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Interconnected Power Transmission Network of Chattogram Circle: A Survey

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Abstract: ***This paper deals with the problem of power transmission system in Chattogram Zone. Firstly Interconnected grid system in Chattogram circle and generation capacity of Chattogram areas is briefly discussed. We have studied schematic diagram, existing sub-stations, protection scheme and existing transmission lines. We have also discussed maximum load study in some important sub-stations and peak hour demands of different grid sub-stations. A discussion is included on the problems of existing transmission system of Chattogram and remedies of those problems.***

Keywords: Transmission system, Power plant, Sub-station, power load, PGCB

1. Introduction

Power transmission systems have been growing in size and complexity due to the necessity to monitor lower and lower voltage levels in detail in order to track power flows manipulated by renewable sources. These sources are increasingly being connected in large numbers at lower voltage sections of the grid. Furthermore, due to the possibilities brought up by wide-area control and optimization over long distances, monitoring very large scale powergrids covering multiple control areas is becoming a necessity [1].

The Connection of several generating stations in parallel for effective and efficient delivering electricity from suppliers to consumers is known as interconnected grid system. We study only the portion of grid circle Chattogram of Power Grid company of Bangladesh (PGCB). To find out the problem and solution of that portion we have taken the following action named as Mission & Vision.

A Grid can assent a resource balancing effect by scheduling and load balancing of grid actions at machines with downcast utilization [2]. During the early years small local generating Stations supplied power to respective local loads. Each generating station needed enough installed capacity to feed the local peak loads. The interconnected system is very efficient in reliable transmission and distribution of electric power due to proper modeling and design of the power system. Gradually the merits of interconnected ac power systems were recognized.

Bangladesh is an underdeveloped country. Its socio-economic structure is gradually increasing. So the demand of power is extending day by day and thus the importance of Transmission and Distribution are becoming more complicated.

The optimal power flow (OPF) problem is one of the most widely studied subjects in power systems, and is researched mainly based on the centralized method in current practice [3]. An electric power system consists of three principle components are the generating system, the transmission system and the distribution systems. The transmission lines are the connecting links between the generating stations and the distribution system and lead to the power systems over interconnections.

In this modern world, the dependence on electricity so much that it has become a part of our life. Power Systems (PS) are continuously monitored in order to maintain the normal and secure state of operating conditions [4]. The over-increasing use of electric power for domestic, commercial and Industrial purposes necessities to provide bulk electrical power economically. This suitable power producing units known as power plants or electric power generating station.

Chattogram is also home to a large number of industries from small to heavy. Around 40% of the heavy industrial activities of the country is located in Chattogram city and adjacent areas, which include dry dock, Dock Yards, Oil Refinery, Steel Mills, Power Plant, Cement clinker factory, automobile industries, pharmaceutical plants, chemical plants, cable manufacturing, textiles mills, jute mills, urea fertilizer factory along with other private sector medium size industrial developments and activities. So electricity demand increase day by day in Chattogram [5].

In 1948, Electricity Directorate was created in order to plan and improve power supply situation. In 1959, Water and Power Development Authority (WAPDA) was created and the power sector really started working satisfactorily. In 1960, Electricity Directorate was merged with WAPDA. The basic philosophy was to give more autonomy to an organization for development of this basic infrastructure. At that time relatively higher capacity plants were built at Siddhirganj, Chattogram and Khulna (highest plant size was only 10 MW Steam Turbine at Siddirganj. At the same time Kaptai dam was under construction under Irrigation department. Unit size of Kaptai was 40 MW, which for that time was considered to be a large power plant. Side by side construction of Dhaka-Chattogram 132 KV transmission line was in progress. Construction of Kaptai dam and commissioning of Dhaka-Chattogram 132 KV transmission line in the year 1962 may be taken as milestone of power development of this country [6,7].

2. Profile of Power Grid Company of Bangladesh Limited (PGCB)

2.1 Background of PGCB

PGCB is only authorized company to power transmission all over Bangladesh. Power Grid Company of Bangladesh was created under the restructuring process of power sector in Bangladesh with the objective of bringing about a change in the sector for establishing an environment based on commercial footing. With a view to enhance efficiency, accountability and dynamism in its functions. PGCB was incorporated as a subsidiary company under BPDB in 1996.
Power Grid Company of Bangladesh (PGCB) is engaged in the transmission of Power in Bangladesh. It had been gradually receiving the transmission facilities and personnel from Bangladesh Power Development Board (BPDB) for the last several years a process that was completed recently [8].

Services of PGCB
Transmission of Electricity throughout Bangladesh. The transmission Voltage level at present is 132KV & 230KV and 400KV.

2.2 Functions/Activities PGCB [5]:

a) Operation & maintenance of grid sub-station and transmission line.
b) National Load dispatching.
c) SCADA & SAS System.
d) Operation & maintenance of communication system.
e) Protection, relay co-ordination.
f) Design & evaluation.
g) Transmission network planning.
h) Implementation of development projects.

a) Operation & maintenance of grid sub-station and transmission line

- Operation & Maintenance of grid substation and Transmission Line.
- Regular inspection of line, tower, cutting of trees.
- Preventive maintenance program.
- Inspection of sub-station equipment.
- Annual deadline checking.
- Check list.
- General neat & cleanliness.
- Inspection by different level of officers.

b) National Load dispatching
Under the supervision of Chief Engineer (System Operation), Load Dispatch Circle is headed by a Superintending Engineer who is performing the following operations:

- Generation planning & schedule preparation.
- System control by maintaining load-generation balance.
- Operational record keeping.
- Monthly operational report.
- Monthly interruption report.
- Preparation of economic order of generators (Annual).

c) SCADA & SAS System
Under the supervision of Chief Engineer (System Operation), SCADA Circle is headed by a Deputy General Manager who is performing the following operations:

- Operation and Maintenance of Telemetering/ SCADA system.
- Communication Network Supervision and Transmission.
- Maintenance of Mimic board and console.

d) Operation & maintenance of communication system
Under the supervision of Superintending Engineer (System Operation), Communication Circle is headed by a Superintending Engineer who is performing the following operations:

- O & M of power line carrier communication system of PGCB and OPGW communication in future.
- O & M of different types of PLC sets used in PGCB.
- O & M of different types of exchanges used in PGCB.
- Operation & maintenance of R.T.U s and A.C.C s.
- O & M of coupling system , battery and battery charger etc.

e) Protection, relay co-ordination of Transmission System
Under the supervision of Superintending Engineer (P&D), SPMC is headed by a Superintending Engineer and are performing the following jobs:

- Relay Testing and Co-ordination.
- Annual maintenance of Relays.
- Troubleshooting of protection and control system.
- Pre commissioning test & commissioning of Grid S/S and transmission lines.
- Auto load shedding scheme planning and implementation.
- Energy meter testing & calibration.

f) Design & Evaluation
Under the supervision of Superintending Engineer (P&D), Design Circle is headed by a Superintending Engineer who is performing the following jobs**:**

- Preparation of Technical specification of substation equipments, tower, conductors, insulators etc.
- Preparation of Tender Documents, Technical Specifications, Contractor Qualification, Condition for Execution of works etc.
- Evaluation of Tender Documents.
- Drawing approvals.
- Testing and Commissioning.
- O & M Technical Support.

g) Transmission network planning.
Under the supervision of **Chief Engineer** (P & D), Planning Circle is headed by a **Superintending Engineer**s performing the following jobs.

- Load forecasting
- Load flow and short circuit analysis

- Future expansion planning.
- System problem analysis.
- Management Information System (MIS) compilation.
- In house study of new projects.
- Preparation of Development Project Performa (DPP).
- Annual development program.
- Progress report of development projects.

h) Implementation of development projects

Under the supervision of Chief Engineer (Projects), five Project Offices each headed by a Project Director and Superintending Engineers performing the following jobs:

i. Project implementation planning.
ii. Finalization of work program which includes the following:
    - Each stage of design
    - Procurement
    - Manufacturer delivery to site
    - Construction
    - Erection
    - Testing and commissioning etc.
iii. Supervision of progress.
iv. Approval of drawings and documents.
v. Work execution and inspection.
vi. Testing and Commissioning.
vii. Preparation of project completion report.

2.3 Existing Transmission Map of Chattogram Circle:

In the grid system of Chattogram, mainly two types of transmission line are used. These are 230KV and a 132KV lines.

There are 03 number 230/132 KV gird sub-station in electric power system in Chattogram and power capacity is 980 MVA and 24 numbers 132/33 KV gird sub-station power capacity is 1733 MVA as are in Chattogram.

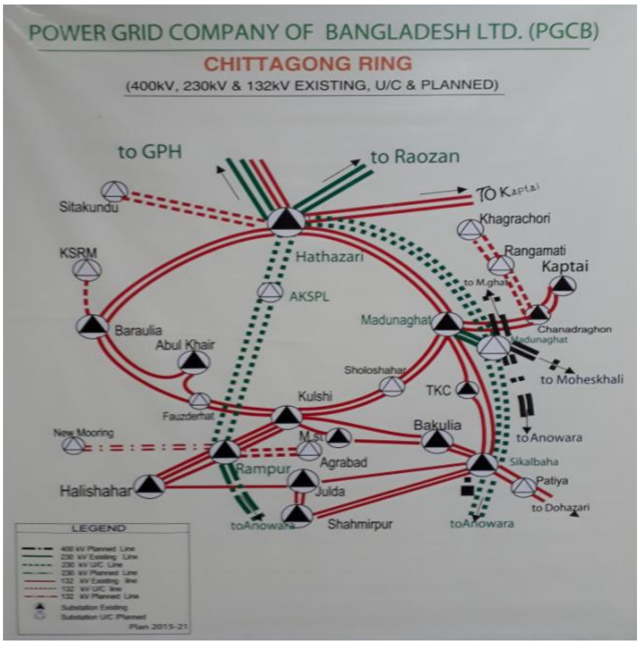

Figure 1: Existing grid map of Chattogram Circle [6]

2.4. Singla Line Diagram of Different Sub-Station:

2.4.1 Madunaghat Grid Sub-Station

In Madunaghat Grid Sub-Station has 08 numbers of 132KV lines and 05 numbers of 33KV feeder and there associate equipments.

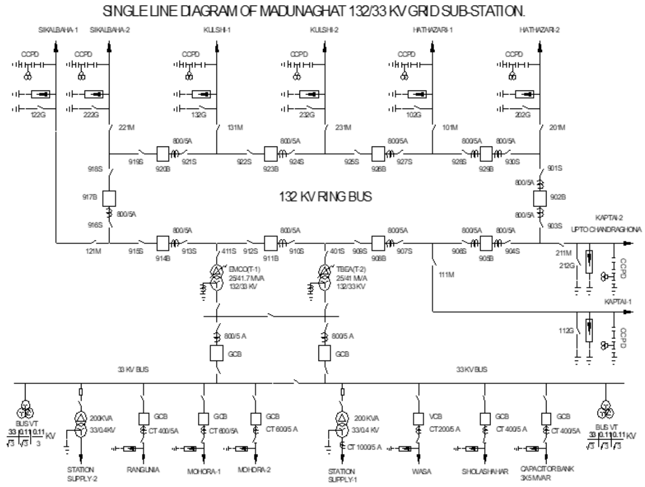

Figure 2: Single Line Diagram of Madunaghat Grid Sub-Station [9]

2.4.2 Dohazari Grid Sub-Station

In Dohazari Grid Sub-Station has n 04 numbers of 132KV lines and 05 numbers of 33KV feeder and there associate equipments.

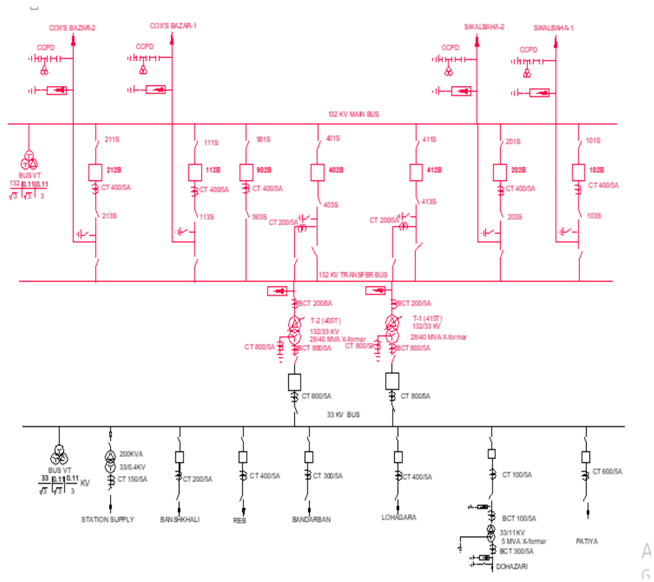

Figure 3: Single Line Diagram of Dohazari Grid Sub-Station

2.4.3 Khulshi Grid Sub-Station

In Khulshi Grid Sub-Station has 08 numbers of 132KV lines and 05 numbers of 33KV feeder and there associate equipments.

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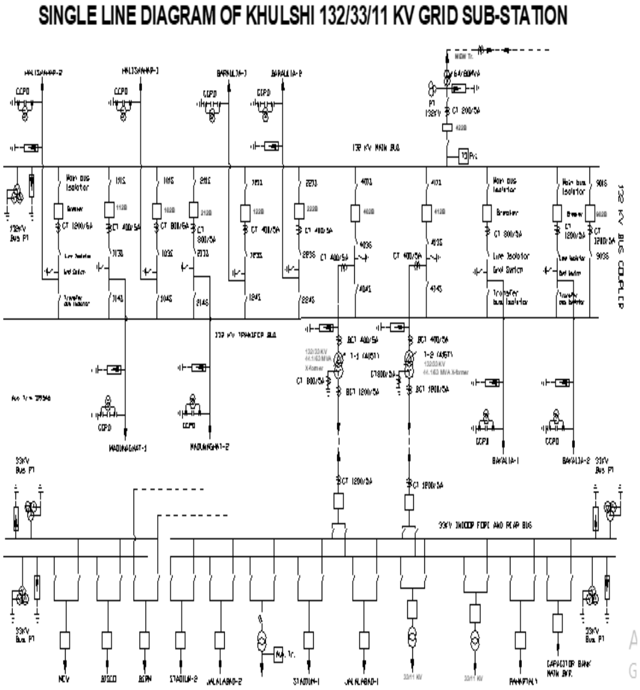


Figure 4: Single Line Diagram of Khulshi Grid Sub-Station [10]

2.4.4 Halishahar Grid Sub-Station.

In **Halishahar** Grid Sub-Station has 04 numbers of 132KV lines and 14 numbers of 33KV feeder and there associate equipments.

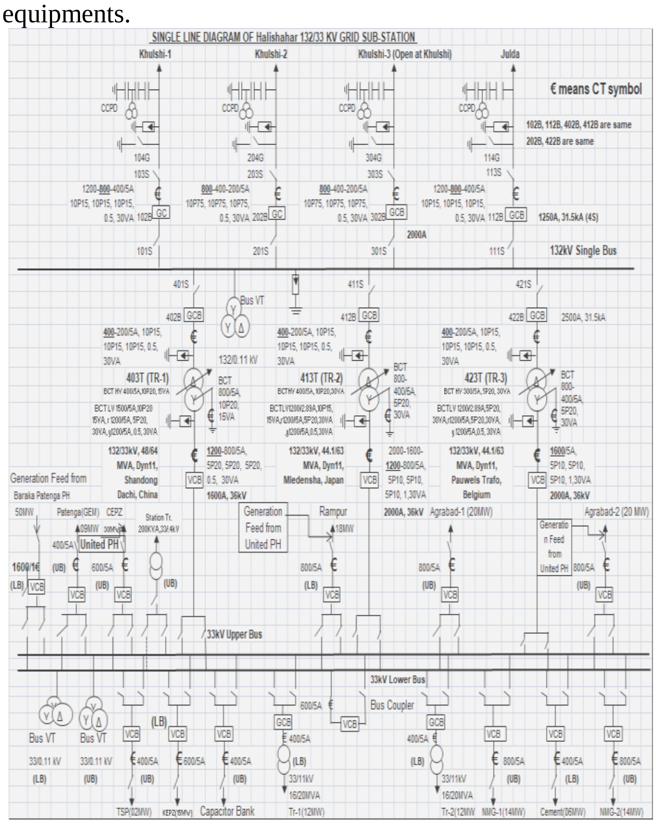


Figure 5: Single Line Diagram Of Halishahar Grid Sub-Station

2.5: Distribution Southern Zone, BPDB, Chattogram.

Distribution Sub-Station (PDB): 33/11KV Sub-Station, 41Nos-962MVA

Distribution Lines:

1) 33KV	: 1135 Km
2) 11KV	: 2458 Km
3) 0.4KV	: 4136 Km

Distribution Transformer (PDB):

33/0.4 KV	: 35Nos	8.05MVA
2) 11/0.4KV	: 3511Nos	663.50MVA
Total: 3546 Nos		671.55MVA

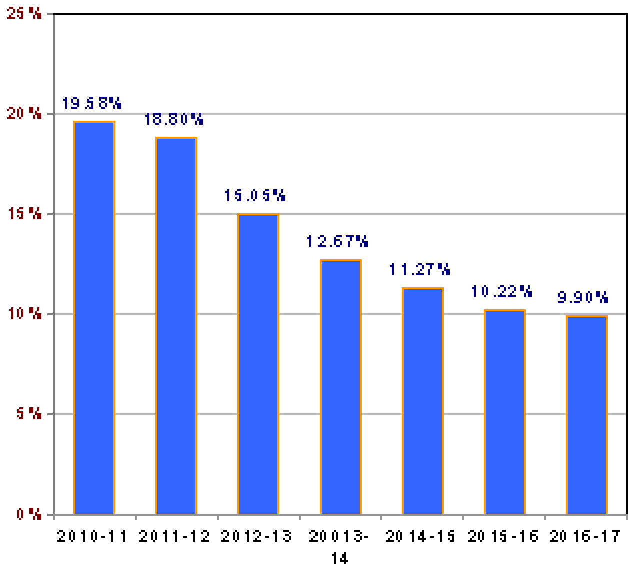


Figure 6: System Loss Southern Zone during 2010-2017.

3. Power Generation in Chattogram

3.1 Power generating system:

Chattogram is a city in south eastern Bangladesh and the capital of an eponymous district and division Built on the banks of the Karnaphuli river the city is home to Bangladesh's busiest seaport and has a population of over 4.5 million making it the second largest city in the country.

In this modern world the dependence on electricity is so much that it has become a par and parcel of our life. The ever-increasing use of electric power for domestic, commercial and industrial purposed necessitates to provide bulk electric power economically. The design of power plant should incorporate two important aspects. Firstly the selection and placing of necessary power generating equipment should be such so that a maximum of return will result from a minimum of expenditure over the working life of the plant. Secondly, the operation of the plant should be such so as to provide cheap, reliable and continuous service.

Generation Expansion Plan
Immediate: 6 -12 Months
Rental Plants (liquid fuel)

Short term: 18 - 24 Months
Peaking Plants (liquid fuel)

Medium term: 3 - 5 years
Combined Cycle Plants (Gas or dual fuel)
Peaking Plant (Gas or dual fuel)
Coal fired steam plants

Long term: beyond 5 years
LNG based Combined Cycle Plants
Domestic/Imported Coal Power Plant
Gas/Oil based Peaking Plant
Nuclear Power Plant
Renewable Energy

3.2 Generating station: special plants known as generating stations or power plants produce bulk electric power. The generating stations are mainly classified as the following:
1) Stream Turbine power station.
2) Hydroelectric power station.
3) Diesel power station.
4) Wind power station.
5) Solar power station.

3.2.1Stream power station (thermal station):
A generating station which coverts heat energy of coal combustion into electrical energy is known as stream power station.

A stream power station basically works on the ranking cycle, stream produced in the boiler by utilizing the heat of coal combustion. This type of power station is suitable. Where coal and water are available in abundance and a large amount of electric power is to be generated.

Advantages:
1) The fuel (i.e. coal) used is quite cheap.
2) Less initial cost as compared to other generating stations.
3) It requires less space as compared to the hydro-electric power station.
4) The cost of generation is lesser then that of the diesel power station.

Disadvantages:
1) It pollutes the atmosphere due to production of large amount of smoke and fumes.
2) It is easier in running cost as compared to hydro-electric plant.

Efficiency of stream power station:
The overall efficiency of a steam power station is about 29%
Overall efficiency,
η =Heat equivalent of electrical output/heat of combustion of coal.

3.2.2Hydro-electric power station:
A generating station which utilizes the potential energy of water at a high level for the generation of electrical energy is known as Hydro-electric power station.

Advantage
a) It requires no fuel as water is used for the generation of electrical energy.
b) It is quite neat and clean as no smoke or ash is produced.
c) It requires very small running charge because water is the source of energy which is available free of cost.
d) It is robust and longer life.

Disadvantages:
a) It involves high capital cost due to construction of dam.
b) Skilled and experience hands need to build up the plant.
c) There is uncertainty about the availability of huge amount of water due to dependence on weather conditions.
d) It requires high cost of transmission lines as the plant is located in hilly areas which are quite away from the consumers.

3.2.3 Diesel power station:
A generating station in which diesel engine is used as the prime mover for the generation of electrical energy is known as diesel power station.

Advantages
a) It requires less space as compared to other stations.
b) The design and layout of this plant are very simple.
c) For cooling system less quantity of water is required.
d) It can be located at any place.
e) There is no stand by losses.
f) It can be started quickly.

Disadvantages:
a) This plant can generate small power.
b) The fuel cost is high.
c) This plant does not work for a longer period.
d) The cost of lubrication is high.
e) The maintenance charge is high.
f) It pollutes the atmosphere.
g) It makes a noise [11]

3.3 Power station of Chattogram:

1) **Karnafuli Hydro-electric power station:** The Karnafuli Hydro-electric power station is situated karnafuli river in the district of Rangamati. It has two 40 MW units and three 50MW units. But most time generation capability approximately 170-190 MW. Its two 40MW units installed in 1962 and rest three 50 MW units installed in 1982, 1987 and 1988. The power station generation capability is dependent on the water head. It is most profitable power station.
2) **Raozan power station:** it has two 210 MW S/T units use gas as fuel. The first one installed in 1993 and the second one installed in 1997.
3) **3.Shikalbaha 60MW power station:** Shikalbaha power station is situated in Patiya Thana under the district of Chattogram. It has one 60 MW stream turbine system which used gas as fuel.
4) **Shikalbaha 150MW power station:**Shikalbaha 150MW power station installed year of 2010. It's Maintained by PDB.
5) **Shikalbaha 55MW** Peaking power station maintained by Privet sector.
6) **Regent 22MW** Power Station. It's maintained by Privet sector.
7) **United Power72 MW** Power Station. It's maintained by Privet sector.
8) **Dohazari 100MW** Power Station. It's connected to National Grid since November 2017.
9) **Hathazari 100MW** Power Station. It's connected to National Grid since November 2017.
10) **Baraka Patenga 50 MW** Power Station. It's maintained by Privet sector.

11) **Julda Power 100 MW** Power Station. It's maintained by Privet sector.

Table 1: Data list of power station of Chattogram Circle

Station Name	*Fuel*	*Producer*	*Installed Capacity*		*Present Capacity (MW)*
			MW	*MW*	
ChattogramRaozan ST 1 & 2	Gas	PDB	2x210	420	360
Raozan 25MW	Gas/FO	RPCL	25x1	25	25
Kaptai Hydro unit 1,2,3,4&5	Hydro	PDB	2x40+3x50	230	230
Sikalbaha ST	GAS	PDB	1x60	60	40
Sikalbaha GT	GAS	PDB	1x225	225	202
Sikalbaha	HFO	RPP 3yrs	4x12.5+2x11.9+1x3+1x1	55	55
Regent Power	GAS	SIPP	8x2.90	23.2	22
United Power,Ctg EPZ	GAS	MHCL	8x9.0	72	70
Teknaf Solartech	Solar	PDB	1x20	20	00
Dohazari	HFO	PDB	102	100	51
Julda	HFO	B. CAT	100	100	100
Hathazari	HFO	PDB	100	100	57
Baraka,Patenga	HFO	Baraka Ltd.	50	50	50
	Total Present Capacity =			1480.2	1262

3.4 Different source of energy in Bangladesh

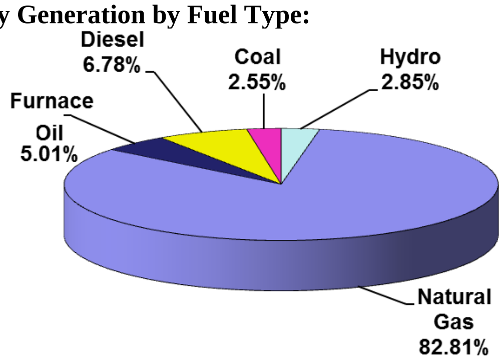
Electrical energy is produced from energy available in various forms in nature the various source in Bangladesh are: Natural gas, Water, Coal, Oil / HFO, Solar Wind.

Natural gas: At present the natural gas is the main source of energy in our country. Most of the power plant in our country is used natural gas. i.e. Raozan power plant, Sikabaha power station, and Privet Power Station are used in gas. Mean white some of the gas fields are discovered in our country are: Haripur, B-baria, Bakhrabad, Chattogram.

Water: Karnafully hydro-electric power station is only one plant in Bangladesh. it is fully depended in water. It has five units i.e. two units are 40 MW and rest are 50 MW. It is most profitable power plant. Principle of this power plant is, water energy can be converted into mechanical energy with the help of water turbines. The water turbine drives the alternator, which converts mechanical energy into electrical energy.

Oil: It is liquid fuel. Dohazari & Hathazari power plant, are operation as Dual fuel (HFO/Gas)

Energy Generation by Fuel Type:



3.5 Peaking Power Station of Chattogram:

Table 2: Data of Hathazari under construction100 MW Peaking Power Plant

SL	*Item*	*Particulars*
1.	Contractor	Guangdong Power Engineering Corp., China
2.	Site	Hathazari, Chattogram (acquired and BPDB land)
3.	Project Cost	Tk. 1025 Crore
4.	Capacity	98.164 MW (8.924 X 11)
5.	Manufacturer	Wartsila Finland
6.	Fuel	Dual fuel (HFO/Gas)
7.	Transportation of Fuel & Equipment	By Rail

Table 3: Data of Dohazari under construction100 MW Peaking Power Plant Project

Sl.	*Item*	*Particulars*
1	Contractor	Guangdong Power Engineering Corp., China
2	Site	Dohazari, Chattogram (BPDB's land)
3	Project Cost	Tk. 1089 Crore
4	Capacity	102.456 MW (17.076 X 6)
5	Manufacturer	Wartsila ,Finland & Italy
6	Fuel	Dual fuel (HFO/Gas)
7	Transportation of Fuel & Equipment	By Rail

Table 4: Data of Juldha 100 MW Quick Rental Power Plant

SI No	*Item*	*Particulars*
1	Sponsor	Acorn Infrastructure Services Ltd.
2	Site	Dohazari, Chattogram (BPDB's land)
3	Site & Land	Juldha, Chattogram (Sponsor's own land)
4	Capacity	100 MW (13.97 X 8)
5	Manufacturer	Caterpillar Motoren GmbH & Co. KG
6	Fuel	HFO
7	Tariff (Tk./KWh)	7.76
8	Rental Period	5 (Five) years

4. Transmission System in Chattogram

4.1 Introduction

The interconnection of a number of stations results in many advantages. We have already seen that the combine working and operation of different types of power station results in better handling of the system load. The interconnection of two or more power stations always reduces the amount of generating capacity required as compared with that, which would be required without interconnection. The reliability is greater as power can be supplied even with one of the major power station out of operation for some time.

4.2 Interconnection system of Chattogram

Interconnected grid system means every substation, Generating stations all over the country are in inter-connected to each other. In inter-connected systems power may be taken or be injected if generated. The main task of inter-connection systems is to transfer adequate power from one AC system to the other AC system to the other AC system during normal reconditions and also during emergency conditions and maintain system security. If total generation in grid is less then total load on the gird, the frequency of entire grid starts falling. If total generation is more then loads, frequency starts rising. Full of frequency causes increases power inflow neighboring region. The Chattogram existing grid system linking with all over Bangladesh By 230kv Hathazari - Comilla (North) and 132kv of Hathazari - Feni line(Both are double Circuit Line).

4.2.1 Merits of interconnection system

1) Reduced overall installed capacity, interconnection power systems reduce the overall requirement of installed capacity.
2) Better utilization of hydropower, during rainy season the hydro stations are loaded fully and thermal station lightly the flow rate of rivers and water reservoirs fluctuate with rains.
3) Better utilization of reserves, by better co-ordination between hydro, thermal Nuclear and other energy sources, the energy conservation can be planned for optimum utilization.
4) Reduce in operating costs and better efficiency. Energy can thereby be supplied to consumers at lowest cost.
5) Higher unit size possible, generating units of higher unit capacity can be installed and operated economically.
6) Higher system security, the overriding factor in the operation of power system is to maintain system security.
7) Improved quality of voltage and frequency by interconnection, the frequency can be easily held within targeted limits by appropriate generation control and interchange.

4.2.2 Limitation of interconnection systems

a) Interconnection assured the some areas have surplus generation.
b) The frequency disturbance of one area is transferred to adjacent areas, resulting in overall disturbances.
c) Cascade trapping and overall blackouts occur in large interconnected systems.
d) Each regional load control center should fulfill is obligation and co-operate with the master load control center.
e) Technical problems of larger interconnected system regarding planning operation and control etc are more complex.
f) Large Interconnection requires more automation. Reliability security of each system should be high.
g) Large interconnection requires more investments for load control centers and automatic control.

4.2.3 Obligation of interconnection system:

Each particular power system has to fulfill its obligation to overcome the limitation mentioned in below:

a) Each area should have its load control center with sufficiently advance automatic generation control, load frequency control reliable protection system etc.
b) Each area should plan its installed capacity and should maintain adequate spinning reserves.
c) Each area should have efficient load frequency control.
d) Each area should cooperative with national load control center with regard to interchange of power as the instruction of national load control center.
e) Control principle and requirements of parallel operations, overall load frequency control, and steady state/emergency and post emergency should be maintained.
f) Each region should have a strong system analysis group and system operation group with trained manpower [11].

4.3 Grid system in Chattogram

In a power system when all generating station line with the operation of substations called grid system of electric power. In the grid system of Chattogram, mainly two types of transmission line are used. These are 230KV and 132KV lines.
Total length of 230 KV transmission line as of 2017 387Km (Double circuit) and that of 132 KV was 793 Km.

a) 230/132 KV sub-station

There are 03 number 230/132 KV gird sub-station in electric power system in Chattogram and power capacity is 1280 MVA.

This gird sub-station is in below:
1) Hathazari (Controlled by PGCB)
2) AKSML (Controlled by PGCB)
3) BSRM (Controlled by PGCB)

b) 132/33 KV grid Sub-station:

There are 24 numbers 132/33 KV gird sub-station as are in Chattogram.

1) Kaptai- 132KV (Attested power station, Controlled by PDB)
2) Chandraghona- 132KV.
3) Hathazari- 230/132KV
4) Madhunghat- 132KV
5) Sikalbaha- 132KV (Attested power station, Controlled by PDB)
6) Dohazari- 132KV
7) Cox'xbazer- 132KV

8) Halishahar- 132KV
9) Khulshi- 132KV
10) Baraulia- 132KV
11) Julda- 132KV
12) Barayarhat 132KV
13) Bakulia- 132KV
14) Rangamati 132KV
15) Khagrachari 132KV
16) Shamirpur- 132KV
17) Matarbari- 132KV
18) BSRM (132KV Private consumer)
19) T.K Chemical Complex (132KV Private consumer)
20) Modern Steel (132KV Private consumer)
21) AKSML (132KV Private consumer) KYCR (132KV Private consumer)
22) SSML (132KV Private consumer)
23) KSRM (132KV Private consumer)

4.3.1 Individual MVA Capacity of Grid substation in Chattogram

There is 03 number of 230/132 KV gird sub-station in Chattogram and power capacity is 1280 MVA and 24 numbers 132/33 KV gird sub-station are in Chattogram. This gird sub-station is in below:

Table 5: Data of Grid Sub-station of Chattogram Circle

S/N	*Name of Sub-Station*	*Capacity (MVA)*	*Total Capacity (MVA)*	*Remarks*
GMD CHATTOGRAM (North)				
1	Hathazari-230KV S/S	150 X 4	600	
	Hathazari-132KVS/S	63 X 2	126	
2	Baraulia S/S-132KV	64 X 2	128	
3	Khulshi S/S-132KV	120 X 2	240	
4	AKSPL S/S -132KV	80 x 1	80	Maintained by AKSPL
5	AKSML 230kV	130/15x2+ 80x1	380	Maintained by AKSML
6	BSRM S/S- 230KV	150X2	300	Maintained by BSRM
7	Baroyarhat s/s	50/75x2	150	
8	Rangamati s/s	39x2	78	
9	Kagrachori		80	
10	KSRM	28/50X2	100	Maintained by KSRM
GMD CHATTOGRAM (South)				
11	Madunaghat S/S	40 x 1 + 41 x 1	81	
12	Dohazari S/S	40 X 2	80	
13	Chandraghona S/S	20 X 2	40	
14	Cox's Bazar S/S	41 X 2	82	
15	Matarbari	25/41	82	
16	Sikalbaha S/S	41.6 X2	83.2	Maintained by BPDB
17	Kaptai S/S	20 X 1	20	
18	TK Complex	20 X 1	20	Maintained by TK Complex
GMD CHATTOGRAM (CENTRAL)				
19	Halishahar s/s	2x44.1/63, 1x48/64	190	
20	Julda s/s	1x48/64	64	
21	Bakalia s/s	3x48/64	192	
22	Shahmirpur s/s	2x48/64	128	
23	Modern steel s/s	1X25/30	30	
		Total=	3122.2	

Table 6: Load Assessment Report Grid Circle, PGCB, Chattogram

Sl No.	132KV Sub-Station Name	No. of X-former	Capacity (MVA)	Feeder Name	Feeder Max.	NOF PDB	NOF PBS	Remarks
1	Baraulia	2	(64*2)128 MVA	33/11KV T-1 & 2	22	2		
				Fouzderhat-1	30	1		
				KYCR	7	1		
				Chemical	10	1		
				KSRM	8	1		
				GPH	10	1		
				Dhoom (REB)	0		1	Rejent -22 MW
				Barabkunda-1/2	22	2		
				S.Total (MW)	109	9	1	
	SSL	1	20 MVA	Sub Station Total	15	1		
2	Hathazari	2	T-2, 50/75 MVA	Charia (PBS)	14		1	
				Sholoshahar -1 / 2	34	2		
			T-1, 50/83 MVA	Hathazari- 1	33	1		
				Hathazari- 2	22	1		Nazirhat, Fatikchari, Khagrachori, Rangamati
				Fatehabad	10	1		
				S.Total (MW)	113	5	1	
3	Khulshi	2	(80/120+ 63) 183 MVA	2 x 20MVA Tr-1 / 2	28	2		
				Jalalabad -1/2	40	2		
				Stadium- 1 / 2	44	2		
				Pahartali -1(Indoor)	6	1		
				Pahartali -2 (Outdoor)	18	1		
				Ispahani	2	1		
				S.Total (MW)	138	9	0	

	BSRM	1	80 MVA	BISCO	25	1		Private
				SMW	20	1		
				BSRM	15	1		
				BSRM Total	60	3	0	
4	AKSPL	1	64/80 MVA	Sub Station Total	23.2	1		
5	AKSML230kV	3	(130/15*2+80*1)=380MVA		205	1		
6	BSRM 230kV	2	(125/140*2)=280MVA	BSRM	90	1		
				REB	10		1	
				Sub Station Total	100	1	1	
7	KSRM		(28/50*2)=100MVA	KSRM	48	1		
				KYCR	10	1		
				Sub Station Total	58	2	0	
				Mahalchori	1	1		
				Sub Station Total	16	2	0	

There are two types of grid transmission line in Chattogram such as, 230 KV line (Table 4.3) and 132 KV line (Table 4.4)

Table 7: 230 KV Transmission Lines

Sl. No.	*Name of Lines*	*Length in Route kilometers*	*Length in Ckt. Kilometers*	*No. of Ckt.*	*1 Conductor*		
					Amp. Capacity	*Name*	*Size*
1	Raojan - Hathazari	22.5	45	Double	1200	Finch Twin 300 sq.mm	
2	Comilla North - Hathazari	151	302	Double	600	Finch	1113 MCM
	Total =	173.5	347				

Table 8: 132 KV Transmission Lines

Sl. No.	*Name of Lines*	*Lenth in Route kilometers*	*Lenth in Ckt. Kilometers*	*No. of Ckt.*	*2 Conductor*		
					Amp. Capacity	*Name*	*Size*
1	Kulshi - Halishahar	13	26	Double	1200	Grosbeak	636 MCM
2	Madanhat - Sikalbaha	13	26	Double	1200	Grosbeak	636 MCM
3	Sikalbaha - Dohazari	35	70	Double	1200	Grosbeak	636 MCM
4	Kulshi - Baraulia	13	26	Double	1200	Grosbeak	636 MCM
5	Madanhat - Kulshi	13	13	Single	600	Grosbeak	636 MCM
6	Kaptai - Baraulia	65	130	Double	1200	Grosbeak	636 MCM
7	Dohazari - Cox's Bazar	87	174	Double	1200	Grosbeak	636 MCM
8	Feni - Baraulia	90	90	Single	600	Grosbeak	636 MCM
9	Sikalbaha-Bakulia	4	8	Double	1200	Grosbeak	636 MCM
10	Julda-Shahmirpur	12.5	25	Double	1200	Grosbeak	636 MCM
11	Kulshi-Bakulia	4	8	Double	1200	Grosbeak	636 MCM
12	Sikalbaha-Shahmirpur	9	18	Double	1200	Grosbeak	636 MCM
13	Halishahar- Julda	6	6	single	800	AAAC	805sqmm
14	Julda-Sikalbaha	7	7	single	800	AAAC	805sqmm
15	Madunaghat-Chandraghona	35	70	Double	1200	Grosbeak	636 MCM
16	Kaptai- Chandraghona	8	16	Double	1200	Grosbeak	636 MCM
17	Chandraghona-Rangamati	40	80	Double	1200	Grosbeak	636 MCM
	Total =	396.5	793				

5. Power System Protection in Chattogram

5.1 Introduction

Power system protection need to have a reasonable degree of reliability and loss of property has to keep to a minimum, continuous surveillance and monitoring of the operating system, specific to each kind of abnormal condition, along with isolating protective devices must be provided. This is what we call system protection. Power system protection involved following devices; fuses, circuit breakers, isolator, surge diverters etc.

Protective relaying is necessary with almost every electrical plant, and no part of the power system is left unprotected. There are several important components in the protective relaying scheme. These include protective current transformers and voltage transformers, protective relaying, time-delay relays, secondary circuits, trip circuit's auxiliaries and accessories.

The relays are compact, self-contained devices, which respond to abnormal condition. The relays distinguish between normal and abnormal condition. Whenever an abnormal condition develops, the relays close its contacts. Thereby the trip circuit of the circuit breaker is closed. The entire process, occurrence of fault operation of relay-opening circuit breaker-removal of faulty part from the system,-is automatic and fast.

The modern power system is very complex and even through protective equipment from 4% to 5% of the total cost involved in the system. They play very important role in the system design for good quality of reliable supply.

5.2 Used Circuit breaker in Chattogram Grid Substation

Circuit breaker:
Circuit Breaker can make or break a circuit either manually and automatically under all condition viz; no-load, full-load and short circuit condition. There are types of circuits breakers are:

5.2.1 Sulpher Hexafluoride (SF6) Circuit Breakers:

In Chattogram grid only SF6 breakers are used. In such breakers, sulphur hexafluoride (SF6) gas has in used as the arc quenching medium. The SF6 is an electro-negative gas and has a strong tendency to absorb free electrons. The contacts of the breaker are opened in a high-pressure flow of SF6 gas and an arc is struck between them. The gas to form relatively immobile negative ions rapidly captures the conducting free electrons in the arc. This loss of conducting electrons in the arc quickly builds up enough insulation strength to extinguish the arc. The SF6 circuit breakers have been found to be very effective for high power and high voltage service.

Advantages
Due to the superior arc quenching properties of SF6 gas, the SF6 circuit breaker has many advantages over oil or air circuit breakers but has some disadvantages also [11].

5.3 Various Types of Protective Relays are used in the Grid System:

- Protective Relay
- Over Current Relay (50/51)
- Earth Fault Relay (50N/51N)
- Directional Relay (67)
- Differential Relay (87)
- Distance Relay (21)
- Frequency Relay (81)
- Over Flux Relay (24)
- Under Voltage Relay (27)
- Over Voltage Relay (59)
- Carrier / Pilot wire Receiver Relay (85)
- Line Differential Relay (87L)
- Circuit Breaker Relay (52)
- Isolator Relay (89)
- Lockout Relay (86)
- Auto reclosing Relay (79)
- Synchronizing Relay (25)

5.3.1 Protective Relay

A protective relay is a device that detects the fault and initiates the circuit breaker to isolate the defective element from the rest of the system. The relays detect the abnormal conditions in the electrical circuits by constantly measuring the electrical quantities which are different under normal and fault conditions. The electric quantities which may change under fault conditions are voltage, current, frequency and phase angle.

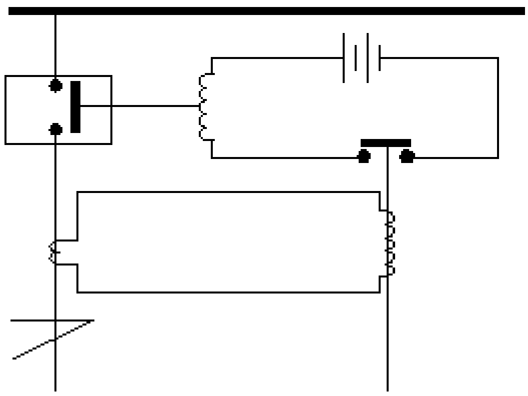


Figure 7: Basic Diagram of Relay circuit

6. Load analysis and forecasting for Chattogram (2011-2017)

Table 9: Data of load assessment 2011 of grid Sub-Stations in Chattogram[5]

Sl. No.	*132 kV Sub-Station Name*	*Date*	*Load Demand MW*								*Evening Max MW*
			Day Peak (Hr.)				*Evening Peak (Hr.)*				
			9	**10**	**11**	**12**	**18**	**19**	**20**	**21**	
1	Hathazari	05.06.11	87	87	87	88	88	88	89	90	90
2	Khulshi	05.06.11	82	82	82	83	83	83	83	84	84
3	Baraulia	06.06.11	90	90	90	91	91	91	92	93	93
4	Bakulia	06.06.11	63	64	64	64	64	64	64	65	65
5	Julda	07.06.11	80	80	80	80	80	80	80	81	81
6	Halishahar	07.06.11	88	89	89	90	90	90	91	92	92
7	MEW Ltd	08.06.11	96	97	97	98	98	99	99	100	101
8	AKSPL	08.06.11	48	48	49	49	49	49	49	50	50
9	Madunaghat	09.06.11	82	82	83	83	83	84	84	85	85
10	Dohazari	09.06.11	57	57	58	58	58	59	59	60	60
11	Chandraghona	12.06.11	47	47	48	48	48	49	49	50	50
12	Sikalbaha	12.06.11	47	47	48	48	48	49	49	50	50
13	Cox's Bazar	13.06.11	28	28	28	28	28	29	29	30	30
14	Kaptai	13.06.11	12	12	12	12	12	13	13	14	14
Grid Circle,Chattogram			907	910	915	920	920	927	930	944	**945**

Table 10: Data of load assessment 2012 of grid Sub-Stations in Chattogram [5]

Sl. No.	*132 kV Sub-Station Name*	*Date*	*Load Demand MW*								*Evening Max. MW*
			Day Peak (Hr.)				*Evening Peak (Hr.)*				
			9	**10**	**11**	**12**	**18**	**19**	**20**	**21**	
1	Hathazari	04.06.12	88	89	89	90	91	91	91	92	92
2	Khulshi	04.06.12	91	91	92	93	93	93	93	94	94
3	Baraulia	04.06.12	93	93	93	94	95	95	95	96	96
4	Bakulia	05.06.12	111	111	112	113	113	114	114	114	114
5	Julda	05.06.12	108	108	108	109	109	109	110	110	110
6	Halishahar	05.06.12	95	95	95	96	96	97	97	98	98
7	MEW Ltd	06.06.12	79	80	80	80	80	81	81	82	82
8	AKSPL	06.06.12	32	32	33	34	34	34	35	35	35
9	Madunaghat	06.06.12	101	102	102	102	102	102	102	103	103
10	Dohazari	07.06.12	66	66	66	67	67	68	68	68	68
11	Chandraghona	07.06.12	97	97	98	99	99	99	99	99	99
12	Sikalbaha	08.06.12	97	97	97	97	97	97	97	97	98
13	Cox's Bazar	08.06.12	31	31	32	32	32	32	32	32	32
14	Kaptai	08.06.12	13	13	13	13	13	13	14	14	14
Grid Circle,Chattogram			1102	1105	1110	1019	1021	1025	1028	1034	1035

Table 11: Data of load assessment 2013 of grid Sub-Stations in Chattogram [5]

Sl. No.	*132 kV Sub-Station Name*	*Date*	*Load Demand MW*								*Evening Max. MW*
			Day Peak (Hr.)				*Evening Peak (Hr.)*				
			9	**10**	**11**	**12**	**18**	**19**	**20**	**21**	
1	Hathazari	03.06.13	40	40	40	41	41	41	41	42	42
2	Khulshi	03.06.13	94	95	95	96	96	97	97	98	98
3	Baraulia	03.06.13	100	100	100	100	100	100	100	101	101
4	Bakulia	04.06.13	103	104	104	105	105	106	106	107	107
5	Julda	04.06.13	110	110	110	111	111	111	111	112	112
6	Halishahar	04.06.13	117	117	117	117	117	117	117	118	118
7	MEW Ltd	05.06.13	116	117	117	118	118	118	118	119	119
8	AKSPL	05.06.13	57	57	57	57	58	58	58	59	59
9	Madunaghat	05.06.13	106	107	107	107	107	107	107	108	108
10	Dohazari	06.06.13	68	69	69	69	70	70	70	70	70
11	Chandraghona	06.06.13	73	73	74	74	75	75	75	76	76
12	Sikalbaha	07.06.13	100	100	100	100	100	100	100	100	100
13	Cox's Bazar	07.06.13	32	32	33	33	33	33	33	33	33
14	Kaptai	07.06.13	7	7	7	7	7	7	7	7	7
Grid Circle,Chattogram			1025	1028	1028	1130	1135	1138	1140	1150	1150

Table 12: Data of load assessment 2014 of grid Sub-Stations in Chattogram [5]

Sl. No.	*132 kV Sub-Station Name*	*Date*	*Load Demand MW*								*Max. MW*
			Day Peak (Hr.)				*Evening Peak (Hr.)*				
			9	**10**	**11**	**12**	**18**	**19**	**20**	**21**	
1	Hathazari	31.05.14	88	88	89	89	89	89	89	90	90
2	Khulshi	02.06.14	81	81	82	82	82	82	82	83	84
3	Baraulia	28.05.14	92	92	93	93	93	93	93	93	93
4	Bakulia	09.06.14	102	102	103	103	104	104	104	104	105
5	Julda	29.05.14	145	145	146	147	148	148	149	149	149
6	Halishahar	01.06.14	117	117	118	118	119	119	120	120	120
7	MEW Ltd	07.06.14	97	97	98	99	99	100	100	101	101
8	AKSPL	05.06.14	125	125	126	126	127	127	128	128	129
9	Madunaghat	07.06.14	89	80	80	80	80	80	80	80	80
10	Dohazari	08.06.14	74	74	74	75	76	76	77	77	77
11	Chandraghona	04.06.14	158	158	158	159	159	159	160	160	160
12	Sikalbaha	29.05.14	89	89	90	90	90	90	90	90	90
13	Cox's Bazar	12.06.14	31	31	31	31	31	31	32	32	32
14	Kaptai	04.06.14	12	12	12	12	12	12	13	13	13
Grid Circle, Chattogram			1290	1291	1300	1304	1309	1310	1317	1320	1323

Table 13: Data of load assessment 2015 of grid Sub-Stations in Chattogram [5]

Sl. No.	*132 kV Sub-Station Name*	*Date*	*Load Demand MW*								*Max. MW*
			Day Peak (Hr.)				*Evening Peak (Hr.)*				
			9	10	11	12	18	19	20	21	

1	Hathazari	07.06.15	102	102	102	103	103	104	105	105	105
2	Khulshi	07.06. 15	91	91	91	92	92	93	94	94	94
3	Baraulia	08.06. 15	94	94	94	94	94	95	96	96	96
4	Bakulia	08.06. 15	111	111	111	112	112	113	114	114	114
5	Julda	09.06. 15	147	146	147	148	149	150	150	150	150
6	Halishahar	09.06.15	118	118	118	118	119	120	120	120	122
7	MEW Ltd	09.06. 15	180	180	180	180	180	181	182	182	182
8	AKSPL	10.06. 15	110	110	110	110	110	110	110	110	111
9	Madunaghat	10.06. 15	105	105	105	106	107	108	109	109	109
10	Dohazari	11.06. 15	88	88	88	88	87	88	88	88	88
11	Chandraghona	11.06. 15	147	147	147	147	148	148	148	149	149
12	Sikalbaha	11.06. 15	151	152	152	152	153	154	154	154	154
13	Cox's Bazar	14.06. 15	33	33	33	33	34	34	34	34	34
14	Kaptai	14.06. 15	12	11	12	12	13	13	13	13	13
Grid Circle,Chattogram			1488	1485	1487	1492	1500	1510	1517	1518	1521

Table 14: Data of load assessment 2016 of grid Sub-Stations in Chattogram [5]

Sl. No.	*132 kV Sub-Station Name*	*Date*	*Load Demand MW*								*Max. MW*
			Day Peak (Hr.)				*Evening Peak (Hr.)*				
			9	**10**	**11**	**12**	**18**	**19**	**20**	**21**	
1	Dohazari	06.06.16	89	90	98	90	90	90	91	91	90
2	Halishahar	06.06.16	94	95	95	195	196	196	197	197	198
3	T K Complex	07.06.16	126	127	127	40	40	39	40	40	41
4	Khulshi	07.06.16	111	112	112	164	165	165	166	166	167
5	Bakulia	07.06.16	38	38	38	110	110	110	111	111	112
6	Madunaghat	08.06.16	86	87	85	116	116	116	116	117	118
7	MEW Ltd	08.06.16	80	80	80	118	118	118	118	119	119
8	Hathazari	08.06.16	87	87	87	110	111	111	112	112	113
9	Baraulia	09.06.16	144	144	144	104	104	104	104	105	105
10	Chandraghona	09.06.16	132	132	132	140	140	140	141	141	142
11	Kaptai	09.06.16	98	98	98	126	126	126	126	126	126
12	Julda	10.06.16	95	95	95	120	121	122	122	122	122
13	AKSPL	10.06.16	120	120	120	132	132	132	132	132	132
14	Cox's Bazar	10.06.16	144	144	144	33	34	34	34	34	34
15	Sikalbaha	10.06.16	198	198	198	69	69	69	69	69	69
Grid Circle,Chattogrm			1655	1660	1666	1667	1672	1670	1677	1680	1688

Table: 15: Data of load assessment 2017 of grid Sub-Stations in Chattogram [5].

Sl. No.	*132 kV Sub-Station Name*	*Date*	*Load Demand MW*								Evening Max. MW
			Day Peak (Hr.)				*Evening Peak (Hr.)*				
			9	**10**	**11**	**12**	**18**	**19**	**20**	**21**	
1	Dohazari	05.06.17	161	161	161	162	164	163	164	164	165
2	Halishahar	05.06.17	117	117	117	118	119	118	119	119	220
3	T K Complex	05.06.17	81	81	81	82	84	83	84	84	85
4	Khulshi	06.06.17	162	162	162	164	166	164	166	166	167
5	Bakulia	06.06.17	110	111	111	112	113	112	113	113	114.8
6	Madunaghat	07.06.17	140	140	140	141	142	141	142	142	143
7	MEW Ltd	07.06.17	156	157	157	157	158	157	158	158	159
8	Hathazari	07.06.17	106	106	106	106	107	106	107	107	108
9	Baraulia	08.06.17	121	122	122	122	123	122	123	123	124
10	Chandraghona	08.06.17	122	122	122	122	120	122	123	123	128.3
11	Kaptai	08.06.17	96	97	97	98	98	98	98	99	99
12	Julda	09.06.17	107	108	108	108	106	108	109	109	109
13	AKSPL	09.06.17	78	79	79	79	80	79	80	80	80
14	Cox's Bazar	12.06.17	39	40	40	40	40	40	40	40	40
15	Sikalbaha	12.06.17	134	135	135	135	130	135	136	136	136.5
Grid Circle,Chattogram			1832	1840	1840	1848	1850	1851	1866	1865	1874

Table 16: Data of Maximum Load at Hathazari S/S from 2011-2017

Maximum Load Khulsi S/S	
Year	Load(MW)
2011	84
2012	94
2013	98
2014	84
2015	95
2016	140
2017	167

Table 17: Data of Maximum Load at Khulshi S/S from 2011-2017

Maximum Load Hathazari S/S	
Year	Load(MW)
2011	90
2012	92
2013	96
2014	99
2015	101
2016	113
2017	115

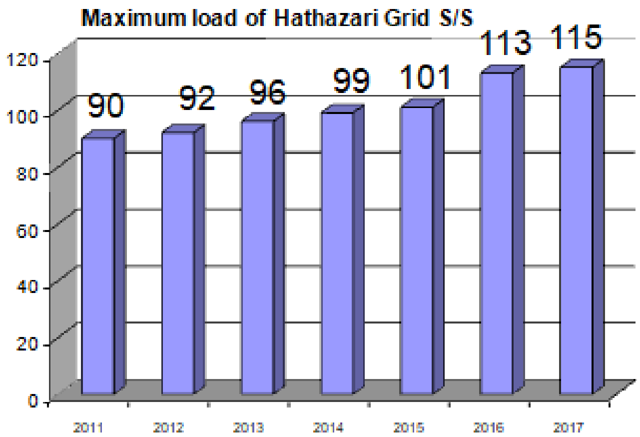


Figure 8: Bar chart of Maximum Load at Hathazari S/S from 2011-2017

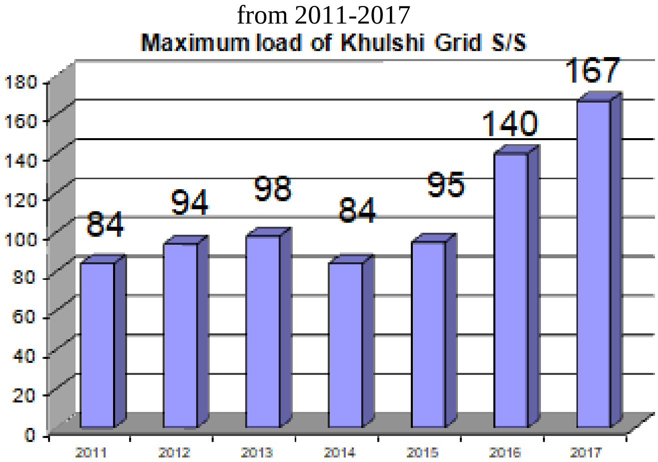


Figure 9: Bar chart of Maximum Load at Khulshi S/S from 2011-2017

Table 18: Data of Maximum Load at Halishahar S/S from 2011-2017

Maximum Load Halishahar S/S	
Year	*Load(MW)*
2011	92
2012	98
2013	118
2014	120
2015	122
2016	198
2017	220

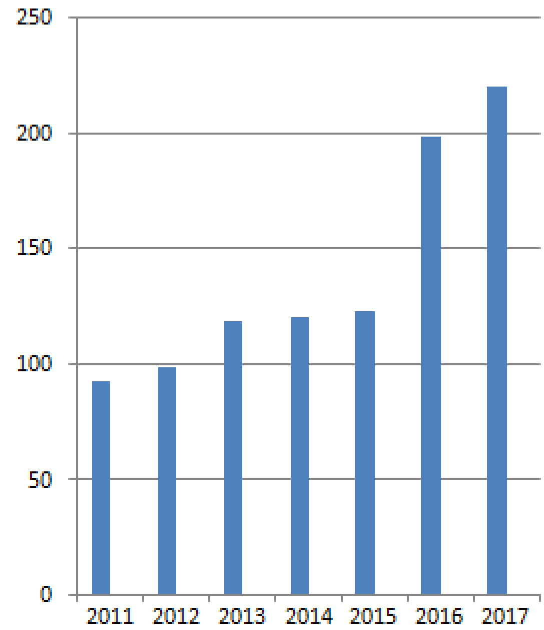


Figure 10: Bar chart of Maximum Load at Halishahar S/S from 2011-2017

Table 19: Data of Maximum Load at Baraulia S/S from 2011-2017

Maximum Load Baraulia S/S	
Year	*Load(MW)*
2011	93
2012	96
2013	101
2014	93
2015	96
2016	105
2017	124

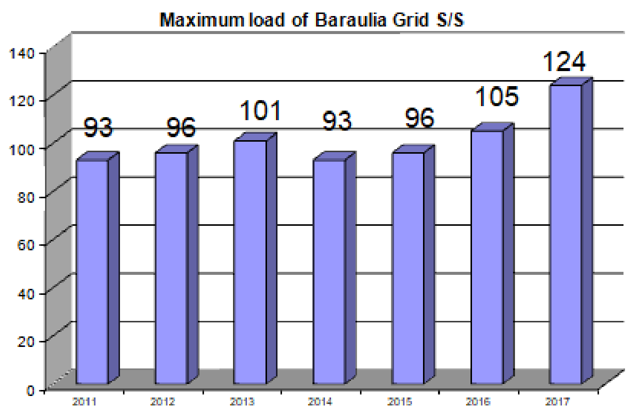


Figure 11: Bar chart of Maximum Load at Baraulia S/S from 2011-2017

Table 20: Data of Maximum Load at Madunaghat S/S from 2011-2017

Maximum Load Madunaghat S/S	
Year	*Load(MW)*
2011	85
2012	103
2013	108
2014	80
2015	109
2016	118
2017	143

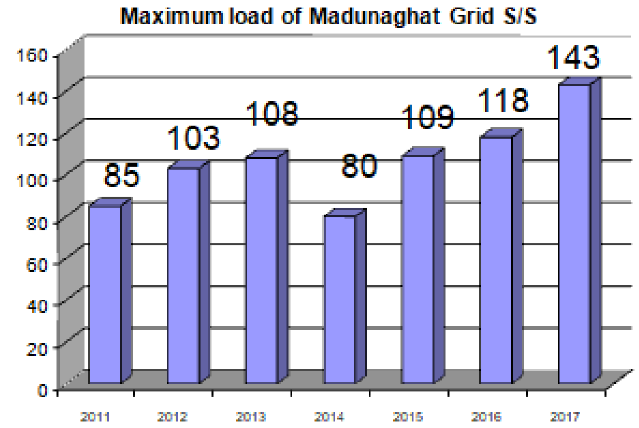


Figure 12: Bar chart of Maximum Load at Madunaghat S/S from 2011-2017

Table 21: Data of Maximum Load at Dohazari from 2011-2017

Maximum Load Dohazari S/S	
Year	*Load(MW)*
2011	60
2012	65
2013	70
2014	77
2015	88
2016	90
2017	115

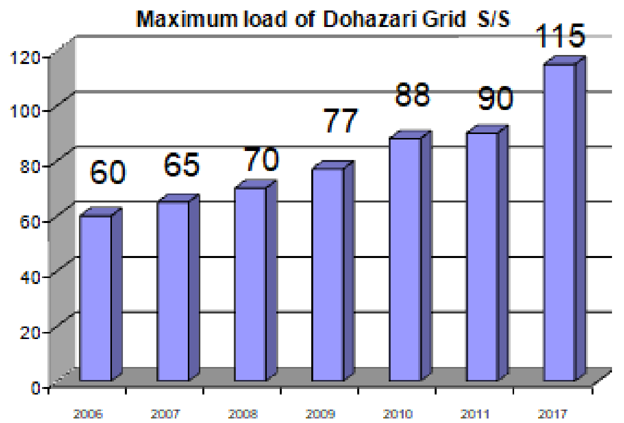


Figure 13: Bar chart of Maximum Load at Dohazari S/S from 2011-2017

Table 22: Data of Maximum Load at Cox's Bazar S/S from 2011-2017

Maximum Load Cox's Bazar S/S	
Year	*Load(MW)*
2011	30
2012	32
2013	33
2014	32
2015	34
2016	35
2017	60

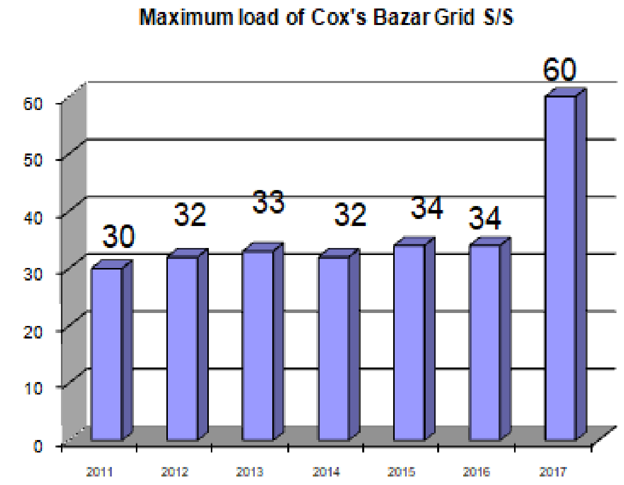


Figure 14: Bar chart of Maximum Load at Cox's Bazar S/S from 2011-2017

Table 23: Data of Maximum Load at MEW Ltd S/S from 2011-2017

Year	*Total Measured MW*
2011	945
2012	1035
2013	1150
2014	1323
2015	1520
2016	1688
2017	1870

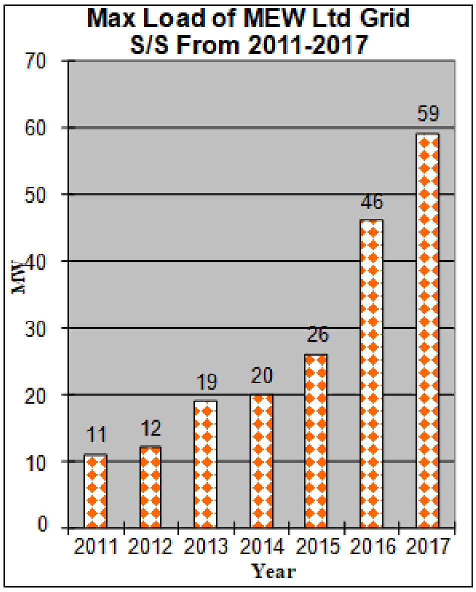


Figure 15: Bar chart of Maximum Load at MEW Ltd S/S from 2011-2017

6.3 Maximum Load Condition during 2011-2017 Under Grid Circle Chattogram

Table 24: Maximum Load Condition during 2011-2017 Under Grid Circle Chattogram

Maximum Load MEW Ltd S/S	
Year	*Load(MW)*
2011	11
2012	12
2013	19
2014	20

2015	26
2016	46
2017	59

6.4 Yearly Variation Load (MW) in Chattogram Circle during 005-2020

Table 25: Data of Yearly Maximum Load (MW) variation in Chattogram Circle During 2005-2020 [6].

Year	*Load(MW)*
2005	460
2006	512
2007	563
2008	625
2009	687
2010	755
2011	945
2012	1035
2013	1150
2014	1323
2015	1521
2016	1688
2017	1874
2018	2080
2019	2300
2020	2550

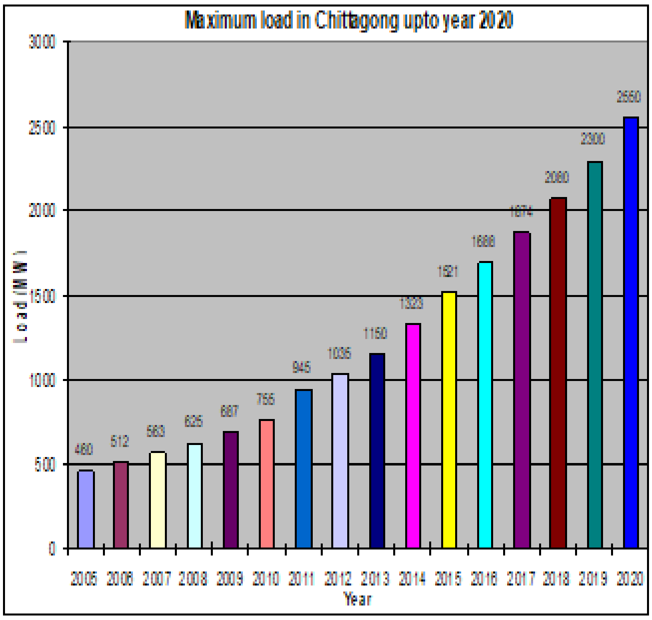


Figure 16: Bar chart of Maximum Load at Chattogram Circle during 2005-2020

6.5 Yearly variation load (MW) in Chattogram circle during 2005-2020

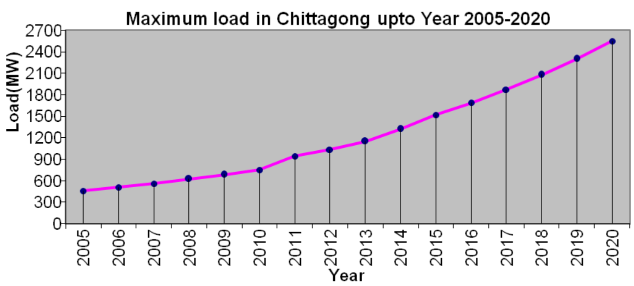


Figure 17: Line chart of Maximum Load at Chattogram Circle during 2005-2011

The load variation rates are almost same (10%) except 2010-2011. In year 2009-2010, that time the new connection to consumer was limited as per government decision. Again all pending connection done at year 2010-2011. That why the load increasing rate at year 2010-2011 is 23.84% [6]

6.6 Energy Efficiency Initiatives

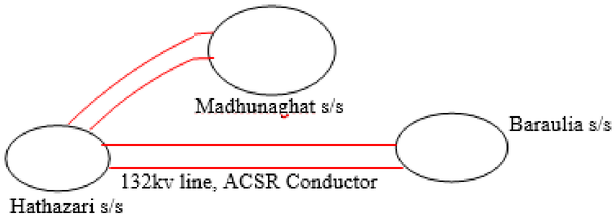
- Include Energy Conservation and Solar Power issues in the National Building Code.
- Include Energy Conservation and Alternative Energy issues in the text book curriculum.
- Installation of Solar Panel in the Govt., Semi Government and autonomous organizations within next 3 years.
- Use of CFL bulb in all ministries and public sector entities.
- Conventional street lights will be replaced by LED and solar subsequently.
- Public awareness for energy conservation.
- Discontinuation of incandescent bulb and electric heater subsequently.
- Limited use of Air Conditioners keeping temp at 25 degree Celsius.
- Encouraging the business community for using solar energy .
- Discouraging use of neon sign in the markets/ shopping malls at night.
- Closing of markets and shopping malls within 8 p.m.
- Introduction of quality pre-paid and smart meters all over the country.

7. Results and Discussion

7.1 Various problem & their solution of Chattogram grid Circle

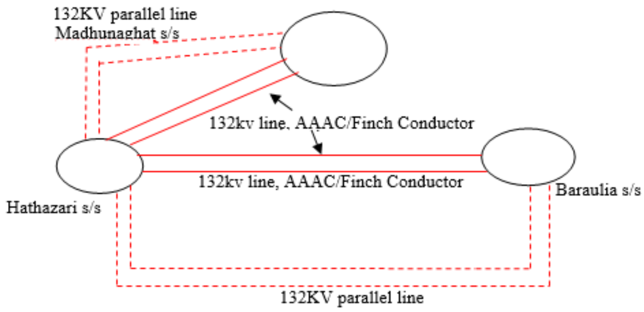
<u>Problem-1</u>

The maximum demand of Chattogram is 1874MW.We can't receive the full loadif Generation fail by the shortage of gas and water, then all load will come from Dhaka through Hathazari grid S/S. The power supplied in Chattogram only by the Hathazari grid S/S through Hathazari-Madunaghat and Hathazari-Baraulia double Circuit lin. The line conductor of Hathazari-Madhunaghat and Hathazari-Baraulia double Circuit line are used **Gross beak** (**Capacity 600A**) and both line are so old. This line can't carry the full load. But we can see that the load of Ctg. are increasing every year 10% (Approximate) and it will be rise at 2020 year 2061MW. Another case, when any circuit of Hathazari-Madhunaghat and Hathazari-Baraulia double Circuit line trip, then all of another 03 circuit of them tripped due to over current(O/C). Then the greater Chattogram area goes to black out.



Solution-01

We suggest to change the line by **AAAC** (**Capacity -1050A**) or **Finch conductor**. Or suggest to increase capacity by construct 132KV new parallel line.



Maximum Ampere on Hathazari – Baraulia line	
Year	*Load(Amp)*
2011	460
2012	465
2013	477
2014	485
2015	500
2016	500
2017	500

1) **Ampere flow chart of Hathazari - Baraulia transmission**

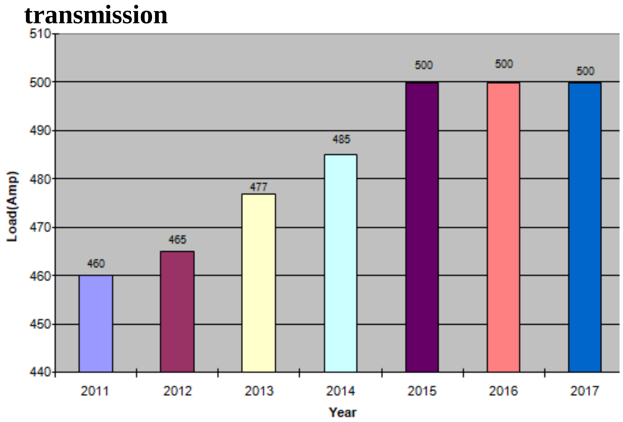


Figure 18: Maximum Ampere flowing record on Hathazari - Baraulia transmission line**.**

Solution: Here we added the maximum Ampere flow record of Hatthazai – Baraulia transmission line through ACSR conductor. Although this conductor capacity is 600Amp, but due to the conductor is so old it cannot carry more then 500 Amp. If they install AAAC/Finch Conductor instead of ACSR conductor, this line can easily carry 1050Amp.

2) **Ampere flow chart of Hathazari - Madunaghat transmission line.**

Maximum Ampere on Hathazari – Madunaghat line	
Year	*Load(Amp)*
2011	326
2012	340
2013	355
2014	380
2015	385
2016	390
2017	400

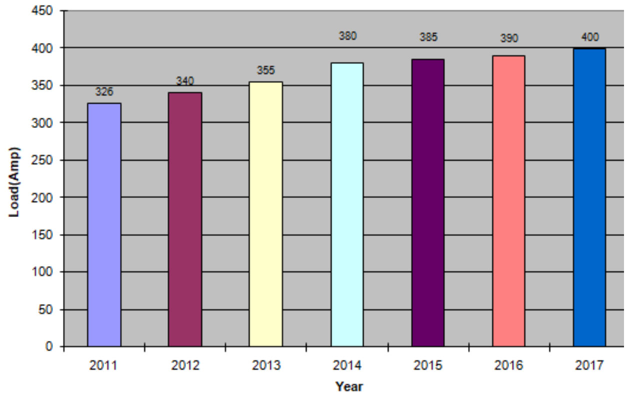
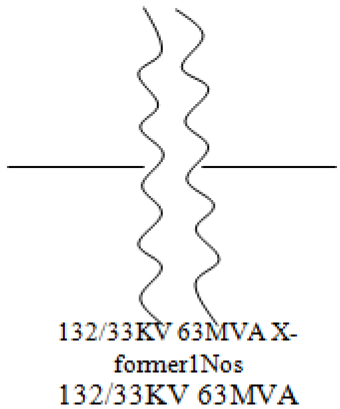


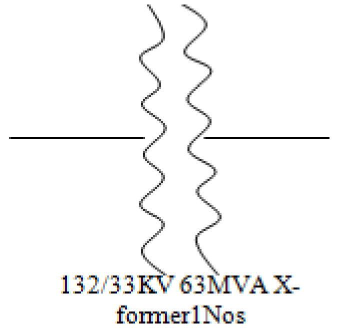
Figure 19: Maximum Ampere flowing record on Hathazari-Madunaghat transmission line**.**

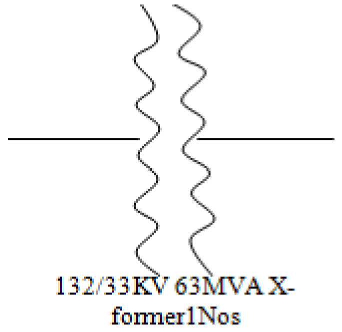
Solution: Here we added the maximum Apmere flow record of Hatthazai – Madhunaghat transmission line through ACSR conductor. Although this conductor capacity is 600Amp, but due to the conductor is so old it cannot carry more then 420 Amp. If they install AAAC/Finch Conductor instead of ACSR conductor, this line can easily carry 1050Amp.

Problem-2 (Halishahar S/S)

The Present capacity of Halishahar Grid S/S is 280MW(3nos-Trasformer-160MW,Baraka P/H-50MW,United PH-70MW) and supplied load of 220MW. As a result load shed occur due to power plant tripped by any cause. With this three 63MVA x-former is not reliable for uninterrupted power supply. As a result the consumer under Halishahar S/S are sufferer.

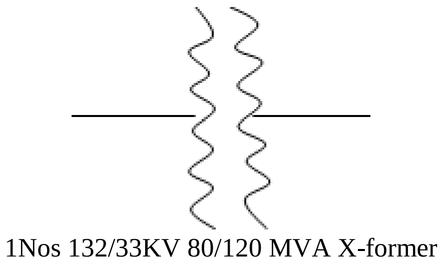


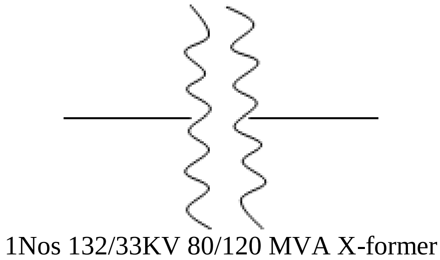


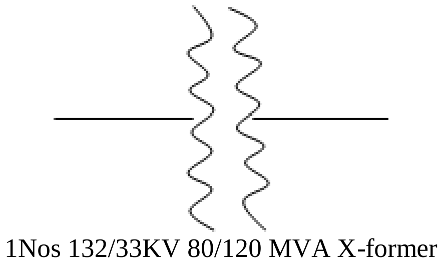


Solution-02

We has suggest that substation capacity increase by replace 80/120 MVA capacity x-former. It is very essential to enhance the reliability of Halishahar grid substation.







Problem-3

The present capacity of Khulshi grid S/S is 2x80 =160MVA and the maximum load is 150MW. With force cooling those transformer is running in over stress. If one transformer trip by any occurrence then another transformer trip by O/C. Khulshi grid S/S has no enough space to install another transformer and expanding the 132KV Bus bar.

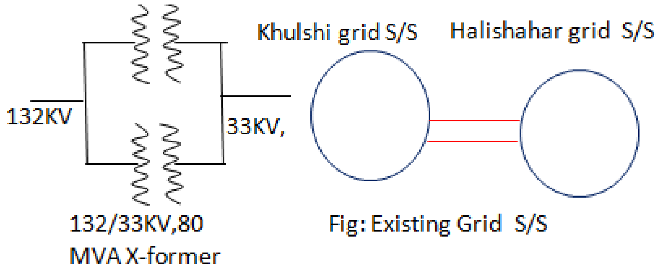


Fig: Existing Grid S/S

Solution-03

The real case for Khulshi grid S/S is that the load of Pahartoli and Stadium area supplied by several 33KV feeder from Khulshi grid S/S. All of this load supplied by 132/33 KV transformer of Khulshi grid S/S. If we can shift the load of Khulshi grid S/S to another 132KV S/S then the stress of Khulshi grid S/S will be released. To overcome this problem we suggest a 132KV substation can be install at Agrabad area. The new substation at Agrabad area will be more economy this new substation has need minimum length of 132KV transmission line. Because the Khulshi-Halishahar 132KV transmission line pass through Agrabadarea.We can make a S/S under the existing 132KV line and S/S can be connected with this line easily. Also that area has enough space to install a grid substation.

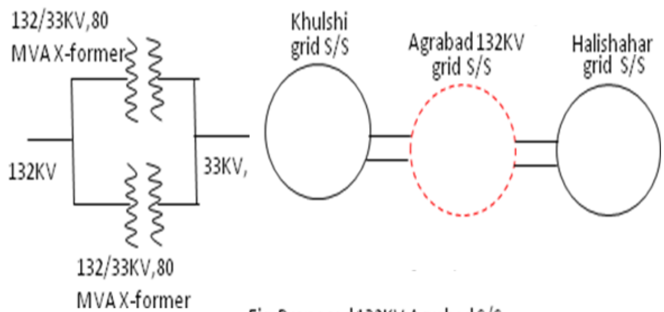
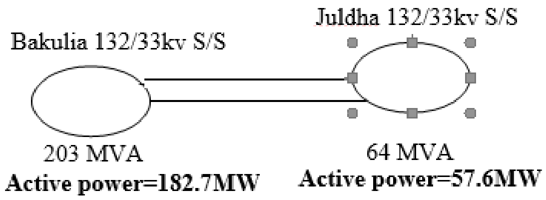
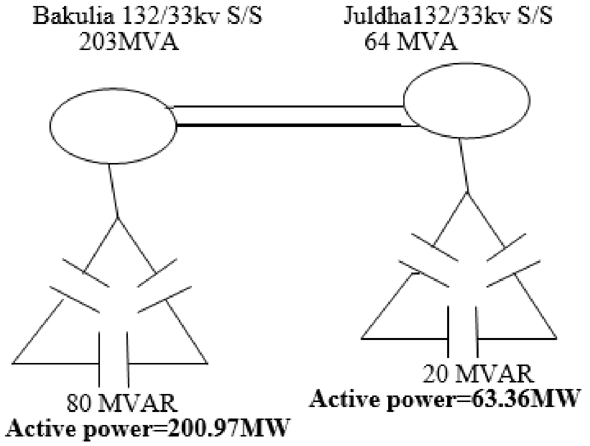


Fig: Proposed 132KV Agrabad S/S

Problem 4: Bakulia & Juldha 132/33kv Sub-station Capacity is (203+64=267MVA) and this sub-station has no Capacitor Bank. That's why they could not use maximum capacity due to low power factor. Now the power factor showing in this sub-stations 0.90. So the Active Power using now 240.3 MW.



Solution 4 : To overcome this problem if they install Capacitor Bank in Bakulia & Juldha 132/33kv Sub-station then power factor can be improve 0.99 and they can found Active Power 264.33 MW. That's how they can get more 24.3 MW which can delivered to consumers.



7.2 Long term solution for Chattogram grid Circle

<u>Problem</u>: If we consider the focus load at years 2020 in Chattogram we should think about it early. In Chattogram has only 132 KV grid ring. But it will not be sufficient after few years. If the power Generation in Chattogram increase linearly it will very difficult to transmit this huge power by 132 KV grid ring.

<u>Solution :</u>

a) We suggest to build a new 230KV Grid Network from Raojan – Madhunaghat – Shikalbaha – Halishahar - Baraulia.

b) We also suggest to build a new 400KV Grid Network from Kumilla – Shikalbaha for better reliable transmission in Chattogram Circle.

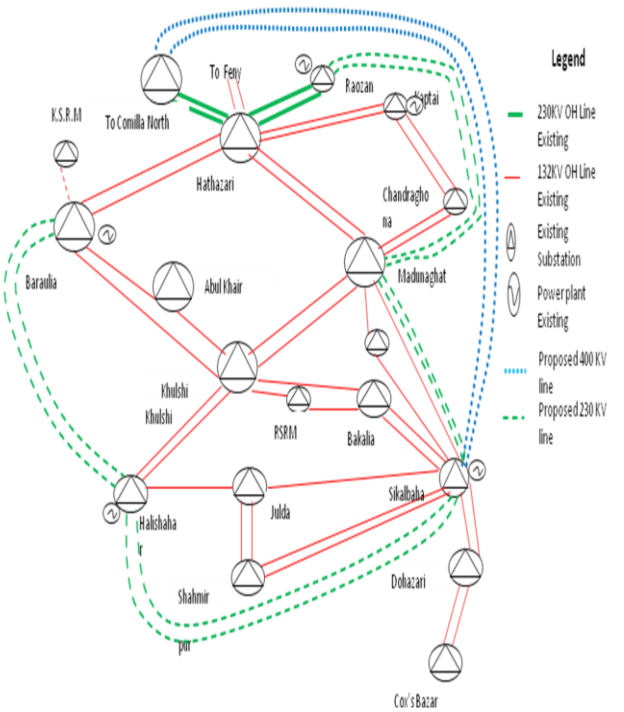


Figure 20: Proposed grid network for Chattogram grid Circle for long term solution.

8. Conclusion

In this study we have found some problem in grid circle Chattogram and we also suggest possible solution. We do not consider the costing for solution. Because we need power anyhow for better life and develop our country. To provide the 10% increasing load every year we should take above necessary action immediately. The electric energy is the basic necessity for the economic development of a country. The economic upliftment of a country is distinguished in terms of per capita consumption of electric power. The earlier ages, the electrical energy has been supplied by the individual generators for the specific region. But at the present interconnection systems are used for the reliable and continuous electrical supply. The name of our thesis is "Study on the Interconnection Power Transmission Network of Chattogram Circle" but we also studied the power generation, power transmission and power supply with protection.

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