in power plants, grid substation and distribution substation during our internship period. A power transformer is used in a substation to step up or step down the voltage. It is important part for a substation; we also mention that power transformer is required for all types of substation. Except at the power station, all the subsequent substation use step down transformers to gradually reduce the voltage and finally deliver it at a usable voltage level. The modern practice is to use 3-phase transformers in substation, although 3 single phase bank of transformers can also be used. The use of 3-phase transformer (instead of 3 single phase bank of transformers) has two advantages. Firstly, only one 3 phase load tap changing mechanism can be used. Secondly, its installation is much simpler that the three single phase transformers. We know from our internship the power transformer is installed on lengths of rails fixed on concrete slabs. The slabs have foundation of 1 to 1.5 m deep. The transformers have rating up to 10 MVA and are naturally cooled. Often forced air immersed transformers are used. For higher ratings, the transformers are generally normal and forced air cooled.

Instrument Transformation: In the grid substation the main lines in sub-station operate at high voltage and carry current of thousand of amperes which we have seen. The measuring instruments and protective devices are designed for low voltage (generally 110V) and currents (about 5A). Therefore, they will not work satisfactorily if mounted directly on the power lines. This difficulty is overcome by installing instrument transformers on the power lines. The function of these instruments of these instrument transformers is to transfer voltage or currents in the power lines to values which are convenient for the operation of measuring instruments and relays. There are two types of instrument transformation viz.

Current Transformer (C.T)

Potential Transformer (P.T)

Current Transformer (C.T.): A current transformer in essentially a transformer which steps down the current to a known ratio. The primary of this transformer consists of one or more turns of fine wire and provides for the measuring instruments and relays a

current which is a constant fraction of the current in the line. Suppose in the Hamannogor grid substation, a current transformer rated at 100:5 A is connected in the line to measure current. If the current the line is 100 A, then current in the secondary will be 5A. Similarly, it current in the line is 50A, then secondary of C.T. will have a current of 2.5 A. Thus the C.T. under consideration will step down the line current by a factor of 20.

- **Voltage Transformer:** It essentially steps down the voltage to a known ratio. The primary of this transformer consists of a large number of turns of fine wire connected across the line. The secondary winding consists of a few turns and provides for measuring instruments and relays a voltage which is a known fraction of the line voltage. In the Hamannogor grid substation, a potential transformer rated at 132KV/33KV, is connected to the power line. If line voltage is 132KV, then voltage across the secondary will be 33KV.

- **Metering and Indicating Instrument:** There are several metering and indicating instruments (e.g. ammeters, voltmeters, energy meters etc.) that are installed in a sub-station to watch over the system performance. During internship, we saw that the instrument transformers are widely used for satisfactory operation of the substations.

- **Miscellaneous Equipment:** In addition to above, we saw the following equipment, which are widely used in a substation:

  - Fuses
  - Carrier-current equipment
  - Substation auxiliary supplies

3.2.2. Arrester and Earthling:

grid substation lighting arrester, absorber and earthling is important for the substation ection. Lighting arrester or surge diverter is a protective device which conducts the high age surges on the grid substation to the ground. These devices work under three conditions. se conditions are - normal operation, over voltage condition and non linear operation of the stor. There is various type of the lighting arrestor which we use in different grid substations.

ghting arrestor are five types. Though all the arrestors serve the same purpose, there are some vantage and disadvantage, which we describe in below in Table 4.

ame	Description
ed type arrestor	Very simple type and consists of the two rods. One is connected to the circuit and another is connected to the earth.
orn type arrestor	Consists of two rods with a small air gap. One of the end is connected to the line through resistance and inductor on the other hand another end is connected to the ground.
ultigap arrestor	Consists of a series of metallic cylinders insulated from one another and separated by small intervals of air gaps.
xpulsion type arrestor	Also called protector tube and used in mainly operating upto 33KV.
alve type arrestor	Important for non linear resistors and operating at high voltages.

Table 4: Description about different type Arrestor

Hamannogor grid substation, horn type arrestor are used. Horn type arrestor has two separate rns. The horns are so constructed that distance between them gradually increase. Both the rns have porcelain type insulators. It has a resistance and inductor or coil so that it helps to llow the limiting current through the resistance. During the internship we observe some vantage and limitation about the horn type arrestor. This type arrestor can self clear arc and ries resistance is able to limit current flow. On the other hand we know horn type arrestor have so some disadvantage. The setting of horn gap is likely to change due to corrosion or pitting d it has adverse affects on the performance of the lighting arrestor. Operation time is mparatively long, which is around three seconds. Surge absorber is also a protective device hich reduces the steepness of wave front of a surge by absorbing surge energy. Now we show e block diagram of the horn type lighting arrestor is given below with the help of the Figure 15:

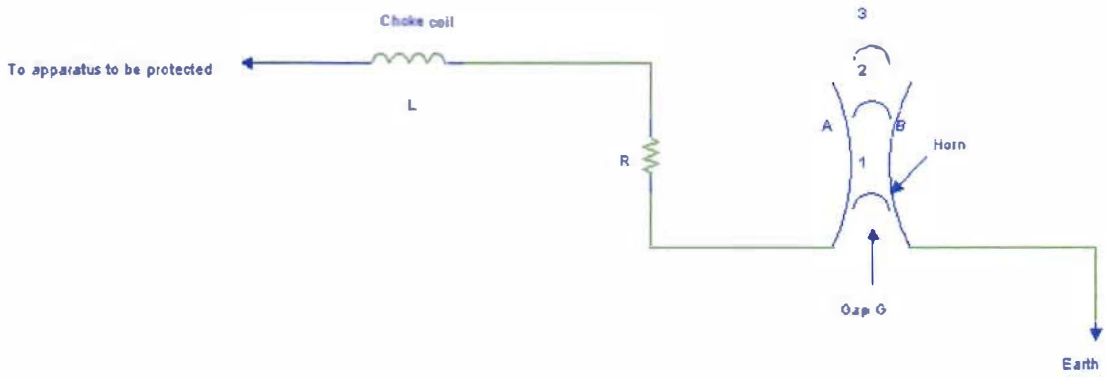


Figure 15: Horn type Lighting Arrestor

wer system engineering there are many types of the earthling process which are commonly During our internship we saw the type of earthling that were used at the substations. Solid ding or earthling is used for protecting the grid substation. In Hamannogor grid substation, e solid earthling. Solid earthling has some advantage and limitation. It can easily protect n from earth faults, which frequently occurs in the substation. The solid grounding of the al point is effectively held at earth potential. Increased earth fault current results in greater ace in neighboring communication lines, which is the disadvantage of the solid earthling.

.3. Load Distribution:

Bidyut Somity-1 import electricity from six grid substations. These six grid substations ded electricity from the consumer premises but these grids are not able to provide sufficient r. Here we show the total imported load at peak hour from different grid in September, as shown in Table 5. It shows the demand, supply and percentage of the supply.

Name of the Grid	Demand in MW	Supply in MW	Percentage of the Supply
Kobirpur Grid	3688	1442	29.62%
Kollanpur Grid	351	236	4.86%
Tongi Grid	Not in service	Not in service	0
Savar Grid	685	501	10.31%
Joydebpur Grid	136	89	1.83%
Power Plant		529	10.59%
Total	4860	2797	57.56%

Table 5: Imported load from the Grid at peak hour

art shows the percentage of total load supply at peak hour of the month with the help re 16 and these data will be taken from above Table 5:

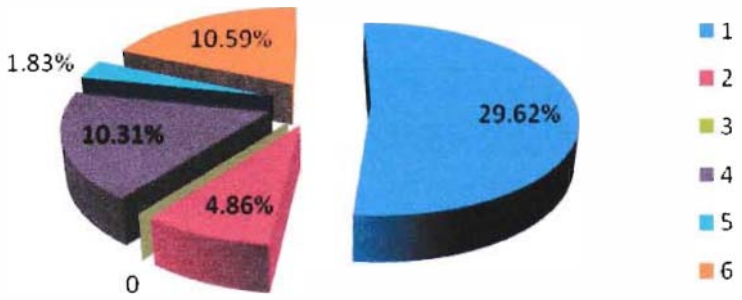


Figure 16: Pie-Chart of the total supply load at peak hour

now the total imported load at off peak hour from different grid in September, 2010, as Table 6, which consists of demand, supply and percentage of supply.

Name of the Grid	Demand in MW	Supply in MW	Percentage of the
Kobirpur Grid	3183	1335	31.06%
Kollanpur Grid	341	228	5.3%
Tongi Grid	Not in service	Not in service	0
Savar Grid	651	531	12.36%
Joydebpur Grid	123	93	2.16%
Power Plant		548	12.75%
Total	4298	2735	63.64%

Table 6: Imported load from the Grid at off peak hour

art will show the percentage of the total load supply at off peak hour of this month elp of the Figure 17 and these data will be taken from above Table 6:

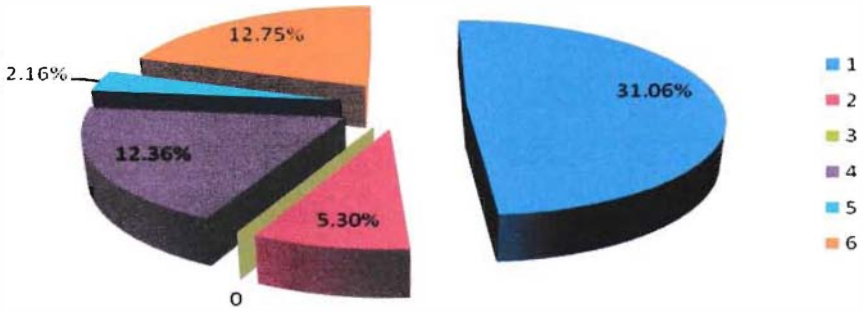


Figure 17: Pie-Chart of the total supply load at off peak hour

ISTRIBUTION SUBSTATION:

ur internship we have visited a distribution substation which is located in the main yard li Bidyut Somity-1. In this distribution substation, 33KV voltages comes from the step- ormer and it reduces the voltage level to 230V. There are 19 distribution substations and tation. In this distribution substation we see the PT (Potential Transformer) rating 0V and this rating is fixed in the substation. We also observe the CT (Current ner) rating 150:5 which is however, variable. There are two distributing unit and the of one of these unit is 20MW. Here the entire transformer is single phase and the f the transformer is 6. We know that the rating of the power transformer is 3.33 MVA. he distribution system is Y connected with the line. Here we also see the use of a egulator (keeping the voltage increase or decrease of the whole system to within 10%) studied the use of filter valve, which is used to see the level of oil. Oil is an important n the transformer and it must be changed. Temperature of the transformer must be °C for good maintenance and protection. For 33KV bus-bar we need 6 lighting All the lighting arrestors are horn type. In a substation there is more than 4 feeders but ubstation there are 6 feeders. Now we show the overall view of the distribution in Figure 18.

Figure 18: Overall View of the Distribution Substation

19 we show the block diagram of the distribution substation. This figure consists of a aker which is operated by SF6 gas, bus-bar which is double bus-bar arrangement, CT, transformer. All this information was given to us by the internship supervisor during ship.

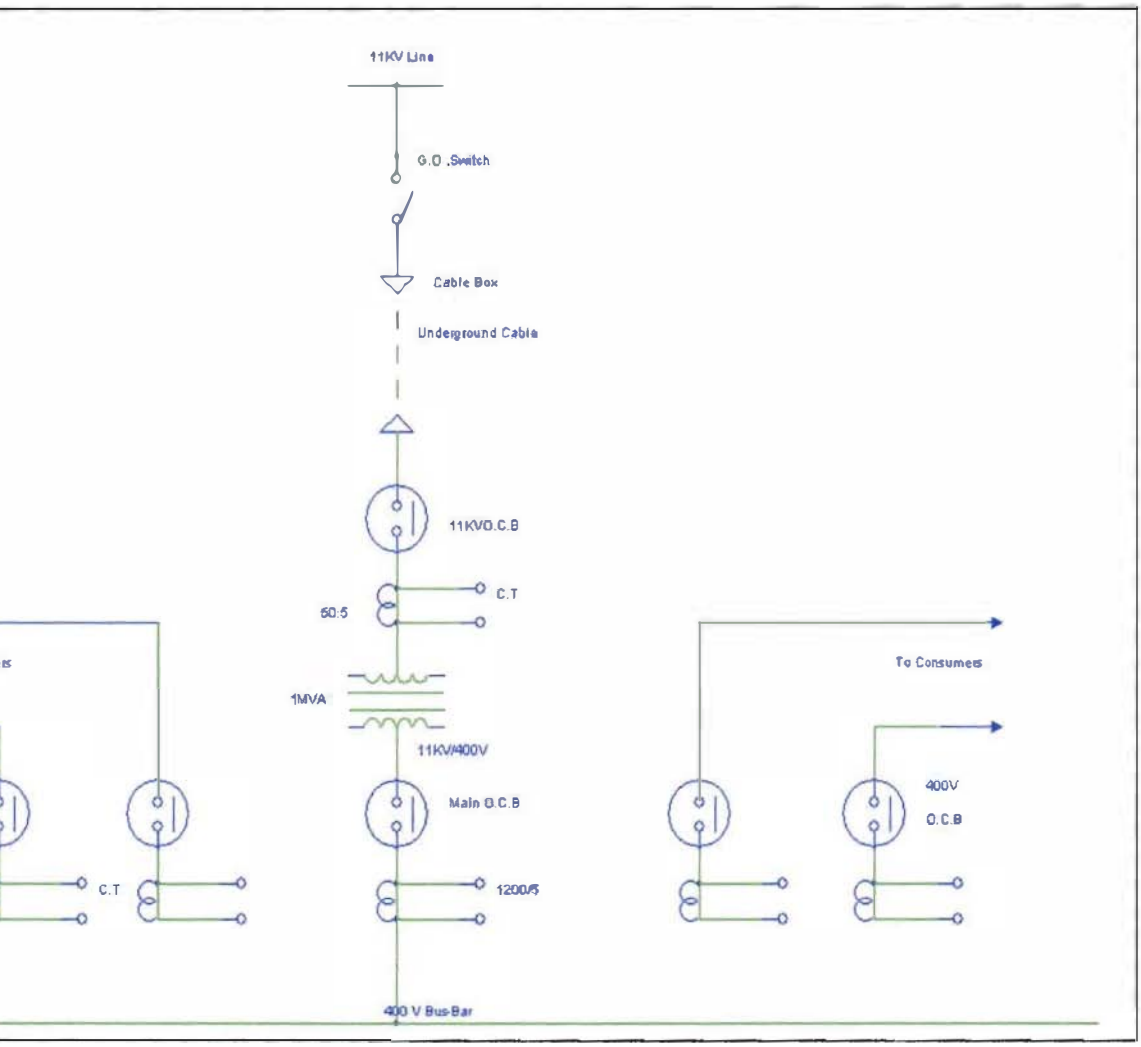


Figure 19: Typical View of Distribution Substation

e mention that in distribution substation they use single phase transformer and these r are manufactured by the Toshiba Company. Now we show the nameplate of these rs in Figure 20. This picture was taken in Nobinogor distribution substation, Savar:

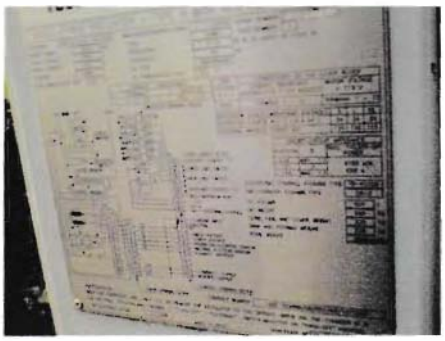


Figure 20: Nameplate of the Transformer

Load Shedding:

ge load shedding of month September, 2010 at different time is shown in Table 7, ws demand and supply.

	Time	Demand	Supply
	1.00 AM	3953 MW	2960 MW
	5.00 AM	3405 MW	3405 MW
	10.00 AM	4980 MW	2858 MW
	17.00 PM	5225 MW	2703 MW
	20.00 PM	5515 MW	2523 MW
	23.00 PM	5430 MW	2567 MW

Table 7: Load Shedding Information of this month

show column chart for the load shedding in giga-watts in Figure 21. Here series1 the load demand and series 2 represents the total supply in September, 2010.

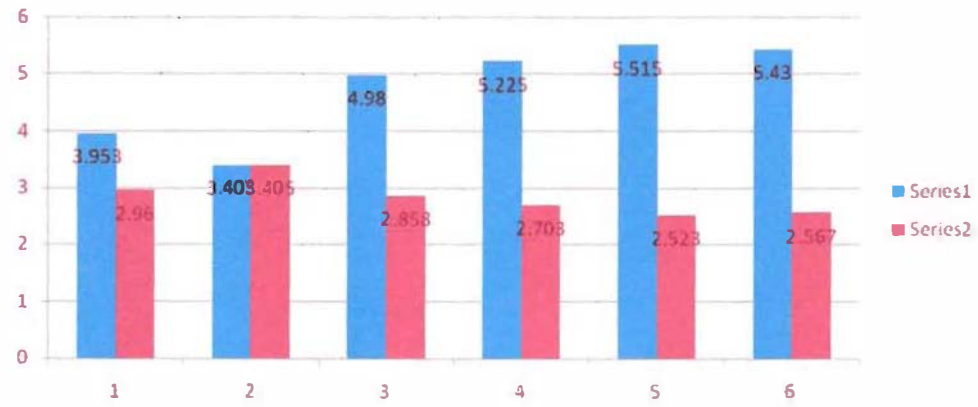


Figure 21: Load Shedding Scenario in this month

AKING DESIGNING AND SUPERVISION:

gn and supervision is an important part of the PBS-1 for both the consumer and the needed to provide proper service and it is also helpful for updating the functioning zation. Staking and supervision department is working for the constructing of new department also works for designing new lines in new areas and to provide the best ionalization of the line and to create the road map for the new consumer is also es for the staking department. To set up the fuse and ACR in the line, to ensure stable voltage, we establish the voltage regulator in the line which is also es of the staking department. Suppose there are 8 consumers located about 200 ft nsformer. The possible power factor and voltage drop can be measured by the ocess.

1600A.Foot
n here, V= IR = IL [here L=R; L=length]
600A.Foot / 1950 = 0.8 [here 1950=constant]

possible power factor will be 0.8 but voltage drop might increase to 11V and in LD 9.2V. Calculating voltage drop is important for this section and it is directly related mer commitment. This department also studies the system loss of the samity. Now system loss flow chart (percentage vs year) from 1981 to 2009, shown in Figure 22. he data of this chart from the Polli Bidyut Somity. This system loss is depending on er things such as technical loss, over load loss, cross section loss etc.

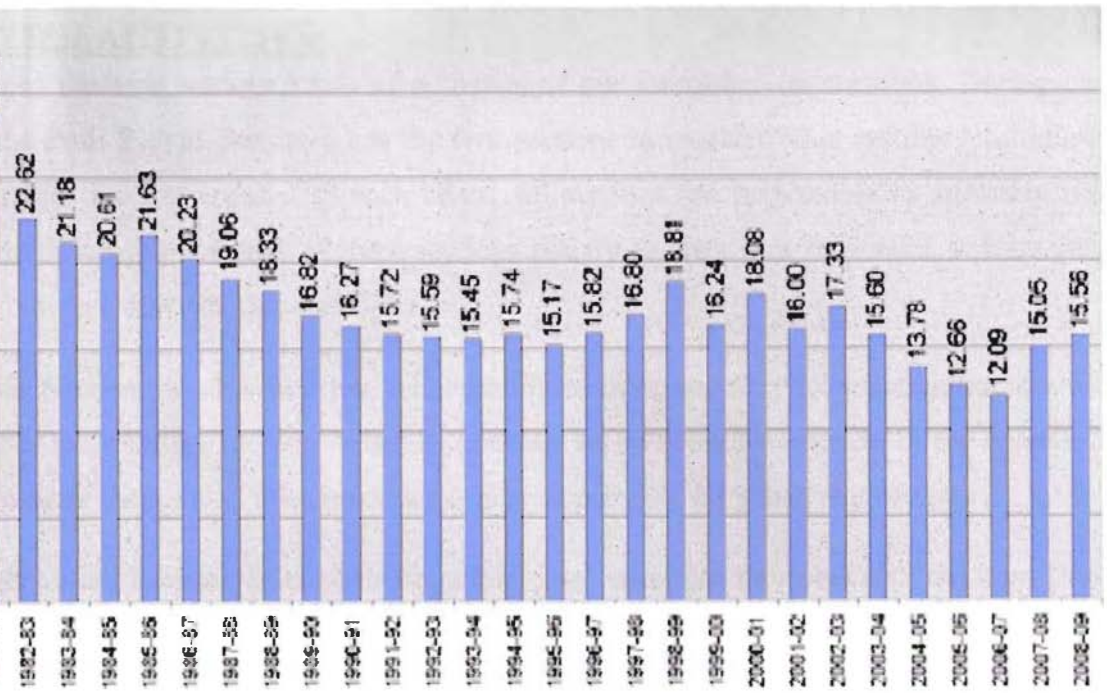


Figure 22: System Loss Chart

IER ACTIVITIES:

en studying various kinds of activities of our internship organization. During our e Polli Bidyut Somity-1 has the five sections to conduct other auxiliary activities. ities are inter-related to each other. All sections are responsible to smoothly run e internship we work at these sections and try to learn how they work or how they Now we describe these sections:

- **Section:** In nipor section, all staffs are working together for maintaining the line or constructing the line. When a consumer receives the line then he or she became a ber of the somity. Then he or she is also responsible for preserving the line.

neering Section: In engineering section, we learn how they construct the line. They upply the necessary equipment for the consumer to get connection. This section also ds the system loss information and the information of the peak demand. They also ded the total receiving power from the grid substation and also distributed power. ged transformers are also repaired by this section. Repairing transformers and ying the new transformers to the consumer or distribution substation is also the responsibilities for the engineering section. Engineering section also manages n accidents and ensures the best solution as early as possible. Load dispose center works under this section. Engineering department estimates the how long the line be constructed in a year and they pass their estimate to the higher authority. The engineer and the staff will work together towards their target. Polarity testing and equired number of the pole supply is also the responsibilities of the engineering n. We show in Figure 23 how they repair the transformer.

Figure 23: Repairing Transformer

mber Service: Member service is also important for the somity. For the members, the ity has established a one point service center. In the one point service center a nber will support any kind of problem the customer may face. One point service is y useful for a consumer because it saves them time and reduces the hassle of hopping ces. In one point service, all the worker of this section is motivated to serve properly. easing somity membership is also the responsibilities of the one point service.

ance Section: Finance department collects the bill from the consumer. They also ord the total earning revenue from the consumer. The finance section also determine bill. Table 8 shows the numbers of different type consumer, total different type enue of the month and the percentage of the total revenue of the current month:

Class of Service	Number of Connections	Revenue	Percentage of 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 8: Total Revenue of this month

ow the pie-chart of the percentage of the total revenue of this month in Figure 24, vs the percentage of total revenue and the data for the pie chart is taken from Table 8.

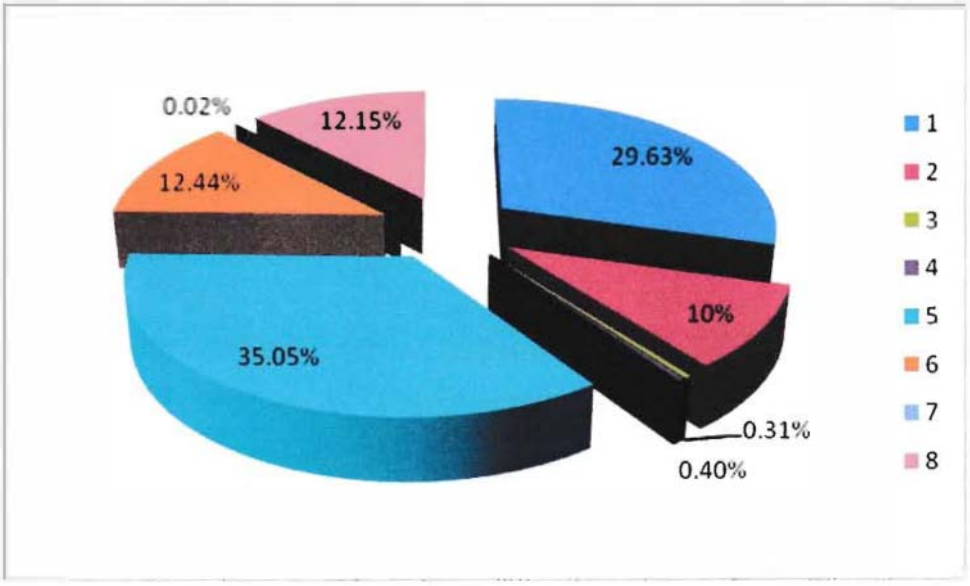


Figure 24: Chart for total revenue collection

onsultant Service: Consultant department works transparently and independently. This ction calculates and receives extra equipment for running their project. This section nnot pass any bill without proper investigation and proper authorization reference. ture master planning and field survey will be done by the consultant section. onsultant department assigns the number to a member when a new line is constructed.

ICLUSION:

Electrification Board) is the semi-autonomous government agency reporting to the Power Energy and Minerals Resources, which is responsible for electrifying rural REB is charged with the responsibility to provide financial support, technical d long-term direction to the rural electrification program in Bangladesh. There are ocal electrical consultants working in PBS. Though REB takes power generated by er Limited, United Power Generation and Distribution Company Limited, and grid PGCB (Power Grid Company Bangladesh) - REB is dependent on those companies pply. We have huge shortage of electricity in Bangladesh but the demand is great or the development of the country. Generation of power, grid supply, sub-station, and local member service of REB are all making significant contribution to this

FERENCES:

://www.reb.bd/: This website is the own website of Rural Electrification Board of ıgladesh. They can upload their past feature, present status and their future work what will be do in future.

://www.summit-centre.com/: This website is the own website of Summit Power ıited of Bangladesh. They can upload their past feature, present status and their future rk what they will be do in future. Also they upload their economical stability in the rket and them also advertising their companies' product.

://www.united.com.bd/united_group/gallery.php?cat=2: This website is the own bsite of United Power Generation and Distribution Company of Bangladesh. They can ertising their past feature, present status and their future work what they will be do in ıre. Also they submit their economical stability in the market through the website and m also advertising their companies' product.

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ENDIX A

Rural Electrification Board
Gross Domestic Product
Government of Bangladesh
Kilo-Watt-Hour
Kilo-Volt
Mega Watt
Polli Biddut Somity
Polli Bidyut Somity-1
Power Development Board
Power Grid Company Bangladesh
United Power Generation and Distribution Company Limited
Potential Transformer
Current Transformer
Load Division
Lighting Arrestor
Income Generating Activities
Export Processing Zones