No.

The STUDY on BHERAMARA COMBINED CYCLE POWER STATION in BANGLADESH

Final Report (Main Report)

February, 2009

Japan International Cooperation Agency (JICA)

Tokyo Electric Power Services Co., LTD
Tokyo Electric Power Co., LTD

IDD
JR
08-076

Preface

In response to a request from the Government of People's Republic of Bangladesh, the Government of Japan decided to conduct the Feasibility Study on Bheramara Combined Cycle Power Station in Bangladesh, and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent to Bangladesh the Study Team headed by Mr. Hideyuki OKANO, Tokyo Electric Power Services Co., Ltd. and organized by Joint Venture of Tokyo Electric Power Services Co., Ltd. and Tokyo Electric Power Company. four times from February 2008 to December 2008.

The team held discussions with the officials concerned of the Government of People's Republic of Bangladesh and conducted a series of on-site surveys. After its return to Japan, the team conducted further studies and compiled the results in this report.

I hope this report will be utilized for contributing to stable power supply and environmental improvement in the People's Republic of Bangladesh as well as further evolution of friendship relations between both nations.

I wish to express my sincere appreciation to all those who participated in this study project for their close cooperation with the team.

February 2009

Seiichi NAGATSUKA
Vice-President
Japan International Cooperation Agency

February 2009

Mr. Seiichi NAGATSUKA
Vice-President
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Tokyo, Japan

Letter of Transmittal

We are pleased to submit to you the final reports of " The STUDY on BHERAMARA COMBINED CYCLE POWER STATION in BANGLADESH." The report is to propose the construction of high efficient and large capacity gas turbine based Combined Cycle Power Station at Bheramara in western Bangladesh and to recommend and propose appropriate management and organization of North-West Power Generation Company (hereinafter refer as "NWPGCL") and new Bheramara power station for smooth and efficient implementation of corporatization from BPDB.

We assure that the construction of the Plant will be contributive to the stabilization of power supply, the improvement of environment and the development of related areas, and that the application of the recommendations of this report to the power development plan of the People's Republic of Bangladesh will contribute to not only the promotion of the republic welfare, but also the industrial development in the country.

Finally, we would like to express our gratitude to your agency, the Ministry of Power, Energy and Mineral Resources, Bangladesh Power Development Board, North-West Power Generation Company, Power Grid Company of Bangladesh Ltd and Department of Environemt and Local Consultants for wellsuited advice and support.

Very truly yours,

Hideyuki OKANO
Team Leader,
The Study on Bheramara Combined Cycle
Power Station
in Bangladesh

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Abbreviations

A&G	Administrative and General
AASHTO	American Association of State Highway and Transportation Officials
AC	Alternating Current
ACCPAC	ACCPAC (Name of Software)
ACE	Advanced Computing Engine
ACI	American Concrete Institute
ADB	Asian Development Bank
ADP	Annual Development Programme
AE	Assistant engineer
AEO	Annual Energy Outlook
AES	American Energy Services Inc. (AES, Inc.)
AIS	Air Insulated Switchgear
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AM	Assistant Manager
ANSI	American National Standards Institute
APC	Auxiliary Power Consumption
APR	Annual Performance Report
APSCL	Ashuganj Power Station Company Limited
ASCE	American Society of Civil Engineering
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AVR	Automatic Voltage Regulator system
AWS	American Welding Society
AWWA	American Water Works Association
B/S	Balance Sheet
BADC	Bangladesh Agriculture Development Corporation
BAPEX	Bangladesh Petroleum Exploration Company Ltd
BAS	Bangladesh Accounting Standard
BB	Bangladesh Bank
BDM	Break Down Maintenance
BEI	Bangladesh Enterprise Institute
BERC	Bangladesh Energy Regulatory Commission
BIWTA	Bangladesh Inland Water Transport Authority
BNBC	Bangladesh National Building Code
BPC	Bangladesh Petroleum Corporation
BPDB	Bangladesh Power Development Board

BPHE	Bangladesh Public Health Engineer
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
C/P	Counterpart
CB	Cash and Bank Management
CBM	Condition Based Maintenance
CCDB	Christian Commission for Development in Bangladesh
CCGT	Combined Cycle Gas Turbine
CCPP	Combined Cycle Power Plant
CCR	Central Control Room
CD	Custom Duty
CE	Chief Engineer
CEMS	Continuous Emission Monitoring System
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CGS	City Gate Station
CHCO	Chief Human Capital Officer
CHRO	Chief Human Resource Officer
CIO	Chief Information Officer
CMD	Chairman and Managing Director
CNG	Compressed Natural Gas
COD	Commissioning Date
COO	Chief Operating Officer
CPA	Certified Public Accountant
CPDO	Chief Planning & Development Officer
CPF	Contributory Provident Fund
CPI	Consumer Price Index
CRO	Chief Risk Officer
CSR	Corporate Social Responsibility
CV	Calorific Value
CWIP	Capital Work In Progress
CZPDC	Central Zone Power Distribution Company
DC	Direct Current
DCCI	Dhaka Chamber of Commerce & Industry
DCS	Distributed Control System
DESA	Dhaka Electricity Supply Authority
DESCO	Dhaka Electricity Supply Company
DG	Director General
DGM	Deputy General Manager
DM	Deputy Manager

DO	Diesel Oil
DOE	Department of Environment
DPA	Direct Project Aid
DPP	Development Project Proforma
DR	Discount Rate
DSCR	Debt Service Coverage Ratio
Dy	Deputy
E&Y	Ernst & Young
EBIT	Earnings Before Interest and Tax
EBITD	Earnings Before Interest, Tax and Depreciation
ECNEC	Executive Committee of National Economic Council
ED	Executive Director
EE	Executive Engineer
EGCB	Electricity Generation Company of Bangladesh Ltd.
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EOH	Equivalent Operation Hour
EPC	Engineering, Procurement and Construction Contract
ERC	Energy Regulatory Commission
ERD	Economic Relations Division
ERP	Enterprise Resource Planning
ES	Escalation rate of power Sales tariff
F(&)A	Finance & Accounting
F.eX	Foreign Exchange
FBCC	Federation of Bangladesh Chambers of Commerce and Industry
FD	Fixed Deposit
FE	Foreign Exchange
FIFO	First In and First Out
FIRR	Financial Internal Rate of Return
FOB	Free on Board
FRRP	Power Sector Financial Restructuring and Recovery Plan
FSA	Fuel Supply Agreement
FY	Fiscal Year
GCB	Gas Circuit Breaker
GCC	Gas Combined Cycle
GCV	Gross Calorific Value
GFA	Gross Fixed Assets
GIS	Gas Insulated Switchgear
GJ	Giga Joules
GL	General Ledger

GM	General Manager
GNI	Gross National Income
GOB	Government of Bangladesh
GOJ	Government of Japan
GSA	Gas Sales Agreement
GT	Gas Turbine
GTCL	Gas Transmission Company Limited
GTG	Gas Turbine Generator
HMS	Human Machine System
HO	Heavy Oil
HR	Human Resource
HRA	House Rent Allowance
HRD	Human Resource Development
HRSG	Heat Recovery Steam Boiler
HSD	High Speed Diesel
HSE	Health Safety & Environment
HSEQ	Health Safety, Environment & Quality
HT	High Tension
I&C	Instrumentation and Control
IAS	International Accounting Standards
IASB	International Accounting Standard Board
Ic/R	Inception Report
ICAB	Institute of Chartered Accountants of Bangladesh
ICMAB	Institute of Cost and Management Accountants of Bangladesh
IDA	International Development Agency
IDB	Islamic Development Bank
IDC	Interest During Construction
IEB	Institute of Engineers of Bangladesh
IEE	Initial Environmental impact Examination
IFRS	International Financial Reporting Standards
IMED	Implementation, Monitoring and Evaluation Division
IMS	Information Management System
INA	Information Not Available
IOC	International Oil Company
IPB	Isolated Phase Bus
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producer
ISA	Instrumentation, System, and Automation Society
ISO	International Standard Organization
IT	Information Technology

JAM	Junior Assistant Manager
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
KEM	Key Executive Manager
KLHEP	Kargi Langpi Hydro Electric Project
KPI	Key Performance Indicator
KSAO	Knowledge, Skills, Abilities and Other traits or factors
KYT	Kiken Yochi Training
L/A	Loan Agreement
L/T	Long Term
LA	Lightening Arrester
LCD	Liquid Crystal Display
LDC	Load Dispatch Center
LTPM	Long Term Parts Management
LTSA	Long Term Service Agreement
MBO	Management by Objective
MD	Managing Director
MES	Manufacturing Execution System
MIS	Management Information System
MLA	Multilateral Lending Agency
mmscfd	Million standard cubic feet per day
MOH	Major Overhaul
MOL	Ministry of Land
MOM	Minutes of Meeting
MoPEMR	Ministry of Power, Energy & Mineral Resources
MP	Master Plan
MS	Multi-shaft
MSCF	Mil (Thousand) Standard Cubic Feet
MTMF	Medium Term Macroeconomic Framework
MU	Million Unit
MW	Mega Watt
NFPA	National Fire Protection Association
NLDC	National Load Dispatch Center
NOx	Nitrogen oxide
NRV	Net Realizable Value
NTPC	National Thermal Power Corporation Ltd
NWPGCL	North-West Power Generation Company Ltd.
O&M	Operation and Maintenance
OA	Office Automation
OCB	Oil Circuit Breaker

OCGT	Open Cycle Gas Turbine
OECD	Organization for Economic Cooperation and Development
OEM	Original Equipment Manufacturer
OH	Overhaul
OJT	On the Job Training
OMCO	Operation & Maintenance Chief Officer
OPGW	Optical Ground Wire
P/S	Power Station
PAT	Profit After Tax
PBITD	Profits Before Interest, Tax and Depreciation
PBS	Palli Bidyut Samities
PC	Personal Computer
PC	Power Cell
PCS	Process Control System
PDA	Personal Digital Assistant
PDCA	Plan Do Check Action
PDPAT	Power Development Planning Assist Tool
PGCB	Power Grid Company of Bangladesh
PI	Plant Information
PIMS	Plant Information Management System
PIU	Project Implementation Unit
PLC	Programmable Logoc Controller
PM	Plant Manager
PMB	Plant Management Board
PMC	Plant Management Committee
POAE	Plant Operating Availability on an Energy basis
POAH	Plant Operating Availability
PP	Power Purchased
PP	Project Proforma
PPA	Power Purchase Agreement
PPE	Personal Protective Equipments
PSMP	Power System Master Plan
PSP	Power Sales Tariff
PTW	Permit to Work
PwC	Pricewaterhouse Coopers Pvt. Ltd.
QC	Quality Control
R&M	Repair and Maintenance
RAO	Regional Administration Office
RDPP	Revised Development Project Proforma
REB	Rural Electrification Board

RMS	Regulative Metering Station
ROA	Return on Asset
RPA	Residual Project Aid
S/S	Substation
SBU	Strategic Business Unit
SCADA	Supervisory Control And Data Acquisition
SCGT	Simple Cycle Gas Turbine
SCI	Statement of Corporate Intent
SDE	Sub Divisional Engineer
SE	Superintending Engineer
SGV	SyCip Gorres Velayo & Co,
SHR	Sensible Heat Ratio
SL	Subordinated Ledger
SL	Transmission and Distribution System Loss
SLDC	State Load Dispatch Center
SOP	Sale of Power
SPP	Small Power Producer
SS	Single-shaft
ST	Steam Turbine
STG	Steam Turbine Generator
SUS	Stainless Used Steel
SZPDC	South Zone Power Distribution Company
TBM	Time Based Maintenance
TBM	Tool Box Meeting
TFD	Time of Flight Diffraction
TGTDCL	Titas Gas Transmission and Distribution Company Ltd.
Tk	Bangladesh Taka
TL	Transmission Line
TMT	Top Management Team
TNA	Training Needs Assessments
TOR	Terms of Reference
TQM	Total Quality Management
UEEP	Used Energy End Point
USD	United States Dollar
UT	Ultrasonic Testing
VAT	Value Added Tax
VC	Variable Cost
VCT	Voltage Circuit Transformer
W/S	Work Shop
WACC	Weighted Average of the Capital Cost

WASP	Wien Automatic System Planning Package
WB	World Bank
WBSEDCL	West Bengal State Electricity Distribution Company Limited
WPI	Wholesale Price Index
WTP	Willingness to Pay
WZPDCL	West Zone Power Distribution Company Ltd.
XEN	Executing Engineer

UNITS

Prefixes

μ	:	micro- = 10^{-6}
m	:	milli- = 10^{-3}
c	:	centi- = 10^{-2}
d	:	deci- = 10^{-1}
da	:	deca- = 10
h	:	hecto- = 10^{2}
k	:	kilo- = 10^{3}
M	:	mega- = 10^{6}
G	:	giga- = 10^{9}

Units of Length

m	:	meter
mm	:	millimeter
cm	:	centimeter
km	:	kilometer
in	:	inch
ft	:	feet
yd	:	yard

Units of Area

cm^2	:	square centimeter
m^2	:	square meter
km^2	:	square kilometer
ft^2	:	square feet (foot)
yd^2	:	square yard
ha	:	hectare

Units of Volume

m^3	:	cubic meter
l	:	liter
kl	:	kiloliter

Units of Mass

g	:	gram
kg	:	kilogram
t	:	ton (metric)
lb	:	pound

Units of Density

kg/m^3	:	kilogram per cubic meter
t/m^3	:	ton per cubic meter

mg/m^3N	:	milligram per normal cubic meter
g/m^3N	:	gram per normal cubic meter
ppm	:	parts per million
μg/scm	:	microgram per standard cubic meter

Units of Pressure

kg/cm^2	:	kilogram per square centimeter (gauge)
lb/in^2	:	pound per square inch
mmHg	:	millimeter of mercury
mmHg abs	:	millimeter of mercury absolute
mAq	:	meter of aqueous
lb/in^2, psi	:	pounds per square inches
atm	:	atmosphere
Pa	:	Pascal
bara	:	bar absolute

Units of Energy

kcal	:	kilocalorie
Mcal	:	megacalorie
MJ	:	mega joule
TJ	:	tera joule
kWh	:	kilowatt-hour
MWh	:	megawatt-hour
GWh	:	gigawatt-hour
Btu	:	British thermal unit

Units of Heating Value

kcal/kg	:	kilocalorie per kilogram
kJ/kg	:	kilojoule per kilogram
Btu/lb	:	British thermal unit per pound

Units of Heat Flux

$kcal/m^2h$	:	kilocalorie per square meter hour
Btu/ft^2H	:	British thermal unit per square feet hour

Units of Temperature

deg	:	degree
°	:	degree
C	:	Celsius or Centigrade
°C	:	degree Celsius or Centigrade
F	:	Fahrenheit
°F	:	degree Fahrenheit

Units of Electricity

W	:	watt
kW	:	kilowatt
A	:	ampere
kA	:	kiloampere
V	:	volt
kV	:	kilovolt
kVA	:	kilovolt ampere
MVA	:	megavolt ampere
Mvar	:	megavar (mega volt-ampere-reactive)
kHz	:	kilohertz

Units of Time

s	:	second
min	:	minute
h	:	hour
d	:	day
y	:	year

Units of Flow Rate

t/h	:	ton per hour
t/d	:	ton per day
t/y	:	ton per year
m^3/s	:	cubic meter per second
m^3/min	:	cubic meter per minute
m^3/h	:	cubic meter per hour
m^3/d	:	cubic meter per day
lb/h	:	pound per hour
m^3N/s	:	cubic meter per second at normal condition
m^3N/h	:	cubic meter per hour at normal condition

Units of Conductivity

μS/cm	:	microSiemens per centimeter

Units of Sound Power Level

dB	:	deci-bell

Units of Currency

Sum	:	Uzbekistan Sum
US$	:	US Dollar
¥	:	Japanese Yen

Exchange Rate : US$ 1 = 68 taka

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Part II Proposal for Corporation Plan and Organiazation of NWPGCL nad Bheramara Combined Cycle Power Station

Overall Evaluation and Recommendation

Introduction

Consultants have taken 6 months in surveying and studying the feasibility on the construction of the Bheramara Combined Cycle Power Plant (hereinafter referred to as "Bheramara CCPP”). This report is to describe the results of survey and study on the "Bheramara Combined Cycle Power Station in Bangladesh" under a commission from the Japan International Cooperation Agency (hereinafter referred to as "JICA"), an independent administrative agency of Japan. The objective of the Study is to evaluate the technical feasibility, environmental and social considerations, and economic feasibility of the construction program and to propose a corporate plan on the autonomous and efficient management of the North-West Power Generation Company (NWPGCL) and Bheramara CCPP, based on the trend of the BPDB spin-off program and the preceding cases of other companies. The following describes the overall evaluation on the aforementioned survey work.

I. Overall Evaluation

As a result of evaluating the technical feasibility, environmental and social considerations, and economic feasibility of the construction program in this survey, the feasibility of the Bheramara CCPP construction has been generally verified, although with certain qualifications. Further, a corporate plan has been proposed on the autonomous and efficient management of the North-West Power Generation Company (NWPGCL) and Bheramara CCPP, and the groundwork is considered to have been laid for the organization, system, and business operation procedures for implementation of this project and operation of the power generation company.

1. Technical Feasibility

1.1 Justification of the construction program

The study has verified the adequacy of the power demand forecast described in the Power System Master Plan update 2006 (hereinafter referred to as "PSMP2006"), acquisition of sufficient beneficial effects such as an increase in the electrification rate due to the implementation of this project and improvement in the practical side of life due to an increase in employment opportunity, adequacy of the electric power development program based on the power demand forecast, and adequacy of the power generation facility arrangement and output of the Bheramara CCPP through system analysis. Verification of the aforementioned adequacies leads to the conclusion that the construction program of this project is suitable.

1.2 Diversification of fuels and selection of the gas turbine type

The study on fuel diversification in the CCPP using gas as a major fuel has demonstrated that use of heavy oil and light oil as an alternative fuel is not a proper selection from the viewpoint of technology, economy, and environment. Preferential supply of gas is essential for the implementation of this project. Our recommendation for fuel diversification is a gas-fired CCPP provided with a light oil backup facility. Further, when consideration is given to the output level programmed in the Bheramara CCPP, possible candidates include the CCPP using two E-type gas turbines (hereinafter referred to as "E-type CCPP), or CCPP using one F-type gas turbine (hereinafter referred to as "F-type CCPP). The E-type CCPP has an advantage in that the output of 450 MW or more (under the site conditions) can be ensured, depending on the manufacturers to be selected by international bid. However, when this type is subjected to an overall evaluation from the technical, economical and environmental point of view, we would like to recommend the F-type CCPP which is characterized by high efficiency and a small environmental load for this project.

1.3 Natural gas supply

The Bheramara CCPP is planned to be fired by natural gas in normal operation, and the reliable supply of natural gas to the Bheramara CCPP determines the success or failure of this project. When this survey started, it was learnt that natural gas would be supplied to the Bheramara CCPP in 2012. However, due to a delay in the development of a new gas field, MoPEMR announced in August 2008 that the supply of natural gas to the Bheramara CCPP might be achieved around 2016. In the meantime, for the earliest possible solution to the current power shortage problem, it is absolutely essential to commence the commercial operation of the Bheramara CCPP in 2014. This makes it necessary for the Government of Bangladesh to set up a definite policy for the preferential supply of natural gas to the Bheramara CCPP by promoting the development of a new gas field and suspension of the existing low efficiency gas-fired power plant.

1.4 Condenser cooling system and use of a groundwater

For the condenser cooling system, a study has been made for a once-through type cooling system, cooling tower system, and air-cooled condenser system from the viewpoint of technology, environment, and economy. Adoption of a cooling tower system has been determined as a result of this study. In the cooling tower system, groundwater is used as the make-up water. As a result of surveying and analyzing the impact of the use of the groundwater on the wells around the new power plant, it has been verified that there is no impact during dry or rainy seasons and in long-term use. However, to verify the impact after

commencement of commercial operation, monitoring of the surrounding wells is essential.

1.5 Transportation of heavy equipment

In the construction of a large gas-fired power plant, a serious impact may occur to the construction process is given by the method adopted for transporting such heavy objects as gas turbine, steam turbine, generator stator, and transformer, and the level of difficulty in their transportation. In this project, heavy objects will be carried mainly through river from the port of Mongla in the southwestern part of Bangladesh to the Bheramara site. In the meantime, river transportation is restricted to the period from July to September by the depth of water in the Padma River in the vicinity near the Bheramara site. Accordingly, a detailed heavy object transportation program must be worked out by the contractor in consultation with the river administrator and transportation company. Further, the material and equipment of 40 tons or less in weight will be carried by land from the port of Mongla to the project site. However, when the heavy objects weighing 40 tons or more are to be carried, the risk of river transportation must be minimized by using land transportation instead of river transportation, for example, by optimizing the individual package weight and dimensions, along with consideration given to the mode of land transportation such as separate transportation.

1.6 Project schedule

The river transportation of heavy objects is restricted to the three-month period from July to September affecting the project schedule. Due to the globally tight conditions of the production line, the required delivery time of an F-type gas turbine will be about 25 months from the design phase to the time of delivery on an F.O.B. basis. Thus, about 64 months will be required from the conclusion of LA to the completion of the power plant construction. Further, there are signs of a global economic recession resulting from the impact of the financial crisis triggered by the United States and the subsequent trend of gas turbine production must be closely watched.

2. Environmental and Social Consideration

The construction site of the Bheramara CCPP is located at the site adjacent to the existing Bheramara power plant in the northeast, and the surrounding land is also owned by BWDB or BPDB. So there is no need for large-scale land acquisition. Natural forests, habitats of precious plants and animals or ancient remains have not been discovered within the project site. This site has no problems with natural environment. Further, there are no particular problems with the social environment, because almost all the inhabitants around the existing power plant and project site are engaged in farming, and their relocation is not required by this

project. With the construction of the Bheramara CCPP, there are concerns about the possibility of noise, vibration, water pollution and air pollution being caused during the construction period, and noise, vibration, air pollution, and water pollution being caused after commencement of commercial operation. However, impact on the surrounding environment and inhabitants can be removed by taking adequate environmental measures based on the simulation analysis results.

In addition, during construction and after commissioning, comprehensive contribution to local economy and industry can be achieved through the employment of the local people who will participate in the training program, procuring the local products from the hometown cooperation and upbringing of new local industry in cooperation with a local self-governing body. And the maintenance of the organization system should be planned in order to grasp the opinion of inhabitants enough and address them.

Based upon the foregoing, it is judged that this Project will not have adverse impact on neighboring environment and the inhabitants. Rather it will be able to contribute to activation of the local economy.

3. Economic Feasibility

There has been a steep rise in the prices of the gas turbine, steam turbine, and generator constituting the CCPP due to the recent rising prices of the materials and overheating of the power generation facility market. With consideration given to market trends and based on the recent conclusion of contracts, the project cost has been calculated as amounting to a total of about 84.5 billion yen (of which the power generation facility cost amounts to about 43.2 billion yen). As a result of economic and financial analyses, the EIRR has been calculated as 20.64% by the method of quantifying the Willingness-to-Pay and FIRR has been calculated as 5.88% on a tentative basis. Thus, the EIRR having been calculated exceeds the opportunity cost of the capital in Bangladesh and the FIRR exceeds the weighted average cost of the invested capital, whereby this project has been verified to be economically feasible.

4. Strengthening the functions of a power generation company and supporting the improvement of basic conditions in a power plant

Based on the study of a preceding company having been spun off in conformity to the Bangladesh policy on the improvement of the electric power sector, analysis of the present situation in Bheramara CCPP was conducted according to the case research from the viewpoint of business administration, risk management, organization management, labor and personnel management, financial and accounting management, O & M management, information management, and environmental management.

The following problems have been detected:

- Stable business administration of the BPDB has not been achieved for a long period of time under the protection of the regulations led by the Government, without sufficient autonomous and efficient management being promoted.

- The business administration vision is not sufficiently captured by the personnel, and there is no clear definition of a grand design on which the organization should be based.

- Since the principle of separating the business administration implementation function from the supervising function is not established, independence of business administration is not ensured, and decision making in business administration is slow.

- There is no incentive/punishment system or employment system that can provide logical and effective functions, as can been observed in the guarantee of lifetime employment and the fixed salary system are not interlinked with individual business performances.

- BPDB is a seller of electricity as well as a purchaser of electricity as a single buyer. Accordingly, this organization has no concept of practical cash flow, which is essential to autonomous management.

- In many of the power plants in Bangladesh, there is a widespread compulsion of breakdown maintenance where "the facility should be operated until it is broken". Proactive maintenance activities can not be conducted at all. As a result, there is rapid dilapidation of the equipment and facilities, hence a perfect "negative spiral" of occurrences in serious accidents and troubles, resulting in occurrence of massive repair costs, failure to repair due to financing difficulties and reduction in supply.

- In Bangladesh, there are many power plants which were constructed and operated before the EIA scheme was improved. Thus, a management scheme based on the environmental management program has not worked out in many cases. The Bheramara power plant will be operated after the environmental management program has been approved. It is very important to strengthen the organization management scheme on environmental management including monitoring.

II. Recommendation

Based on the results of this survey, we would like to submit the following proposals:

1. The construction of this project is planned based on the assumed power demand calculated in the PSMP2006 and electric power development program. The power demand prediction is closely related to the GDP growth rate. The GDP growth rate up to 2025 can be represented by a curve exhibiting an upward slope to the right. Accordingly, the power demand is anticipated to register a favorable increase. As discussed above, due to the global economic recession triggered by the United States, the GDP growth rate is expected to slow down in Bangladesh as well as in other parts of the world. In this situation, it will be necessary to review the power demand prediction based on the real economy.

2. An earlier start of the study is desired in order to work out specific measures on how to implement the preferential supply of gas to the Bheramara CCPP in and after 2014. As most realistic measure, taking into consideration of the efficient utilization of natural gas produced in Bangladesh and balanced business operation of electric power company, natural gas should be re-allocated to the Bheramara CCPP, rather than to aged and low efficient existing gas thermal power plants.

3. A cooling tower system has been adopted as the cooling system and groundwater will be used as the make-up water of this system. Based on the results of the pumping test conducted in September this year, it has been found out from the analysis results that there is a sufficient reserve of groundwater around the site planned for the power plant construction, and there is almost no impact on the existing wells in the surrounding area when a large volume of groundwater is drawn off. However, to verify the impact subsequent to commencement of the commercial operation, we would like to propose continuous monitoring of the wells now running as well as to be implemented in the surrounding area.

4. Transportation of heavy objects is planned mainly based on river transportation, and river transportation is possible only during the period from July to September due to the low water level in the Padma River. In this survey, however, due to the limited time, we measured the water depth of a navigation route from the port of Mongla to the Bheramara site during the period of July. Accordingly, to verify the reliability of the period of river transportation, we would like to recommend measurement of the water depth of the navigation route from the port

of Mongla to the Bheramara site during the period of June through October, starting a year before the river transportation begins.

5. The period of river transportation of heavy objects and the delivery time of the gas turbine are critical points in the project schedule, as discussed above. In the meantime, due to the recent global economic recession, there is a possibility of the combined cycle power generation project being delayed or cancelled. The current tight conditions of the gas turbine production line may be loosened in the future, and the delivery time of the gas turbine may be shortened. These possibilities must be carefully watched.

6. There is a possibility of a slowdown in the steep rise of the project cost resulting from a substantial rise in material costs and overheating of the power generation facility market for the last several years. The trend of the power generation facility market must be carefully watched.

7. We would like to propose the most important six key messages for ensuring that autonomous and efficient management will be carried out by the NWPGCL and Bheramara power plant.

Key Message 1: Working out a business administration vision

To ensure continued development of a company, it is important to implement an efficient management and in-house human resources development program. The target of the NWPGCL is the continued development of the organization, which can be achieved by both autonomous management and human resources development. The three major points of "autonomy of business administration", "highly reliable power supply", and "continued development" are the NWPGCL's business administration vision. Balanced achievement of these major points is the key to success.

Key Message 2: Principle of separating the business administration implementation function from the supervising function

To ensure continued development of a company, it is essential to establish a corporate governance scheme and to work out a framework to direct and unify the company. The major points are:

<1> Separating the business administration implementation function from the supervising function

<2> Implementation and operation of internal regulations

<3> Supervision from outside the company

In particular, it is important to separate the business administration implementation function from the supervising function in order to enhance the independence of the business administration, and to increase the speed of decision making in business administration and job implementation.

Key Message 3: Working out an employment system based on the principle of competition and rating by performance

We would like to propose the introduction of an employment system based on the principle of competition and rating by performance for the purpose of ensuring autonomy and efficient management under the umbrella of NWPGCL. It is important to introduce a framework of a one-year trial period, followed by the conclusion of a three-year employment contract as a regular employee, and then by updating the contract period in conformity to individual performances. Further, roles and responsibilities should be defined through the improvement of the regulations on official authority and others, and adequate evaluation of performances should be carried out according to a multifaceted evaluation procedure, whereby adequate pay (remuneration) is provided. It is necessary to introduce such a framework where incentives effectively come into play.

Key Message 4: Ensuring cash flow

All the electric power generated by NWPGCL will be purchased by the BPDB as a single buyer. Payment will be made to NWPGCL by BPDB according to the PPA agreement to be concluded between BPDB and NWPGCL. This means that the PPA agreement is crucial. In APSCL, the accounts receivable are equivalent to the sales of about one year. Although the balance is kept in the black in terms of the statement of profit and loss, sufficient equipment and materials cannot be procured due to the lack of cash flow, and the operation of the power plant may be adversely affected. Thus, when a PPA agreement is concluded, it is necessary to take into account the management of accounts receivable, for example, through pledging a letter of credit or revolving credit, opening an escrow account, or diversification of electricity buyers.

Key Message 5: Working out the O & M management scheme based on proactive maintenance activities

In many of the power plants in Bangladesh, maintenance is compelled to be carried out on "Level 1: breakdown maintenance (BDM)" where the facility is operated until it is broken down", on a continuous basis. In Japan, the periodic legal inspection is stipulated by regulation authorities and the maintenance is carried out mainly on "Level 2: time based

maintenance (TBM)". As a result of the maintenance activities by the electric utilities and active study of the essential requirements for inspection by regulation authorities, the level is shifting toward "Level 3: condition based maintenance (CBM)" where the periodic inspection interval is prolonged while the current level of safety is kept. Thus, Bangladesh is expected to acquire the skill capable of accurate identification of situations so as to adopt the flexible maintenance management based on the TBM/CBM combination which is similar to that of Japan, and to improve the level of organization and technology, whereby the reliability and safety of the facilities are ensured.

Key Message 6: Working out the management scheme in conformity with the environmental management program

In the Bheramara power plant this time, licensing of power generation depends on the approval of EIA and environmental management programs. Thus, it is strongly desired that effective implementation of environmental management will be accomplished by working out an organization administration scheme related to environmental management in each of the corporate, management, plant and public levels, as well as by working out program, maintenance measures, monitoring and record management programs, whereby adverse impact on the environment subsequent to commencement of commercial operation will be minimized.

Part I

Feasibility
of
Bheramara Combined Cycle Power Station Construction Plan

Chapter 1 Preface

1.1 Background of the study

Bangladesh is aiming for supplying electric power to all the citizens by 2020. However electrification rate is still 42% in 2007. In comparison to 5,100 MW as the peak power demand, the maximum power generating capacity is approximately 3,800 MW. They cause planned power cut because of power supply shortage. On the other hand, power demand growth is forecasted as 8% a year from now on and it is necessary to build approximately 5,500 MW of new power supply for next five years to satisfy power demand growth.
Also natural gas field as the significant natural resource in Bangladesh is unevenly distributed at eastern area in Bangladesh. It leads to build power stations in eastern area not in western area. This unevenly gas distribution situation causes power supply shortage in western area, transmission loss from eastern power to western area and drop in voltage. Generally western area is slowin development and it is a matter of great urgency to aim to raise their living standard in western area.
Now natural gas pipeline is under construction with the support from ADB and Bangladesh is planning to build a large scale gas power plant in western area.
Meanwhile Bangladesh has been reforming the electric power sector in order to improve administrative management and power supply since 1994. So far, BPDB has been divided into APSCL, EGCB and PGCB. Bheramara CCPP is supposed to belong to NWPGCL and company plan is also the subject matter of this study.
In August 2007, Bangladesh requested Japan Government for a feasibility study of Bheramara combined cycle power plant in western Bangladesh. ODA task force in Bangladesh is examining possibility of providing ODA loan from JBIC concerning The Plant construction.
In order to decide the scope of F/S, study the power sector and creation of the company, JICA executed on-site study of The Plant in October, 2007 and recorded M/M concerning the future cooperation plan to confirm the necessary condition of the Plant through discussion with local party and study of the candidate site for The Plant. Based on the draft which was prepared during the last on-site study, JICA agreed with local party concerning contents of S/W afterward.

1.2 Objectives of the Study and Scope of the Study

1.2.1 Objectives of the Study

Objectives of the study are as follows.

(1) To execute the Feasibility Study concerning Bheramara CCPP Construction in The People's Republic of Bangladesh and necessary technology transfer to the staff concerned of local C/P for The Study term.
(2) To support NWPGCL, which will manage The Plant, concerning administrative system and management plan.

Concerned departments in Bangladesh are as follows.

- Ministry of Power Energy and Mineral Resources: MoPEMR
- Bangladesh Power Development Board: BPDB
- NWPGCL
- APSCL
- EGCB

- PGCB
- Petrobangla
- Economic Relations Division : ERD
- Planning Commission
- MOE
- Bangladesh Water Development Board: BWDB

The areas to be studied are as follows.

(1) The areas to be studied are Bheramara and its surrounding places.
(2) The areas to be executed to support management of NWPGCL are Bheramara and its surrounding areas and Dhaka and its surrounding areas.

1.2.2 Scope of the Study

Based on the Minute of Meeting and Scope of Works which were signed in December, 2007 between the Preliminary Study Team of JICA and Bangladesh, the following components of the Study will be carried out:

(1) Collection and confirm of Basic information and plan
- Power demand forecast
- Profitable effect
- Fuel supply system
- Power system plan to connect 230kV power line
- Practicable system
- Adequacy for the site selection

(2) Study for construction site
- Topography survey and study of structures
- Soil quality study
- Study for the cooling system and river conditions

(3) Study for engineering
- Designing for power plant and determination of necessary specification
- Determination of Project cost and financial plan
- Estimation of necessary procurement and delivery schedule
- Basic design
- Construction schedule

(4) Suggestion for administrative system of The Plant
(5) Study of financial analysis and management effect index
(6) Environment and social concern
- Study of the environment
- Study of the social concern
- Study of pollution countermeasure
- Study of reduction plan of environmental impact
- Study of environmental management and monitoring
- Study of resettlement
- Support for stakeholder committee

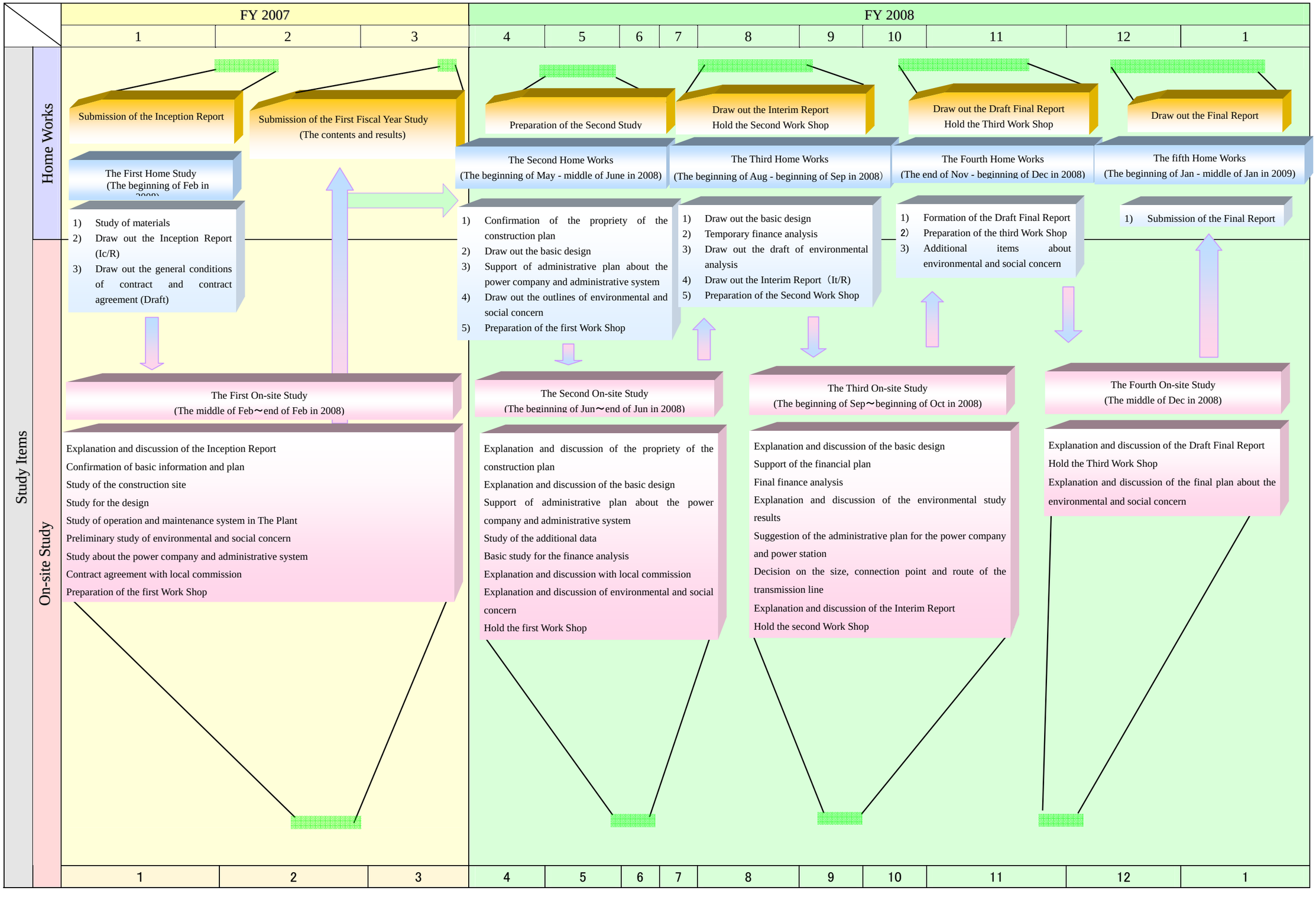
(7) Support of administrative plan about the power company and administrative system
- Support to NWPGCL to establish its organization
- Support for business plan of The Plant

(8) Technology transfer for whole study -term

(9) Work Shop (hereinafter called as "W/S")

1.2.3 Duration of the Study

Schedule of the Study is shown in the next page.


FY 2007
FY 2008
1
2
3
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1
Home Works
Study Items
On-site Study
Submission of the Inception Report
Submission of the First Fiscal Year Study
(The contents and results)
Preparation of the Second Study
Draw out the Interim Report
Hold the Second Work Shop
Draw out the Draft Final Report
Hold the Third Work Shop
Draw out the Final Report
The First Home Study
(The beginning of Feb in 2008)
The Second Home Works
(The beginning of May - middle of June in 2008)
The Third Home Works
(The beginning of Aug - beginning of Sep in 2008)
The Fourth Home Works
(The end of Nov - beginning of Dec in 2008)
The fifth Home Works
(The beginning of Jan - middle of Jan in 2009)
1) Study of materials
2) Draw out the Inception Report (Ic/R)
3) Draw out the general conditions of contract and contract agreement (Draft)
1) Confirmation of the propriety of the construction plan
2) Draw out the basic design
3) Support of administrative plan about the power company and administrative system
4) Draw out the outlines of environmental and social concern
5) Preparation of the first Work Shop
1) Draw out the basic design
2) Temporary finance analysis
3) Draw out the draft of environmental analysis
4) Draw out the Interim Report（It/R)
5) Preparation of the Second Work Shop
1) Formation of the Draft Final Report
2) Preparation of the third Work Shop
3) Additional items about environmental and social concern
1) Submission of the Final Report
The First On-site Study
(The middle of Feb～end of Feb in 2008)
The Second On-site Study
(The beginning of Jun～end of Jun in 2008)
The Third On-site Study
(The beginning of Sep～beginning of Oct in 2008)
The Fourth On-site Study
(The middle of Dec in 2008)
Explanation and discussion of the Inception Report
Confirmation of basic information and plan
Study of the construction site
Study for the design
Study of operation and maintenance system in The Plant
Preliminary study of environmental and social concern
Study about the power company and administrative system
Contract agreement with local commission
Preparation of the first Work Shop
Explanation and discussion of the propriety of the construction plan
Explanation and discussion of the basic design
Support of administrative plan about the power company and administrative system
Study of the additional data
Basic study for the finance analysis
Explanation and discussion with local commission
Explanation and discussion of environmental and social concern
Hold the first Work Shop
Explanation and discussion of the basic design
Support of the financial plan
Final finance analysis
Explanation and discussion of the environmental study results
Suggestion of the administrative plan for the power company and power station
Decision on the size, connection point and route of the transmission line
Explanation and discussion of the Interim Report
Hold the second Work Shop
Explanation and discussion of the Draft Final Report
Hold the Third Work Shop
Explanation and discussion of the final plan about the environmental and social concern

1.3 Assignment of the Study Team

Table I-1-3-1 shows the assignment for each expert of the Team.

Table I-1-3-1 Formation of the Team

Name	Assignment
Hideyuki OKANO	Project Manager
Shinji OUCHI	Power Plant System Planning Expert
Hiroshi SHINOHARA	Fuel Supply Planning Expert
Ichiro KATAGIRI	Civil Expert
Hajime SAIT	Mechanical Expert A
Kenji MIKATA	Mechanical Expert B
Masamichi SHOJI	Electrical Expert
Kenichi KITAMURA	Transmission Expert
Noboru SEKI	Business Management Expert
Kiyoshi KATAOKA	O&M Management Expert
Toshiyuki KOBAYASHI	Organizational Structure Expert
Yasuhisa KURODA	Financial and Accounting Expert
Norihiko FUKAZAWA/ Mitsutake KUDO	Environmental Expert A
Tadashi NAKAMURA	Environmental Expert B
Nobunao TAKAHASHI	Coordinator

1.4 Work Shop

Three Work Shops were held on thefollowing dates. Details of each work shop are described in Technology Transfer Report.

- 1st Work Shop : June 4, 2008
- 2nd Work Shop : September 10 and 18, 2008
- 3rd Worl Shop : November20 and 24, 2008

1.5 Stake Holder Meeting

Stake holder meeting were held three times on the following dates. Details of each stake holder meeting are described in Chapter 7 of Main Report.

- 1st Stake Holder Meeting : June 16 and 17, 2008
- 2nd Stake Holder Meeting : September 21 and 22, 2008
- 3rd Stake Holder Meeting : November 30 and December 1, 2008

Chapter 2 Social / Economic State of Conditions in Bangladesh

2.1 Overview

Bangladesh has been exerting incessant efforts to improve the socio-economic conditions of the country since its independence in 1971 while being continuously assisted by the domestic and external organizations. Notwithstanding those domestic and external efforts, the Gross National Income (GNI) per capita in the country remains at the level of US$ 450 (2006 constant price) and is classified as one of the Least Developed Countries as defined by United Nation[1]. The level of GNI per capita is below the level of US$ 900 which is defined as the threshold for graduating from the category of the Least Developed Countries. The fundamental indicators of the socio-economic conditions of Bangladesh compares with those of other neighboring South Asian countries as follows;

Table I-2-1-1 Comparison of Socio-Economic Indicators among South Asian Countries

Country	GNI/capita	GDP Growth Rate	Average Rate of Inflation	Fiscal Balance (% of GDP)	Poverty Headcount Rate *1	Enrollment for Primary Education	Average Life Expectancy at Birth	Electricity Consumption
	(US$)	(%)	(%)		(%)	(%)	(years)	(kWh/capita)
Year of Data	2006	2000-2006	2000-2006	2006	2004	2006	2006	2005
Bangladesh	450	5.6	5.9	-3.2 *1	36.3	103	64	136
India	820	7.4	4.2	-2.8	35.3	115	64	480
Nepal	320	3.3	5.2	-1.6	30.9	126	63	70
Pakistan	800	5.5	5.6	-4.2	17.0	84	65	456
Sri Lanka	1,310	4.8	9.7	-7.2	5.6	105	75	378

(note) *1: Poverty Headcount Rate is taken from World Bank, “Bangladesh: Country Assistance Strategy 2006-2009”
*2: Fiscal Balance of Bangladesh is taken from IMF, “Bangladesh: Statistical Appendix” June, 2007
(source) World Bank, “World Development Indicators 2008”, 2008
World Bank, “Bangladesh: Country Assistance Strategy 2006-2009”, undated

The above table confirms GNI per capita of Bangladesh being at US$ 450 which ranks second to Nepal from the bottom among the neighboring countries. On the other hand, the growth rate of GDP is second highest after India while the rate of inflation is acknowledged to be high. The country ranks in the middle in its fiscal balance but its poverty headcount rate is the highest in the region. The average consumption of electricity per capita is very low in comparison with the countries of India, Pakistan and Sri Lanka, at less than 30% of India and Pakistan.
Taking a closer look at recent years of economic performance, GDP grew in 2005/06 by 6.7% from the preceding year. Despite suffering from the flood damages in the early part of the fiscal year, the economy has been boosted by the constant inflow of remittances from the workers abroad together with the increase of private investment which grew by 8% for the year. The

[1] United Nations Conference for Trade and Development (UNCTAD) initiated classification of countries by GNI per capita in 1971. The list of the countries is periodically reviewed and updated. The criteria used at present are; for a new country to be listed is the three year average of GNI per capita staying below US$ 750 and for a country to graduate from the list, the GNI per capita must exceed US$ 900. In addition to the criteria by income, other criteria are used by UN to review the classification; the level of human assets as measured through Human Assets Index and economic vulnerability measured through Economic Vulnerability Index.

stagnant inflation has kept the prices high against which the government has taken measures by liberalizing the imports into the country. The fiscal management has followed conservative operation but the fiscal deficit is in the increasing trend recording the deficit of 3.9% of GDP in the fiscal year of 2006. The outstanding balances of domestic and external debts of the government stand at 47% of GDP in the domestic debt and 30% in external debt both of which, are judged being at stable levels. While the economy is treading a healthy growth pattern, the needs are pointed out for the country to curb the inflation and to improve the tax collection in the fiscal front. While the fiscal position of the government is burdened with the continuous deficits, the tasks of the government is frequently pointed out that it improves the efficiency of tax collection so that it can mobilize more of the domestic resource into the development of the socio-economic condition of the country.
Given the current status as such, World Bank recognizes the progress of the socio-economic conditions of Bangladesh as follows[2];

- Bangladesh is the 10th most rapidly growing economy among 31 large developing countries with populations above 20 million and with GDP growth averaging 5% since 1990s;
- Income poverty in Bangladesh declined by 1 %age point per year since 1990 - faster than almost all other developing countries;
- Primary school enrollment is almost 100% - one of the highest in the developing world. The ratio of girls to boys in primary school is higher than most developing countries;
- Bangladesh is the only country to have eradicated polio in South Asia. 77% of all children are immunized before age 2, a national coverage rate far exceeding that of India and Pakistan;
- Bangladesh has consistently allocated its budget in a pro-poor way, injecting substantial public resources into education and health. Bangladesh's military expenditures are the lowest by far of any country in the region, as a %age of GDP;
- While infant and child mortality remains high, Bangladesh has reduced this scourge faster than any other developing country; and
- Despite progress, governance and corruption remains a major concern in Bangladesh. Bangladesh performs poorly relative to other low income countries in political stability, regulatory quality and control of corruption.

Based on the perception of the country as above, World Bank is summarizing its long term outlook on the strategy for economic development of Bangladesh which spells out that, the country has the necessary assets; much-improved economic fundamentals; success in implementing many first-generation reforms; a young, rapidly growing labor force; and an established entrepreneurial culture and the country could join the ranks of middle-income countries within a decade (by 2016) or some time after[3].

2.2 Population and Labor Force

2.2.1 Population Census

In Bangladesh, Bangladesh Bureau of Statistics is conducting the national census once every 10 years. The latest survey was conducted in July 2001 which determined the total population as

[2] World Bank, "Bangladesh Fact Sheet 2005-6", 2008
[3] World Bank, "Bangladesh: Strategy for Sustained Growth", July, 2007

124.35 million out of which 23.5% resided in the urban area and 76.5 in the rural area. The annual growth rate of population after the census is recognized as 1.58% which will lead to the forecast of population in 2011 as 145.5 million. The government is vigorously pursuing the family planning campaign and the growth of population is expected to slow down gradually. The total population is comprised of; Muslims 89.6%; Hindus 9.3%; Buddhists 0.6%; and Christians 0.3%. Due to the population increase, the population density increased from 720/km² in 1991 to 843/km² in 2001. The gender is composed of 106 males versus 100 females. The literacy rate found in 2001 census as 46.2% among those whose ages are 7 years and older. The total number of households was found to be 25.5 million[4]. The populations in major cities were; 5.3 million in Dhaka (metropolitan area); 2.0 million in Chittagong; 0.8 million in Khulna; and 0.4 million in Rajshahi. Cities and township other than those mentioned are; Barisal; Sylhet; Mymensingh; Commila; etc. Administratively, the country is comprised of 6 Divisions under the State and each Division is divided into Zilas (Districts) which is sub-divided into Upazilas (Sub-districts). The area, population, number of households and administrative units are enumerated in the following table;

Table I-2-2-1 Administrative Units, Population and Households (2001 Census)

Division	Area (km²)	Population (thousand)	Households (thousand)	No of Zila	No. of Upazila (Thana)	No. of Union	No. of Village	No. of City Corporation
Barisal	13,644	8,174	1,648	6	39	334	4,273	22
Chittagong	33,771	24,290	4,472	11	102	914	15,060	38
Sylhet	12.596	7,939	1,388	4	35	322	10,101	14
Dhaka	30,985	39,045	8,236	17	141	1,236	25,283	64
Khluna	22,285	14,705	3,119	10	64	565	9,284	28
Rajshahi	34,495	30,202	6,627	16	127	1,094	23,361	57
Total	147,570	124,355	25,491	64	508	4,466	87,320	223

(source) Bangladesh Bureau of Statistics, "Statistical Yearbook of Bangladesh 2006"

2.2.2 Labor Force Survey

(1) Employed Labor

With respect to the labor force, Bangladesh Bureau of Statistics is conducting the Labor Force Survey. The total population of Bangladesh is known to have increased approximately three times from 52 million in 1960 to 140 million as of today. Female population has grown faster than male population reflecting the underlying improvements in gender parity with the share of female population increasing from 47% in 1960 to 49% in 2005 is slightly higher than in India and Pakistan.

Recent trend shows that the growth of the working-age population outpaced that of the population as a whole. While the total population has increased by about 70 % between 1980 – 2005, working-age population (those in 15 – 64 age group) practically doubled – increasing from 44 million in 1980 to 86 million in 2005. Demographic factors such as increased life expectancy and markedly lower infant mortality have offset the slowdown in population growth (from 2.5 % in 1980s to about 1.5 %), resulting in working-age population growth remaining largely unchanged at about 3 % per annum. Under-5 mortality rates fell from 205 per 1,000 live births in 1980 to 77 in 2004; one of the fastest rates of decline in the

[4] Bangladesh Bureau of Statistics, "Statistical Yearbook of Bangladesh 2006"

developing world. Life expectancy at birth increased from 49 years to 64 years over the same period. The growth rate of working-age population is expected to slow down to 2 % a year in the coming years. Still more than one-third of the population is currently under the working-age, a sizable pool to be fed by the robust labor supply growth.

In Bangladesh, the predominant majority of the population lives in the rural areas and so is the labor force with 76% residing in the rural areas. According to the 2003 Labor Force Survey, total labor force was counted as 46.3 million, out of which male were 36.0 million and female 10.3 million. The Survey conducted 3 years later in 2006 found the total labor force as 49.5 million out of which male were 37.4 million and female 12.1 million. The female labor force grew at the surprising annual rate. During 1996 – 2003, the number of female labor force has doubled and reached 10 million while male labor force increased by 17% during the same period. There exists the trend of urbanization in the labor market, too, as the share of the urban labor force among the total increased from 23% in 1996 to 24.5% in 2003.

(2) Employment

Taking a look at the employment opportunity, Bangladesh economy is observed to have created 5.3 million new jobs during 2000 – 2003. This is a sizable increase but it still falls short of the 5.6 million new entrants to the labor force by 0.3 million. New jobs for females kept pace with the increase in female entrants while the shortage of job opportunities was all among the male entrants. With respect to the urban – rural breakdown, 2 million new jobs were created in urban areas where the labor force increased by 2.1 million. In rural areas, 3.3 million new jobs were created whereas the labor force increased by 3.5 million.

In 2003, despite accounting for just 21% of GDP, agriculture sector accounted for 52% of the labor force, up from 49% in 1996. During the same period, the share of agriculture among GDP decreased from 25% to 21%. Industry- wise, almost 90% of male workers are engaged in agriculture (50%) or in services (38%), while only about 10% are engaged in the manufacturing and construction industries which jointly comprise about a quarter of GDP. Among the female jobs, share of agriculture rose from 28% in 1996 to 59% in 2003 and this increase of female labor pushed up the total labor force in agriculture.

One cannot understand fully the job opportunity in Bangladesh without going into the status of the jobs and employment. The status of the jobs are enumerated in the following table;

Table I-2-2-2 Status of Jobs（%）

Status of Employment	Bangladesh			Urban			Rural		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Employee	13.8	13.4	13.7	24.4	21.6	23.7	10.5	10.5	10.5
Employer	0.4	0.2	0.4	0.7	0.3	0.6	0.4	0.1	0.3
Self-Employed	50.6	24.5	44.8	47.1	21.6	41.2	51.6	25.5	45.9
Day Labor	22.9	9.6	20.0	17.3	10.1	15.6	24.7	9.5	21.4
Unpaid Family Work	9.9	48.0	18.4	7.6	39.3	15.0	10.6	51.0	19.4
Domestic Worker	0.1	2.5	0.6	0.1	4.3	1.1	0.1	1.8	0.5
Apprentice	1.0	0.6	0.9	1.3	1.2	1.3	0.9	0.4	0.8
Others	1.2	1.2	1.2	1.4	1.6	1.4	1.1	1.1	1.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

(source) Bangladesh Labor Force Survey 2003 (World Bank, “Bangladesh: Strategy for Sustained Growth”, July 2007)

Among the labor force that has responded as having jobs, 45% of the total are self-employed

which is close to half of the labor force. The self-employed constitute 41% of the urban labor force and 46% of the rural labor force. Next to be noted is the unpaid family work in which 18% of the total labor force, (15% of the urban and 19% of rural labor force) are engaged. The self-employed and the unpaid family work being combined, 63% of the total labor force, (56% of urban and 65% of rural labor force) are found to be engaged. Those employment status are closely related to the low level of personal income of the country. Gender-wise, 51% of male are self-employed as against 25% of female. In addition 10% of male workers are engaged in the unpaid family work while 48% of female workers are in the same category. The level of female workers in the category is astounding and further broken down into the 39% in urban against 51% in rural female workers.

(3) Unemployment

In Bangladesh, the statistics of unemployment reports consistently low percentage levels as is usual in most of the developing countries. The definition of unemployment in Bangladesh is any person of age 15 years or above if he or she did not work at all during the preceding week of the survey and was actively looking for work[5]. According to the definition, the unemployment rate in 2003 is recorded as 4.3% or in the absolute number of 2 million. The unemployment rate increases with the education levels of the labor force. The more educated workers have higher reservation wages and are less willing to compromise on the quality of job they accept. In furtherance, those who go for higher level of education often come from more well-off family and can afford to stay away from working for a longer period.

Should we consider monthly income of Taka 2,000 which is equivalent to one dollar a day, definition set up by UN for absolute poverty, about half of the self-employed fell below the poverty level in 2003[6]. About 35% of the urban self-employed and 40% of the rural self-employed belonged to the category in 2003, which compares with the 40% and 43% respectively in 2000. Rural workers are recognized to be in harder conditions through those statistics.

2.3 Macro Economy

2.3.1 Economic Growth

The macro economy of Bangladesh is represented by the following indicators;

Table I-2-3-1 Macro Economic Indicators

Fiscal Year	2002/03	2003/04	2004/05	2005/06	2006/07
National Accounts	**(Annual percentage change, unless otherwise specified)**				
GDP (nominal: Taka billion) *1	3,005	3,330	3,707	4,157	4,675
Real GDP *1	5.26	6.27	5.96	6.63	6.51
CPI Inflation (average) *1	4.38	5.83	6.48	7.16	7.20
CPI Inflation (end-of-period) *1	5.03	5.64	7.35	7.54	9.20
WPI Inflation (average) *1	3.07	3.72	13.82		
Unemployment (%) *2	3.2	3.2	4.3		
No. of Employed (end-of-period: in million) *3	46.3		49.5		
Poverty Headcount Index (% of population)		36.3			

[5] World Bank, "Bangladesh: Strategy for Sustainable Growth", June 2007
[6] ditto

Fiscal Year	2002/03	2003/04	2004/05	2005/06	2006/07
Investment & Saving			**(in % of GDP)**		
Gross National Saving *1	24.45	25.44	25.84	27.67	29.15
Investment *1	23.41	24.02	24.53	24.65	24.33
Saving/Investment Balance *7	1.04	1.42	1.31	3.02	4.82
Government Finance			**(in Taka Billion)**		
Revenue *4	309,7	339.0	389.2	443.7	
Expenditure *4	411,4	441.6	513.3	578.2	
Out of which Subsidy *4	70.2	78.9	103.2	108.6	
Balance *4	-101.7	-102.6	-124.0	-134.5	
Overall Fiscal Deficit (% of GDP) *6		-2.4	-2.6	-2.7	-3.9
Net Public Debt *5	488.7	547.2	607.3	691.6	784.2
Monetary Sector			**(in Taka Billion)**		
Money Supply (M2) *1	1,140	1,297	1,516	1,812	2,120
Credit to Private Sector *1	829	946	1,107	1,310	1,508
External Sector			**(in US$ Million)**		
Exports of Goods *4	6,492	7,521	8,573	10,422	12,093 *7
Imports of Goods *4	8,707	9,840	11,870	13,301	15,581 *7
Trade Balance *4	-2,215	-2,319	-3,297	-2,879	-3,488 *7
Current Account Balance *4	176	176	-557	572	951 *7
In % of GDP *4	0.3	0.3	-0.9	0.9	1.4 *7
Capital Account Balance *4	841	165	947	218	-278 *7
Overall Balance *4	815	171	67	365	1,493 *5
External Debt *4	16,455	16,761	19,286	19,420	
In % of GDP *4	32.8	30.4	29.3	28.6	28.3*6
Debt Service *4	926	1,043	1,139	1,458	
Debt Service Ratio (%) *1		7.0	6.7	5.8	5.3
Gross Official Reserve *4	2,471	2,714	2,930	3,471	5,077 *1
In months of Imports *4	2.9	2.8	2.5	2.7	3.9 *7
Memorandum Item					
Exchange Rate（Taka/US$: average）*1	57.90	60.43	63.75	69.67	68.80

(source) Data taken from the following sources and processed by the author;

*1: Bangladesh Bank, "Monthly Economic Trends" September 2008

*2: World Bank, "World Development Indicators" Various Years

*3: Bangladesh Bureau of Statistics, "Statistical Yearbook of Bangladesh: 2006", 2006

*4: IMF, "Bangladesh: Statistical Appendix", June 2007

*5: Bangladesh Bank, "Major Economic Indicators: Monthly Update", February 2008

*6: ADB, "Bangladesh: Quarterly Economic Update", June 2008

*7: processed by the author

During the 5 years covered by the above table, the macro economy performed comfortably well. GDP has been on the growth orbit by growing at average annual rate of 6.13%. For the fiscal year 2008, the economy apperas to have achieved 6.2% which is slightly lower than 6.5% in 2007[7]. The good performance has been supported primarily by the domestic consumption and the remittance from oversea workers. In 2008/09, the economy has started showing its vulnerability to the international aggravation of the financial sector triggered by the problem of

[7] ADB, "Bangladesh: Quarterly Economic Update", June 2008

sub-prime lending in U.S.A. World Bank is lowering its estimate of the economic growth of the country from the previous estimate of 6.5% to 4% in its worst case of the scenarios[8] stemming from the slowdown in export and workers oversea remittance.
In the investment front, the domestic investment took a minor setback to 24.2% of GDP. Meanwhile, it has been continuously pointed out that the economy is in critical shortage of the infrastructure. The shortage of electricity and the bottlenecks in the transport sector are major hindrances halting the international trades with neighboring countries. While the investment is showing sluggishness, the national saving is on the increasing trend. The national saving, being the aggregate of the domestic saving plus the fund transfer from oversea countries (net), has achieved a steady increase owing to the increasing amount of the remittances by the workers overseas. This has widened the gap between the national saving and investment.
What has been behind such scene is that the economic environment has not been sufficiently developed to the extent that entices the private investor to make investment decisions or that due to the inadequate functioning of the financial institutions to intervene the financial market and the money flow so that the national saving is effectively directed to the private sector for investment. There remains the task for the country to develop the environment for investment and enable the national economy to mobilize the robust saving and facilitate the investment.
While the weakness and the task being identified, Bangladesh is assessed by international institutions that it embraces a potential capability to attain GDP growth at an average of 7%. As one of such assessments of the country, PricewaterhouseCoopers reportedly evaluates Bangladesh as one of the 13 countries that have potentialities of achieving the GDP growth which is higher than the average of the member countries of OECD. Countries classified there are; Bangladesh; Argentina; Egypt; Iran; Malaysia; Nigeria; Pakistan; Philippines; Poland; Saudi Arabia; South Africa; Thailand; and Vietnam[9].

2.3.2 Inflation

Inflation is to be dealt with later in section 2.6.

2.3.3 Fiscal Balance

In the fiscal year of 2004, the revenue grew 9.5% from the preceding year which was short of meeting the growth of nominal GDP but attained the growth of 14.8% in 2005 and 14.0% in 2006 in line with the growth of nominal GDP. Similar to the revenue, the expenditure is also on an increasing trend. Approximately 20% of the expenditure are routed to the subsidies which include fuel, fertilizer, food, etc. The expansion of expenditure caused the fiscal deficit to inflate and that is causing the public debt balance to expand.
The fiscal deficit has been seen at 3.2% of GDP in 2007 which will further be deteriorated in 2008 as the international prices of commodities and resources climbed after Bangladesh fiscal year 2007 has been over. The deficit for 2008 is reported to have been 4.8% of GDP[10]. The world has seen the crude oil price soaring toward the end of Bangladesh fiscal year of 2008 (June), the government has made a belated step on September 1, 2008 to revise the prices of petroleum products such as kerosene, diesel oil, etc. whose prices have been withheld since April 2007. The government has revised the gas tariff in part while the one for power sector has been kept unchanged since November 2005. The application submitted by PETROBANGLA for

[8] "The Daily Star" dated November 27, 2008
[9] PricewaterhouseCoopers, "The World in 2050: Beyond the BRICS: A broader Look at Emerging Market Growth Prospects", 2008
[10] ADB, "Bangladesh: Quarterly Economic Update", March 2008

the revision of the tariff is under appraisal now by BERC.
The subsidies granted by the government in 2008 are as follows: (a) Bangladesh Petroleum Corporation for the petroleum products for 6.2% of total fiscal outlay; (b) PETROBANGLA for the gas for fertilizer production and electricity generation at 4.2%; and (c) the food sector received 0.9% of the outlay. The government is reported to have spent in total 14.1% of the total expenditure as subsidies[11].

2.3.4 Monetary Policy

Monetary policy is in purview of the Central Bank, Bangladesh Bank. Bangladesh Bank exercises the monetary policy through the control of money supply. The past record of the money supply shows the increase of money supply by 13.8% in 2004; 16.9% in 2005; 19.5% in 2006; and 17.0% in 2007. The money supplied for each year has kept pace with the nominal growth of GDP and to be understood being sufficient enough to endorse the economic growth.
The official discount rate has been fixed and maintained at 5.0% as a result of lowering in 2004. The weighted average of interest rates at commercial banks has been fluctuating within the ranges of 5.6-6.9% for deposits and 10.9-12.9% for lending during such period. The spread between the two rates is seen to be as large as 5-6%. The magnitude of the spread margin indicates the inefficiency of financial intervention function. In addition, the level of non-performing loans at the commercial banks staying at about 12% is pushing up the financial intervention cost of the banks. Both the deposit rate and the lending rate of interest used to be at the lower end of the range stated above during 2004 and 2005 but shifted upward within the range lately.

2.3.5 Balance of Payments

The exports of Bangladesh are predominantly, approximately two thirds, are occupied by the readymade garments. The export of readymade garments took a setback and recorded negative growth from the preceding year in 2002 due to the lifting of quota by U.S.A. but regained its momentum in 2004 and has been growing steadily ever since. The growth rates recorded were 27.3% in 2005; 21.6% in 2006; 28.0% in 2007; and 16.2% in 2008[12] and are higher than the growth of exports as a whole. With exception of the readymade garments, exports are composed of the commodities such as fish & shrimp; raw jute and jute products; leather; others (items processed at export processing zones) but noe of such items occupy a substantial share among the country's total.
On the other hand, the growth of imports used to be lower than that of exports up till 2006, but in 2007 and later the imports of food staff sharply increased by 26% in 2008[13] from the preceding year. On top of this, the skyrocketing prices of international commodities caused the imports of petroleum products and industrial intermediary goods to soar to a significant extent. The sharp increase of imports caused the deficit in the trade balance to inflate. The remittances from the oversea workers amounting as much as 50% of the total exports on constant basis has contributed the current account to be in surplus. The amount of remittances are recorded as; Taka 322.7 billion (US$ 4,801 million) in 2006; Taka 412.9 billion (US$ 7,978 million) in 2007; Taka 544.5 billion (US$ 7,915 million) in 2008[14].

[11] ADB, "Bangladesh: Quarterly Economic Update", June 2008
[12] Bangladesh Bank, "Major Economic Indicators: Monthly Update" September 2008
[13] ditto
[14] ditto

Table I-2-3-2 Remittances from Oversea Workers

(Unit：Taka billion)

Fiscal Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total Remittances	82.0	98.1	101.7	143.8	177.3	198.7	236.5	322.7	412.9	544.5*1
% change from preceding year	18.2%	19.6%	3.7%	41.4%	23.3%	12.1%	19.0%	36.5%	27.9%	31.9%
Trade Balance	-176.3	-172.1	-179.5	-181.2	-226.8	-236.8	-300.6	-365.2	-395.6	-376.8*1
Current Account Balance	-18.9	-0.1	-43.3	14.0	11.4	30.1	-23.6	47.9	65.4	59.3*1

(note) *1：Figures denominated in US$ (US$7,914.78 million) was converted by the average exchange rate in 2008.
(source) Bangladesh Bank, **"**Major Economic Indicators: Monthly Update" September 2008

The continuous and increasing trade deficit and the trend of overseas remittances are illustrated to be offsetting each other in the following figure;

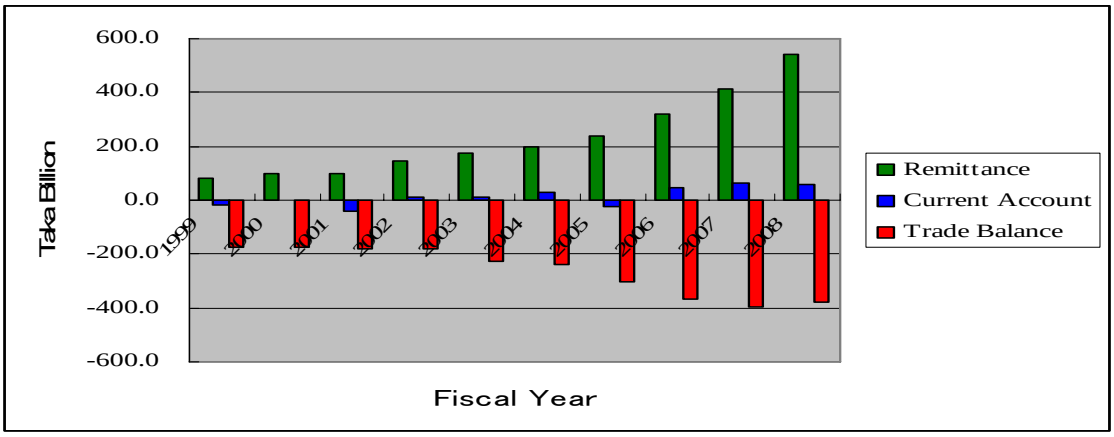


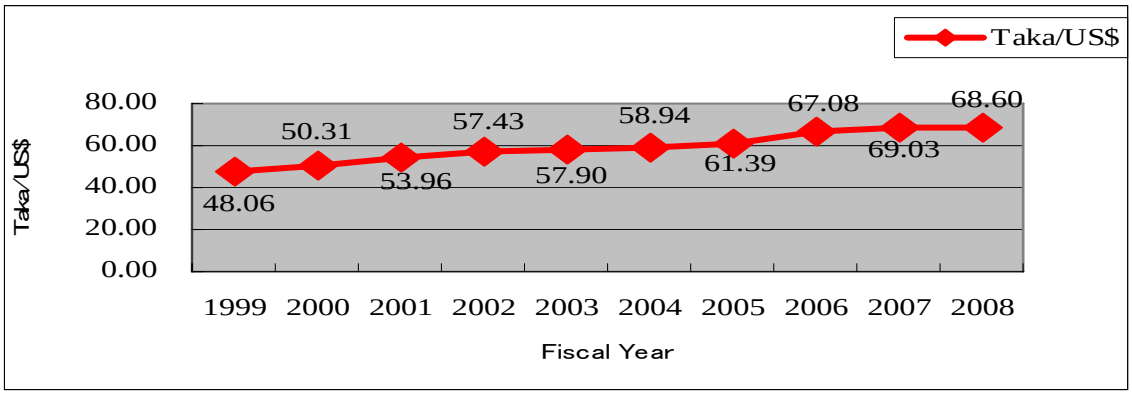
Figure I-2-3-1 Trade Deficit and Overseas Remittances

The current account balance recorded a deficit in 2005. Fiscal years other than 2005 is maintaining the surplus and the surpluses contributed the foreign exchange reserves to accumulate from US$ 2,471 million in 2003 to US$ 5,077 million in 2007 and US$ 6,149 million at the end of fiscal year 2008[15].

2.3.6 Foreign Exchange Rate

Foreign exchange is also under the purview of Bangladesh Bank. The exchange rates for the past decade between 1999 and 2008 are traced in the following figure;

[15] ditto



(source) Bangladesh Bank, "Monthly Economic Trends", April 2008

Figure I-2-3-2 Trend of Foreign Exchange Rate

Against the US Dollar, Taka had been depreciating consistently up till March 2006 when Taka recorded US$ 1 = Taka 68.0. Since then, till now the currency has somewhat stabilized. Having the ample and accumulating foreign exchange reserves, the Central Bank has been providing the foreign currency sufficient enough to meet the demand in the market with the aim to keep the market stabilized. The stabilized exchange rate is helping to curb the increase of import price which should have taken place if the exchange rate deteriorated. The stabilization of the exchange rates is contributing to prevent aggravation of the inflationary pressure.

2.3.7 Government Budget

In June 2008, the national budget for the fiscal year of 2009 has been compiled. The budget reflects the Medium Term Macroeconomic Framework (MTMF) of the government and incorporates the growth target of GDP at 6.5%; the inflation at 9%; the growth of exports at 16.5% and imports at 21%. The total expenditure budgeted for 2009 is Taka 1 trillion, which includes Annual Development Programme (ADP) of Taka 256 billion (16% of GDP) and recurrent expenditure of Taka 744 billion. The fund raising for the budget is planned to be from fiscal revenue of Taka 694 billion (11.1% of GDP), domestic borrowing of 2.7% and external borrowing of 2.2%. The fiscal budget for 2009 is outlined in the following table;

Table I-2-3-3 Outline of Budget for 2009

(Unit : Taka Billion)

	Budget for FY 2009 (A)	FY 2008 Budget Revised (B)	% Change (A over B)	(A) in % of GDP
Total Revenue	693.8	605.4	14.6	11.1
Tax Revenue	567.9	480.1	18.3	9.1
Non-tax Revenue	125.9	125.3	0.5	2.0
Total Expenditure	999.6	860.9	16.1	16.0
Current Expenditure	619.5	536.2	15.5	9.9
ADP	256.0	225.0	13.8	4.1
Other Development Expenditure	124.1	99.7	24.5	2.0
Fiscal Deficit	305.8	255.5	19.7	4.9
Financing of Deficit				
External Resources (net)	135.8	131.5	3.3	2.2
Foreign Grant	63.4	43.9	44.5	1.0
Foreign Loans	72.4	87.5	-17.4	1.2
Domestic Resources	170.0	124.0	37.1	2.7
Domestic Bank Borrowing	135.0	104.0	29.8	2.2
Domestic Non-bank Borrowing	35.0	20.0	74.8	0.6

(source) ADB, “Bangladesh: Quarterly Economic Update”, June 2008

2.4 Industrial Structure

Bangladesh has long been dependent on agriculture. However, the country’s dependence on agriculture is gradually decreasing and a variety of new industries are burgeoning. The industrial structure is seen in the following table in which one can notice the manufacturing sector exceeding agriculture in its output.

Table I-2-4-1 Composition of GDP at Market Price

(Unit : Taka Billion)

Fiscal Year	1994-95		1999-00		2006-07	
	Amount	(%)	Amount	(%)	Amount	(%)
Agriculture & Forestry	310	20.3	447	18.9	678	14.5
Fishing	76	5.0	137	5.8	173	3.7
Mining & Quarrying	15	1.0	23	1.0	53	1.1
Manufacturing	225	14.7	348	14.7	810	17.3
Electricity, Gas & Water	23	1.5	31	1.3	58	1.2
Construction	97	6.4	176	7.4	368	7.9
Wholesale & Retail Trade	189	12.4	292	12.3	657	14.1
Hotel & restaurant	9	0.6	15	0.6	33	0.7
Transport & Communication	135	8.9	197	8.3	484	10.3
Financial Intermediations	22	1.5	36	1.5	74	1.6
Real Estate & Business Activities	131	8.6	211	8.9	349	7.5

Fiscal Year	1994-95		1999-00		2006-07	
	Amount	(%)	Amount	(%)	Amount	(%)
Public Administration & Defense	37	2.4	62	2.6	127	2.7
Education	31	2.0	54	2.3	114	2.4
Health & Social Works	34	2.2	54	2.3	100	2.1
Community, Social & Personal Services	131	8.6	204	8.6	435	9,3
Custom Excises & Duties	61	4.0	83	3.5	161	3.5
Total	1,525	100.0	2,371	100.0	4,675	100.0

(source) Bangladesh Bank, "Monthly Economic Trends", April 2008

In 2007, the industry that appeared on top of the industry-wise GDP output list was manufacturing with its contribution of 17.3%, followed by agriculture of 14.5% and wholesale and retail trades of 14.1%. Agriculture used to lead the list by occupying the shares of 20.3% in 1995 and 18.9% in 2000, but has retreated since then. The manufacturing has taken over the leading position and occupies the share of 17.3% in 2007. The industries that have expanded their shares between 1995 and 2007 include; manufacturing by 2.6%; wholesale and retail trades by 1.7%; construction by 1.5%; and transportation and communication by 1.4%. The industries that have decreased their shares include; agriculture by 5.8% which is particularly noteworthy; fishing and shrimp by 1.3%; and real estate by 1.1%.

The prime feature of the manufacturing industry in Bangladesh is broadly defined as the one utilizing and processing the indigenous and/or imported materials. Typical examples of such are found in; readymade garments; cotton products; pharmaceuticals; fertilizers; wooden products; iron and steels; ceramics; cements; plastic products, chemicals; etc. There exist other industrial sectors such as; engineering; shipbuilding; oil refineries; paints; dyeing and tanning materials; electric wires; lighting apparatuses; florescent lamps; other electrical appliances; cigarettes; matches; etc. In addition, handicrafts sector includes; handlooms; carpets weaving; shoes; bamboos and canes; porcelain; brass products; decorations; etc. While manufacturing industry comprises 17% of GDP, the overwhelming majority is shared by the readymade garments in which Bangladesh stands at the 5th among the ranking of the exporting countries to EU and is counted among the top 10 apparel exporting countries to U.S.A.

As there is no existance of statistics in respect of the sector-wise value additions, we are finding it hard to check and confirm the ups and downs of different sectors of the manufacturing industry in such respect. Instead, we hereby resort to the statistics of exports as a proxy to the measure of the rises and falls of the sectors. The statistics of sectoral composition of exports are captured as in the following table;

Table I-2-4-2 Exports of Sectors

(Unit : Taka Billion)

Fiscal Year	1994-95		1999-00		2006-07	
	Amount	(%)	Amount	(%)	Amount	(%)
Jute	2.6	2.0	3.7	1.5	9.8	1.2
Jute Product	13.7	10.4	11.3	4.5	26.0	3.3
Tea	1.3	0.9	0.9	0.4	0.4	0.1
Leather	8.8	6.7	7.6	3.0	22.9	2.9
Fishing and Shrimp	13.2	10.0	18.1	7.3	37.0	4.7
Readymade Garments	74.4	56.7	157.2	63.1	518.9	65.8
Petroleum Products	0.5	0.4	0.6	0.2	3.3	0.4
Fertilizer	3.1	2.4	-	0.0	2.7	0.3
Others (including EPZ)	13.8	10.5	49.8	20.0	168.4	21.3
Total	131,3	100.0	249.2	100.0	789.2	100.0

(source) Bangladesh Bank, "Monthly Economic Trends", April 2008

The above table confirms that the overwhelming majority of exports are occupied by the readymade garments. The share of the sector that had been 56.7% in 1995 has kept increasing to 63.1% in 2000 and 65.8% in 2007. To the contrary of the readymade garments, the jute and jute products which has been counted as one of the traditional industries have nosedived from 12.4% in 2007 to 4.5% in 2007. Similar trends are observed for fish and shrimp which has seen its share halved from 10.0% to 4.7% during the same period and this is also true for leather industry. Meanwhile, the one classified under "others (including EPZ)" are doubling its share from 10.5% in 1995 to 21.3% in 2007 demonstrating the upsurge of new industries and the demise of the old ones.

2.5 Household Economy

Bangladesh Bureau of Statistics is conducting another periodical survey, Household Income and Expenditure Survey" once in every 5 years, the latest one of which has been done in 2005. The output of the survey is summarizing the size of households, income, expenditures, etc. as in the following table;

Table I-2-5-1 Household Income and Expenditure Survey

	2000 Survey			2005 Survey					
	Urban	Rural	Total	Urban		Rural		Total	
				Actual	% Change	Actual	% Change	Actual	% Change
Number of Samples	2,400	5,040	7,440	3,680		6,400		10,080	
Population (million)	25.3	100.8	126.1	34.3	35.6%	104.5	3.7%	138.8	10.1%
No. of Households (million)	4.9	19.4	24.4	7.3	49.0%	21.4	10.3%	28.6	17.2%
Average Household Size (person)	5.13	5.19	5.18	4.72	-8.0%	4.89	-5.8%	4.85	-6.4%
Average Earner per Household (person)	1.54	1.43	1.45	1.50		1.37		1.40	
Income (Taka/month)									
Income per Household	9,878	4,816	5,842	10,463	5.9%	6,095	26.6%	7,203	23.3%
Income per Capita	1,926	928	1,128	2,217	15.1%	1,246	34.3%	1,485	31.6%
Expenditure (Taka/month)									
Expenditure per Household	7,337	4,257	4,881	8,533	16.3%	5,319	24.9%	6,134	25.6%
Consumption Expenditure per Household	7,125	3,879	4,537	8,315	16.7%	5,165	33.2%	5,964	31.4%
Food Expenditure per Household	3,175	2,300	2,477	3,756	18.3%	3,023	31.4%	3,175	28.2%
Share of Food Expenditure on (%)									
Total Expenditure	43.3	54.0	50.7	44.0		56.8		52.3	
Consumption Expenditure	44.6	59.3	54.6	45.2		58.5		53.8	
Calorie Intake (K. cal/capita/day)	2,150	2,263	2,240	2,194	2.0%	2,253	-0.4%	2,239	2.1%
Source of Drinking Water (%)	32.1	0.4	6.8	28.5		0.5		7.6	
Access to Electricity (%)	80.4	18.7	31.2	82.6		31.2		44.2	

(source) Bangladesh Bureau of Statistics, "Household Income and Expenditure Survey 2005"

The above table lists those of the important data complied during the Household Income and Expenditure Survey which indicates various facts concerning the household and living of Bangladesh population. The population data indicates the progress of urbanization by showing its increase in the urban areas by 36% between 2000 and 2005 whereas that in rural areas by 10%. The number of households is witnessed to be increasing at higher rate than the total population while the average size of the households has reduced from 5.18 in 2000 to 4.85 in 2005. The average earner per household became smaller but its extent of reduction is in line with the reduction of the average number of persons per household and deemed unchanged against the size of household.

The income per household has increased by 23%, being constituted by the increase of 6% in urban areas and 25% in rural areas. The increase in rural areas has outpaced the one in urban areas. The average monthly income per capita is recognized as Taka 1,485 (equivalent to US$ 24), of which the urban is Taka 2,217 (US$ 36) and the rural is Taka 1,246 (US$ 20). The line of absolute poverty is defined by the United Nations as one dollar per capita per day which

is converted to Taka 1,860 per month by using the exchange rate then prevailing. The average income in the urban areas is exceeding the poverty line by about 20%, whereas that of rural areas is undermining the line by about 40% and so is the national total by about 20%. From such data, one can surmise that more than half of the population belongs to the absolute poverty level. The average expenditure per household is recognized as Taka 6,134 per month out of which the consumption expenditure occupies Taka 5,964 per month. The propensity to consume stands at 83% for the national total; 79% in the urban areas; and 85% in rural areas. The share of the food among the total consumption expenditure, Engel's co-efficient, is noticed to be as high as 54% for the national total; 45% in the urban areas; and 58% in rural areas. The low level of income and high Engel's co-efficient are co-habiting ubiquitously throughout the country.
Finally, the list provides the source of drinking water and the access to the electricity grid. The source of drinking water data appears noteworthy in such respect that the percentage taking water from the water supply systems in the urban areas has retreated from 32% in 2000 to 28% in 2005. This may be the reflection of the inability of the public infrastructure to keep up with the urbanization. To the contrary of drinking water, the electricity data indicates that 83% of the urban areas are connected to the grid whereas the rate of access to the grid in the rural areas grew from 19% in 2000 to 31%. The national average rate of access to the grid has increased from 31% in 2000 to 44% in 2005.

2.6 Inflation and Prices

In Bangladesh like other countries, there exist two kinds of price indices, the consumer price index (CPI) and wholesale price index (WPI). Those indices are captured and released by Bangladesh Bureau of Statistics. While CPI is followed month by month and is released in one or two months after the date of the statistics, WPI is officially followed annually and is released at later date of over one year. As WPI comes at such later date and is not of use for timely analysis, the inflation of the country is predominantly discussed by using CPI. The following table shows the CPI during past 10 years;

Table I-2-6-1 Inflation

Fiscal Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average
CPI: Average Annual Rate of Increase (%)	7.06	2.79	1.94	2.79	4.38	5.83	6.49	7.16	7.20	9.94	4.63
CPI: Point to Point Increase at Year End (%)			1.66	3.58	5.03	5.64	7.35	7.54	9.20	10.04	
CPI (Food): Average Annual Increase (%)	9.30	2.68	1.39	1.63	3.46	6.92	7.91	7.76	8.11	12.28	6.14
CPI (Food): Point to Point Increase at Year End (%)			0.87	1.94	5.22	6.64	8.73	8.81	9.82	14.10	

(source) Bangladesh Bureau of Statistics

The annual increase of CPI has hit the bottom at 1.9% in 2001 and has been on the continuous increase for 7 years since then. The indices were; 2.79% in 2002; 4.38% in 2003; jumped to 6.49% in 2005; and climbed high closer to 10% in 2008.
The average taken for the past 10 years stands at 4.63% which is far beyond the levels of the targets established at many of the developed countries but remains within a complacent level considering the stable growth rates of GDP. The average is the outcome of the low inflation recorded in 2000 – 2002 that has been offset by the high rates during later years. Curbing of inflation remains to be one of the important tasks of the government in its economic policy.

With respect to the basket comprising the CPI, the largest among the components is food which occupies 58.8% of total CPI. The inflation appears to be a lot severe in the food category. CPI (food) that used to be stagnant in 2001 and 2002 has moved to the higher layer in 2004 and it has eventually hit the annual average of 12.28% in 2008, or 14.10% in the point-to-point at the year end of 2008, due primarily to the increase of food prices in the international market. Some of the examples are found in rice whose price rose by 61% during the twelve months since April 2007 to April 2008. The price of wheat also rose 56% during the same period.

In order to curb the price hike of foods, the government took the measures of reducing the custom duties levied on food imports, increasing the imports of foods by the government sector, providing subsidies to the marketing of foods, etc. Financial institutions joined such move by softening the terms and conditions for financing the imports of foods aiming at contributing to mitigate the inflationary pressure in its eventuality[16].

[16] ditto

Chapter 3 Power Sector in Bangladesh

3.1 Brief of Power Sector in Bangladesh

(1) Power generation facilities

In fiscal year 2007 the total installed capacity was 5,202 MW, which comprised a thermal power capacity of 4,972 MW (95.6%), and a hydroelectric power capacity of 230 MW (4.4%). In terms of fuels, natural gas-fired power stations represent 81.3% of the total capacity. In terms of the installed capacity of different electric power utility companies, as of March 2004 the installed capacity of the BPDB (Bangladesh Power Development Board) was 3,429 MW while that of the IPPs (independent power producers) was 1,260 MW. However, the percentage of power generating facilities that were inoperable due to aging was high, between 30% and 40%.

Although natural gas is the central pillar of domestic energy production in Bangladesh, because the gas fields are unevenly distributed, located primarily in the east of the country, the fuels used and the types of generating facilities differ between the eastern and western regions. In the east, all thermal power stations use natural gas as fuel, but in the west the main fuel is oil.

Because there is a chronic supply shortage in Bangladesh, electric power utility companies cannot afford to stop power stations for inspection and maintenance, and because periodic inspections are also not being sufficiently performed, the generating capacity of most thermal power stations is substantially less than the rated power.

Table I-3-1-1 Power Generating Facilities using Fuel

Fuel	MW	%
Natural Gas	4,228	81.28
Heavy Oil	280	5.38
Diesel	214	4.11
Hydroelectric Power	230	4.42
Coal	250	4.81
Total	5,202	100.0

(source) BPDB Annual Report 2006/2007

Table I-3-1-2 Power Generating Facilities using a Generation Method

Fuel	MW	%
Hydroelectric Power	230	4.42
Steam Turbine	2,638	50.71
Gas Turbine	1,106	21.26
Combined Cycle	990	19.03
Diesel	238	4.58
Total	5,202	100.0

(source) BPDB Annual Report 2006/2007

(2) Power transmission facilities

In fiscal year 2006, transmission facilities comprised 230 kV lines and complementary 132 kV lines. The combined length of the lines was 3,796.5 km. The 230 kV bulk transmission lines all comprise of two transmission lines and form a loop together with the 132 kV lines in the area around the capital. The 230 kV systems link the main substations around the capital and interconnect the eastern and western regions.

Details of transmission facilities in Bangladesh are described in 4.4.1

(3) Power distribution facilities

As the high-voltage distribution lines, 33 kV and 11 kV lines are used, and 400V and 230V lines are used as the low-voltage distribution lines. Power is distributed by means of three-phase, four-wire systems and single-phase systems. The single-phase systems are primarily used in rural areas for the purpose of rural electrification. The combined length of the distribution lines is 47,646 km.

(4) Generated power and peak load

The generated power of the BPDB in Bangladesh and the rate of increase in generated power are shown in Table I-3-1-1 and Figures I-3-1-1 and I-3-1-2. Maximum demand and its rate of increase are shown in Table I-3-1-2 and Figure I-3-1-3.

The generated power increased by more than 10% over the decade of the 1980s, which corresponds to a period of rapid economic growth. Since then, generated power has continued to grow in response to economic growth.

The significant reduction in the rates of increase in generated power for 2006/2007 was due to serious gas supply shortage.

The average rate of increase in generated power over the past 27 years has been 8.95%.

The peak load has increased in the same way as generated power, with the exception of 1996, at an average rate of 7.1% for the past 20 years.

As the above shows, the demand for electrical power in Bangladesh is rising rapidly. Normally, this rise in demand would be accompanied by gas field development and increased gas production, but in recent years gas production has leveled off, making it impossible to increase power generation.

(5) Breakdown of generated power

The breakdown of generated power by fuel is shown in Table I-3-1-3 and Figure I-3-1-4. As the table clearly shows, thermal power generation is dominant and hydroelectric power generation is supplemental in Bangladesh, and thermal power stations are largely dependent on natural gas as fuel.

(6) Supply and demand conditions

As shown in Table I-3-1-5, the available power in Bangladesh is less than the estimated demand, making regular scheduled outages necessary.

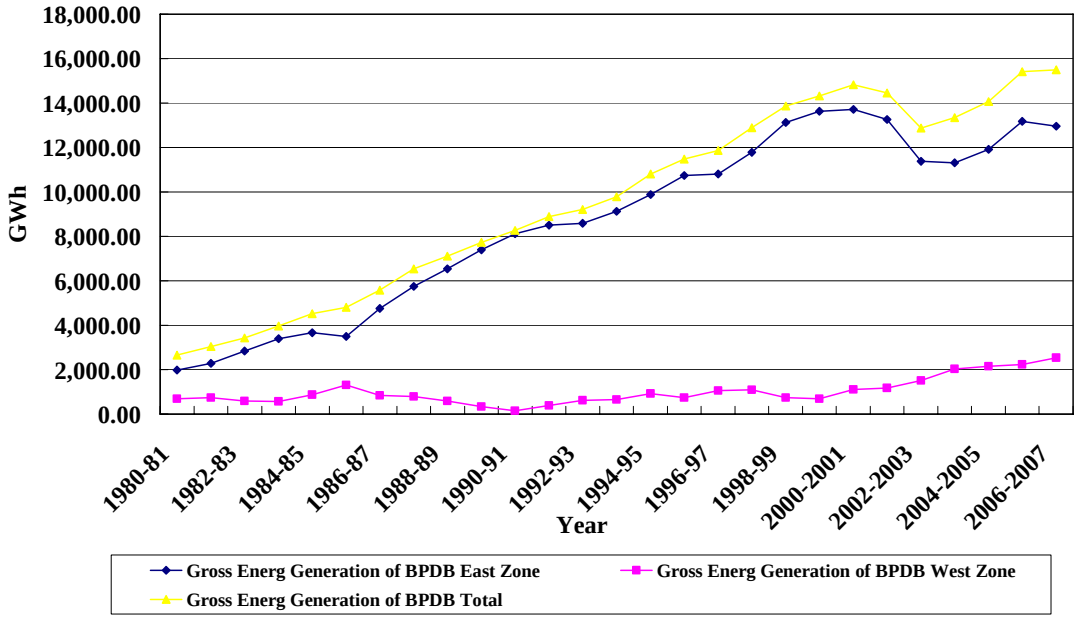
Especially since 2005, the amount of scheduled outages has been increasing, due in large part to gas supply shortages.

Also, as noted above, because of the chronic power shortage in Bangladesh, power-generating facilities cannot be stopped, and thus appropriate maintenance cannot be performed. As a result, facilities are often happened trouble due to insufficient maintenance and many are unable to generate their rated power. Unoperable thermal power plants cause to be one of the chronic power shortage.

Table I-3-1-3 Generated Power (GWH)

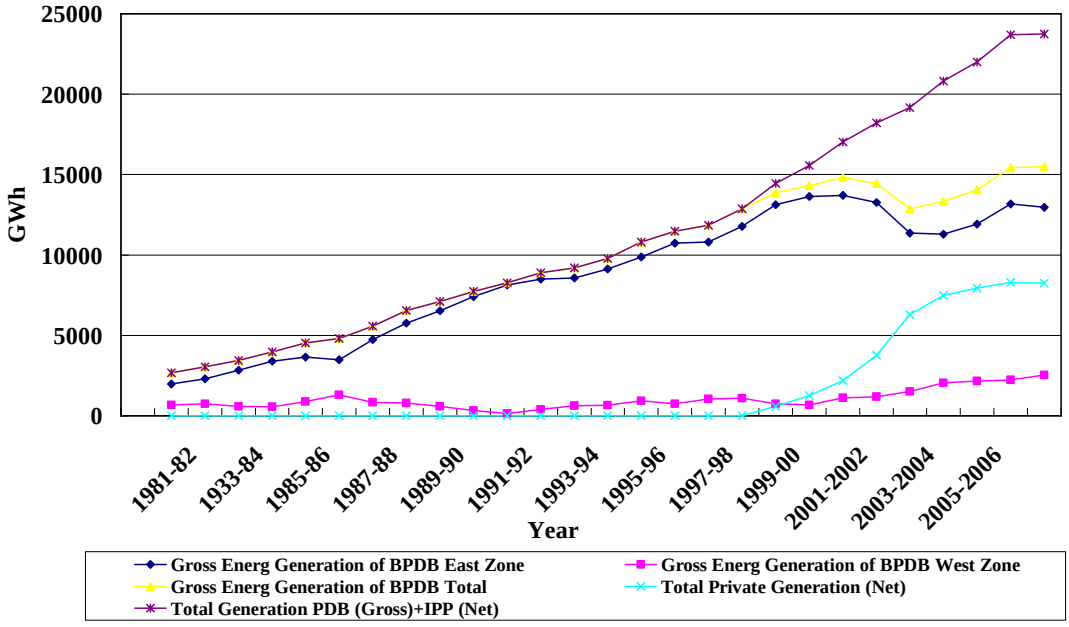
Year	Gross Energ Generation of BPDB			Total Private Generation (Net)	Total Generation PDB (Gross)+IPP (Net)	% Increase over the Preceding Year	Energy Transfer through East-West Interconnector	
	East Zone	West Zone	Total				East to West	West to East
1980-81	1,978.27	683.54	2,661.81	0	2,661.81	11.31	0	0
1981-82	2,292.02	744.42	3,036.44	0	3,036.44	14.07	0	0
1982-83	2,845.68	586.99	3,432.67	0	3,432.67	13.05	341.32	0.24
1933-84	3,398.19	568.00	3,966.19	0	3,966.19	15.54	519.04	1.44
1984-85	3,655.89	872.55	4,528.44	0	4,528.44	14.18	477.41	20.63
1985-86	3,487.90	1,312.36	4,800.26	0	4,800.26	6.00	222.40	106.43
1986-87	4,749.10	837.85	5,586.95	0	5,586.95	16.39	797.84	10.91
1987-88	5,752.54	788.86	6,541.40	0	6,541.40	17.08	1,179.54	0.02
1988-89	6,533.94	580.91	7,114.85	0	7,114.85	8.77	1,550.00	0
1989-90	7,400.98	330.96	7,731.94	0	7,731.94	8.67	1,956.78	0
1990-91	8,125.80	144.40	8,270.20	0	8,270.20	6.96	2,314.07	0
1991-92	8,499.90	394.35	8,894.25	0	8,894.25	7.55	2,213.00	0
1992-93	8,582.69	623.75	9,206.44	0	9,206.44	3.51	1,919.89	0
1993-94	9,129.04	655.31	9,784.35	0	9,784.35	6.28	1,980.76	0
1994-95	9,885.28	921.15	10,806.43	0	10,806.43	10.45	1,954.62	0
1995-96	10,734.62	739.59	11,474.21	0	11,474.21	6.18	2,215.02	0
1996-97	10,804.70	1,052.89	11,857.59	0	11,857.59	3.34	1,924.17	0
1997-98	11,789.06	1,093.34	12,882.40	0	12,882.40	8.64	1,997.00	0
1998-99	13,126.07	746.13	13,872.20	578.22	14,450.42	12.17	2,186.00	0
1999-00	13,634.19	684.23	14,318.42	1,244.29	15,562.71	7.70	2,482.45	0
2000-2001	13,717.26	1,110.92	14,828.18	2,192.68	17,020.86	9.37	1,979.40	0
2001-2002	13,266.78	1,182.78	14,449.56	3,771.19	18,220.75	7.05	2,249.16	0
2002-2003	11,370.99	1,509.79	12,880.78	6,298.81	19,179.59	5.26	2,170.40	0
2003-2004	11,302.91	2,039.17	13,342.08	7,478.18	20,820.26	8.55	2,135.55	0
2004-2005	11,909.63	2,157.37	14,067.00	7,939.19	22,006.19	5.70	2,146.20	0
2005-2006	13,177.27	2,239.68	15,416.95	8,286.07	23,703.02	7.71	2,344.72	0
2006-2007	12,963.82	2,530.88	15,494.70	8,244.54	23,739.24	0.15	1,950.25	0

(source) BPDB Annual Report 2006/2007



(source) BPDB Annual Report 2006/2007

Figure I-3-1-1 Generated Power of BPDB



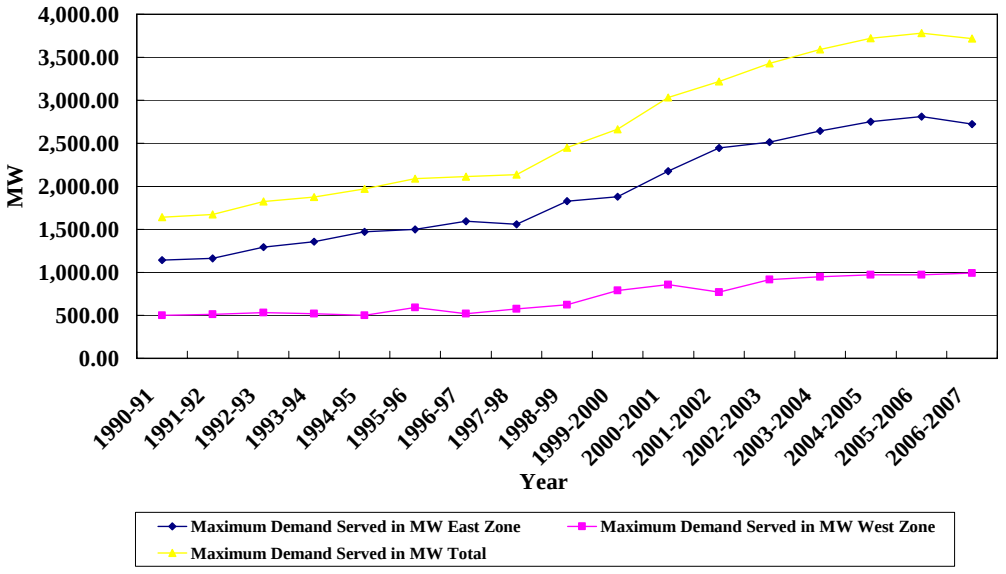
(source) BPDB Annual Report 2006/2007

Figure I-3-1-2 Generated Power of BPDB and IPP

Table I-3-1-4 Maximum Power Demand

Year	Maximum Demand Served in MW			% Increase over the preceding year
	East Zone	West Zone	Total	
1990-91	1,141.00	499.00	1,640.00	
1991-92	1,160.00	512.00	1,672.00	1.951
1992-93	1,293.30	530.00	1,823.30	9.049
1993-94	1,355.00	520.00	1,875.00	2.836
1994-95	1,472.00	498.00	1,970.00	5.067
1995-96	1,497.00	590.40	2,087.40	5.959
1996-97	1,594.30	520.10	2,114.40	1.293
1997-98	1,559.60	576.50	2,136.10	1.026
1998-99	1,828.00	620.50	2,448.50	14.625
1999-2000	1,878.00	787.00	2,665.00	8.842
2000-2001	2,175.00	858.20	3,033.20	13.816
2001-2002	2,447.00	770.50	3,217.50	6.076
2002-2003	2,511.50	916.50	3,428.00	6.542
2003-2004	2,646.00	946.10	3,592.10	4.787
2004-2005	2,749.50	971.30	3,720.80	3.583
2005-2006	2,809.00	973.10	3,782.10	1.647
2006-2007	2,725.00	992.80	3,717.80	-1.700

(source) BPDB Annual Report 2006/2007



(source) BPDB Annual Report 2006/2007

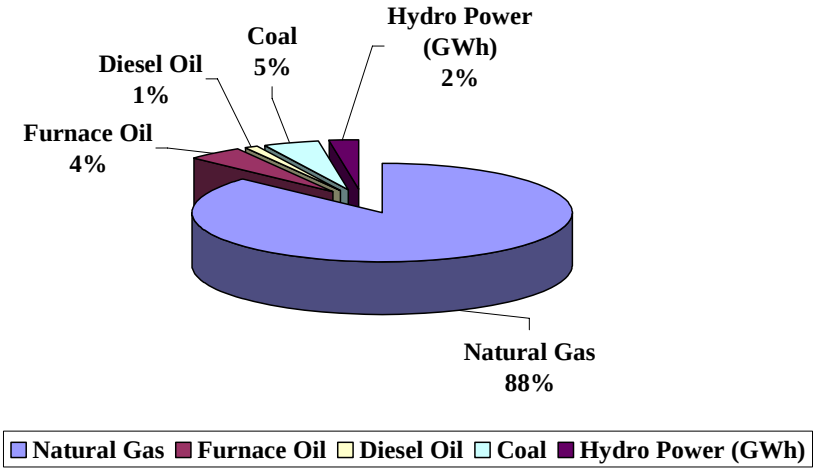
Figure I-3-1-3 Maximum Power Demand

Table I-3-1-5 Generated Power by Fuel

Unit:GWh

Year	Thermal Power				Hydraulic Power	Total
	Natural Gas	Heavy Oil	Deisel Oil	Coal		
2007	19,832.46	1,023.37	279.51	1,081.44	566.31	22,783.09

(source) BPDB Annual Report 2006/2007



(source) BPDB Annual Report 2006/2007

Figure I-3-1-4 Generated Power by Fuel

Table I-3-1-6 List of Power-Generating Facilities

SL No.	Name of Power Plant	Type of fuel	Installed Capacity (As of June) (MW)	Gross Energy Generation (GWh)	Annual Plant factor (%)	Efficiency (%) (Net)	Overall Thermal Efficiency (%) (Net)
1	Karnafuli Hydro (2x40 MW-3x50 MW)	Hydro	230	569.06	28.24		
2	Chittagong Thermal Power Plant Unit 1	Gas	210	997.21	54.21	28.66	
	Chittagong Thermal Power Plant Unit 2	Gas	210	1,026.28	55.79	31.30	
3	Sikalbana 60MW Steam Turbine	Gas	60	122.67	23.34	24.42	
	Sikalbana 2x28 MW Barge Mounting GT	Gas	28	8.52	3.47	20.82	
4	Ashuganji 2x64 MW Steam Turbine	Gas	128	899.30	80.20	30.27	
	Ashuganji 3x150 MW Steam Turbine	Gas	450	2,,012.01	51.04	31.92	
	Ashuganji GT 1	Gas	56	238.0	48.52	19.00	
	Ashuganji ST	Gas	34	80.76	36.55	25.86	
	Ashuganji GT 2"	Gas	56	207.39	42.28	19.01	
5	Ghorasal 2x55 MW Steam Turbine (1+2nd Unit)	Gas	110	185.45	19.25	21.60	
	Ghorasal 3x150MW Steam Turbine (3+4th Unit)	Gas	420	1,894.61	51.50	31.11	
	Ghorasal 2x210MW S/T (5+6th Unit)	Gas	420	2,490.36	67.69	32.88	
6	Siddhirganj 50 MW Steam Turebine**	Gas	0	169.51	38.70	26.61	
	Siddhirganj 210 MW Steam Turbine	Gas	210	1,074.70	58.43	33.96	
7	Haripur 3x33 MW Gas Turbine	Gas	99	29.24	38.70	26.61	
	Tongi 100 MW Gas Turbine	Gas	109	181.58	58.43	33.96	
8	Shahjibazar Gas Turbine (7 units)	Gas	57	81.43	16.31	15.04	
	Shahjibazar 60 MW Gas Turbine	Gas	70	25.61	4.18	21.71	
9	Sylhet 1x20 MW Gas Turbine	Gas	20	139.00	79.30	24.64	
10	Fenchuganji C.C.	Gas	90	529.06	67.11	35.73	
11	Khulna 1x110 MW Steam Turbine	F. oil	110	301.55	31.29	22.24	
	Khulna 1x60 MW Steam Turbine	F. oil	60	4.69	0.89	23.57	
	Khulna 2x28 MW BMPP	SKD	56	43.95	8.96	22.75	
12	Barisal 2x20 MW Gas Turbine	HSD	40	57.99	16.55	15.04	
	Barisal Diesel (9 units)	HSD	7	3.73	6.08	21.72	
13	Bhola Diesel	HSD	3	2.56	24.79	25.94	**32.34**
		FO		3.96			
	Bhola Old	HSD	2	0.26	1.63	19.18	
	Bhola New	HSD	2	1.55	8.83	18.62	
14	Bheramara 3x20 MW Gas Turbine	HSD	60	106.77	20.31	24.2	
15	Baghabari 71 MW Gas Turbine	Gas	71	0	0	0	
	Baghabari 100 MW Gas Turbine	Gas	100	738.94	84.35	29.30	
16	Ranppur 20 MW Gas Turbine	HSD	20	25.47	14.54	21.79	
17	Saidpur 20 MW Gas Turbine	HSD	20	35.73	20.39	22.29	
18	Barapuluria 2x125 MW ST (COAL)	COAL	250	1,201.26	54.85	29.89	
19	Thakurgaon 3x1.5 MW Diesel	LDO	5	1.69	4.28	27.28	
	Total (Grid)		**3872**	**15,491.94**	**45.67**		
20	Isolated East	HSD		1.97			
	Isolated West	HSD		0.79			
	Total BPDB		**3872**	**15,494.70**	**45.68**		
1	KPCL (Khulna BMPP)	FO	110	746.58			
2	WEST MONT (Baghabari, BMPP)	Gas	90	491.9			
3	NEPC (Haripur, BMPP)	Gas	110	655.56			
4	RPC (Mymensihgh)	Gas	210	930.92			
5	AES Haripur	Gas	360	2,538.47			
6	AES Meghnaghat	Gas	450	2,883.10			
	Total Private (Net Generation)		**1330**	**8,244.54**			
	BPDB Net Generation			14,538.55			
	IPP Net Generation			8,244.54			
	Total Net Generation (BPDB+IPP)			**22,783.09**			
	Total Generation (BPDB Gross+IPP Net)			**23,739.24**			

**Siddhirganj 50 MW has been dismantled in June '2007. So its installed capacity is shown 0 MW.

(source) BPDB Annual Report 2006/2007

Table I-3-1-7 Facility Capacities, Available Power, Demand Estimates, and Scheduled Outages

Year	Installed Capacity (MW)<1	Generation capability (MW)<2	Demand Forecast (MW)<3	Demand served (MW)<4	Load Shedding (MW)<5
1990-91	2,350.00	1,719.00	-	1,640.00	340-15
1991-92	2,398.00	1,724.00	-	1,672.00	550-25
1992-93	2,608.00	1,918.00	-	1,823.00	480-20
1993-94	2,608.00	1,881.00	-	1,875.00	540-23
1994-95	2,908.00	2,133.00	2,038.00	1,970.00	537-10
1995-96	2,908.00	2,105.00	2,220.00	2,087.00	545-10
1996-97	2,908.00	2,148.00	2,419.00	2,114.00	674-20
1997-98	3,091.00	2,320.00	2,638.00	2,136.00	711-32
1998-99	3,603.00	2,850.00	2,881.00	2,449.00	774-16
1999-2000	3,711.00	2,665.00	3,149.00	2,665.00	536-10
2000-2001	4,005.00	3,033.00	3,394.00	3,033.00	663-15
2001-2002	4,230.00	3,217.50	3,659.00	3,217.50	367-5
2002-2003	4,680.00	3,428.00	3,947.00	3,428.00	468-5
2003-2004	4,680.00	3,592.10	4,259.00	3,592.10	694-2
2004-2005	4,995.00	3,720.80	4,597.00	3,720.80	770-7
2005-2006	5,245.00	3,782.10	4,693.00	3,782.10	1312-15
2006-2007	5,202.00	3,717.80	5,112.00	3,717.80	1345-40

Note :

<1 Installed capacity as of June of the year

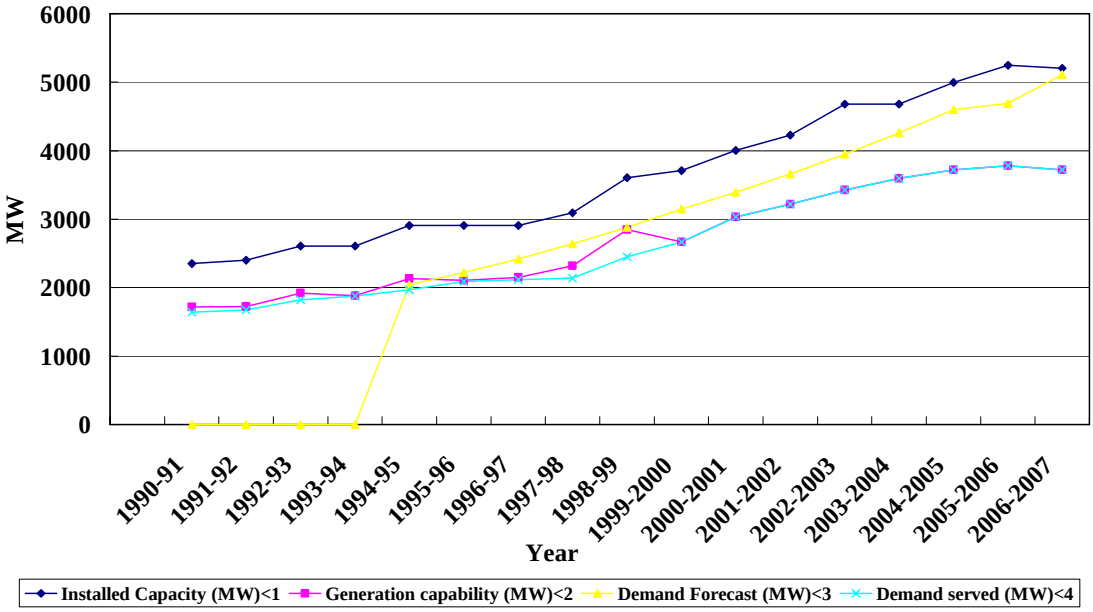
<2 Generation capability is the Maximum availble generation capacity after maintenance outage in the year

<3 Demand forecast is the Base Forecast of PSMP 2005

<4 The dates of maximum demand served and maximum available generation capcasity may not be the same.

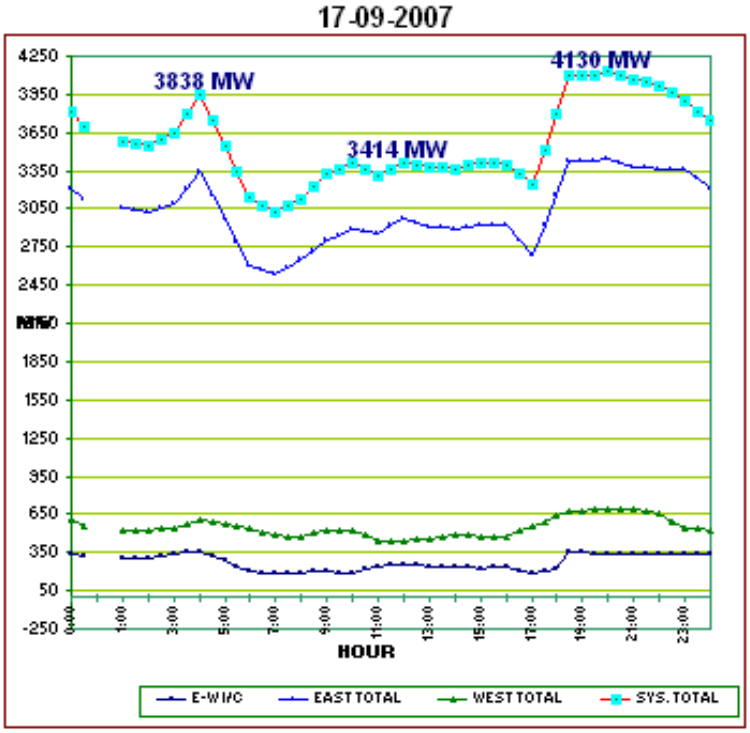
<5 Load sheding is the range of maximum and minimum throughout the year

(source) BPDB Annual Report 2006/2007



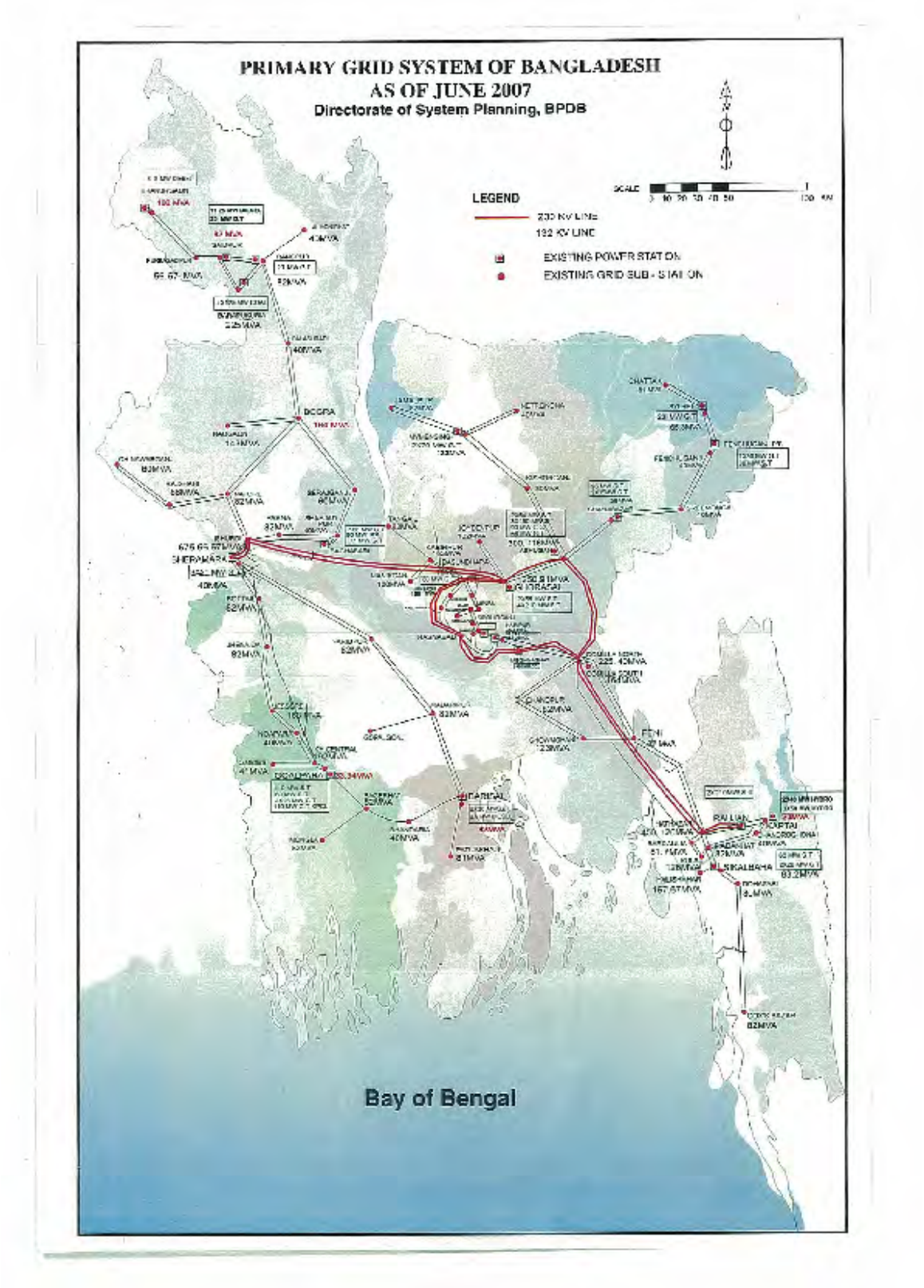
(source) BPDB Annual Report 2006/2007

Figure I-3-1-5 Facility Capacities, Available Power, Demand Estimates, and Scheduled Outages



(source) BPDB Annual Report 2006/2007

Figure I-3-1-6 Daily Power Consumption Patterns



(source) BPDB Annual Report 2006/2007

Figure I-3-1-7 Locations of Existing Power Stations

3.2 Organization of Power Sector in Bangladesh

The long-term vision of the government of Bangladesh is to supply electricity to all citizens by 2020. The government has announced a reform of the power sector so as to achieve a reliable, high quality supply of power at appropriate charges. The BPDB is acting in line with this government strategy.

(1) Company form

In Bangladesh, the Ministry of Power, Energy, and Mineral Resources (MoPEMR) manages the power industry. Under the management of MoPEMR, power is generated by the Bangladesh Power Development Board (BPDB), independent power producers (IPP) that were created as spin-offs or subsidiaries of the BPDB, and investor-owned utilities. Power is supplied to consumers via BPDB transmission facilities by the BPDB for provincial cities, by the Dhaka Electricity Supply Authority (DESA) and the Dhaka Electricity Supply Company (DESCO) in Dhaka, and by rural electrification cooperatives called Palli Bidyut Samities (PBS) in rural areas. Figure I-3-2-1 shows the organization of the power sector in Bangladesh.

1) Ministry of Power, Energy, and Mineral Resources (MoPEMR) and Power Cell (PC)

The MoPEMR is responsible for controlling the formulation of plans for electricity providers and making investment decisions. Power Cell was established in 1995 within the Power Division of the MoPEMR for the purpose of carrying forward of the power sector reform activities of the Government of Bangladesh. The primary objectives of the reform program are stated as; to develop an implementation plan of reform program; to implement programs to achieve performance improvements, customer satisfaction; to help facilitate the development of the sector with optimum utilization of resources; to develop strategy for corporatization of different entities; to structure financial and business plan of the entities; to develop the strategy for distribution area demarcation and rationalization of utilities; to develop the human resource development plan; to develop the power sector master plan; etc[1].

2) Bangladesh Power Development Board (BPDB)

The BPDB was established in 1972, the year after Bangladesh gained independence, and is engaged in the development of power supplies, the formulation and implementation of generating plans, managing the power from the IPPs, and generating, transmitting, and supplying power. In addition to using its own transmission and distribution equipment to supply power to divisional cities, it sells electricity wholesale to the Dhaka Electricity Supply Authority (DESA), which transmits and distributes power in the region of the capital, and the Rural Electrification Board (REB), which is responsible for rural electrification. BPDB handles about 40% of the wholesale electric power supply in the country. The number of power consumers is about 1.6 million.

3) Power Grid Company of Bangladesh (PGCB)

In 1996 the power transmission division of the BPDB was spun off and the PGCB was established under the 1994 Company's Act as the organization for planning and operating the national grid system. The PGCB is (owned 75%) subsidiary of the BPDB. The transfer

[1] The website of Power Cell, “About Us”

of authority over all the transmission system facilities from the BPDB and the DESA was completed by December 2002.

4) Dhaka Electricity Supply Authority (DESA)

The DESA was established in 1990 to separate the transmission and distribution of the capital region (districts) from the BPDB. The DESA purchases power from the BPDB via 132 kV transmission lines for retail supply to its consumers and wholesale supply to the REB. The number of consumers is roughly 600,000.

As per Government dicision, Dhaka Power Distribution Company (DPDC) has taken over DESA activities from 1st July 2008.

5) Dhaka Electric Supply Company Ltd. (DESCO)

The Dhaka Electric Supply Company Ltd. (DESCO) was established under the Company's Act in 1996 as a private power distribution company by the government of Bangladesh, with assistance from the Asian Development Bank, in an effort to improve the efficiency of the power distribution business that had previously been a state-run monopoly. In particular, DESCO aims to resolve the problems of uncollected charges and stealing electricity. In addition to power distribution in the Mirpur area, DESCO took over the power distribution for the Gulshan area from DESA on April 10, 2003. Furthermore, DESCO executes distribution business in Uttra Tongi area. The number of consumers is about 347,000. The performance of DESCO is better than that of DESA in terms of its systems and electricity charge collection.

6) Rural Electrification Board (REB) and Palli Biddyut Samities (PBS)

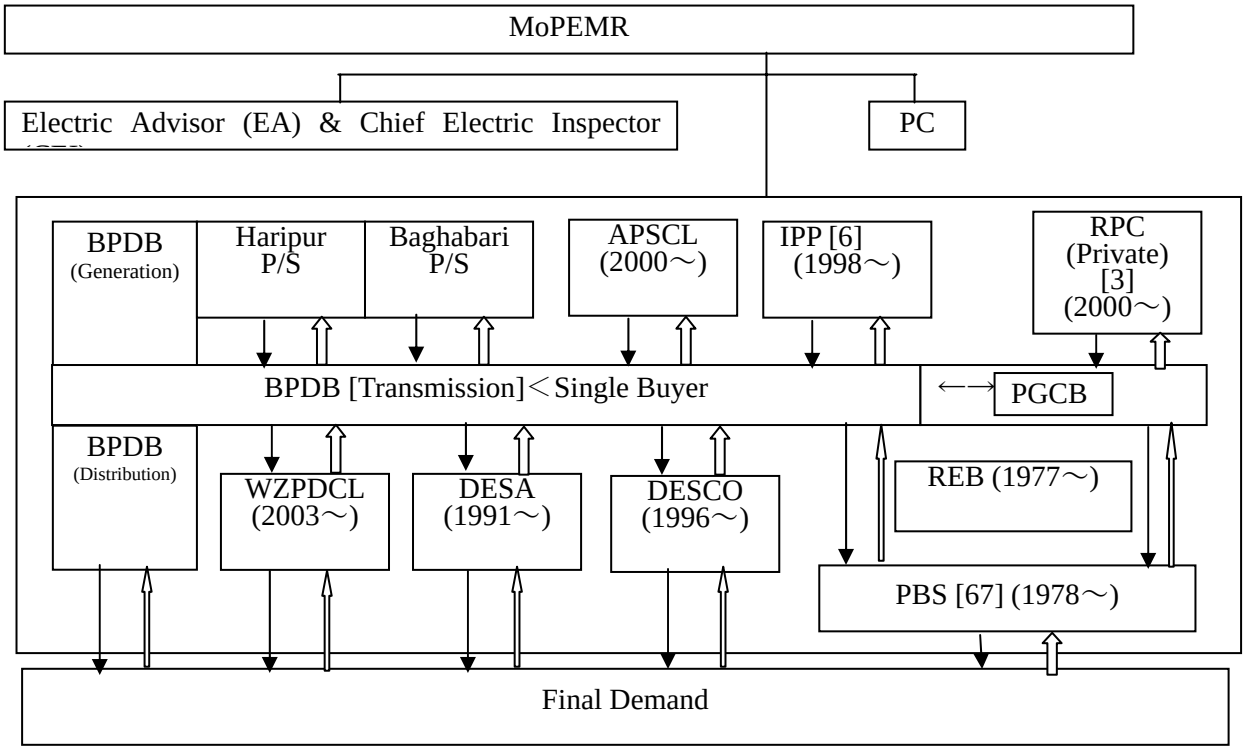
Since its establishment in 1977, the REB has been engaged in constructing substation and distribution facilities to allow the provision of electrical power from the existing transmission system to the regions away from the capital. In addition, in regions where there is no transmission system in place, the REB is pursuing rural electrification by setting up small-scale generation and transmission facilities using power sources such as diesel fuel and solar power. In April 1998, the Small Power Generation Policy was enacted to promote rural electrification by setting up power stations of 10 MW or less in rural areas.

The completed power facilities are transferred to the rural electrification cooperatives (PBS) in the various regions, which manage the facilities. From the outset, the rural electrification of Bangladesh has been supported by the United States Agency for International Development (USAID). The PBSs were established on the model of the American rural electrification cooperatives, and in organization and operation they are a form of direct democracy in which the residents, who are the beneficiaries, can participate. As of 2003, the REB had established PBSs in seventy (70) locations, which supply power to approximately 3 million households. The performance of the REB/PBSs (distribution loss rate: about 15% and electricity charge collection rate: about 95%) compares favorably with that of the BPDB (distribution loss rate: about 30%, electricity charge collection rate: about 80%) and the DESA (distribution loss rate: about 25%, electricity charge collection rate: about 60%).

The REB purchases power from the BPDB and the DESA via 33 kV transmission lines, which comprises 24% of power supplied on a retail basis. The number of consumers is about 4.529 million.

7) Bangladesh Energy Regulatory Commission (BERC)

BERC was established in 2003 by the virtue of Act No. 13 of 2003[2]. The objectives of the organization are specified by the law as; to create an atmosphere conducive to private investment in the generation and transmission in power sector, transportation and marketing of gas resources and petroleum products; to ensure transparency in the management, operation and tariff determination in these sectors; to protect consumers' interest and promote the creation of a competitive market. The law also specifies the functions and power of BERC as; to enhance the efficiency of the use of energy; to ensure efficient use, quality service, determine tariff of electricity for generation, transmission; to issue, cancel and determine conditions of licences; to approve schemes on the basis of overall program of licencees; to collect the statistics of energy; to resolve disputes; etc. The law specifically states the relationship between the Government and BERC in its Chapter 5 wherein it is specified that the government shall have the power of giving policy directives for the development and overall planning of the energy sector and shall issue any policy directive in consultation with BERC.The tariff setting polisy of BERC is disribed in the item 3.4.3 Tarrif Policy of Energy Regulatory Commission.



Remark: ⟶ Flow of Electricity ⟹ Capital
(source) Japan Electric Power Information Center, Inc.

Figure I-3-2-1 Electrical Power Sector in Bangladesh

(2) Reforms in the power sector and the current organization

The Ministry of Power, Energy, and Mineral Resources (MoPEMR) embarked in 1994 on a reform of the power sector that is ongoing and includes the participation of IPPs and the break-up and privatization of the BPDB. In 1994, the Power Sector Development & Reform

[2] Bangladesh Gazette, S.R.O. No. 228/Law/2003, Act No. 13 of 2003 to make Provisions for the Establishment of an Independent and Impartial Regulatory Commission for the Energy Sector

Program was implemented, and in 1996 the Power Sector Power Generation Policy was enacted to open up the power generation sector to private interests. In 2000, a Vision Statement/Policy Statement announced the goal of supplying inexpensive and reliable electrical power to all citizens by 2020 and set the direction for power sector reforms. In 2003, the Energy Regulatory Commission Act was enacted in preparation for the establishment of an independent and fair Energy Regulatory Commission (ERC) for the energy sector.

Regarding the power generation division of the BPDB, the Haripur power station became a division based on the Vision Statement/Policy Statement of January 2001. The Ashganj power station became a spin off. With the Energy Regulatory Commission Act of May 2003, the Baghabari power station became a division.

Similarly, in the distribution division of the BPDB, the West Zone Power Distribution Co. Ltd. (WZPDCL), which distributes power to the Khulna and Barisal divisions, was spun off from the Energy Regulatory Commission Act.

3.3 Financial Standing of Bangladesh Power Development Board

Bangladesh Power Development Board (BPDB) is the nodal institution in the power sector under the jurisdiction of the Ministry of Power, Energy and Mineral Resources (MoPEMR) assigned with the functional responsibilities of generation, transmission and distribution of electricity. The Government of Bangladesh and MoPEMR has been vigorously pursuing the structural and institutional reform of the power sector which envisages the unbundling and corporatizing the power entities functioning under its jurisdiction aiming at the ultimate target of fully commercialized and self sufficient entities. The financial statements of BPDB since 2000 till 2006 are summarized and shown below, based on which we will review and delve into the issues and constraints BPDB is faced in its financial performance.

Table I-3-3-1 Financial statements of BPDB since 2000 till 2006

(in Taka Million)

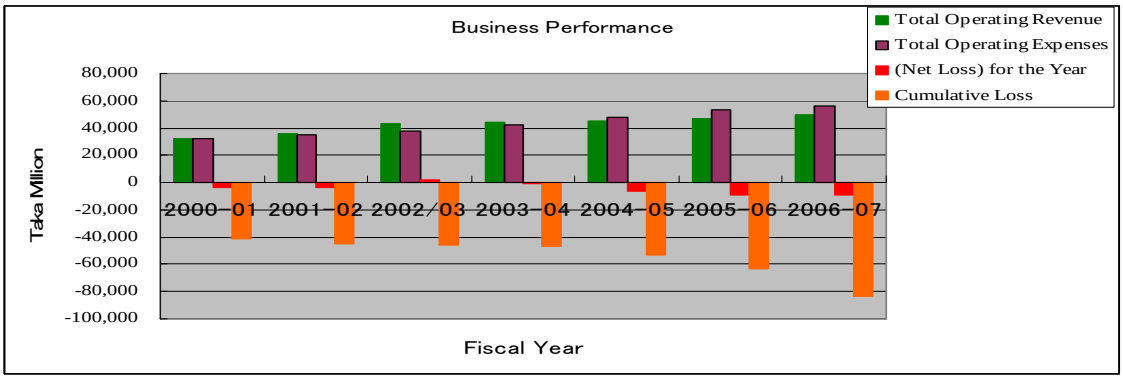
	2000-01	2001-02	2002/03	2003-04	2004-05	2005-06	2006-07
INCOME STATEMENT							
Operating Revenue							
Energy Sales	31,483	35,248	40,040	43,432	43,581	45,859	47,986
Other Operating Income	753	762	2,804	1,194	1,124	710	1,598
Total Operating Revenue	32,235	36,010	42,843	44,626	44,705	46,568	49,583
Operating Expenses							
Generation Expenses	18,034	17,451	17,652	15,939	18,568	21,362	24,400
Electricity Purchase from IPP	7,882	10,865	13,338	20,233	22,490	25,382	25,166
Transmission Expense	1,742	2,056	2,336	1,243	1,369	1,162	1,216
Distribution Expense	3,694	3,919	3,887	4,392	4,380	4,495	4,351
Customer Accounts Expenses	375	374	406	425	448	299	270
General & Administrative Expenses	375	463	468	531	484	817	964
Total Operating Expenses	32,103	35,128	38,086	42,765	47,738	53,517	56,366
Operating Income	132	882	4,757	1,861	-3,033	-6,948	-6,783
Provision for Assets Insurance Fund (PAIF)	15	15	15	15	15	15	15
Financing & Other Charges	2,891	2,555	2,205	1,562	1,728	1,355	2,150
Net Loss before Charging Exchange Rate Fluctuation	-2,773	-1,688	2,537	285	-4,777	-8,319	-8,948
Loss due to Exchange Rate Fluctuation	-976	-2,063	872	-1,418	-1,309	-1,062	-93
(Net Loss) for the Year	-858	-3,751	1,664	-1,133	-6,086	-9,381	-9,040
Retained Earnings							
Balance Brought Forward from Previou Year	-36,596	-41,669	-44,982	-45,688	-47,094	-53,577	-63,234
Previous Year's Adjustment	-1,324	438	-2,370	-273	-397	-277	11,558
Net Income/(Loss) for the Year	-3,749	-3,751	1,664	-1,133	-6,086	-9,381	-9,041
Balance Carried Forward to Succeeding Year	-41,669	-44,982	-45,688	-47,094	-53,577	-63,234	-83,833
BALANCE SHEET							
Fixed Assets							
Utility Plants in Service	230,840	230,268	170,848	177,308	172,956	200,570	293,023
Less Accumulated Depreciation	114,096	121,277	94,428	99,213	101,392	106,547	124,702
Written Down Value	116,744	108,991	76,421	78,095	71,564	94,023	168,321
Project in Progress	21,777	27,355	28,830	36,653	48,365	39,450	18,367
Total Fixed Assets	138,521	136,345	105,251	114,748	119,930	133,473	186,688
Investment							
Investment	2,276	2,683	5,430				14,502
Investment Share from PGCB	2,071	3,343	3,816				
Total Investments	4,347	6,026	6,617	15,643	15,216	15,366	14,502
Current Assets							
Cash in Hand & at Bank	12,286	10,809	7,360	9,989	14,821	14,023	16,567
Accounts Receivable - Trade	32,657	40,780	44,639	47,469	50,198	51,232	45,714
Accounts Receivable - others	3,586	2,829	3,215	4,643	4,535	5,140	5,728
Receivable to REB		2,077	3,723	1,645	1,645	1,645	1,645
Provision for Bad & Doubtful Debts	-639	-680	-703	-725	-795	-823	-532
Advance to Contractors & Suppliers	3,133	1,592	436	799	780	953	1,036
Advance to Employees	613	771	985	1,094	1,136	1,132	1,133
Stock & Stores	6,738	7,067	7,303	7,748	7,331	7,338	7,977
Deposits & Prepaid Expenses	1,205	1,232	138	131	84	110	225
Total Current Assets	59,579	66,476	67,096	72,794	79,735	80,751	79,495
Total Property & Assets	202,446	208,849	188,210	203,185	214,881	229,590	280,685
Capital & Liabilities							
Capital & Reserve							
Paid up Capital	60,833	64,077	67,992	73,526	78,156	84,647	89,323
Net Surplus/(Deficit)	-41,669	-44,982	-45,688	-47,094	-53,577	-63,234	-83,833
Appraisal Surplus	55,748	55,748	55,748	55,748	55,748	55,748	117,058
Grants	3,966	3,980	4,015	4,050	4,120	4,221	4,548
Deposit Work Fund	734	796	829	871	934	992	1,102
Liquidity Damage Reserve	116	116	72	72	72	72	72
Total Capital & Reserve	79,729	79,735	82,969	87,174	85,455	82,447	128,270
Long Term Liabilities							
Government Loan	15,594	16,382	16,981	20,503	23,569	27,842	33,322
Foreign Loan	37,317	32,196	19,721	21,159	21,902	26,914	23,589
Total Long Term Liabilities	52,911	48,578	36,702	41,662	45,471	54,756	56,911
Medium Term Liabilities							
Security Deposit (Consumers)	1,463	1,600	1,729	1,869	2,022	2,172	2,325

(in Taka Million)

	2000-01	2001-02	2002/03	2003-04	2004-05	2005-06	2006-07
CASH FLOW STATEMENT							
Cash Flow from Operating Activities			2,212	2,727	1,085	-4,317	-811
Total Receipts			38,621	42,467	41,782	44,957	54,222
Total Payment for Operating Expenses			-35,161	-38,052	-39,879	-47,768	52,572
Debt Service Liabilities-Interest Payment			-1,248	-1,688	-818	-1,506	2,454
Cash Flow from Investing Activities							
Net Cash Flow from Investing Activities			-10,043	-8,175	-9,241	-16,230	-8,238
Cash Flow from Financing Activities							
Net Cash Flow from Financing Activities			4,382	8,076	12,988	19,750	11,593
Net Cash Flow			-3,449	2,629	4,832	-798	-2,544
KEY INDICATORS							
Total Volume of Sales (GWh)	14,003	15,243	16,332	18,023	19,196	20,954	21,181
System Loss							
T&D Loss (% of Generation)	13.85%	12.62%	11.35%	10.16%	9.29%	7.86%	7.03%
Distribution Loss (% of Import)							
Including REB	18.77%	17.20%	14.81%	10.90%	9.41%	8.21%	7.20%
Excluding REB	26.11%	24.50%	22.35%	21.33%	20.00%	19.06%	16.58%
T&D Loss (net for whole system in % of generation)	30.02%	27.65%	24.48%	19.95%	17.83%	15.42%	13.72%
Unit Supply Cost (Tk/kWh)	2.50	2.47	2.47	2.54	2.62	2.70	2.77
Average Billing Rate (Tk/kWh)	2.25	2.31	2.45	2.41	2.27	2.19	2.26
Total Number of Employees		28,027	25,691	21,272	21,230	21,254	20,494
Personnel Expenses	2,322	2,479	2,528	2,971	2,374	2,766	3,263
Depreciation	6,933	7,181	6,618	4,785	4,901	5,156	6,677
Net Cash Flow from Operating Activities	4,751	6,423	2,212	2,727	1,084	-4,317	-811
Debt Service							
Payment of Interest	2,891	2,555	2,205	1,562	1,728	1,355	2,150
Repayment of Loan							
Foreign Loan	4,854	8,243	1,781	1,988	1,921	3,290	4,540
Government Loan	629	778	750	1,100	900	300	409
Total Repayment	5,483	9,021	2,531	3,088	2,821	3,590	4,949
Capital Expenditure							
UPIS			625	757	663	964	655
PIP			6,948	7,752	12,407	15,639	8,845
Total Capital Expenditure	7,573	7,948	7,573	8,509	13,070	16,603	9,500
Key Performance Indicators							
Debt Service Coverage Ratio (net ope revenue before debt service/debt service) (times)	1.07	0.52	2.21	1.12	0.12	-0.58	-0.03
Self-financing ratio (funds from internal source/ave of capex) (%)	62.74%	80.81%	29.21%	32.05%	8.29%	-26.00%	-8.54%
Return on Equity (net income/equity) (%)	-1.08%	-4.70%	2.01%	-1.30%	-7.12%	-11.38%	-7.05%
Return on Net Fixed Assets (net income/net fixed assets)	-0.73%	-3.44%	2.18%	-1.45%	-8.50%	-9.98%	-5.37%
Debt Equity Ratio (Debt/(Debt + Equity)) (%)	60.62%	61.82%	55.92%	57.10%	60.23%	64.09%	54.30%
Current Ratio (current assets/current liabilities) (%)	94.04%	95.13%	111.96%	110.43%	105.35%	95.40%	91.20%
Operating Ratio (operating cost/total revenue) (%)	1.00	0.98	0.89	0.96	1.07	1.15	1.14
Construction Work in Progress/Total Fixed Assers (%)	15.72%	20.06%	27.39%	31.94%	40.33%	29.56%	9.84%
Stock & Stores/Total Fixed Assets (%)	5.77%	6.48%	9.56%	9.92%	10.24%	7.80%	4.74%
Account Receivable Turnover (months)	12.45	13.88	13.38	13.12	13.82	13.41	11.43
Sales per Employee (kWh/employee)		543,868	635,709	847,264	904,192	985,885	1,033,522
Employment Cost/Total Revenue (%)	7.20%	6.88%	5.90%	6.66%	5.31%	5.94%	6.58%

3.3.1 Business Performance

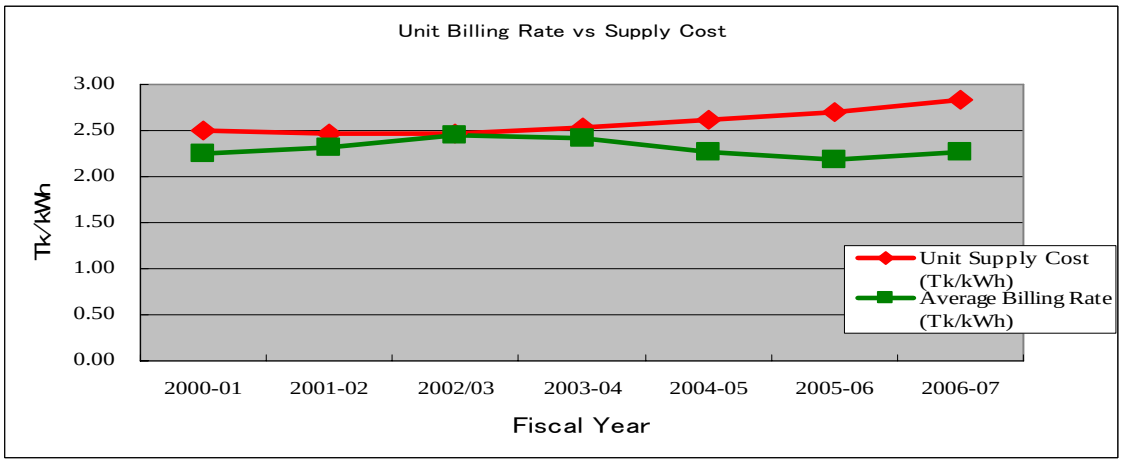
The business performance of BPDB has been in the chronic slump for a long time till today, with the accumulation of the insurmountable losses which amounts to Taka 83.8 billion. The paid up capital of BPDB has been deeply encroached to virtually zero level by the accumulated losses.



(source) BPDB, "Annual Reports 2001/02 - 2006/07"

Figure I-3-3-1 Business Performance of BPDB

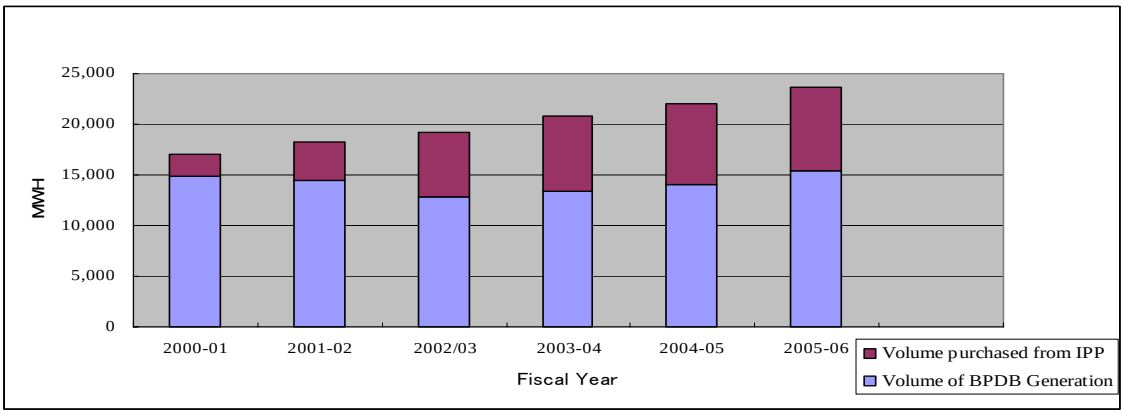
To be specifically noteworthy, BPDB has undergone the deficits at the level of gross margin subtracting the operational expense from the operational revenue during the three years succeeding the fiscal year of 2004/05, which obviously has fallen short of appropriating the financial expenses. In 2006/07, the accumulated deficits went up to Taka 83.8 billion which is the level equal to 1.7 times of annual revenue and is beyond the capability of BPDB to restore the financial health. The prime most reason causing the slump in the business performance of BPDB rests with the low electricity tariff that can not cover the electricity supply cost.



(source) BPDB, "Annual Reports 2001/02 - 2006/07"

Figure I-3-3-2 Average Supply Cost and Average Billing Rate

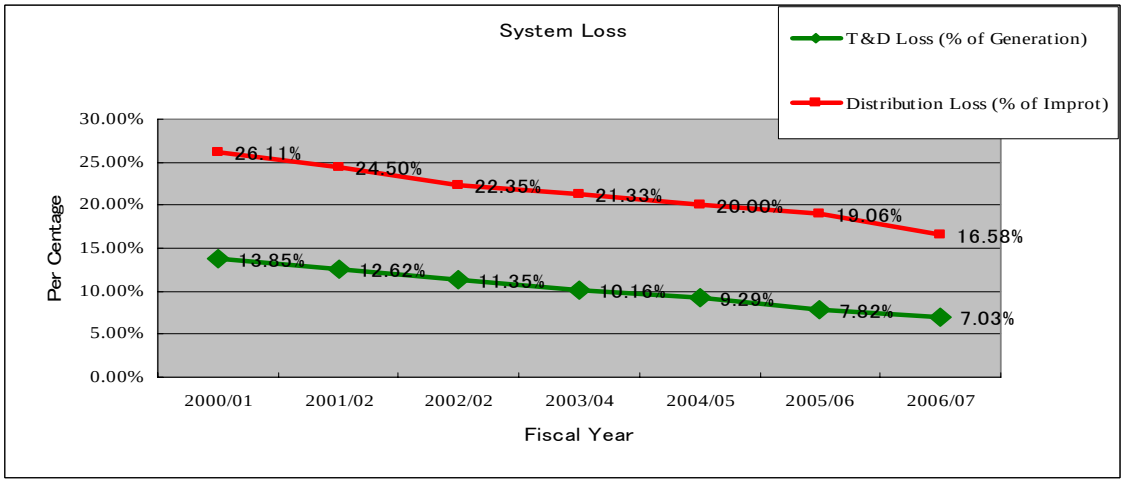
Among the total volume that BPDB supplies, the proportion of the IPP generated electricity is on the steady increase. In general, IPP generates and sells electricity based on the generation cost while adding a certain margin which tends to be higher than the cost of the power generated by BPDB and its affiliated entities. In 2004/05, the volume of the energy purchased from IPP constituted 35% of the total energy BPDB sold and the amount spent for the purchase of IPP energy occupied 47% of the total expenditure of BPDB. Abiding by the contract, BPDB is not able to contain the increase of the electricity cost while IPPs are engaged in the generation activities in accordance with the power purchase agreement signed between BPDB and IPPs.



(source) BPDB, "Annual Reports 2001/02 - 2006/07"

Figure I-3-3-3 Power Generated at BPDB and Volume Purchased from IPP

Remaining concomitantly responsible for generation, transmission and distribution, BPDB has been faced with the serious problem of power loss incurred in its supply system. The following figure illustrates the power losses BPDB has been suffering both for the power coming from its own generation and the one purchased from IPPs, including the auxiliary consumption, transmission and distribution losses. Although the steady trend of decrease is in place during recent years, the amount of the auxiliary consumption stays as high as 7% while BPDB is suffering from the aggregate system loss of 16.6% if it includes the generation, transmission and distribution. The high percentage of system loss indicates the urgent necessity BPDB is confronted with in reducing the loss of the precious energy reaching to the end beneficiaries.



(source) BPDB, "Annual Reports 2001/02 - 2006/07"

Figure I-3-3-4 System Loss of Electricity

The nation-wide system loss in the power sector is followed by Power Cell of the Ministry of Power, Energy and Mineral Respurces which indicates the astonishing level of losses; the auxiliary consumption at 6.0%; transmission loss at 5.63%; distribution loss at 20.97%; making the total losses at 32.60%[3]. The statistics implies that out of the total volume generated, one third is lost before it reaches to the end-users.

[3] Power Cell, MoPEMR, "Bangladesh Power Sector Databook", June 2006

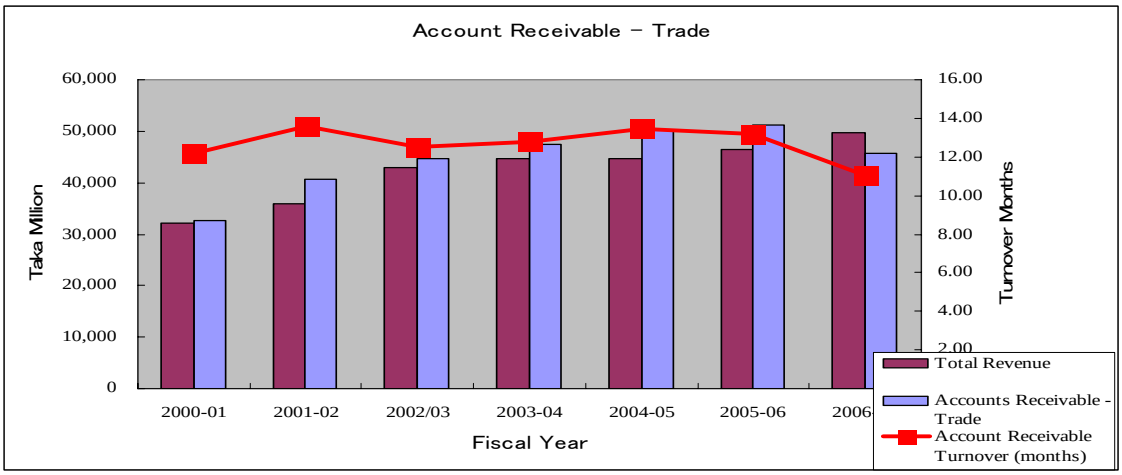
3.3.2 Equity Capital Account

BPDB practiced the revaluation of assets twice in recent history, once in the fiscal year 2000 and the second time in 2007 which generated the revalued surplus of Taka 117.0 billion into the capital accounts with the effect of saving the capital account going into negative balance. In addition to the two-time revaluations, the government has periodically converted BPDB's debt to the equity so that the capital account of BPDB has been kept from plunging into the deficit ridden position. While the revaluation had the effects of saving BPDB's capital account from falling to the negative balance, it has failed to generate fresh money which BPDB has freedom to spend for its own use. The practice caused the balance sheet to superficially improve but has realized no addition of fresh money. In order for the practice of revaluation to bear fruits, the higher value of the fixed assets will have to be depreciated properly and entail the increase of the tariff so that it will assure BPDB to recover the full cost of the fixed assets. Though BPDB revalued its fixed assets in the fiscal year of 2000, no change took place in the depreciation since the time of revaluation till the fiscal year of 2006. The revaluation done has been no more than a make-up in its appearance. In the balance sheet of 2006/07, the total fixed assets increased by Taka 92 billion in whose opposite the accumulated depreciation increased by Taka 18 billion, the capital project in progress decreased by Taka 21 billion and the surplus from asset valuation increased by Taka 61 billion. It is to be noted that a significant amount was transferred from the capital projects in progress to the fixed assets that has increased the total assets as of the fiscal year.

3.3.3 Asset Accounts

The power sector business is the one of highly capital intensive nature with a large amount of long term investment in its operational assets. The weight of the current asset tends to become smaller as the entity succeeds in improving its efficiency. In BPDB, the current assets are swollen to be of significant existence constituting a large position due to the increase of the accounts receivable. In the fiscal year of 2006/07, the percentage of the current assets among the total assets stood at 28%. At Japanese power companies which have achieved the high operational efficiency, the weight of the current assts is seen to be as low as 5%[4] on an average of the 10 power specialized companies in the fiscal year of 2006. There appears a notable difference between Bangladesh and Japan. With respect to the accounts receivable, the turnover of BPDB's account receivable stands at about 360 days though the indicator showed the sign of downtrend during the past two years. The electricity is billed and paid once a month regularly, and the turnover should not be longer than 30 days, should there be no arrear in collecting them. The number stands at 21 days in Japan that exactly meets the above contention. The long period of the turnover at BPDB stems nothing but from the vicious cycle of non-payment of bills at all levels of power generation till consumption. It is imperative to scrutinize the causes of slow and/or non-payment and exert efforts to assess the outstanding account receivable collectible from the non-collectible. What is suggested is that BPDB exerts its efforts in collecting the good receivable while writing off the non-collectible ones.

[4] The Federation of Electric Power Companies of Japan: http://3.fepc.or.jp/tok-bin/kensaku.cgi

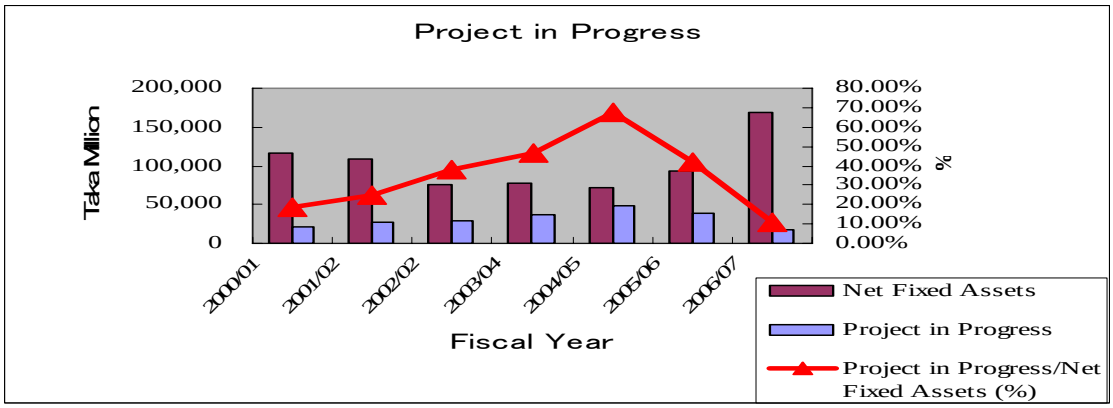


(source) BPDB, "Annual Reports 2001/02 - 2006/07"

Figure I-3-3-5 Balances of Accounts Receivable

With respect to the turnover of the fixed assets against the total revenue which checks how many times the fixed assets roll over through the amount of total revenue. It is learnt that the fixed assets turned over 0.25 times in BPDB. The total assets of BPDB are swollen due to the revaluation and such fact causes the turnover at lower rate which should be much higher as the power sector of the country is suffering from the acute shortage of power due to the insufficient investment. The number stood at 0.16 times in Japan where the capital investment into fixed assets is considered at the saturated level.

The insufficiency of investment drives the power entity to make aggressive investment while such is evidenced by the capital work in progress and its relative weight against the total fixed assets. In the fiscal year of 2004/05, the ratio of the capital work in progress against the total fixed assets recorded 40.3% but is on a continuous declining trend ever since. In particular, the value of fixed assets inflated in 2006/07 due to the second revaluation and caused the ratio to decline sharply.



(source) BPDB, "Annual Reports 2001/02 - 2006/07"

Figure I-3-3-6 Trends of the Fixed Assets and Capital Work in Progress

The capital work in progress represents the construction work that is going on prior to the commissioning of the asset. The fact that the ratio stands high indicates the capital investment is going on at a high rate but it should be noted that those assets are yet to be commissioned and to be engaged in the productive activities. The balance in the account delivers a negative impact upon the total operational efficiency. It is imperative to plan the capital investment in such a

manner that will maintain the balance in execution of investment to meet with the increase of demand for power. The ratio is observed to be as low as 5.2% among the Japanese companies in the power sector.

An attention is invited to the next important point among the asset accounts which is concerned with the depreciation. BPDB has seen its assets expanded due to the revaluation carried out in the fiscal year of 2000. From the very moment of the revaluation done, the depreciation should have been done based on the increased value of the properties. In reality, no such change has taken place in the practice of BPDB during the period of fiscal year of 2000/01 through 2005/06. The change of depreciation has been instituted only in the fiscal year of 2006/07 and the delay in the implementation of the change caused BPDB to lose the opportunity to recover the capital invested.

3.3.4 Liability Accounts

There exists an account which should never be overlooked, i.e. Debt Service Liabilities. The account represents the liabilities that had been owed but had not been met by BPDB on the due dates of both principal and interest payments. Those are the arrears accumulated with the debt service of BPDB owed to the government who borrowed the funds from the donor institutions and on-lent to BPDB. The government has been serving the original debts due to the donors; but could not realise its claim from BPDB. The fundamental structure of BPDB's debt service is that BPDB collects the electricity bill which includes but not limited to the depreciation. BPDB should have made payments of the principal and interest of debts out of the proceeds collected through the electricity bills. Should the tariff be set at the level that covers the cost incurred for the supply, the amounts collected through the billing should be sufficient to pay the expenses of fuel and others and also make payment of principal and interest of the loans taken? The funds collected in reality were insufficient to honor those debts due to the simple reason that the average billing rate obviously undermined the average cost of supply. The government and the power sector have an obvious task to rectify such disorder of the electricity tariff as their first priority issue.

In respect of the employees' retirement benefit account there is a need for the management to seriously consider the future implication of the current system with a view to their sustainability of the systems in the long term. At present, BPDB maintains three kinds of the employees' retirement benefit plans, i.e. the Retiree Pension Plan, the Contributory Provident Fund and the Gratuity Fund. While the Pension Plan is a defined benefit plan providing pension payments to the retirees after the eligibility age, the other two are the plans providing one-time lump sum payment. The defined benefit plan requires the sponsor to contribute the funds necessary to cover the pension liability which is calculated through the actuarial valuation of the age structure of beneficiaries. Apparently, no efforts are being made by BPDB for conducting and assessing the actuarial valuation and determining the pension liabilities. A significant risk lies in the fact that when the life expectancy becomes longer this will undoubtedly increase the potential future payments to the retirees. The management is urged to delve into the nature of the matter and cause the appropriate measures to be taken or introduced.

3.3.5 Ratio Analysis

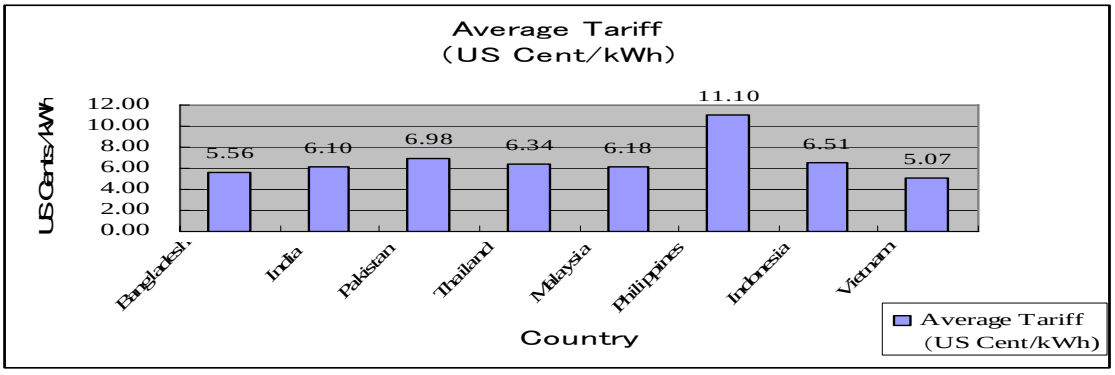
One can assess the solvency of a business entity by calculating the ratio of the current assets and the current liabilities. The ratio checks whether the entity maintains sufficient liquid assets that should be appropriated to pay the liquid liabilities. The general rule of thumb for the solvency is often quoted to be 150%. BPDB used to maintain momentarily the ratios above 100% during the fiscal years 2003 through 2005 but submerged below 100% in the fiscal year of 2006. The ratio for the fiscal year of 2006/07 was 91.2%. There is a serious problem that is inherent to the

figure of the current assets before arguing the current ratio. The current assets that are divided by the current liabilities include the gigantic sum of the account receivable the major part of which are deemed irrecoverable. The ratio calculated, thus, needs to be discounted by a considerable margin. The ratio cannot be quoted healthy by any means.
Another point of concern surfaces at the calculation of debt service coverage ratio (DSCR). The ratio is calculated by dividing the net operating income before debt service by the sum of loan repayment and interest paid. The prevailing standard for the ratio is 1.3 in general. BPDB recorded DSCR of 1.1 and 0.5 in 2000/01 and 2001/02 before hitting 2.2 in 2002/03. The ratio took a sharp decline starting from 2003/04 at the level of 1.1 to 0.1 in 2004/05 and went deep into the minus territory by aggravating the ratio to -0.6 in 2005/06. The major cause of the negative ratio is due to the poor performance that has ended in the continuous deficits. The ratio also contains a hidden danger that cannot be identified from the outcome. The deflator of the equation needs to cover all the sums of payment of principal and interest that falls due in any particular year. It appears that BPDB relocated and hid the sums that cannot be paid for the debt services into the debt service liability account and therefore excluded them from the deflator. The ratios calculated apparently took only the amount BPDB actually paid which may or may not include any amount included in the debt service liability account during the period. What is indicated here is the fact that the actual financial condition of the entity is undoubtedly serious and needs immediate actions to cope with.

3.4 Electricity Tariff

3.4.1 International Comparison of Electricity Tariff

Bangladesh has the universal tariff which covers the entire country under one tariff system. The following figure compares the electricity tariffs imposed in some of the neighboring countries in Asia.



(source) Bangladesh: Annual Report of DESCO. Pakistan: WAPDA Others: Japan Electric Power Information Center, Inc,, "Kaigai Shokoku no Denki Jigyo", 2006

Figure I-3-4-1 Average Power Tariff in Asian Countrie

As is shown in the above figure, the power tariff prevailing in the Asian countries as of 2004 are; Bangladesh: US ¢ 5.56/kWh[5]; Pakistan: US ¢ 6.98/kWh[6]; Indonesia: US ¢ 6.51/kWh; Malaysia: US ¢ 6.18/kWh; Philippines: US ¢ 11.10/kWh; Thailand: US ¢ 6.34/kWh; Vietnam:

[5] DESCO, "Annual Report 2007", 2008
[6] Water and Power Development Authority of Pakistan

US ¢ 5.07/kWh and India: US ¢ 6.10/kWh[7]. Philippines is way out high in comparison with the other countries while Vietnam is the lowest trailing the others. The average tariff in Bangladesh is recognized as US ¢ 5.56/kWh which more than in Vietnam but is lower than in the countries of India, Pakistan, Thailand, Malaysia and Indonesia as the second lowest among the compared countries.

3.4.2 Electricity Tariff

In Bangladesh, entities engaged in the power sector undertakings are regulated to obtain the approval of Bangladesh Energy Regulatory Commission (BERC) for the tariff, fixing the price of electricity they supply based on the actual cost of their operation. The prevailing tariff was updated as of January 1, 2007 and has been in force ever since. The tariff is given in the following table;

Table I-3-4-1 Electricity Tariff

Consumer Category	Range	Rate/kWh	Charges		
			Demand	Service	Minimum
Domestic Category-A	・000-100kWh ・101-400kWh ・401kWh 超	・Tk 2.50 ・Tk 3.15 ・Tk 5.25	Tk 10.00/kW/month	Single Phase: Tk 5.00/month 3-phase: Tk 25.00/month	Tk 100.00/month
Agricultural Pumping Category-B	・Flat	・Tk 1.93	Tk 35.00 /kW/month	1-phase: Tk 5.00/momth 3-phase Tk 25.00/month	Tk 125.00/H.P./month
Small Industry Category=C	・Flat ・Peak ・Off peak	・Tk 4.02 ・Tk 5.62 ・Tk 3.20	Tk 35.00 /kW/month	Tk 60.00/month	Not applicable
Non-Residential Category-D		・Tk 3.35	Tk 10.00/kW/month	1-phase Tk 5.00/month 3-phase Tk 25.00/month	Tk 100.00/month
Commercial Category-E	・Flat ・Peak ・Off peak	・Tk 5.30 ・Tk 8.20 ・Tk 3.80	Tk 20.00 /kW/month	1-phase: Tk 5.00/month 3-phase: Tk 25.00/month	Tk 125.00 /kW/month
Medium Voltage 11kV General Category-F	・Flat ・Peak ・Off peak	・Tk 3.80 ・Tk 6.73 ・Tk 3.14	Tk 40.00 /kW/month	Tk 350.00/month	Tk 80.00 /kW/month but not less than Tk 8,000.00/month
Extra High Voltage Category-G-1	・DESA-132kV ・DESA-33kV	・Tk 2.34 ・Tk 2.39	Tk 35.00/kW/month	Not applicable	Tk 80.00/kW/month
Extra High Voltage 132kV General Category G-2	・Flat ・2300-0600hrs ・0600-1300hrs ・1300-1700hrs	・Tk 2.82 ・Tk 1.49 ・Tk 2.48 ・Tk 1.66	Tk 35.00/kW/month	Tk 80.00/kW/month	Tk 60.00/kW/month

[7] Japan Electric Power Information Center, Inc,, “Kaigai Shokoku no Denki Jigyo”, 2006

Consumer Category	Range	Rate/kWh	Charges		
			Demand	Service	Minimum
	・1700-2300hrs	・Tk 5.52			
High Voltage 33 kV General Category-H	・Flat ・Peak ・Off peak	・Tk 3.58 ・Tk 6.45 ・Tk 3.03	Tk 35.00/kW/month	Tk 400.00/month	Tk 80.00/kW/month
Category I-1	REB 1) 132kV 2) 33kV ・ Economically insolvent ・ Economically marginal ・ Economically solvent	 ・Tk 2.34 ・Tk 2.05 ・Tk 2.05 ・Tk 2.39	Not applicable	Tk 400.00/month	Not applicable
Category I-2	DESCO ・132kV ・33kV	 ・Tk 2.34 ・Tk 2.39	Not applicable	Tk 400.00/month	Not applicable
Category I-3	WZPDCL ・132kV ・33kV	 ・Tk 2.34 ・Tk 2.39	Not applicable	Tk 400.00/month	Not applicable
Category I-4	Distribution of BPDB ・132kV ・33kV	 ・Tk 2.34 ・Tk 2.39	Not applicable	Tk 400.00/month	Not applicable
Category I-5	Distribution Company in Future ・132kV ・33kV	 ・Tk 2.34 ・Tk 2.39	Not applicable	Tk 400.00/month	Not applicable
Street Lights & Pump Category-J		・Tk 3.86	Tk 35/kW/month	Tk 200.00/month	Not applicable

(note) As of December 2008, the exchange rate stands at US$1=Taka 67.59 and Taka 1=US$0.0148 in the monthly average. (source: eXchangeRate.com)
(source) MoPEMR

The prevailing tariff establishes rates applicable to categorized consumers of households, agricultural pumping, small industry, commercial, bulk for wholesale; street lights and pumping. Different rates are set for the volume of consumption, size of contract (demand) and differentiated time zones.
The following are the points to be noted;

1) The tariff is suppressed at a low level in general. At BPDB, the average billing rates are undermining the average supply costs.
2) In particular, the tariffs are notably lower for agriculture, bulk for wholesale and a part of the households and existence of such low rates are triggering the cross subsidy from the other categories of users.
3) The tariff for REB among the bulk wholesale is allowed to be charged with the lower and benevolent rate for the economically insolvent class.

BPDB submitted an application for the revision of its tariff for the increase of an average of 41% in June 2008 which was officially received by BERC on July 3, 2008. In accordance with the prevailing regulation for setting the electricity tariff, BERC took the steps of appraising and approving the application through conducting the public hearing on August 20, 2008. The

Commission made its official announcement on the revision of tariff on September 29, 2008. During the course of the appraisal, BERC and BPDB agreed to separate the application of revising the retail tariff from the wholesale tariff and concentrate the initial round of the appraisal into the wholesale tariff. The rationale behind this separation was such that the retail tariffs are dependant on the revision of the wholesale tariff and the distribution companies may reasonably apply for its revision after the whole sale tariff will be notified. BPDB, in regard to the retail tariff, should be placed in the same position with other distribution companies. The appraisal was been conducted based on the audited financial performance for 2006/07 and 2007/08. BERC made its decision to approve the increase of such tariff by 16% from the weighted average whoklesale tariff of Taka 2.04/kWh before the application to be immediately effective. BERC was reportedly conservative in making the appraisal as it was the first instance of handling the tariff application and such posture of BERC led the appraisal to totally deny the return on equity applied by BPDB for the percentage of 3%. The tariff approved by BERC is barely equal to the cost of purchase of the power by BPDB from IPPs. For this, BPDB has not been allowed any cost of service at all. The outcome of the application implies that the business environment for BPDB's operation shall continue to be tough and severe in terms of attaining profitable operation.

The revision of the wholesale tariff is understood to invoke the revision of the retail tariff at distribution companies. As of November 2008, the distribution companies are reported to have filed or are under preparation of their applications for increase of their tariffs. Depending upon the ultimate decision to be reached by BERC, the universal tariff might cease to exist. A new tariff regime might be created, should BERC pursue the principle of "actual cost plus reasonable margin". As of present, BERC is stating that its policy has not been established on the issue[8].

In addition to the tariff of electricity, BERC has also received an application for the revision of the gas tariff from Petrobangla and is in the stage of appraisal. The decision is mentioned to be announced on November 30, 2008. Unlike for the power tariff, BERC reveals that the reasonable rate of return will be allowed for the gas tariff. The difference of treatment between the two sector is explained to be due to the facts that; 1) BPDB, the applicant of the bulk tariff revision is 100% owned by the government while the companies in gas sector are partially invested by the private capital; 2) gas sector has long contributed to the fiscal budget position whereas the power sector has long been consuming the fiscal expenditure. The revision of the gas tariff will trigger another revision of the power tariff. Under the regulation for setting the electricity tariff, power sector entities are permitted to apply twice a year for the revision of the tariff.

In a separate motion, the government announced to revise the tariff of petroleum products by an average rate of 35% on September 1, 2008. On October 27, the tariff was reversed downward by approximately 16%. Through such changes, the price of high speed diesel oil was brought up from Taka 40.00/liter to Taka 55.00/liter on September 1 and to Taka 46.61/liter on October 27. Due to the recent international trend of crude oil and petroleum products, the price is expected to be reduced once again in late 2008 or early 2009. Such changes of the price have not been reflected in the revision of power tariff of September 2008, the power tariff might undergo another round of adjustment.

3.4.3 Tariff Policy at Bangladesh Energy Regulatory Commission

Bangladesh Energy Regulatory Commission (BERC) has been established in 2004. The tariffs at which power companies and entities sell electricity irrespective of wholesale or retail have to be approved by BERC before they become effective. In reality, BERC has been and still is in the

[8] Interview at BERC on November 26, 2008.

process of hiring the staff and organizing the institution. It barely started its oversight activities but yet to wait for December of 2008 before it will be operating in a full fledged manner. MoPEMR solicited BERC to approve the tariff revision that took place in March 2007, though BERC itself was then in the midst of aligning the organization. In addition, the government is reported to have approached BERC for another increase of tariff by additional 10% during the year of 2007. The application has not been processed as requested partly due to the fact that BERC was yet to strengthen its institutional capacity before making the drastic decision.

The fundamental rules and regulations that are providing BERC with the authority to regulate and rule the power sector are; 1) Bangladesh Energy Regulatory Commission Act 2003 (Act No. 13 of 2003), 2) Licensing Regulation, 3) Electric Generation Tariff Regulation 2008. The rules and regulations for establishing the electricity tariff are being prepared by BERC which includes the regulations such as; 1) Electric Generation Tariff Regulation 2008, 2) (draft) Electricity Transmission Tariff Regulation 2008, 3) (draft) Electricity Distribution Tariff Regulation 2008. Out of these three tariff regulations, the generation tariff regulation has been approved and become effective in 2008 while the other two are in the stage of draft and are yet to be approved. The generation tariff regulation prescribes that BERC shall, within 60 days of official acceptance of the application, hold a public hearing and that BERC shall make its final decision and notification within 90 days after its official receipt of the application.

The Generation Tariff Regulation sets forth the following principles in setting up the electricity tariff[9]. The power tariff is composed of “fuel charge” and “service rate charge”. The fuel charge describes that the licensed power companies will earn no profit or return on the cost and the rates for fuel recovery will change on a semi-annual basis. The service tariff rate is intended to establish the tariff rates which provide the least cost to consumers while providing the opportunity for licensed power companies to earn sufficient revenues to cover all of their operating expense and providing for the continued improvement of their operating system and attract capital for investment. The amount that the licensed companies are allowed to recover through billing is demonstrated by the following equation;

Revenue Requirement = Operating Expenses + Taxes + Annual Depreciation Expense
+Overall Rate of Return X (Gross Investment - Accumulated Depreciation)

The power company, filing an application to BERC for approval of the tariff, has to establish a test period in which the applicant compiles his data on the basis of operation. BERC’s analysis and decision is made based on the data produced for the test year. A generating entity, who has no operating history, which will make the best estimate for a fiscal year, outcome of which will be considered by BERC. For the purpose of the regulation, the capital work in progress is allowed to be included in the total rate base for calculating the return on assets. Likewise, the regulation also allows inclusion of the regulatory working capital into the rate base. The amount of working capital allowed are: the amount equivalent to the two months of operation and maintenance expenses; two months of fuel inventory, if the plant operates on liquid fuel or coal but not for gas nor hydro power; one month of materials and supplies inventory and one month of pre-payments. For the return on capital, the applicant shall apply to BERC with the expected returns on investment accompanied by adequate support to justify such return. It is understood that BERC prefers to consider the cost of equity as the sum of a risk-free rate of return plus a return to compensate the investor for the market risk.

[9] Bangladesh Energy Regulatory Commission, “Bangladesh Energy Regulatory Commission Electric Generation Tariff Regulation 2008”

3.4.4 The Electricity Tariff of Independent Power Producer (IPP)

The IPPs are operating based on the long term power purchase contracts signed with BPDB prior to the commencement of the projects, which governs the methodology of pricing and actual prices of power to be sold. Those contracts and the prices have been approved by the government before starting productive operation of their plants. The following table lists up outline profiles of IPPs with the average tariff approved;

Table I-3-4-2 Electricity Tariff of IPPs

Company	Fuel	Rated Capacity (MW)	Date of Commissioning	Average Tariff (US Cents/kWh)	Plant Factor
Khulna Power Co., Ltd.(KPCL)	Heavy Oil	110	1998.10	Heavy Oil: 5.83 Gas: 4.40	80%
Baghabari, WESTMONT	Gas	90	1999.6	4.30	80%
NEPC, Haripur	Gas	110	1999.6	4.41	80%
Rural Power Co., Ltd. (RPCL)	Gas	140	2001.4	4.30	80%
AES Haripur(*1)	Gas	360	SC: 2001.6 CC: 2001.12	2.73(*2)	85%
AES Meghnaghat(*1)	Gas	450	2002.11	2.79(*2)	85%
Summit Power Co., Ltd.	Gas	30	2003.10	Tk 1.69 /kWh	75%
Baghabari 2nd , WESTMONT	Gas	40	2006.8	2.79	80%
Rural Power Co., Ltd (RPCL)	Gas	70	2006.9	4.30	80%
Meghanaghat 2nd BON Consortium	Gas	450	2008 (scheduled)	2.7865	75%
Summit Power Co., Ltd (Narsingi PBS-1)	Gas	24	2006 (scheduled)	Less than 3 Paisa from BST of PBS	
Summit Power Co., Ltd. (Comilla PBS-1)	Gas	13	2006 (scheduled)	Less than 3 Paisa from BST of PBS	
Summit Power Co., Ltd. (Dhaka PBS-1)	Gas	25	2007 (scheduled)	Less than 3 Paisa from BST of PBS	

(note) (*1) : The owner of the project was changed due to the sale of the project to Pendekar Energy, current owner.

(*2) : The price of gas was set at US$ 2.40/GJ for the tariff. The gas is supplied at US$ 1.20/GJ at present.

(source) Power Cell, MoPEMR, “Bangladesh Power Sector Data Book”, June 2006

All the electricity generated by IPPs is sold to the single buyer, BPDB. The average billing rate of BPDB is Tk 2.26/kWh for the fiscal year of 2006/07. Five plants out of the above listed IPPs are exceeding the average billing rate of BPDB. In general, IPPs are approved with higher tariffs and higher plant factors. Based on those terms of the contract, they operate as the base load supplier while they are required to maintain their plants operative without any breaks at all times with the exception of the scheduled and agreed maintenance periods. The management of IPPs is carried out in confrontation with those pressures for constant operation.

Chapter 4 Technical Feasibility of the Project

4.1 Power Demand Forecast

4.1.1 The Way of Thinking of the Power Demand Forecast

According to Power System Master Plan Update 2006 (PSMP) prepared by Power Cell with support from the ADB, the power demand forecast follows the growth rate of the GDP (the gross national product) closely and as a technique of the electricity demand prediction in PSMP, the growth rate of the GDP in the future is predicted and then power demand is forecast based on these.

4.1.2 Justification of Power Demand Forecast in PSMP 2006

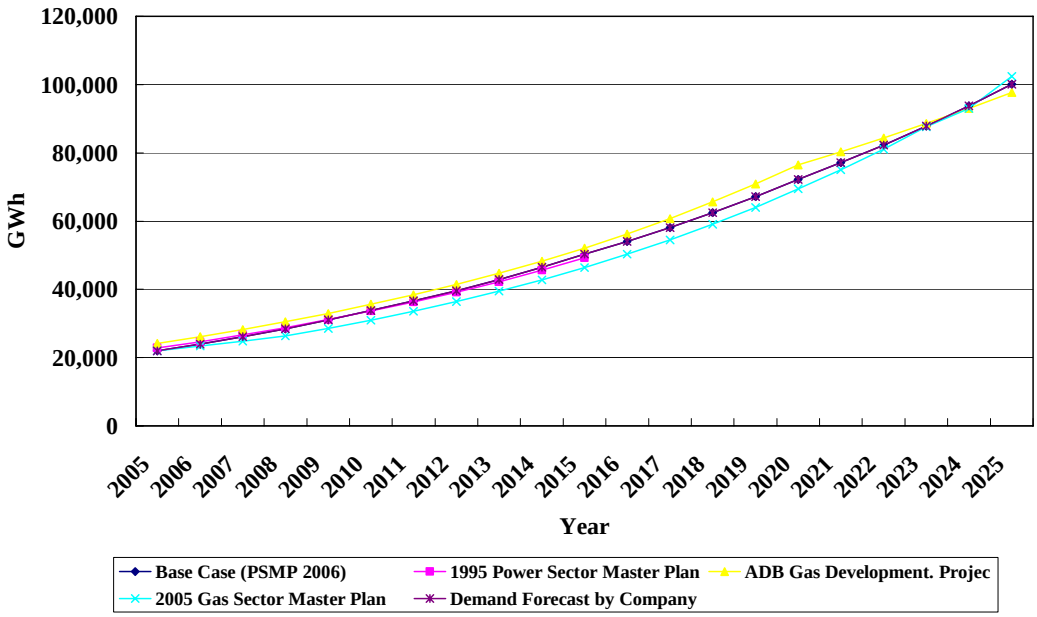
Table I-4-1-1 and Figure I-4-1-1 show approximation curves which display power demand forecasts made in the Power System Master Plan in 1995, the ADB Gas Development Project, 2005 Gas Sector Master Plan and PSMP 2006, and those curves show approximately same trend. Therefore, the power demand forecast in PSMP 2006 is proper and justified.

Table I-4-1-1 Comparison of Power Demand Forecast

(Unit: GWh)

Fiscal Year	Base Case (PSMP 2006)	1995 Power Sector Master Plan	ADB Gas Development. Projec	2005 Gas Sector Master Plan	Demand Forecast by Company
2005	21,964	22,823	24,161	21,989	21,964
2006	23,945	24,662	26,108	23,361	23,945
2007	26,106	26,651	28,214	24,818	26,106
2008	28,461	28,804	30,492	26,366	28,461
2009	31,028	31,133	32,959	28,581	31,028
2010	33,828	33,654	35,628	30,982	33,828
2011	36,622	36,300	38,428	33,584	36,622
2012	39,647	39,157	41,452	36,406	39,647
2013	42,922	42,243	44,720	39,464	42,922
2014	46,467	45,578	48,250	42,780	46,467
2015	50,306	49,180	52,064	46,374	50,306
2016	54,079		56,229	50,269	54,079
2017	58,135		60,727	54,493	58,135
2018	62,496		65,586	59,070	62,496
2019	67,183		70,832	64,033	67,183
2020	72,222		76,499	69,412	72,222
2021	77,092		80,324	75,029	77,092
2022	82,290		84,340	81,100	82,290
2023	87,839		88,557	87,662	87,839
2024	93,761		92,985	92,985	93,761
2025	100,083		97,634	102,422	100,083

(source) PSMP 2006



(source) PSMP 2006

Figure I-4-1-1 Comparison of Power Demand Forecast

4.2 Benefits

4.2.1 Electrification rate

Construction of the Bheramara Combined Cycle Power Plant (hereinafter referred to as "Bheramara CCPP") will contribute to stable power supply in the western zone (Khulna, Rajshai and Barisal Division) currently suffering from a power supply shortage.
It will also improve the electrification rate in the western zone.
It is estimated (see the Table I-4-2-1~3) that construction of the Bheramara CCPP is expected to achieve electrification of about 1,900,000 general households in the western zone. Calculation is as bellows.

g (359.88MW) x h (70%) x 365day x 24hour x b (42.71%) / e (497 kWh)≒n (1,900,000)

Electrification rate of households in the western zone after operation of Bheramara Power Station shall increase from 21.93% to 39.50% (Table I-4-2-3).

Table I-4-2-1 Annual power consumption per household in Bangladesh

	Item	Unit	Calculation formula	Value
a	Annual power consumption per household in Bangladesh	GWh	―	6,457
b	Percentage of power consumption of general households in "a"	%	―	42.71
c	Power consumption of general households	GWh	a x b	2,758
d	Number of electrified households in Bangladesh	10,000	―	555
e	Annual power consumption per household	kWh	c / d	497

(source) Annual Power Consumption: FY 04-05 June MIS Rpt.
Consumer Connections: Cumulative thru Dec '05 MIS Rpt.

Table I-4-2-2 Annual power consumption by households from the Bheramara CCPP in the western zone of Bangladesh

	Item	Unit	Calculation formula	Value
f	Output of Bheramara CCPP	MW	―	360.00
g	Power consumption in the western zone in "a"	MW	―	359.88
h	Capacity factor of Bheramara CCPP	%	―	70
i	Annual power consumption in the western zone	GWh	g x 24 x 365 x h	2,206.8
j	Annual power consumption by general households in the western zone	GWh	i x b	942

(source) Power Grid Company of Bangladesh Load Flow Study 2008

Table I-4-2-3 Estimated number of electrified households and the electrification rate in the western zone of Bangladesh

	Item	Unit	Calculation formula	Value
k	number of households in the western zone	10,000		1,080
l	electrification rate of households	%		21.93
m	number of electrified households in the western zone	10,000	k x l	237
n	Estimated increasing number of electrified households in the western zone by operation of Bheramara P.S	10,000	j / e	190
o	Estimated total number of electrified households in the western zone after operation of Bheramara P.S	10,000	m + n	427
p	Estimated electrification rate of households in the western zone after operation of Bheramara P.S	%	o / k	39.50
q	Estimated increasing electrification rate of households in the western zone by operation of Bheramara P.S	%	p - l	17.57

(source) Bangladesh Bureau of Statistics Bangladesh 2006

4.2.2 Benefits to Accrue in the Industrial Sector

Bangladesh is plagued with the acute power shortage which causes the load shedding both scheduled and unscheduled. In addition, the fluctuation of voltage is rampant and volatile from which the industrial sector is suffering a significant negative impact. The Power Sector Master Plan Update conducted in 2006 reveals that the power demand was recorded as 3,925MW in the fiscal year of 2004 whereas 461MW of electricity was shed representing 12% of the maximum demand[1] and the total volume of energy lost from the opportunity was 221GWh, being equivalent to 11% of the total volume of electricity generated. The project we are working on is of the rated capacity of 360MW which is anticipated to generate 2,200 GWh annually at the plant factor of 70%. Once completed, this project is to cover approximately 90% of the shortage at the peak hours and more than sufficient to cover fully the shortage of annual energy that was recorded to experience of 2004. In the fiscal year of 2006, the increase of electricity demand caused the aggravation of the power shortage which was recorded as 1,312MW. The extent this project could cover will be approximately 1/4 of the shortage of the year.

Table I-4-2-4 Electricity Generated and Load Shedding

FY	Actual Net Peak Load (MW)	Estimated Load Shedding (MW)	Estimated Net Peak Load (MW)	Net Energy Generation (GWh)	Estimated Load Shedding (GWh)	Estimated Net Energy Generation (GWh)
2000	2,538	462	3,000	14,739	182	14,921
2001	2,904	280	3,184	16,254	178	16,432
2002	3,110	289	3,399	17,445	105	17,549
2003	3,333	330	3,663	18,422	104	18,526
2004	3,491	461	3,952	20,062	221	20,283
2005	3,721	771	4,597			
2006	3,782	1,312	4,693			

(source) For FY 2000-2004: Power Cell, "Power System Master Plan Update", June 2006
For FY 2005 and 2006: BPDB, "Annual Report FY 2006"

The volume of 221GWh energy lost due to load shedding in the fiscal year 2004 can be valued at Tk 716 million at the rate of Tk 3.24/kWh which used to be the average selling price of power by DESCO[2], the representative power distributor for the year of 2004. While the GDP used to stand at Tk 3,329.7 billion for the year of 2004, the energy lost is calculated to be equivalent of 0.2% of the country's GDP.

Going further back to 1990s, there exists a study titled "South Asia Growth and Regional Integration" conducted by World Bank on the power supply condition in Bangladesh[3]. The study describes the power supply condition of Bangladesh in 1998 that the number of days that BPDB operated with no power cut are counted as 49 days only out of the whole year making the load shedding as the frequent routine events. Out of the total demand, approximately 25% were not met and the power shortage caused the situation in which the industrial production contributing 15% of GDP was not able to produce about 10% of the sector's output. What is suggested here is that approximately Tk 30 billion, 1.5% of GDP, had been lost in its production opportunity.

[1] Power Cell, "Power System Master Plan Update", June 2006
[2] DESCO, "Annual Report" 2007
[3] World Bank, "South Asia Growth and Regional Integration: Chapter 6, Power Sector Reform, Private Investment and Regional Cooperation", 2000

The gloomy state of condition lingered in the country ever since. In 2005, Energy Information Agency of U.S.A. reported that every year in Bangladesh, the load shedding and the fluctuating voltage of power were causing the loss of industrial production for the value of US$ 1.0 billion. More recently, Transparency International Bangladesh has made a sampling survey[4] covering 1,027 consumers (corporate and individuals) over the impact of the power shortage and the quality of power. From the survey of the industrial sector, it has been learnt that out of the sample beneficiary industries, 39% has responded that they have suffered from the inferior quality of power in such manner that the fluctuating voltage has caused damages to the productive equipment. In the ready made garment industry, it has been reported that 90% of the industrial concerns were to suffer from the disruption of the operation for producing the export products due to the power failures. It has been also reported that they should have been able to produce approximately 5% more than what has been actually produced, should there have been no load shedding. The value of the loss of production has been estimated to be approximately Tk 18.2 billion and the damages caused to the machinery has been approximately US$ 1.7 billion.
The Bheramara CCPP Project is planned to operate as the base load supplier, a significant portion of the power shortage mentioned above will be covered by the project and the economic loss caused by the load shedding should be mitigated by a considerable extent.

4.3 Power Generation Development Planning

4.3.1 Existing power generation facilities

Table I-4-3-1 shows a list of power generation facilities in Bangladesh as of July 26, 2008, and the maximum power output on the same date. The derated generation capacity is 4830 MW including the IPPs. All power output is provided by thermal power plants, except for 230 MW Karnafuli hydro power plants.

[4] Transparency International Bangladesh, “The State of the Governance in the Power Sector of Bangladesh”, November, 2007

Table I-4-3-1 List of existing power generation facilities (as of July 2008)

		Derated Generation Capacity /MW	Generation at the time of max. demand / MW	Remarks	Generation Reduced / MW
1	Karnafuly Hydro Power Station (2x40, 3x50M	230	113	No.3 overhauling	50
2	Chittagong (Raojan) (2x210MW)	360	90	Generation reduce due to gas shortage	270
3	(a) Sikalbaha Steam (1x60MW)	40	0	Generation closed due to gas shortage	40
	(b) Sikalbaha BMPP (1x28MW)	10	0	Generation closed due to gas shortage	10
4	(a) Ghorasal Steam (2 x 55MW)	85	30	No.1under maintenance	55
	(b) Ghorasal Steam (4x210MW)	750	560	No.4under maintenance	190
5	Tongi GT (1x80MW)	80	70		
6	Sylhet GT (1x20MW)	20	19		
7	(a) Shahjibazar GT (1x12, 3x15MW)	38	20		
	(b) Shahjibazar GT (1x12, 3x16MW)	60	63		
8	(a) Fenchuganj GT(2x30MW)	60	30	No.1under maintenance	30
	(b) Fenchuganj Steam (1x30MW)	28	14		
9	(a) Khulna Steam (1x110MW)	60	0	Under maintenance	60
	(b) Khulna Steam (1x60MW)	35	0		35
10	(a) Barisal GT (2x20MW)	35	30		
	(b) Barisal Diesel (1x1.5MW)	2.5	1.3		
11	Bhola Diesel (2x1.5MW)	2.5	2.4		
12	Bheramara GT (3x20MW)	54	42		
13	Rangur GT (1x20MW)	18	20		
14	Saidpur GT (1x20MW)	18	19		
15	Bhoro Pukuria Coal (2x125MW)	220	200		
16	Thakurgaon Diesel (1x3MW)	3	2		
17	Haripur GT (3x33MW)	96	0	Generation closed due to gas shortage	96
18	(a) Baghabari GT (1x71MW)	71	0	Generation closed due to gas shortage	71
	(b) Baghabari GT (1x100MW)	100	100		
19	Siddhirganj Steam (1x210MW)	190	100	Generation reduce due to gas shortage	90
20	(a) Ashuganji Steam (2x64MW)	128	124		
	(b) Ashuganji Steam (3x150MW)	440	275	No.3 under maintenance	150
	(c) Ashuganji GT (2x56MW)	60	70		
	(d) Ashuganji CCPP (1x34MW)	18	0	Under maintenance	18
21	Meghnaghat IPP (2x150+150MW)	450	442	Generation reduce due to gas shortage	8
22	Haripur IPP (1x240+120MW)	360	348	Generation reduce due to gas shortage	12
23	Mymensingh IPP (4x35+70MW)	210	143	Generation reduce due to gas shortage	67
24	Haripur NEPC IPP (8x15MW)	110	89	Under maintenance	15
25	KPCL IPP (19x6.5MW)	110	90		
26	Westmont IPP (2x45MW)	70	68		
27	Sylhet Rental (1x50MW)	48	45		
28	Khulna Rental (1x40MW)	40	39		
29	Bogra Rental (1x20MW)	20	18	Synchronized at 33kV	
30	Sumit Power (1x100MW)	100	99	Synchronized at 33kV	
	Total	4830	3376	Total Generation reduce due to gas shorta	664
				Maintenance / rehabilitation	603

(source) BPDB Homepage

Further, percentage of the amount of power generation by type of energy is shown in Figure I-4-3-1. As illustrated, almost 90 percent of power is generated by locally produced natural gas.

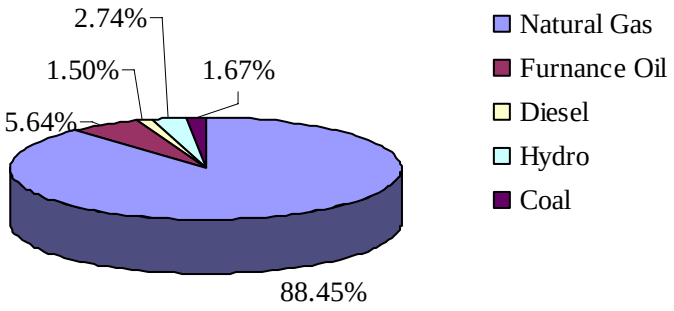


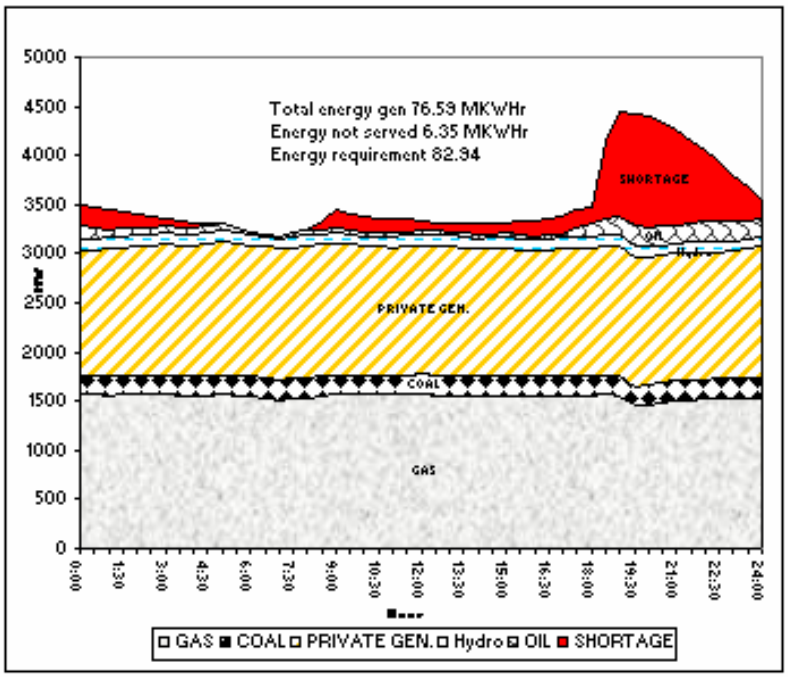
Figure I-4-3-1 Percentage of the amount of power generation by energy type for FY2006

4.3.2 Current Situation of Demand – Supply Balance

As shown in Table I-4-3-1, as of July 26, 2008, the generation at the time of maximum demand is only 3376 MW although derated generation capacity is 4830 MW. On examination of the reason, it reveals that the shutdown of the power plant resulting from maintenance or trouble corresponds to 603 MW; on the other hand, the shortage of gas supply corresponds to 664 MW. This suggests that a shortage of gas supply in Bangladesh is very serious.

Figure I-4-3-2 shows the load curve of the same date. It shows that a shortage of power supply occurs at all times. Especially as shown in Table I-4-3-2, load shedding of 825 MW occurred at the time of maximum demand at 20:00. Should the aforementioned gas supply shortage problem be solved, there is still a shortage of electric power generating capacity of 161 MW. This requires quick action to be taken to launch a new power generation development project.

Further, 80 percent of the power plants in Bangladesh are concentrated in the eastern zone close to the natural gas filed. This requires power transmission of about 200 to 300 MW from east to west. Thus, from the viewpoint of system operation, power generation development in the western zone is an urgent necessity.



(source) BPDB homepage

Figure I-4-3-2 Load curve as of July 26, 2008

Table I-4-3-2 Load shedding as of July 26, 2008

Zone	Area	Actual Shedding/MW
East	Dhaka	224
	Cittagong	120
	Comilla	27
	Mymensing	59
	Sylhet	40
East Sub-Total		470
West	Khulna	162
	Rajshahi	100
	Barisal	24
	Rangpur	69
West Sub-Total		355
Total		825

(source) BPDB homepage

4.3.3 Power Generation Development Planning

BPDB is working out power generation development planning according to the demand assumption of the basic case carried out in PSMP 2006. In this assumption, in the meantime, as discussed in Section 4.5, outlook of gas supply for the future power plant is unclear due to a delay in gas development. The Government of Bangladesh has worked out a policy for screening of a gas-fired thermal power plant construction plan and for cancellation of construction of a gas-fired thermal power plant after Bheramara CCPP. Table I-4-3-3 shows the list of power generation development projects which was revised in August 2008 as a result of this coordination (hereinafter referred to as “the Projects List”). In this list the commercial operation date of the Bheramara CCPP is amended as September 2014 according to the result in

Sub-section 4.9.

Table I-4-3-4 shows the list of the retirement plan for the existing thermal power plant stated in PSMP2006. Most of these plants have operated 20 – 30 years and most of those thermal efficiencies are within the range of 20 - 25%. This value is quite lower comparing average thermal efficiency of thermal power plant of a Japanese electric power company who introduces high efficient power plants is recorded around 46% and BPDB's one is reported as 32.34%. The thermal efficiency of Bheramara CCPP is planned around 54%. For balanced business operation of electric power company, balanced replacement of power plant and cost down of generation cost is necessary, therefore aged power plant should be retired and be built new high efficiency power plants as planned. However those plants can not retire due to delay of construction of new power plants described bellow.

Table I-4-3-5 shows the balance of power demand and supply up to 2014. The retirement plan listed in Table I-4-3-4 is not reflected in the estimated power supply. Considering the expected maximum power demand of 4700MW in 2008, the power demand expectation in PSMP2006 might be higher than actual demand. However even in 2014 when the Bheramara CCPP commences commercial operation, the power supply would be short by 650MW compared to power demand.

The following describes the progress of other subjects to be developed by BPDB. In the first place,

Japanese ODA Loan Agreement was signed for the Haripur 360 MW CCPP on December 12, 2007, and bids will be invited for the power generation facilities in the beginning of the next year. However the commercial operation is expected to start in 2014 due to the delay of fuel gas supply. Almost other projects will be delayed for about 2 years due to the delay of fuel gas supply. As for the Khulna 210 MW thermal power plant, there was a re-bidding in March 2008, but the result was not successful. Thus, the project was excluded from the Project List.

The following describes the IPP project in Bangladesh. For the Bibiyana 450 MW CCPP requested by the Power Cell, the bid was closed on July 24, 2008. Although only one Consortium of Powertek Malaysia, KEPCO Korea and Siemens offered the bid and it was canceled at last governmental approval process. In this situation the commercial operation in 2012 will be unrealistic. The bid of Sirajiganji 450 MW CCPP is conducted a few months behind that of the Bibiyana CCPP and the commercial operation will start in 2013 due to delay of gas supply. Further, the Meghnaghat 450 MW CCPP Unit 2 and 3 were excluded from the Projects List. Re-bidding was planned for the Unit-2 after 2006; however it seems to be cancelled. Thus, the IPP projects in Bangladesh seem to be not going smoothly.

As described above, Bangladesh is facing retirement of some plants and cancellation or delays of the major power plant construction project. If the Bheramra CCPP Project is financed by Japanese ODA Loan and the commercial operation date will start as planned, the Project will make a significant contribution to secure generation capacity in Bangladesh.

Table I-4-3-3 List of power generation development projects (as of August 2008)

Generating Station	Type of Fuel	Capacity	Expected Commissioning date	Source of Fund
Under-construction				
Sikalbaha 150 peaking Power Plant	Gas	150	FY 2009	GOB
Sylhet (Fenchuganj) 90 MW CCPP	Gas	90	FY 2008	GOB
Siddhirganj 2x120 MW peaking power Plant	Gas	240	FY 2009 (Dec/08)	ADB
Small IPP				
BPDB				
1. Feni	Gas	22	January /2009	
2. Tangail	Gas	22	January /2009	
3. Barabkundu	Gas	22	January /2009	
4.Jangalia	Gas	33	January /2009	
REB	Gas	121		
Sub-Total		**700**		
Under Process				
Khulna 150 MW Peaking PP	Gas/Oil	150	December 2010 *1	ADB
Sirajganj 150 MW Peaking Power Plant	Gas	150	June 2013	ADB
Chandpur 150 MW CCPP	Gas	150	June 2012	GOB
Sylhet 150 MW CCPP	Gas	150	June 2010	GOB
Horipur 360 MW CCPP	Gas	360	June 2014	JBIC
Siddhirganj 2x150 MW peaking power Plant	Gas	300	June 2014	WB
Bheramara 360 MW CCPP	Gas	360	September 2014 *2	JBIC
Bhola 150 MW CCPP	Gas	150	June 2012	IDB
Bibiana 450 MW CC PP IPP	Gas	450	December 2011	WB
Sirajganj 450 MW Combined Cycle IPP	Gas	450	June 2013	
Sub-Total		**2670**		
New Addition				
Barapukuria 125 MW (3rd Unit) Coal fired TPS	Coal	125	FY 2012	Supplier's Credit
Kaptai Hydro Power Plant extension 2x50 MW (6th & 7th unit)	Hydro	100	FY 2012 (As per DPP)	(Not yet funded)
Sub-Total		**225**		
Total		**3595**		

(source) The Study Team made it from the documents of MoPEMR and BPDB.

(Note) *1: The plant will be operated by diesel oil until June 2013 when the supply of fuel gas is started.

*2: The expected commissioning date is amended as September 2014 according to the result in Sub-section 4.9.

Table I-4-3-4 List of the retirement plan for the existing thermal power plant

Retirement Year	Plant Name	Output / MW	Efficiency / %	Gas Demand / mmcfd	Commercial Opertion Year
Gas fired Thermal Power Plant					
2006	Mymensingh IPP	140	-	38	
2007	Shahjibazar	30	20.82	10	1968-69
2008	Ashuganji (ST)	120	31.92	36	1970
	Sylhet	19	24.64	6	1986
2010	Ashuganji (CC+GT)	140	-	13	1982-86
	Haripur	90	23.55	18	1987
2012	Ghorasal	37	21.60	12	1974-76
2013	Baghabari	70	29.30	17	1991
	Sub-total	646	-	150	
Oil fired Thermal Power Plant					
2008	Bheramara	54	24.20	N/A	1976-80
	Khulna(GT)	32	22.75	N/A	1980
2009	Khulna(ST)	47	23.57	N/A	1973
	Sub-total	133	-	N/A	
	Total	779	-	150	

（source） Study Team makes from Power System Master Plan Update 2006 and the documents provided by BPDB such as Annual Report 2006-2007.

Table I-4-3-5 Balance of power demand and supply

	2008	2009	2010	2011	2012	2013	2014
Power Peak Demand (PSMP Base Case) / MW	5569	6066	6608	7148	7732	8364	9047
Planned Generation Capacity / MW	4830	5409	5709	6159	6684	7284	8394
Capacity Shortage / MW	-739	-657	-899	-989	-1048	-1080	-653

（source）Study Team makes from Power System Master Plan Update 2006 and Table I-4-3-1, Table I-4-3-3.

4.4 Power System Planning

4.4.1 Transmission and substation facilities owned by PGCB

Power Grid Company of Bangladesh Ltd. (PGCB) is in charge of grid planning, construction, operation and maintenance in Bangladesh. Voltage of transmission system is 230kV, 132kV and 66kV at present, and the voltage of Meghnahat – Aminbazar transmission line, which will be constructed in the future, is planned to be 400kV. Table I-4-4-1 and Table I-4-4-2 shows the breakdown of transmission and substation facilities owned by PGCB as of June 2007

respectively.

Table I-4-4-1 Transmission facilities owned by PGCB

Voltage	230kV	132kV	66kV
Length	1,466.5 ckt km	5,577.6 ckt km	167 ckt km

Table I-4-4-2 Substation facilities owned by PGCB

Voltage	230/132kV	132/66kV	66/33/11kV
Unit	10	70	2
Capacity	5,175 MVA	7,219 MVA	25.6 MVA

In addition, Figure I-4-4-1 shows the grid map of PGCB.
Electric power flows from eastern zone to western zone at present, because almost all power stations are located in the eastern zone of Bangladesh. Example of the result of power flow analysis is shown in Figure I-4-4-2. This figure is the result of power flow analysis of 230kV transmission lines in the last year at peak power generation.

Figure I-4-4-1 Grid map

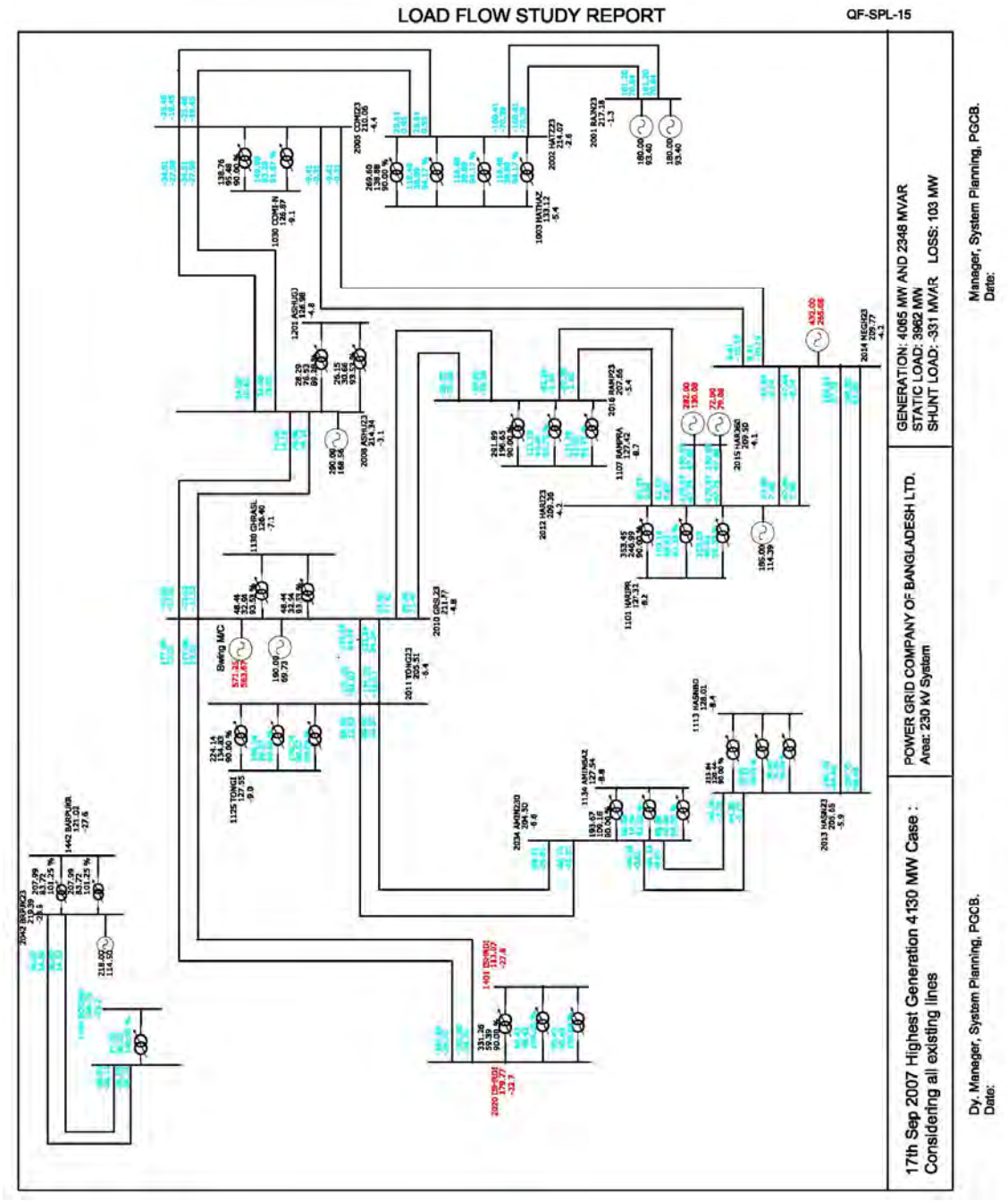


Figure I-4-4-2 Example of power flow analysis

Table I-4-4-3 shows the investment plan of transmission and substation facilities up to 2012. Following projects are also considered in this study.

Table I-4-4-3 Investment plan of PGCB

	Name of the Project	Estimated cost (MUS$)			Expected Completion Year
		Foreign	Local	Total	
1	Shunt Compensation at Grid Substations by Capacitor Banks (Phase -1)	11.76	6.53	18.29	2007-08
2	Ishurdi – Baghabari – Sirajganj - Bogra 230 kV Transmission Line	42.28	26.59	68.87	2008-09
3	National Load Dispatch Centre	54.35	37.89	92.24	2008-09
4	Construction & Extension of Grid Substations including transmission line facilities (Phase-1)	57.29	36.37	93.66	2008-09
5	Naogaon - Niamatpur 132 kV Transmission Line	-	13.25	13.25	2008-09
6	Aminbazar - Savar 132 kV Transmission Line	7	5	12	2008-09
7	Ashuganj - Shahjibazar 132 kV single circuit line	-	2.5	2.5	2008-09
8	Three Transmission Lines Project. i. Thakurgaon - Panchgar 45 km 132kV Line ii. Naoga - Joypurhat 40 km 132kV Line iii. Cuadanga – Jhenaidha - Magura 73 km 132kV Line	31.94	24.39	56.33	2009-10
9	Meghnaghat - Aminbazar 400 kV Transmission Line	22.86	17.39	40.25	2009-10
10	Aminbazar - Old Airport 230 kV Transmission Line and Associated Substations	53.22	40.03	93.25	2009-10
11	Transmission Efficiency Improvement through Reactive Power Compensation at Grid Substations and Reinforcement of Goalpara Substation	20.45	13.11	33.56	2009-10
12	Bhola - Barisal 132 kV Transmission Line	18.57	21.43	40.00	2009-10
13	Chandraghona – Rangamati – Khagrachari 132 kV Transmission Line	13.2	10	23.2	2009-10
14	Sylhet – Shahjibazar - Brahmanbaria 230 kV transmission Line with associated substations	71.20	51.32	122.52	2010-11
15	Ishurdi - Rajshahi 230 kV Transmission Line	30	10	40	2010-11
16	Construction of 230/132 kV Substations at Shyampur, Jhenaidah (or Jessore), Bheramara and Sripur	50	32	82	2010-11
17	Raojan – Madunaghat - Sikalbaha 230 kV Transmission Line	38	30	68	2010-11

	Name of the Project	Estimated cost (MUS$)			Expected Completion Year
		Foreign	Local	Total	
18	Eight new 132/33 kV S/Ss with Interconnecting 132 kV line (2008-09 to 2010-2011)	53.383	31.04	84.423	2010-11
19	Haripur 360 MW Power Plant and Associated Substation Construction Project	-	-	-	2011-12
20	Enhencement of Capacity of Grid Substations and Transmission Line (Phase-I)	90	65	155	2011-12

4.4.2 Transmission facilities related to this project

The survey and study of the items related to 230kV line near this project site, new 230kV Bheramara substation and existing 132kV Bheramara substation were carried out.

(1) Present situation of construction of transmission line

Figure I-4-4-3 shows the plan of connection of new Bheramara substation with 230kV transmission line.

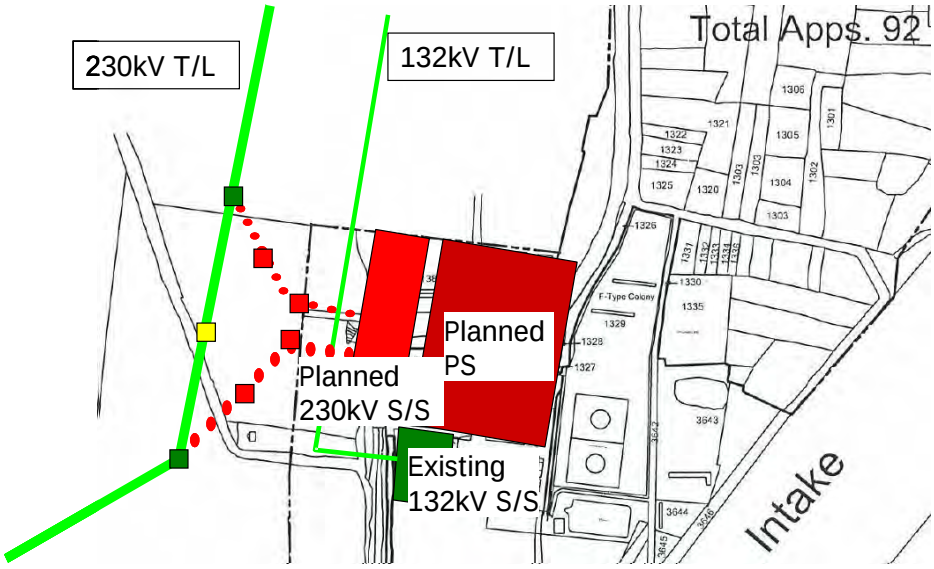


Figure I-4-4-3 Overview of transmission system around Bheramara substation

As for the construction of 230kV transmission line, gap conductor stringing at Hardinge Bridge, a part of stringing, etc are already completed.

Figure I-4-4-4 Situation around Bheramara substation

4.4.3 System analysis

The results of system analysis at the operation year of Bheramara power station were confirmed. PGCB uses the software prepared by CYME INTERNATIONAL for the power system.

(1) Power flow and voltage analysis

230kV line, which is under construction at present, is connected with new power plant (substation). Following table shows the case of one line fault (N-1) in order to confirm the transmission capacity. Because the thermal capacity of new power station is not determined, expected maximum thermal capacity (575MW), which is severe for transmission capacity, is applied for this study.

Case	Fault location
1	230kV Bheramara S/S - 230kV Jhndh S/S
2	230kV Bheramara S/S - 230kV Ishudri S/S
3	230kV Bheramara S/S - 132kV Bheramara S/S
4	230kV Bheramara S/S - Bheramara CCPP
5	230kV Ishudri S/S - 230kV Baghabari S/S
6	230kV Ishudri S/S - 230kV Ghorasal S/S

As a result, it was confirmed that the fault location between 230kV Bheramara S/S and 230kV Ishudri S/S was most severe case, and that the power flow was 184MW. This amount is less than 60% of transmission capacity (322MW), and it is confirmed that the transmission capacity is enough for power flow.

In addition, it was confirmed that voltage was satisfied with the criteria (between -10% and +10%).

(2) Fault current analysis

It was confirmed that maximum fault current at each substation was less than maximum allowable current of circuit breaker.

(3) Dynamic stability analysis

Dynamic simulation was carried out in order to confirm the effect of the accident of Bheramara power station. It was confirmed that the result was the same as the effect occurred

by the accident of other power station.

4.5 Fuel Supply Planning

4.5.1 Gas production volume and forecast of gas reserve

Table I-4-5-1 shows the gas production volume in Bangladesh as of June 2008, gas production volume during the period from 2008 through 2020, and the forecast of gas reserve by fiscal year 2020.

Table I-4-5-1 Gas production volume and forecast of gas reserve (unit: Bcf)

Company		Recoverable (P1+P2)	Cumulative Production (June 2008)	Remaining Reserve (P1+P2)	Production (2008 - 2020)	Remaining Reserve (P1+P2) (2020)
Petrobangla	BGFCL	10,876.0	5,374.1	5,501.9	4,726.0	775.9
	SGFL	3,476.0	914.8	2,561.2	1,799.0	762.2
	BAPEX	1,015.0	105.3	909.7	1,220.0	-310.3
IOC-1	CHEVRON	3,687.0	732.9	2,954.1	2,966.0	-11.9
	CAIRN	500.0	439.7	60.3	40.0	20.3
	TULLOW	305.0	47.3	257.8	274.0	-16.2
	NIKO	603.0	86.6	516.4	75.0	441.4
IOC-2	Block-5,7,10	0	0	0	621.0	0
	Block-16	0	0	0	329.0	0
	Block-17,18	0	0	0	274.0	0
IOC-3		0	0	0	949.0	0
Total		20,462.0	7,700.7	12,761.4	13,273.0	1,661.4

(source) Petrobangla (July, 2008)

BGFCL, SGFL, and BAPEX as gas producing companies described in Table I-4-5-1 are subsidiaries of Petrobangla, and are financed by the Government of Bangladesh. CHEVRON, CAIRN, TULLOW, and NIKO are the international petroleum and gas companies which are called the International Oil Company (IOC).
The IOC-1 shows the supply plan of private mining companies already under contract. The supply plan is based on P1 (supply probability: 90%) and P2 (supply probability: 50%). And the IOC-1 concluded production sharing agreements with Petrobangla, and the produced gas is sold to Petrobangla.
The IOC-2 shows the individual site (block), year of drilling, and supply volume. The gas reserve has not yet been verified by Petrobangla.
The IOC-3 assumes an offshore supply. The bidding was termed only in May 2008. Similarly to the case of the IOC-2, the year of drilling and supply volume are shown. The gas reserve has not been verified by Petrobangla.
The remaining reserve (P1+P2) of IOC-2 and IOC-3 is not verified by Petrobangla. Thus, total of gas reserve in Bangladesh in fiscal year 2020 is total of Petrobangla and IOC-1.

4.5.2 Forecast of gas supply volume and gas demand

Table I-4-5-2 shows the forecast of gas supply volume during the period from 2008 through 2020 in Bangladesh. According to the gas supply volume forecast by Petrobangla for the IOC-2 and IOC-3 where the individual site (Block) and the year of drilling have not yet been verified, gas supply can be started in 2011 for the IOC-2 and in 2014 for the IOC-3.

Table I-4-5-2 Forecast of gas supply volume (Daily maximum supply volume, unit: mmcfd)

Company		2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Petrobangla	BGFCL	782	817	907	976	1,090	1,079	1,091	1,100	1,100	1,095	1,095	1,095
	SGFL	180	190	222	280	320	350	430	480	540	590	590	590
	BAPEX	53	112	185	230	260	328	348	345	365	364	363	363
IOC-1	CHEVRON	830	760	740	710	680	650	620	590	540	480	420	370
	CAIRN	50	0	0	0	0	0	0	0	0	0	0	0
	TULLOW	100	100	60	60	60	60	60	60	60	60	0	0
	NIKO	45	45	55	55	75	75	50	50	50	50	50	50
IOC-2	Block-5,7,10	0	0	0	100	200	200	200	200	200	200	200	200
	Block-16	0	0	0	100	100	100	100	100	100	100	100	100
	Block-17,18	0	0	0	0	50	100	100	100	100	100	100	100
IOC-3		0	0	0	0	0	0	300	300	500	500	500	500
Total		2,040	2,024	2,169	2,511	2,835	2,942	3,299	3,325	3,555	3,539	3,418	3,368

(source) Petrobangla (July, 2008)

Table I-4-5-3 shows the gas demand forecast in Bangladesh during the period from 2008 through 2020.

According to the gas demand forecast by Petrobangla, during the period from 2008 through 2020, the demand in each field is represented as about 52 % for electric power, about 10 % for household consumption, and about 9 % for fertilizer.

The average annual growth rate in each field is shown as 7.82 % for electric power, 0.08 % for household consumption, and 0.02 % for fertilizer during the period from 2008 through 2020.

Table I-4-5-3 Forecast of gas demand volume (Daily maximum demand volume, unit: mmcfd)

Company	Category	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
BGSL	Power	138.3	148.3	183.3	218.3	218.3	218.3	218.3	218.3	218.3	218.3	218.3	218.3
	Captive	29.6	32.0	34.5	37.3	40.3	43.5	47.0	50.7	54.8	59.2	63.9	69.0
	Fertilizer	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0
	Non-Bulk	122.7	132.5	143.1	154.6	166.9	180.3	194.7	210.3	227.1	245.3	264.9	286.1
	Sub-total	410.6	432.8	480.9	530.2	545.5	562.1	580.0	599.3	620.2	642.8	667.1	693.4
JGTDSL	Power	136.7	166.7	241.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7
	Captive	5.8	6.2	6.7	6.9	7.0	7.2	7.4	7.6	7.8	8.0	8.3	8.5
	Fertilizer	15.0	15.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
	Non-Bulk	33.5	36.2	39.1	42.2	45.6	49.2	53.2	57.4	62.0	67.0	72.3	78.1
	Sub-total	191.0	224.1	312.5	279.8	283.3	287.1	291.3	295.7	300.5	305.7	311.3	317.3
PGCL	Power	85.0	85.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
	Captive	4.0	4.8	5.8	6.9	8.3	10.0	11.9	14.3	17.2	20.6	24.8	29.7
	Fertilizer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	70.0	70.0	70.0	70.0	70.0
	Non-Bulk	11.0	13.2	15.8	19.0	22.8	27.4	32.9	39.4	47.3	56.8	68.1	81.7
	Sub-total	100.0	103.0	221.6	225.9	231.1	237.4	244.8	323.7	334.5	347.4	362.9	381.4
TGTDCL	Power	757.0	863.0	982.0	1147.0	1162.0	1179.0	1270.0	1288.0	1331.0	1356.0	1493.0	1523.0
	Captive	198.1	213.9	231.0	249.5	269.5	291.0	314.3	339.5	366.6	395.9	427.6	461.8
	Fertilizer	155.0	155.0	155.0	155.0	155.0	155.0	155.0	155.0	155.0	155.0	155.0	155.0
	Non-Bulk	551.4	595.6	643.2	694.7	750.2	810.3	875.1	945.1	1020.7	1102.3	1190.5	1285.8
	Sub-total	1661.5	1827.5	2011.2	2246.2	2336.7	2435.3	2614.4	2727.6	2873.3	3009.2	3266.1	3425.6
SGCL	Power	0.0	0.0	135.0	135.0	298.0	298.0	298.0	298.0	298.0	298.0	298.0	298.0
	Captive	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Fertilizer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Non-Bulk	0.0	0.0	14.0	15.1	16.3	17.6	19.1	20.6	22.2	24.0	25.9	28.0
	Sub-total	0.0	0.0	149.0	150.1	314.3	315.6	317.1	318.6	320.2	322.0	323.9	326.0
Total Demand		**2363.1**	**2587.4**	**3175.2**	**3432.2**	**3710.9**	**3837.5**	**4047.6**	**4264.9**	**4448.7**	**4627.1**	**4931.3**	**5143.7**

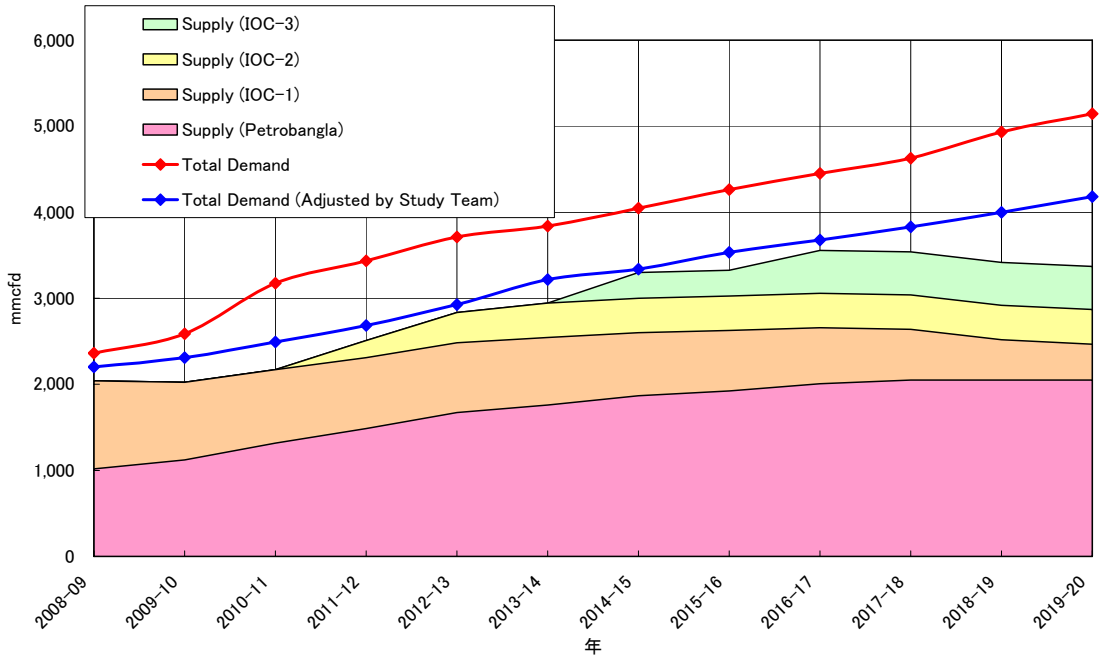
(source) Petrobangla (July, 2008)

Lastly, Figure I-4-5-1 shows a summary of the gas supply and demand forecast.

In the Petrobangla project on July 2008 (line: total demand), the forecast of gas demand is much higher than the forecast of gas supply even when all the supply plans of Petrobangla, IOC-1, IOC-2 and IOC-3 have been completed.

Meanwhile, MoPEMR readjusted that postpone of gas supply for new gas thermal power plant as shown on Table I-4-5-4. The forecast of gas demand for electric power (line: total demand (adjusted by Study Team)) according to this readjustment, the forecast of gas supply is slightly lower than the forecast of gas demand when Bheramara CCPP will commence commercial operation in the vicinity of 2014 if all the supply plans of Petrobangla, IOC-1, IOC-2, and IOC-3 have been achieved. This forecast of gas demand indicates maximum gas demand. Thus, it is hard to say that there is shortage of gas supply at any time and if the gas could be supplied to efficient thermal power plants when peak of gas demand, the Study Team deems that it is

possible to supply gas for Bheramara CCPP.
After fiscal year in 2017, if there is gas supply plan just indicated on Table I-4-5-2, the gas supply volume will be decreasing. Thus, the Study Team deems that it is necessary to ensure exploration and development of new gas fields should be accelerated except for planning.
In addition, the result of economic evaluation for prioritizing gas supply to Bheramara CCPP by management team is described on Volume II 9.3.2 Gas Shortage.



(source) Petrobangla (July, 2008)
(Total Demand (Adjusted by Study Team) was made be the Study Team)
Figure I-4-5-1 Forecast of gas demand and supply

Table I-4-5-4 Period of gas supply for new gas thermal power Plant

No.	Generating Station	Type of Fuel	Expected Commissioning date by BPDB	Revised Commissioning date by MoPEMR	Gas Demand (mmcfd)
1	Sikalbaha 150 peaking Power Plant	Gas	FY 2009	FY 2012	35
2	Siddhirganj 2x120 MW peaking power Plant	Gas	FY 2008	FY 2008	65
3	Khulna 150 MW Peaking PP	Gas/Oil	FY 2010	FY 2013	35
4	Sirajganj 150 MW Peaking Power Plant	Gas	FY 2010	FY 2013	35
5	Chandpur 150 MW CCPP	Gas	FY 2010	FY 2012	30
6	Sylhet 150 MW CCPP	Gas	FY 2010	FY 2010	30
7	Haripur 360 MW CCPP	Gas	FY 2012	FY 2014	55
8	Siddhirganj 2x150 MW peaking power Plant	Gas	FY 2010	FY 2014	70
9	210 MW Khulna Thermal Power Station	Gas/Oil	FY 2011	Cancel	
10	Bheramara 360 CCPP	Gas	FY 2012	FY 2016	55
11	Bhola 150 MW CCPP	Gas	FY 2011	FY 2012	30
12	Bibiana 450 MW CCPP IPP	Gas	FY 2010	FY 2011	75
13	Sirajganj 450 MW Combined Cycle IPP	Gas	FY 2010	FY 2013	75
	Total				590

(source) MoPEMR (August, 2008)

4.5.3 Gas pipeline construction project

Figure I-4-5-2 shows the gas pipeline route under construction financed by ADB. Much of the gas being produced in Bangladesh is located in the northeastern region. Thus, when the ADB financed gas pipeline is used to transport the gas produced in the northeastern region to the western or southwestern region where Bheramara CCPP is located, gas pressure may be reduced because of the pressure loss of the gas pipe line, and gas may not be easily supplied to the gas consumers including the Bheramara CCPP.

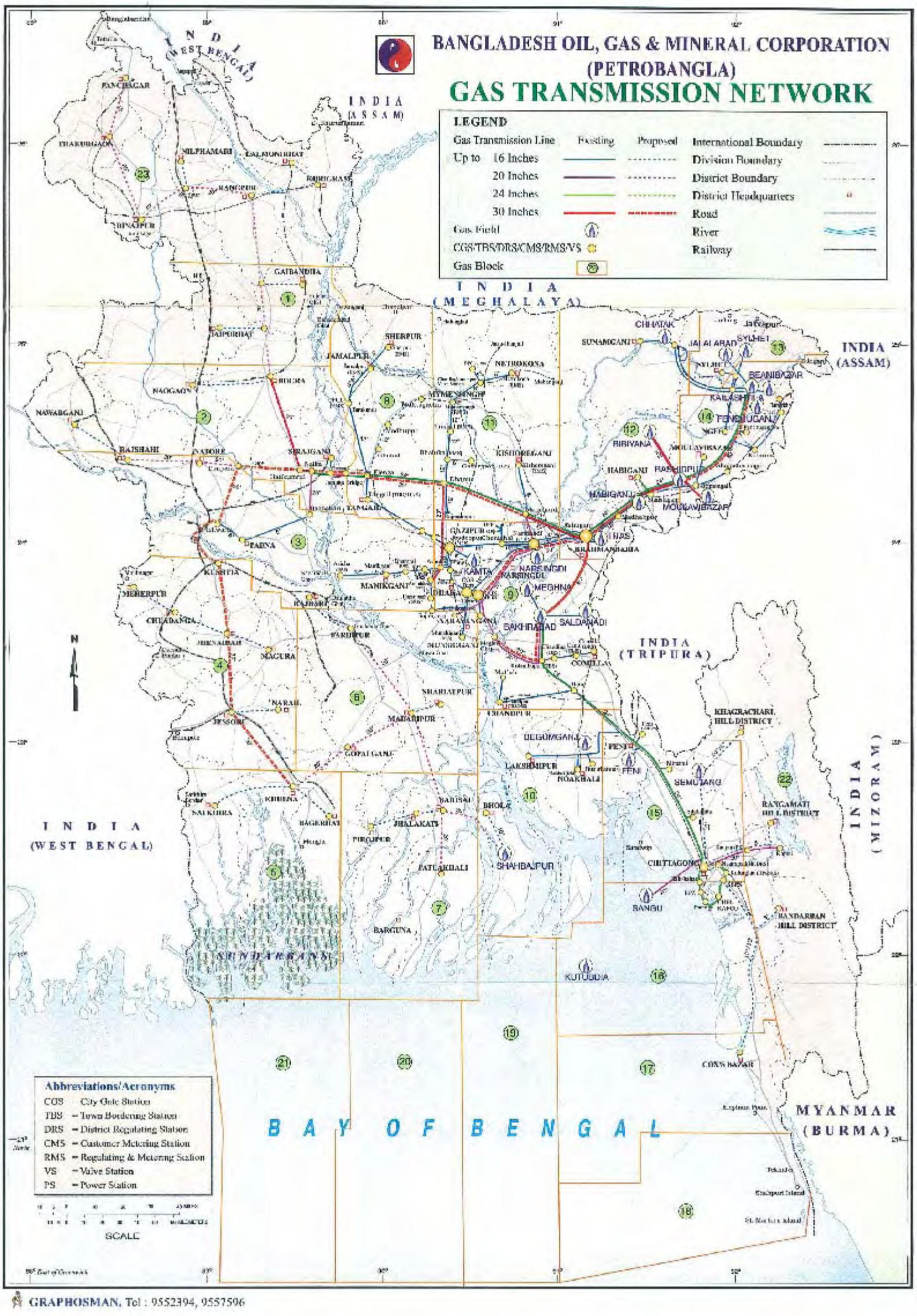
To solve this problem, the ADB loan includes the plan for the construction of gas compressors in Ashuganj and Elenga so as to solve the problem of insufficient gas supply pressure.

It has been confirmed that construction of the gas pipe line (up to Khulna) and gas compressors will be completed by 2011.

Gas is supplied to the Bheramara CCPP through a gas pipeline which is branched off from some midpoint (between Ishwardi and Kushtia) of a 240 km, 30 inch gas pipeline which is laid between Hatikumrul and Khulna.

The new gas thermal power plants, Bheramara CCPP, Khulna 150 MW Peaking PP, Sirajganj 150 MW Peaking Plant and Sirajganj 450 MW Combined Cycle IPP will be constructed down the stream of Elenga, and the total gas demand of these new thermal power plants included Bheramra CCPP will be 200 mmcfd.

Khulna 150 MW Peaking PP is dual firing thermal power plant. Thus, in case of Khulna 150 MW Peaking PP is operated by oil, total gas demand is 170 mmcfd.
The maximum gas supply capacity of the 30 inch gas pipeline is about 350 mmcfd. Thus, if Khulna 150 MW Peaking PP is operated by oil and there are affect the supply of gas to household consumptions, it seems to be possible to supply of gas to the Bheramara CCPP that requires 55 mmcfd.



(source) Petrobangla

Figure I-4-5-2 Gas Transmission Network in Bagladesh

4.5.4 Possibility of gas supply to the Bheramara CCPP

As indicated in section 4.5.2, since there is concern about insufficient gas supply in Bangladesh, the Study Team make a judgment that it is necessary to ensure stable gas supply to the Bheramara CCPP which is planned to commence commercial operation in 2014, the Government of Bangladesh should set up a policy as followings.

- Exploration and development of new gas fields should be accelerated.
- Gas should be supplied to efficient thermal power plants, especially CCPP with priority.
- Old and low efficient gas thermal power plants should be stopped, if required after the high efficient thermal power plants such as Haripur and Bheramara CCPPs will be put into operation.
- A long term agreement stipulated minimum gas supply should be signed.

List of old and low efficient gas thermal power plants should be stopped to supply gas to high efficient thermal power plants such as Bheramara CCPP with priority is described in section 4.3.3.
The Study Team make a judgment that it is necessary to be stopped the existing gas thermal power plants considering following items.

- Management policy of power plants
- Construction plan of new gas thermal power plants
- Efficiency of thermal power plants
- System stability
- Balance of gas supply and gas demand

4.5.5 Supply of fuel oil to Bheramara CCPP

The Study Team has concern about insufficient gas supply for Bheramara CCPP, we survey and study the possibility of supplying fuel oil to Bheramara CCPP.
All the fuel oil used in Bangladesh is imported from abroad. The HSD to be used in the Bheramara CCPP is imported from the Middle East. The major storage tanks are located in Chittagong, Bagabari, and Khulna. The recent demand for fuel oil remains flat.
The fuel oil rate is determined by the Government of Bangladesh. The heavy oil rate in Bangladesh is less than 50 % of the market price, and the light oil rate is about 50 % of the market price.
At present, the Bheramara CCPP is provided with HSD tanks (3,000 KL x 2 tanks) to supply fuel to the existing power plant. HSD is transported from the Khulna to these tanks by railway (maximum carrying capacity: 50 m^3 (42.5 KL) @0.85kg/m^3).
The Bheramra CCPP will use HSD for emergency and not in a continuous basis from technical and economical points of view as followings and described on section 4.7.1;

- Bangladesh Petroleum Corporation (BPC) should import more HSD from abroad. (2,000 KL/day x 365 days = 730,000 KL/year)
- BPC should prepare tanker for importing HSD.
- BPC should construct HSD storage tank in Khulna.
- The railway company should upgrade (40 kL x 25 vehicles x 2 trains = 2,000 kL) the existing railway for transportation of HSD from Khulna to Bheramara CCPP.
- Two (2) Large HSD storage tanks having a capacity of 50,000 kL and HSD unloading facilities should be constructed at Bheramara CCPP.
- It is necessary to huge investment for above-mentioned.