Chapter 5 Basic Design

5.1 Outline of the Project

From the result of Sub-section 4.7.2 and 4.7.3, Bheramara CCPP is planned as a nominal 360MW high efficiency combined cycle power plant consisting an F class gas turbine generator, a heat recovery steam generator (HRSG), a steam turbine generator and related facilities. And the Project additionally includes the branch 230kV transmission line from adjacent main 230kV transmission line, new 230kV substation, rehabilitation of the existing 132kV transmission line and branch gas pipeline from the adjacent city gate station (CGS). Forced draft cooling tower system is utilized for the cooling system of condenser of steam turbine and groundwater is used for water supply of the system.

5.2 Operational Requirements

5.2.1 General

The main components and their auxiliaries shall be designed to ensure that trouble free starts and operations are achieved throughout the design life of the new plant. Adequate redundancies for auxiliary facilities & equipment shall be made available to achieve high availability. The main components and their auxiliaries shall be designed to be able to start and rise up to full load by the initiation of a single push-button. The entire plant shall be suitable for continuous heat and power load operation keeping the required heat energy export.

5.2.2 Plant Duty

The new plant shall have high efficiency and reliability based on proven advanced technology.

(1) Start-up Time Schedule Requirements

The start-up time shall be as short as possible to cope with the function of this new plant. The start-up time shall be defined as the time required from the initiation of the start button to the full load conditions, provided that the condenser vacuum is established and the new plant is ready for start. The time for air purge of special volume post gas turbine and synchronization shall be excluded.

(2) Service Life Time

The new plant and associated equipment shall be designed and constructed for the service time as specified below:

Minimum Service Time = 30 years
Equivalent Service Hours = 183,960 hours on a full load basis [1]

The new plant shall be designed for a continuous load operation with more than 6,132 actual operating hours per year on a basis of the full load. Necessary hours for starting and shutdown cycle are not included in the above operating hours.

(3) Start-up and Shutdown Times

1) Equivalent Service Hours : 24 x 365 x 30 x Plant Load Factor 70 %

For the design requirements as stated above, the following annual start-up times shall be considered:

Type of Start	Annual Times	Total Times through Service time
Cold Start (S/Down > 36h)	2	60
Warm Start (S/Down < 36h)	5	150
Hot Start (S/Down < 8h)	30	900
Very Hot (S/Down < 1h)	5	150
Total	42	1,260

5.2.3 Control and Operation Philosophy

(1) Plant Automation

The degree of automation is such that the start-up/shutdown sequential control and the protection of the new plant shall be fully automated to enable overall supervision of the new plant by operators at the CCR. However, the start-up/shutdown control sequence shall include break points to allow the operator to intervene and provide normal assistance as needed.

The start-up/loading procedures, including draining and venting of the new plant, shall be selectable and controlled automatically dependant upon such state conditions of the new plant as very hot, hot, warm, or cold status.

(2) Plant Operation

The CCR shall be accommodated in the new turbine building of the new plant and be equipped with the state-of-the-art DCS (Distributed Control System) with data logging system so that power can be automatically controlled to meet the demands. The operator console which consists of LCD (Liquid Crystal Display) for monitoring of operating conditions and keyboard panels with mouse for operation of the new plant will be installed as the operator console in the CCR.

The CPU shall be of duplicate configuration using the standby redundant system to ensure the reliability of the control system.

(3) Power Control

The plant power load will be demanded by SCADA system from the load dispatch center to the new plant. The new plant shall be automatically operated after setting the plant power load demand into the DCS through the operator console by the operator of the new power plant so that the plant power load demand will be satisfied.

5.3 Study on Basic Technical Issues

5.3.1 Expected Performance of Bherarma Combined Cycle Power Plants

(1) Candidate Models of CCPP

Four (4) models are available in the international market as the combined cycle power plant (CCPP) which is comprised of a 50 Hz use largest capacity gas turbine model of which turbine inlet temperature is of F class level. The F class models of gas turbines of four (4) original equipment manufacturers (OEMs) are matured with much operating experience and are deemed to be best suited for the Project from operating experience points of view. According to the Gas Turbine World 2007-08 GTW Handbook, the four (4) models of combined cycle power plants are as tabulated below:

Name of OEM of GT Model of CCPP

Alstom	KA26-1 (with air quench cooler)
General Electric	S109FA
Mitsubishi	MPCP1(M701F)
Siemens	SCC5-4000F 1×1

Above models were shosen provided that they could be put into commercial operation in advance as a simple cycle.

(2) CCPP Performance Data on ISO Conditions

In the said GTW Handbook, performance data of above models of CCPPs are described at ISO conditions (101.33 kPa, 15 ^{o}C, 60 % RH) on natural gas are as described below:

Model of CCPP	Net Plant Output (kW)	Net Plant Efficiency (%)
KA26-1 with AQC	Not specified	Not specified
S109FA	390,800	56.7
MPCP1 (M701F)	464,500	59.5
SCC5-4000F 1×1	416,000	58.2

(3) Calculation Results of CCPP Heat Balance on Unfired Conditions

Performances of the four (4) models of CCPPs on rated and maximum capacity site conditions must be predicted to specify the performance requirements of the Plant in the Bidding Documents. For the purpose, the heat balances at the rated and maximum capacity site conditions were calculated using the gas turbine performance data on ISO conditions specified in the said GTW Handbook. The types of gas turbines to be used for calculation of the CCPP heat balances and their performance data cited from the said Handbook are as shown below:

Model of Gas Turbine	GT26 (AQC)	PG9371(FB)	M701F4	SGT5-4000F
ISO base rating (MW)	288.3	255.6	312.1	286.6
Efficiency (%)	38.1	36.9	39.3	39.5
Pressure ratio	33.9	17.0	18.0	17.9
Air flow rate (kg/s)	648.6	640.9	702.6	689.4
Exhaust gas temp (oC)	616.1	602.2	596.7	577.2
Fuel gas flow rate (kg/s)	15.40	14.09	16.16	14.76
Fuel gas flow rate (MMcf/hr)	2.78	2.55	2.92	2.67

Where, the net specific energy (lower heating value) of the natural gas is assumed to be 49,150 kJ/kg (979.2 kJ/cf at 60 ^{o}F) calculated from the averaged volume fraction of the natural gas of Bangladesh. The correction of the performance data of above gas turbines to the site, inlet and exhaust conditions is conducted in accordance with various correction factors based on our many experiences with them. The site conditions are designated as tabulated below as per the site survey results:

Type of Site Condition	Rated	Max. Capacity
Dry Bulb Temperature (^{o}C)	35.0	10.0
Relative Humidity (%)	80.0	80.0
Wet Bulb Temperature (^{o}C)	31.8	8.3
Barometric Pressure (kPa)	101.3	101.3

The rated site conditions are specified in accordance with ones for the existing gas turbine power plants, while the maximum capacity site conditions are specified as the monthly averaged minimum ambient temperature and the relative humidity for the time.
The installation capacities of electrical and auxiliary equipments must be determined to cope with the gas turbine maximum capacity and the performances of the bottoming system (HRSG and steam turbine) dependable upon it. To determine the installation capacities of electrical and auxiliary equipments, therefore, the site ambient conditions where the gas turbine maximum capacity is defined must be specified.
The mean value of monthly averaged site ambient dry bulb lowest temperature is plus 10 ^{o}C according to the recorded data for five (5) years during the year 2002 to 2007 at Ishdri in the northwest of Bheramara site. Therefore, the installation capacities of electrical and auxiliary equipments shall be determined to meet the operating performances of gas turbine and bottoming system at the ambient dry bulb temperature of 10 ^{o}C. The relative humidity for the ambient temperature is 80 %.
The following cycle configurations and parameters are preliminarily assumed for calculation of CCPP heat balances in accordance with similar CCPPs.

GT Inlet Air Cooling System	Not considered
Exhaust Gas Leakage	0.5 %
Cycle Configuration	Triple-pressure, reheat
Cooling System	Mechanical draft cooling tower
Type of HRSG	Unfired type
Steam Conditions at Turbine Inlet for Site Rated Conditions	
HP Steam	
Temperature	560 (540) ^{o}C
Pressure	11.8 (9.81) MPa
IP Steam (Mixture of hot reheat and IP SH steams)	
Temperature	560 (540) ^{o}C
Pressure	2.94 (2.45) MPa
LP Steam	
Temperature	Mixed temperature of LP SH and IPT outlet steams
Pressure	0.34 (0.29) MPa
Condenser Vacuum	Depends on cooling tower characteristics.

Where, bracketed figures are used for Siemens SCC5-4000F 1×1 CCPP where the gas turbine exhaust gas temperature is lower compared to other plants.
The leakage of 0.5 % of the exhaust gas flow rate from the gas turbine is considered for calculation of heat balance of the bottoming system.

(4) Heat Balance Calculation Results under unfired conditions

Results of heat balance calculations for the said four (4) models of CCPPs under unfired conditions are summarized as tabulated below:

CCPP model	KA26-1 with AQC		S109FA		MPCP1 (M701F)		SCC5-4000F 1×1	
Site Condition	Rated	Max Cap	Rated	Max Cap	Rated	Max Cap	Rated	Max Cap
Plant Gross Power Output (MW)	374.7	433.5	344.9	396.3	403.9	465.0	365.6	421.1
Gas Turbine (MW)	245.5	288.7	221.8	260.8	270.5	318.1	244.1	287.0
Steam Turbine (MW)	129.2	144.8	123.1	135.5	133.4	146.9	121.5	134.1
Plant Gross Thermal Efficiency (%)	54.8	56.6	54.6	56.0	55.8	57.3	55.8	57.3
Auxiliary Power (MW)	12.4	14.2	9.9	11.4	11.6	13.4	10.5	12.1
Plant Net Power Output (MW)	362.3	419.3	335.0	384.9	392.2	451.6	355.1	409.0
Plant Net Thermal Efficiency (%)	53.0	54.7	53.0	54.4	54.2	55.6	54.2	55.7

As can be seen in the above table, the plant net power outputs of four (4) models of CCPPs are estimated to range from 335.0 MW to 392.3 MW at the rated site conditions under specified calculation conditions. The averaged net power output is calculated at 361 MW. Therefore, the nominal plant power output should be 360 MW. The requirement range of the plant net power output under unfired conditions to be prescribed in the tender documents should be “320 MW ~ 410 MW” in consideration of proper tolerance to expedite participation of many bidders in the bidding.

The plant net thermal efficiencies are predicted to range from 53.0 % to 54.2 % on the same conditions. Therefore, the requirement of the plant net thermal efficiency under unfired conditions to be prescribed in the tender documents should be “not less than 52.0 %”.

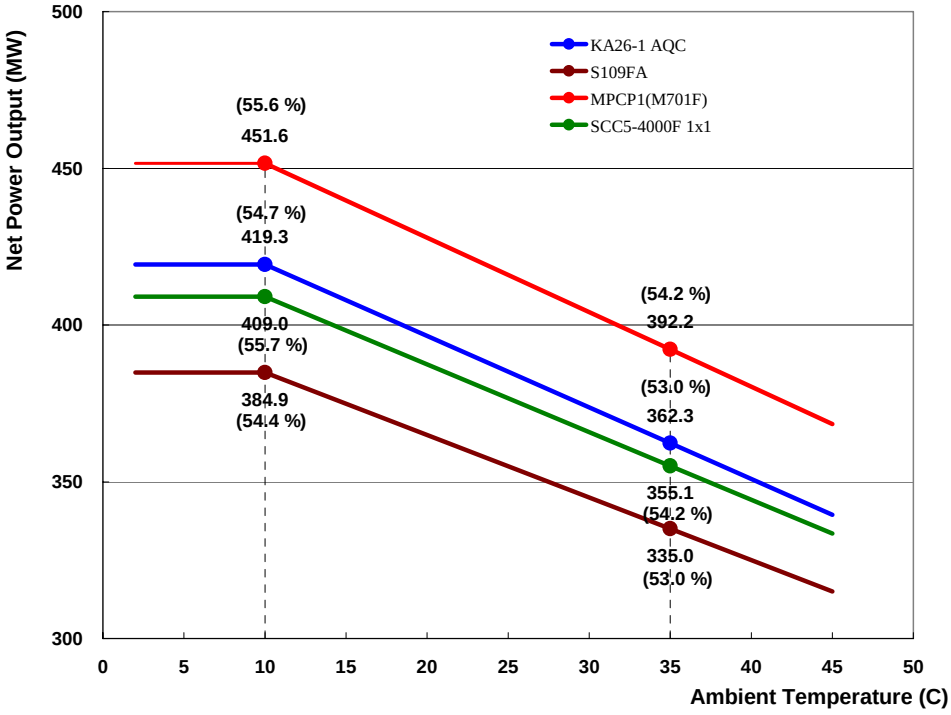
The maximum net power outputs are estimated to be ranging from 396.3 MW to 465.0 MW. Any issues in Electrical network system in Bangladesh shall be analyzed against the power output of 500 MW in consideration of a certain margin.

The ambient temperature performance characteristics of four (4) models of CCPPs are shown in the next page. From this figure, it is found that each model of CCPP has the similar power output characteristics against the ambient temperature.

The sample of the heat balance diagram for CCPP is shown in the pages to be continued to this sub-section.

(5) Heat Balance Calculation Results under Duct-Fired Conditions

The duct-fired CCPP is a commonly employed system to augment the power output of the bottoming system of the CCPP. There are many experiences with this system which is a matured technology without any difficulties. In accordance with the present tariff systems of electricity and fuel tariffs of Bangladesh, even if the plant thermal efficiency and construction cost are sacrificed by the duct firing, it is envisaged that the plant shall be evaluated to be more economical because the economic effect due to the power output increase by means of

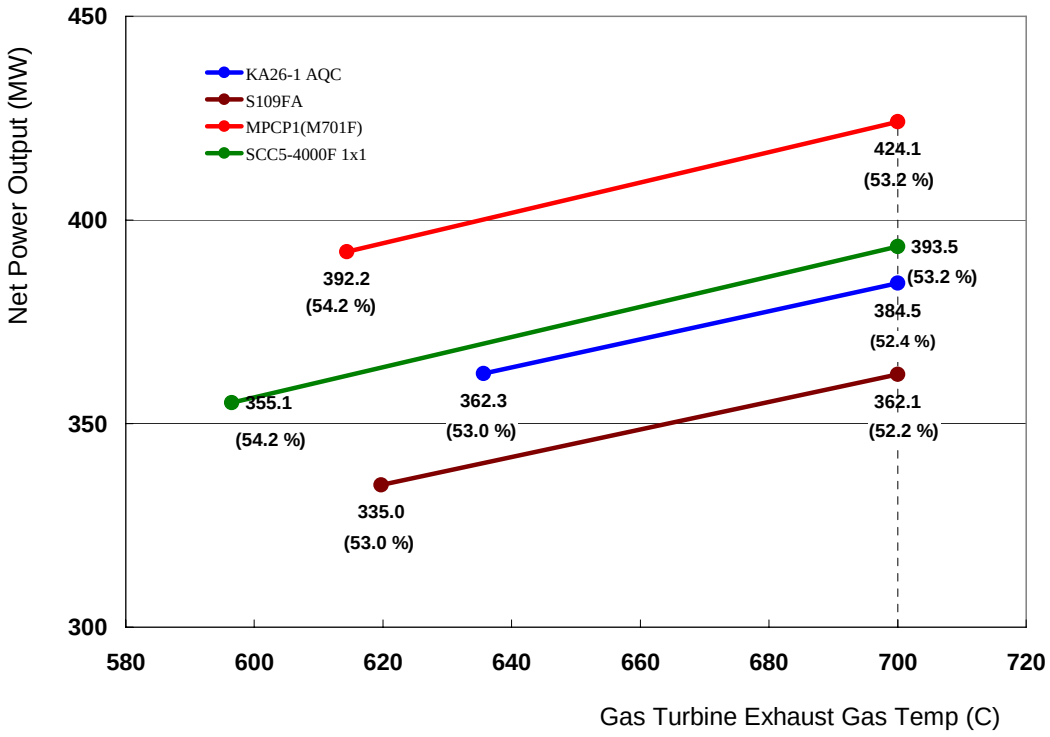


Ambient Temperature Performance Characteristics Curve

electricity and fuel tariffs of Bangladesh, even if the plant thermal efficiency and construction cost are sacrificed by the duct firing, it is envisaged that the plant shall be evaluated to be more economical because the economic effect due to the power output increase by means of the duct firing shall be sufficiently large to compensate the sacrifice of them. For study of the advantage of the duct firing, the performances of the four (4) models of CCPPs at the rated site were calculated under fired conditions up to 700 ^{o}C. The calculation results are as tabulated below:

Model of CCPP	Net Plant Output (kW)	Net Plant Efficiency (%)
KA26-1 with AQC	384,500	52.4
S109FA	362,100	52.2
MPCP1 (M701F)	424,100	53.2
SCC5-4000F 1×1	393,500	53.2

It is well known that the duct firing limit temperature without large design change of HRSG casing is generally said to be 750 ^{o}C. The above performance calculation was carried out for the firing temperature of 700 ^{o}C in consideration of proper tolerance. The next figure shows the relationship between the net power output and the duct firing temperature of four (4) CCPP models.



Relationship between Power Output and Duct Firing Temperature

(6) Performance and Economy Evaluation between Non-duct-firing and Duct-firing

1) Total Comparison

Comparison Item	Non-duct-firing	Duct-firing
Plant Net Thermal Efficiency (SCC5-4000F 1×1)	54.2 %	53.2%
Plant Net Power Output (SCC5-4000F 1×1)	355.1MW	393.5MW
Name of equipment to be additionally installed and their construction costs	-	Name of equipment — Cost(1,000US$) A part of HRSG — 2,900 A part of Steam turbine & acc. — 11,100 A part of Electrical equipment — 300 A part of Condenser/cooling system — 1,000 A part of Fuel system — 800 Duct-firing system — 3,000 Total — 19,100
Annual Revenue due to Sales of Incremental Electrical Power	-	6,932,000 US$
Annual Cost due to Incremental Fuel Consumption	-	1,900,000 US$
Maintenance	-	The inlet temperature to HRSG is increased by duct-firing, while the temperature and pressure of the produced steam is not changed. The metal temperature of the heat transfer tubes of the HRSG is governed by the temperatures of fluids (steam, pressured water) inside the cubes. Therefore, the metal temperatures of

Comparison Item	Non-duct-firing	Duct-firing
		cubes in case of duct-firing design remain unchanged compared with non-duct-firing.design. In turn, there is not any change for maintenance between non-duct-firing and duct-firing.

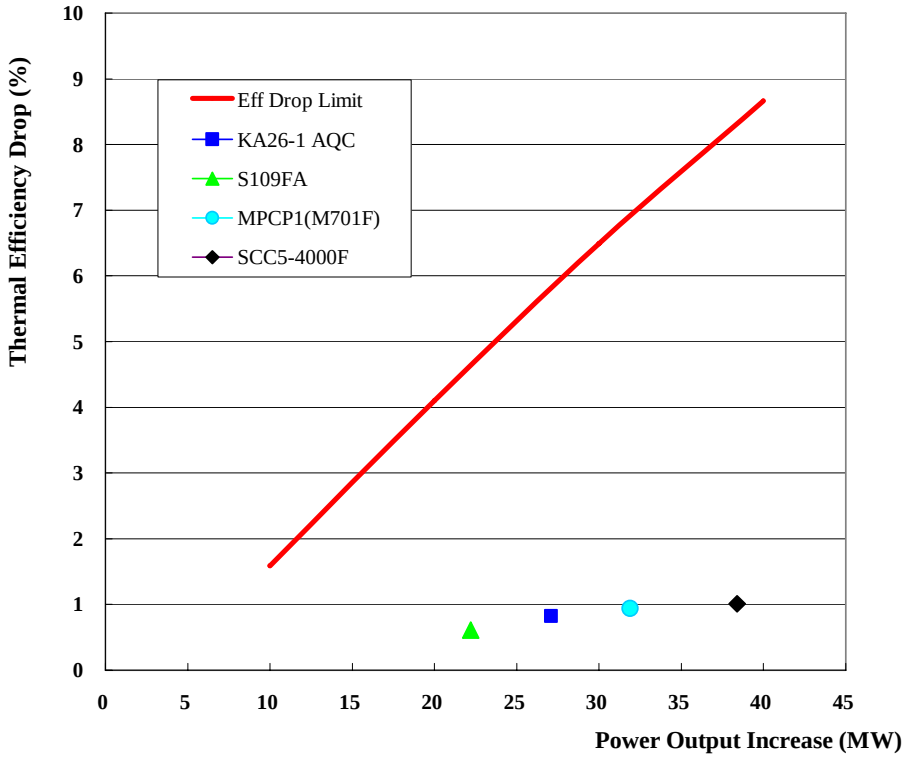
As shown in the above table, the additional cost due to installation of equipment for duct-firing could be paid back in about 4.3 years provided that additional costs such as for operation and maintenance are around 3 % of the additional installation costs for duct-firing. The construction cost for the incremental plant net power output is some 500 US$/kW.

2) Economical Evaluation

The following conditions are assumed for study of economy comparison between non-duct-firing and duct-firing:

Electricity tariff (Weighted mean value)	3.2 US cents/kWh
Fuel gas tariff	0.1 US cents/cf at 60 oF, 1 atm
Annual escalation rate (Electricity and fuel gas tariffs)	1.5 %
Evaluation period	30 years
Construction period	3 years
Capacity factor	70 % ($= \frac{\text{APG}}{8{,}760 \times \text{RPO}}$)
Transmission and distribution loss	8.0 %
Discount ratio	10.0 %
Construction cost increase	As per computer software

Where, APG and RPO denote Annual Power Generation (MWh) and Rate Power Output (MW) respectively.
The following curve (red solid line) shows the relationship between the plant net thermal efficiency drop limit and plant power output increase due to duct firing. If the calculated net thermal efficiency due to duct-firing is less than the thermal efficiency drop limit, the plant could be evaluated to be more economical by it. This relationship is obtained from the condition that the net present value for sales of increased power generation equals the net present value for cost of the increased fuel consumption plus the construction cost increase.

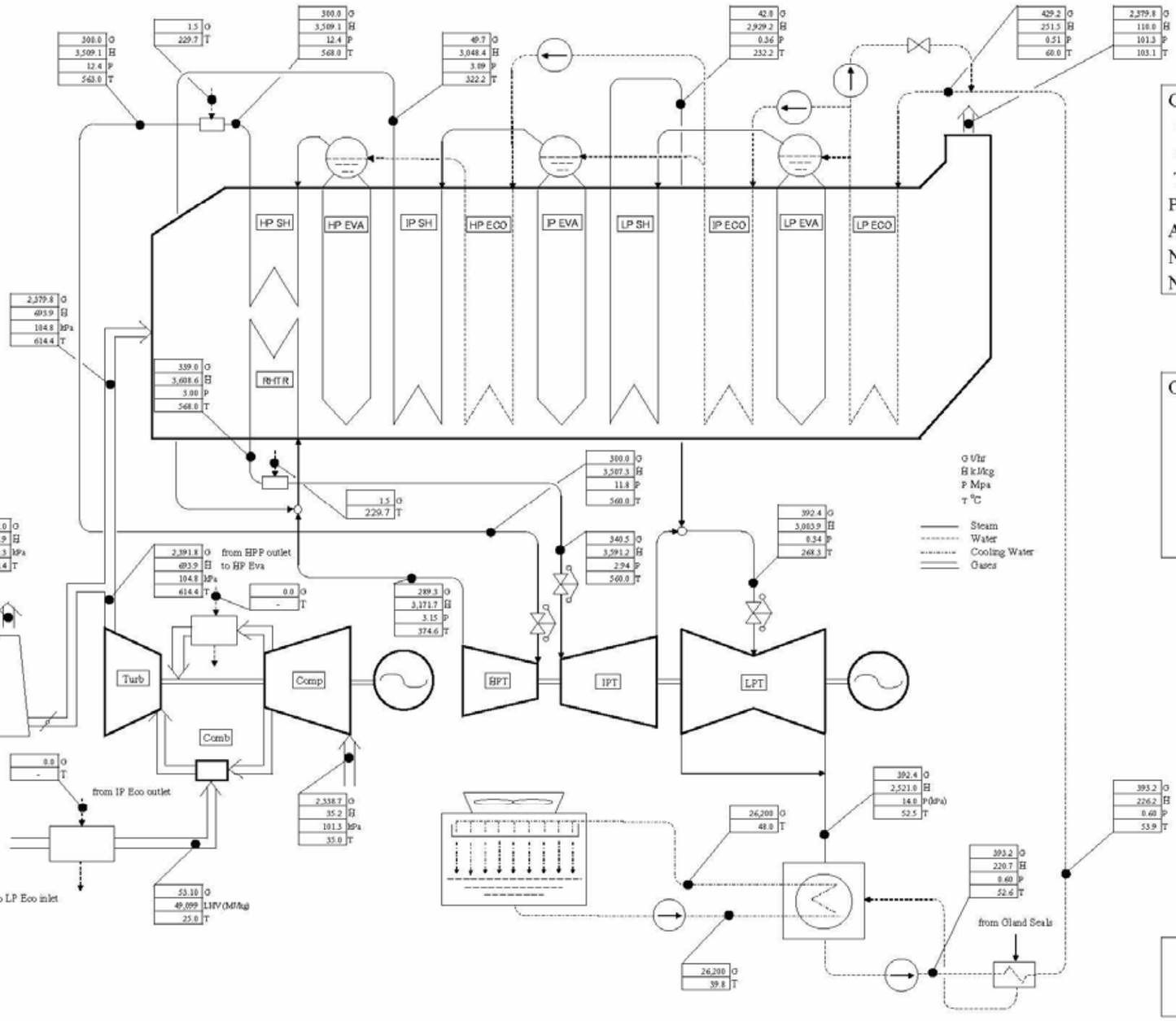


Relationship between Power Output Increase and Thermal Efficiency Drop Limit

The calculation results of four (4) models of CCPPs are shown with dotted points in this figure. It is clear that the duct firing is economically advantageous for every model of CCPP from the relationship between the thermal efficiency drop limit curve and calculated performances shown by dotted points.

From the study results described above, the CCPP with fired HRSG should be specified in the tender documents as an option of bidders. In such case, the requirement range of the plant net power output under fired conditions should be specified as “340 MW~450 MW” considering the proper tolerance to expedite participation of many bidders in the bidding.

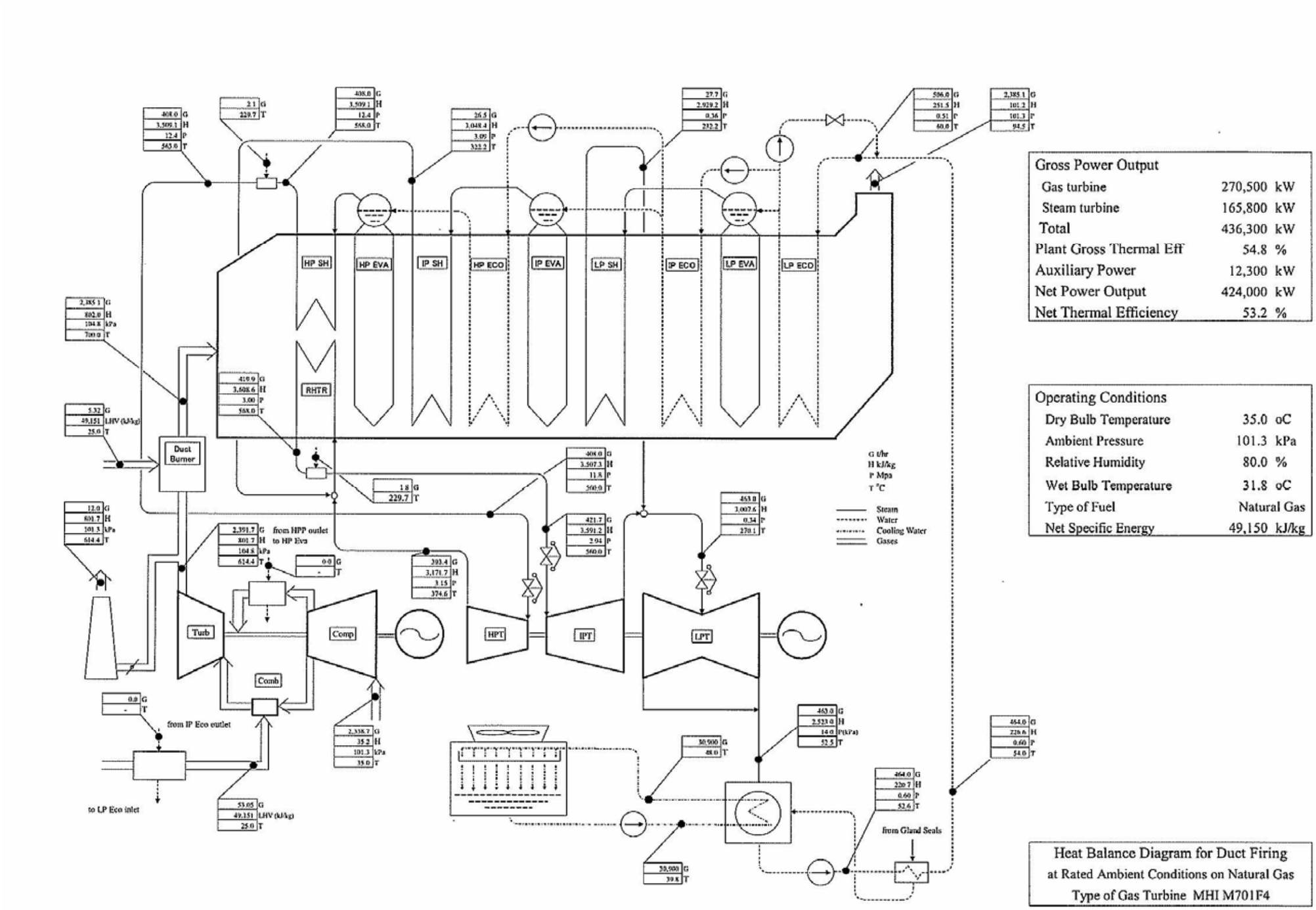
The minimum value of the plant net thermal efficiency is calculated at 52.0 % from the above calculation results. Therefore, the requirement of the plant net thermal efficiency under unfired conditions to be prescribed in the tender documents should be “not less than 51.0 %”.



Gross Power Output		
Gas turbine	270,500	kW
Steam turbine	133,400	kW
Total	403,900	kW
Plant Gross Thermal Eff	55.8	%
Auxiliary Power	11,700	kW
Net Power Output	392,200	kW
Net Thermal Efficiency	54.2	%

Operating Conditions		
Dry Bulb Temperature	35.0	oC
Ambient Pressure	101.3	kPa
Relative Humidity	80.0	%
Wet Bulb Temperature	31.8	oC
Type of Fuel	Natural Gas	
Net Specific Energy	49,100	kJ/kg

Heat Balance Diagram
at Rated Ambient Conditions on Natural Gas
Type of Gas Turbine MHI M701F4



Gross Power Output		
Gas turbine	270,500	kW
Steam turbine	165,800	kW
Total	436,300	kW
Plant Gross Thermal Eff	54.8	%
Auxiliary Power	12,300	kW
Net Power Output	424,000	kW
Net Thermal Efficiency	53.2	%

Operating Conditions		
Dry Bulb Temperature	35.0	oC
Ambient Pressure	101.3	kPa
Relative Humidity	80.0	%
Wet Bulb Temperature	31.8	oC
Type of Fuel	Natural Gas	
Net Specific Energy	49,150	kJ/kg

Heat Balance Diagram for Duct Firing
at Rated Ambient Conditions on Natural Gas
Type of Gas Turbine MHI M701F4

5.3.2 Bottoming Cycle Optimization

In case of employment of the gas turbine with a turbine inlet temperature of 1,300°C class, three (3) types of bottoming systems of triple pressure reheat and non-reheat, dual pressure non-reheat cycles will be considerable.
The difference of performances of each types combined cycle power plants is equal to the difference of electric power outputs because the performances are calculated for the condition of the same heat input. The difference of electric power output leads to the difference of the power sales amount through the plant service life. On the other hand, the construction cost of the triple pressure reheat type plant that is more complicated is higher than the triple pressure and dual pressure non-reheat type plant. Therefore, the evaluation could be conducted by comparison between differences of the construction cost and present value of electric power sales amount through the service life.
Resulting from calculation of present values of power sales between each type of plants through the service life and their construction cost, the difference of present values of power sales between each types of plants through the service life is far larger than that of construction. This means that the reheat type plant is economically more advantageous than the non-reheat type plant. Therefore, it is definitely considered that the reheat type plant is recommendable as the combined cycle power plant for this project. The basic design and tender documents will be prepared on the condition that the reheat type plant will be employed for this project.
Under such situation, local gas price will be also raised to significant degree in near future. Therefore in economical point of view, higher efficiency is better solution against future gas price increase and thus F class CCPP with triple pressure reheat type for the Bheramara CCPP will be recommended.
Triple pressure reheat type with duct burner system shall be proposed because of generating more electrical energy for emergency electric power demand but duct burner outlet flue gas temperature shall be designed with less than 700°C to apply high temperature materials within reasonable equipment investment.

5.3.3 Exhaust Gas Bypass System

In case of a multi-shaft CCPP, the exhaust gas bypass system is usually equipped for a simple cycle operation due to any reasons which may happen to the bottoming system. In case of a single-shaft CCPP, this system may be equipped for the CCPP with an engagement/disengagement clutch. This system will be also required when the gas turbine power package of topping system must be put into commercial operation in advance separately from the bottoming system due to any impending power demand. For the purpose, a bypass stack and a damper must be equipped in the high temperature gas stream between the gas turbine exhaust system and the heat recovery steam generator. This system must be of a huge shape of mechanical equipment to cope with the high temperature around 650 °C. Therefore, the system has an advantage to be contributable to the flexible operation, while the plant cost is higher and the operational reliability may be lessened. Besides, the performance loss may happen due to a leakage of gas turbine exhaust gas to atmosphere. Such issues are studied from the viewpoints of such as operational flexibility, operational reliability, cost impact, phased construction, performance, application experiences and instllation space.
As the results, it goes without saying that the operational flexibility of the plant will be enhanced due to employment of the exhaust gas bypass system, while the drop of the operational reliability and the burden of the project cost will not be avoided. However, considering the backgrounds and location where this project is placed, the exhaust gas bypass system will be recommended all together with the employment of the multi-shaft type CCPP.

According to the study results concerning the application experiences of the exhaust gas bypass system, there were many experiences with CCPPs equipped with the bypass system.

5.3.4 Auxiliary Boiler

HRSG and Auxiliary Equipment shall be designed to be able to start up in the shortest time in the both case of open cycle circuit mode (the diverter damper is bypass stack open position) and combined cycle circuit mode (the diverter damper is bypass stack close opposition).
When a standalone auxiliary boiler will be applied to this project, then the tender shall recommend the specification for a standalone auxiliary boiler.
If a standalone auxiliary boiler shall not be applied to this project, the tender shall clarify the start up procedure without a standalone auxiliary boiler and start up time schedule, operating and permissible oxygen concentration in the HRSG inlet feed water during start up.

5.4 Scope of Works

5.4.1 Procurement and/or Manufacture

The Contractor shall procure and/or manufacture including expediting and quality inspection, for all equipment, materials for a complete and operational combined cycle power plant.

5.4.2 Works and Services to be provided by Contractor

The works and services to be provided by the Contractor shall include furnishing a complete power plant of existing infrastructures of Bheramara CCPP to be used for the new power plant, including design, equipment, materials, transportation, erection, construction, and services as specified herein.
The Works shall include all temporary and permanent works in place from initial site preparation to start-up and testing as required for a complete operable plant, including electrical power for construction activities.
The Services shall include Contractor's and Vendors' services of technical instruction as required for placing the new plant into successful operation, and for training of the operation and maintenance personnel of the new plant.
The Contractor shall coordinate checkout, start-up and perform initial operation of plant equipment and systems in coordination with plant operation staff. The new plant operating staff of NWPGCL will be supervised by the Contractor. The Contractor shall work with NWPGCL to develop a plan for smooth transition from construction and start-up of the new plant.

5.4.3 Works and Services to be provided by Employer

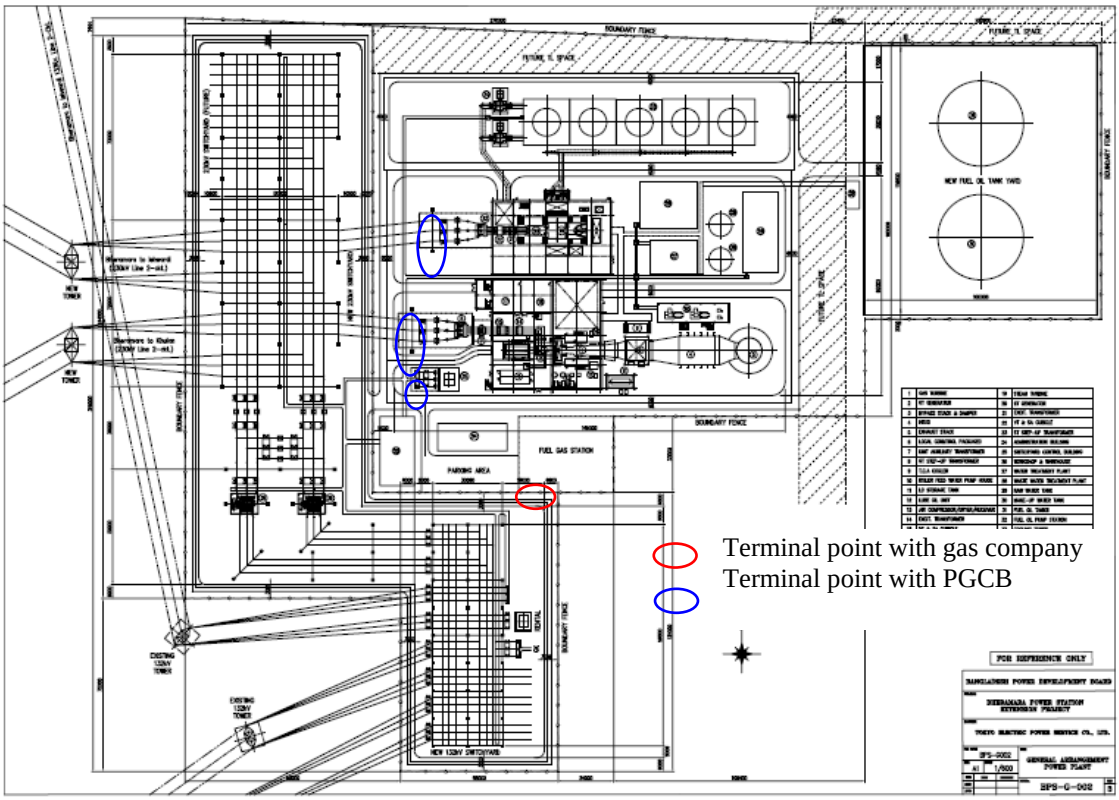
The following works and services associated with the new plant shall be provided by NWPGCL and/or the Consultant employed by the NWPGCL.

(1) Drinking water, hot water, natural gas, electric power for use during construction.
(2) Electric power and auxiliary steam for start-up of the new plant
(3) Detailed Environmental Impact Assessment (EIA) Report
(4) Assistance for acquisition of all permits necessary for construction and operation of the new plant.
(5) Topography mapping/surveying
(6) Site soil investigation/borings

(7) Natural gas, electric power load, and heat export demand for commissioning and guarantee and reliability tests.
(8) Periodic provision of operation and maintenance record data and information during the Defect Liability Period of two (2) years to the Contractor and Consultant for evaluation of operation and maintenance conditions.
(9) Labors, facilities and tools available at the Site for the inspection at the end of Defect Liability Period.

5.4.4 Terminal Points

The planning of he terminal points between Bheramara CCPP and gas company, PGCB are shown as following.



5.5 Plant Design Considerations

5.5.1 Design Conditions

From data in Sub -section 7.1.2, the Plant shall be designed according to Table I-5-5-1 Design Conditions.

Table I-5-5-1 Design Conditions

Design Ambient Dry BulbTemp. /Relative Humidity for Performance Guarantee	35°C / 80%
Design Minimum Ambient Dry BulbTemp. /Relative Humidity for Maximum Capability of Generator	10°C / 80%

Minimum / Maximum Relative Humidity	60% / 95%
Minimum Ambient Dry BulbTemp. / Maximum Ambient Dry Bulb	5°C / 43°C
Barometric Pressure	0.1013 MPa
Elevation	EL+16 m
Minimum/Maximum River Water Level (*: average of 1976-2006)	LLWL = EL+4.22 m LWL = EL+5.47 m* MWL = EL+8.74 m* HWL = EL+13.63 m* HHWL = EL+15.19 m
Seismic Criteria	BNBC 1993; Zone III Basic Seismic Coefficient = 0.04g
Wind Design	60 m/s
Annual Rainfall	1,524 mm
Maximum Rainfall Rate	25 mm/hr (1hr continuous intention)
Snow Load	0 kg/m^2

5.5.2 Codes and Standards

For mechanical, electrical and control plant and equipment, except there are particular codes and standards in Bangladesh, the Plant and equipment shall be designed to the following acceptable International Codes and Standards.
For civil and architectural works, the engineering, design and construction of civil and architectural works shall conform to the Bangladesh relevant codes and standards except where the particular ones must be applied.

5.5.3 Site Layout

Layout of the Bheramara CCPP is planned as Figure I-5-5-1. Detail Drawing is attached as Attachment 4 BPS-G-002"General Arrangement Power Plant". Main considerations for arrangement of the equipments are as follows.

- At first location of 230kV S/S will be selected to the northwest side of the site taking into account future extension of the S/S.
- As for arrangement of the power block, the location of the cooling tower should be considered at first because location of air intake for gas turbine should be considered to minimize the influence of the exhaust of the cooling tower. According to the meteorological data, main wind direction during the summer season at the site is south. That's why the location of cooling tower is the north side of the site.
- Accordingly steam turbine generator will be arranged adjacent the cooling tower. Gas turbine generator and HRSG will be arranged to the south of steam turbine generator. Gas turbine generator and steam turbine generator together with those associated equipments are installed inside the turbine building.
- Central Control Room, electrical room and battery room are set up in the turbine building.
- Diesel oil tanks will be sited next to the existing diesel oil tanks. Those will be two 20,000 kl tanks, one tank contains diesel oil about enough capacity of oil for 7 days operation. And required area and height of retention basin will be calculated according to the NFPA30.

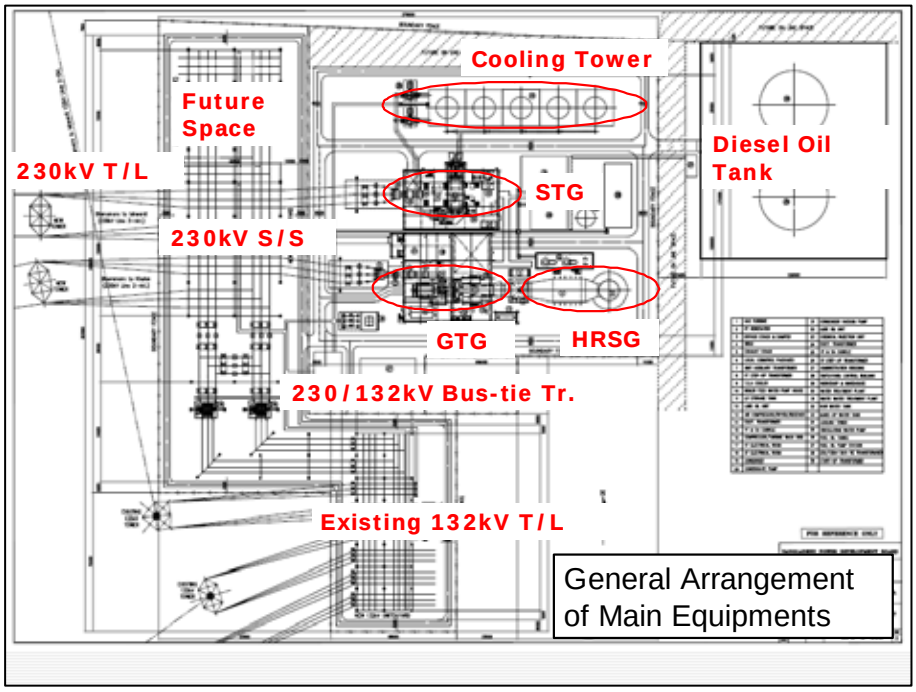


Figure I-5-5-1 General Arrangement of Main Equipments

5.5.4 Environmental Requirements

(1) Airborne Emissions

The plant exhaust emissions shall not exceed the emission limit specified in this project shown on Table I-5-5-2 based on power output range of 75-100% of plant capacity with natural gas and diesel oil firing.

Table I-5-5-2 Emission Limit of Pollutant

Pollutant	Emission Limit	
NOx	Natural Gas	Not more than 40 ppmv
	Diesel Oil	Not more than 100 ppmv
CO	Natural Gas	Not more than 20 ppmv
	Diesel Oil	Not more than 50 ppmv
Particulates	Natural Gas	Not more than 10 mg/m^3N
	Diesel Oil	Not more than 10 mg/m^3N
SO_2 *	Diesel Oil	Not more than 200 ppmv

(Note) The above are based on 15% O_2 dry condition.
* Considering 1% max of sulphur content.

(2) Noise Control

Ambient noise level for all equipment operating under steady state conditions shall not exceed 85 dB(A) at a height of 1 m and a distance of 1 m from the edge of the equipment or the enclosure. Equivalent noise level at a height of 1 m on the power station boundary shall not exceed 70 dB(A). Maximum Noise level for this project are summarized on Table I-5-5-3.

Table I-5-5-3 Noise Standards

Condition	Maximum Noise level
At 1m from the edge of the equipment or the enclosure	Not more than 85 dB(A)
At the power station boundary	Not more than 70 dB(A)

(3) Treated Wastewater Quality

The treated wastewater discharge quality shall meet the standards of World Bank and Bangladesh Standards for Effluent.

5.5.5 Gas Turbine

The basic design functions to be required to the gas turbine which will be employed for this project are as described hereon.

The gas turbine shall be of an open cycle heavy duty single-shaft type of which turbine inlet temperature level is of F-class. The gas turbine shall be supplied by original equipment manufacturers. The gas turbine shall be capable of operating on a simple cycle mode because it is scheduled to put into commercial operation in advance separately from the bottoming system considering present impending power supply shortage situation in Bangladesh. For the purpose, an exhaust gas bypass system shall be equipped. The following four (4) models of gas turbines could be identified with Gas Turbine World 2007-08 GTW Handbook (Volume 26) as F-class gas turbines.

Name of OEM	Type of Model
Alstom Power	GT26 with air quench cooler
GE Energy Gas Turbine	PG9351 (FA)
Mitsubishi Heavy Industry	M701F4
Siemens Power Generation	SGT5-4000F

The gas turbine power output shall be specified on a basis of continuous base load with the load weighting factor of 1.0 for calculation of the equivalent operating hours (EOH) which will be a scale of the inspection interval of hot gas path parts.
The gas turbine shall be normally operated on indigenous natural gas specified in the sub-section 5.5.8 "Fuel Supply System" and be equipped with the function to be operated on Diesel oil equivalent to No.2-GT oil specified in ASTM D-2880 for emergency operation in case of lack of the natural gas.
The gas turbine shall be of an advanced design to meet the NOx emission requirement of less than 40 ppm (15% O_2 basis on dry volume) on a dry condition for operation on the specified natural gas under 75 – 100 % load. It shall be also capable of operating to meet the NOx emission requirement of less than 100 ppm (15% O_2 basis on dry volume) with injection of water for operation on the oil fuel.
The gas turbine shall be of proven design with manufacturer's design practices to basically meet the requirements of ISO 21789 Gas turbine applications – Safety.
It can be allowable that the gas turbine will be equipped with the evaporative type inlet air cooling system to augment the gas turbine power output. According to climate data recorded for six (6) years from 2002 to 2007 at Ishurdi near Bheramara site, the temperature difference between averaged dry and wet bulb temperatures is estimated at 2.8 ^oC. This means that the gas turbine inlet ambient temperature could be decreased by at least 2.4 ^oC utilizing the current evaporative cooling system with many experiences. Consequentially, the power output increase of some 1.3 % (equivalent to some 5 MW) will be expected with increase of the fuel consumption of some 0.9 %. Such situation implies that the adoption of the inlet air cooling system is economically and technically advantageous.
The gas turbine to be proposed shall be of similar model to the gas turbines, of which at least one (1) gas turbine has the experience of successful commercial operation with not less than 6,500 hours of actual operating hours on the Bid closing date.
The gas turbine design shall be with a minimum number of bearings, and shall be located on a steel frame or on adequate steel structures and concrete foundation, sized for the transient maximum transmittal torque imposed on the shaft in case of short circuit of the generator or out-of-phase synchronization, whichever is larger. The power output shall be taken out at the cold end of the shaft.
The gas turbine shall be directly coupled to the generator without any power transmission gear.

5.5.6 Heat Recovery Steam Generator

Advantages claimed for forced circulation design are quick warm/hot startup capabilities. However, natural circulation designs do not need circulation pumps to maintain the circulation of steam water mixture through the evaporator tubes, thereby saving operating cost and concerns about pump failure or maintenance. Availability of natural circulation type HRSG is higher because of the absence of the critical rotating equipment such as circulation pumps.
There is no difference in cold startup time periods due to the fact that in the transient heat up phase, the bulk of the time is spent on heating the metal and water of the evaporator module, which is nearly the same whether it is a natural or a forced circulation HRSG.

In summary, both natural and forced circulation HRSG are widely used in the industry, while the natural circulation design has an edge over the forced circulation design as discussed above. Hence the natural circulation type HRSG are proposed for this project.
HRSG is available for both horizontal and vertical flow directions. Vertical flow directional HRSG occupy less floor space. Also the HRSG forms part of the main stack and hence the main stack requires less material.
The flue gas flow direction will be decided based on manufacturer's recommendation and the layout proposed during contract stage etc.

5.5.7 Steam Turbine

The steam turbine shall be of a reheat, triple-pressure, two-casing or single casing, condensing type directly connected to the generator. The steam shall be downward or axially exhausted to a surface condenser which is cooled by the fresh circulating water which is in turn cooled with a forced draft wet type cooling tower.
The steam turbine shall be of the manufacturer's standard proven design and construction to allow economical and reliable service with less maintenance works.
The steam turbine to be proposed shall be of similar design to the steam turbines of which at least one (1) unit shall has the commercial operation hours not less than 6,500 hours on the Bid closing time.
The steam turbine and auxiliary systems shall be designed to run continuously under all specified operating conditions over the specified lifetime of the plant.
The steam turbine maximum capability shall be such as satisfies the conditions of steam pressure, temperature, flow as developed by the HRSG when the gas turbine is operated on the maximum capability ambient conditions. In case that the HRSG is supplementary fired, the steam turbine shall be sized to cope with the maximized capability of the HRSG in consideration of the supplementary firing over the specified ambient conditions.
The steam turbine shall be designed so that the expected life expenditure of the main components shall not exceed 75% of the expected lives of them at the end of the specified service hours when it will be operated on the specified conditions.
The turbine shall be provided with necessary number of bore scope ports for easy inspection of the operating conditions of the blades and rotor at periodical intervals, if applicable.

5.5.8 Fuel Supply System

(1) Fuel gas supply system

The new plant shall be operated on the specified natural gas.
The fuel gas supply system shall cover all the equipment required for the start-up, shutdown and continuous operation of the gas turbine. A booster compressor station, a pre-treatment system, and a gas pressure-regulating device shall be also included in the scope of the Contractor. The pre-treatment system shall be facilitated to clean the specified gas to the extent that it will be used for the gas turbine without any difficulties.

(2) Fuel oil supply system

The new plant shall be operated on the HSD for emergency.
The gas turbine and heat recovery steam generator shall also be designed to operate on the specified HSD.
The fuel oil supply system shall cover all the equipment required for the start-up, shutdown and continuous operation of the gas turbine same as the fuel gas supply system. The HSD fuel oil tanks which have a capacity of 20,000m^3 x 2, a pre-treatment system, and an oil pressure-regulating device shall be also included in the scope of the Contractor.

5.5.9 Water Treatment System

The process water for demineralized water, potable water and sanitary water, fire fighting water and miscellaneous service water shall be produced through pretreatment system from under ground water.
The process water for cooling tower shall be producted from under ground directly.
The demineralized water shall be used as HRSG make-up water, auxiliary cooling water, chemical dosing preparation etc.
The pre-treatment system consists of coagulator and filter, etc.
The demineralizer system consists of chemical storage and regeneration equipment, etc.
Necessity and specification of pre-treatment system will be decided based on quality of ground water.

5.5.10 Wastewater System

Wastewater shall consist of neutralized regeneration waste from HRSG blowdown, floor drains from the gas turbine and steam turbine buildings, contaminated yard drains from the transformer area.
Sewage and sanitary wastewater shall be treated in purifying facility.
Floor drains from the gas turbine and steam turbine building and contaminated yard drains from the transformer area shall be treated in oil/water separators.
After treatment, these clean wastewater streams shall be discharged through the main drainage pipe to river.
The cooling tower drain without treatment shall be discharged through the main drainage pipe to river.

5.5.11 Fire Fighting System

The fire protection system will generally follow the applicable stipulations of NFPA codes.
Extinguishers will be sized, rated and spaced in accordance with NFPA 10.
Local buildings fire alarms, automatic fire detectors and the fire signaling panel will be in accordance with NFPA 72.
It will be assured that a dedicated two (2) hour fire water supply to cover the system design flow rate is available for the facility in accordance with NFPA.
A main firewater pipeline will be provided to serve strategically placed yard hydrants and supply water to the sprinkler and spray system.
The firewater distribution system will incorporate sectionalizing valves so that a failure in any part of the system can be isolated while allowing the remainder of the system to function properly.
Fuel oil tanks are furnished with foam fire fighting systems.

5.5.12 Electrical Equipment

(1) Electrical System

1) Evacuation of Power

Figure I-5-5-2 shows the scheme of power station and 230 / 132kV substation. The design of electrical system shall be based on the multi shaft configuration of the having two (2) generators, Gas Turbine Generator (hereinafter called as “GTG”) and Steam Turbine Generator (hereinafter called as “STG”) and two (2) generator step-up transformers, Gas Turbine Transformer (hereinafter called as “GT transformer”) and Steam Turbine

Transformer (hereinafter called as "ST transformer"). The voltage of the power output from the gas turbine and steam turbine generators shall be stepped up to 230kV via GT transformer and ST transformer. The output from these two GT transformer and ST transformer is transmitted to the 230kV substation respectively. The bus switching arrangement utilizes breaker and one half bus scheme.

During the unit operations, the power source to the unit auxiliary loads will be fed from the GTG via the unit transformer. During the unit shut down and the unit start-up, the power source to the unit auxiliary loads will be fed from 132kV substation via the start-up transformer. The unit transformers shall be connected to the 6.9k unit bus A via the circuit breakers. On the other hand, the start-up transformer shall be connected to the 6.9k unit bus B via the circuit breakers. The power will be distributed to the auxiliary loads from the unit bus.

The auxiliary system and associated equipment shall be designed with flexibility and adequate redundancy to provide a reliable source of power for all auxiliaries that will be required for the new plant.

GT Generator is synchronized at 230kV power system via GT circuit breaker when GTG is attained at rated speed and voltage. Next ST Generator is synchronized at 230kV power system via ST circuit breaker when STG is attained at rated speed and voltage.

GTG and STG can be synchronized at 230kV power system breaker which is formed by one half bus scheme. For that reason there is no need to introduce GT and ST circuit breakers. However 230kV substation shall be owned by PGCB. Also GTG and STG are synchronized by BPDB. As a result GT and ST circuit breakers shall be set at power station side (2nd side of GT and ST transformer) for synchronization by BPDB.

2) Generator Main Circuit

The design of generator main circuit shall be based on the multi shaft configuration of the having two (2) generators (GTG and STG) and two (2) generator step-up transformers (GT transformer and ST transformer). Each generator, transformer, PT is connected to Isolated Phase Bus (IPB) and transmitted 230kV substation via each generator circuit breaker and generator disconnecting switch.

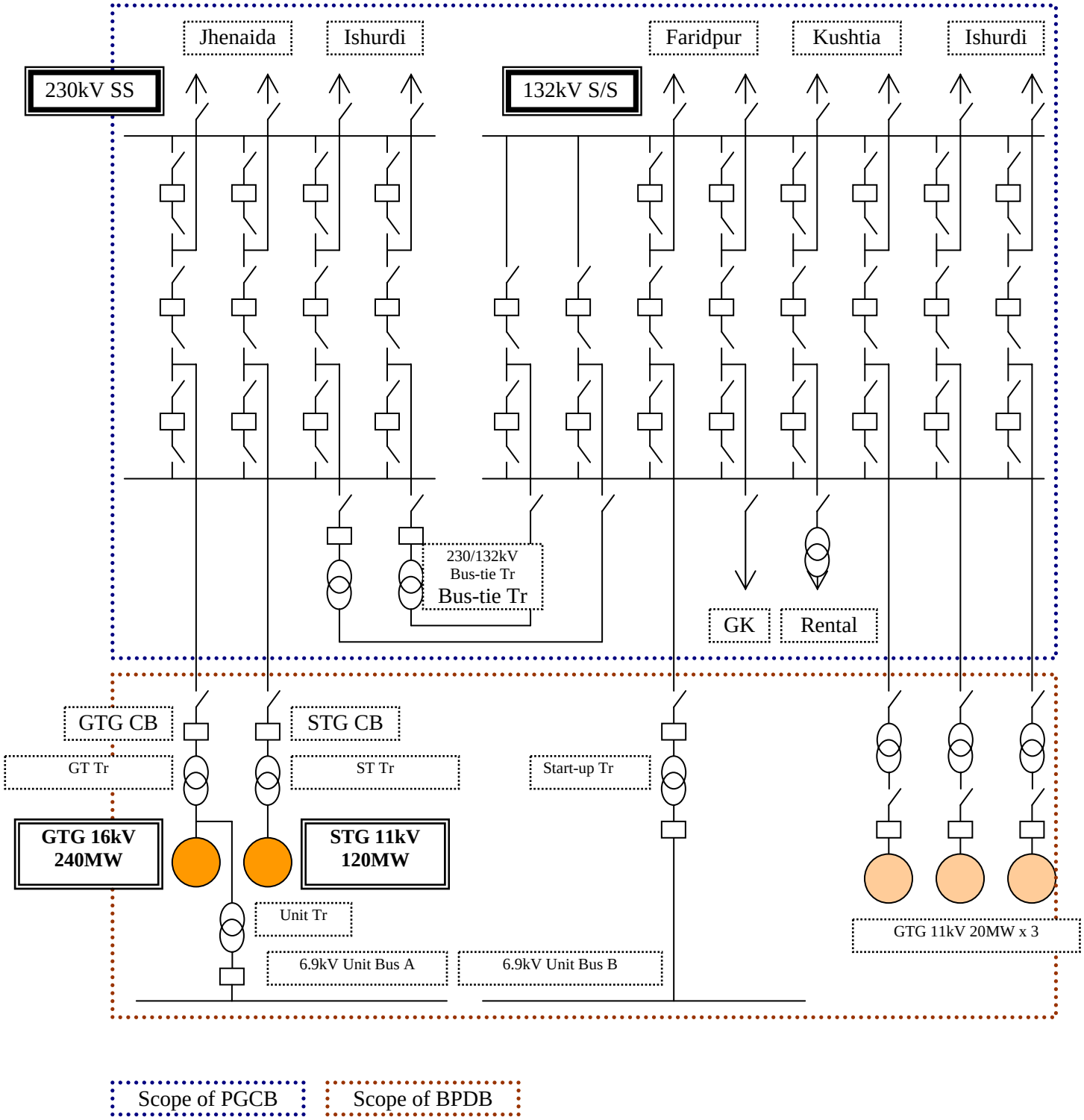


Figure I-5-5-2 The scheme of power station and 230 / 132kV substation

(2) Generators

1) GT Generator and ST Generator

The overview specifications of the Generators are shown below.

Table I-5-5-4 Overview Specifications of the Generators

Generator	GT Generator	ST Generator
Type	Three Phase Synchronous	Three Phase Synchronous
Number of Poles	2	2
Number of Phases	3	3
Rated Capacity	248MVA	131.6MVA
Frequency	50Hz	50Hz
Rated Speed	3,000rpm	3,000rpm
Terminal Voltage	16kV	11kV
Power Factor	0.80（Lagging）	0.80（Lagging）
Rotor Cooling Method	Hydrogen or Water Cooled	Hydrogen or Water Cooled
Stator Cooling Method	Hydrogen or Water Cooled	Hydrogen or Water Cooled

(3) Transformers

Attached Single Line Diagram shows the each transformer.

The overview specifications of the Transformers are shown below.

Table I-5-5-5 Overview Specifications of the Transformers

Transformer		GT Transformer	ST Transformer	Unit Transformer	Start-up Transformer
Rated Voltage	1st	16.0kV	11.0kV	16.0kV	132.0kV
	2nd	230.0kV	230.0kV	6.9kV	6.9kV
Rated Current	1st	11,547A	8,398A	722A	87.5
	2nd	803A	402A	1,674A	1,674A
Rated Capacity	1st	320MVA	160MVA	20MVA	20MVA
	2nd	320MVA	160MVA	20MVA	20MVA
Phase Connection		Δ-Y	Δ-Y	Δ-Y	Y-Y-Δ (Stabilizing Winding)
Cooling Type		ONAF (Oil Natural Air Forced)	ONAF (Oil Natural Air Forced)	ONAN (Oil Natural Air Natural)	ONAN (Oil Natural Air Natural)

(4) Generator Circuit Breaker and Disconnecting Switch

GT Circuit Breaker, Disconnecting Switch and ST Circuit Breaker, Disconnecting Switch are set at 2nd side of GT and ST transformer for synchronization.

GT and ST circuit breakers shall adapt the load capacity. The normal specifications of the GT and ST circuit breakers are shown below.

- Rated Normal Current：800 – 1,250 A
- Rated Short Circuit Breaking Current：25.0 – 31.5 kA

(5) Unit Electric Supply

The unit electric supply shall be configured from unit transformer and start-up transformer.

The equipment used for power plant operation shall be powered from the unit transformer.
The equipment used for common equipment (water handling, waste water handling, etc) shall be powered from the start-up transformer system.
Moreover, as electric power source for emergencies, 1 set of 3 phase diesel fueled generator is installed for power plant and this enables obtaining safety electricity upon total cessation of the operation of the power plant.

1) 6.9kV Unit Bus
6.9kV Unit Bus shall supply necessary auxiliary power for plant operation.
The design of generator main circuit shall be based on the two (2) configuration of A and B.

2) 415kV Unit Bus
415kV Unit Bus shall supply medium motors and auxiliary power for switching.

3) 220V DC Electric Supply System
220V DC Electric Supply System shall have two (2) battery equipment and DC load shall be supplied the power from DC distribution board.

4) Emergency Diesel Generator Equipment
Plant shall have one (1) Emergency Diesel Generator Equipment.
It shall be capable for restart-up of the plant by power from Emergency Diesel Generator Equipment.

5.5.13 Protection and Control System

(1) Generator-Transformer Protection
The GTG, GT transformer and STG, ST transformer together form the plant.
The generator-transformer as a unit and severally protected by 87G and 87T. As a back-up protection for generator, restricted earth fault relay as well as voltage type ground fault relay is also proposed.

(2) System Configuration of the Control and Monitoring Equipment
The configuration of the system for control and monitoring of fully automated operation of the plant will be the DCS (Distributed Control System) from the perspective of technology and cost. The DCS equipment undertakes control and monitoring of whole power plant including the common equipment.

(3) DCS Function of the Power Station
The design of the control system for the new plant shall utilize the state-of-the-art DCS (Distributed Control System) with data logging system in combination with proprietary controls furnished with the gas turbine / generator, steam turbine / generator, HRSG and BOP (Balance of Plant), gas compressor system and so on.

5.5.14 Civil and Building Works

(1) General
Civil and Building Works shall include geological exploration, site preparation, design and construction of storm and plant drainage systems, underground utilities and circulating water pipes, road work, paving and gravel surfacing, main/auxiliary buildings and structures including their foundations, indoor and outdoor equipment foundations, building

facilities such as lighting, lightning protection, sanitary and sewage, air conditioning and ventilation and all other necessary items to complete the new plant.

(2) Site Conditions

1) Site Area

The prescribed construction-site is shown on the drawing "Plot Plan" in ATTACHMENT 2.

The area of approximately 250m x 250m + 100m x 100m is prepared for the Project and the temporary area for construction is also prepared and available depending upon the requirement of the EPC Contractor.

2) Site Elevation

Site elevation should be the same as the existing Bheramara station as following.
GL=EL+16.00m
All ground levels and 1st floor level quoted on all Drawings shall be referred to EL.

3) Geological

Geological conditions are shown in the Section 4.6.4 Soil Investigation of this document.

4) Ambient Conditions

Site climatic parameters in general are given in Section 7.1.2 Summary of Natural Environment and Socio Environment of this Document.

(3) Scope of Work

All the civil and building works include, but not limited to, the following principal features:

- GT and ST buildings for 1 GT unit and 1 ST unit with the CCR (Central Control Room), associated rooms, auxiliaries, fixtures and building facilities
- Auxiliary buildings for Gas compressor, etc.
- Warehouse and Workshop
- All outdoor structures, stacks, equipment foundations such as HRSG, auxiliary equipment, outdoor switch yard, pipe, cable supports, etc. supplied by the EPC Contractor
- Circulating water supply system
- Drinking water supply system
- Waste water treatment system of discharged contaminated drain/overflow water from the plant equipment
- Roads, pavements, landscaping, outdoor lighting and other outdoor works in the prescribed construction-site including fencing of the boundary of the new plant
- Site preparation work including demolition of structures and compensation of demolished structures, as well as, preliminary grading to EL+15.00m.

5.5.15 Substation

(1) 230kV substation

The overview specification of the 230kV substation is shown below.

Table I-5-5-6 Overview Specifications of the 230kV Substation

Voltage	230 kV
Type of Bus bar	Breaker and One-half System
Type of Substation	Outdoor Conventional Type
Number of Bay	Four (4)

Number of Circuit Breaker	twelve (12)

Figure I-5-5-3 shows the scheme of 230kV substation.
The existing power station is connected to the 132 kV national grid systems. The 360 MW Combined Cycle power plant is connected to the 230 kV substation. The power output via GT and ST transformers shall be transmitted to the 230 kV substation with two (2) circuit lines.
New 230kV substation shall be of air insulated outdoor type. The bus switching arrangement utilizes breaker and one half bus scheme. A method of interconnecting several circuits and breakers in a substation so that three circuit breakers can provide dual switching to each of two circuits by having the circuits share one of the breakers, thus a breaker and one-half per circuit; this scheme provides reliability and operating flexibility. In case of 230kV substation, there are four (4) circuit breaker bays and twelve (12) circuit breakers.
The power output via the GT and ST transformers shall be transmitted to the 230kV substation with two (2) circuit lines.
Circuit breakers shall adapt the load capacity. The normal specifications of circuit breakers are shown below.

- Rated Normal Current：1,600 – 2,000 A
- Rated Short Circuit Breaking Current：40.0 – 50.0 kA

(2) 132kV substation
The overview specification of the 132kV substation is shown below.

Table I-5-5-7 Overview Specifications of the 130kV Substation

Scheme	Existing Substation	Replaced Substation
Voltage	130 kV	
Type of Bus bar	Breaker and One-half System	
Type of Substation	Outdoor Conventional Type	
Number of Bay	Six (6)	Eight (8)
Number of Circuit Breaker	Seventeen (17)	Twenty-two (22)

Existing 132kV substation is operated more than 30 years, and many facilities have aged deterioration.
132kV substation shall be of air insulated outdoor type. The bus switching arrangement utilizes breaker and one half bus scheme. Figure I-5-5-3 shows the scheme of power station and 230 / 132kV substation. A method of interconnecting several circuits and breakers in a substation so that three circuit breakers can provide dual switching to each of two circuits by having the circuits share one of the breakers, thus a breaker and one-half per circuit; this scheme provides reliability and operating flexibility.
The power from 132kV substation via the Start-up transformer shall be transmitted to the 6.9kV house bus with two (2) circuit lines. This received power is for supply of starting and stopping auxiliary power.
Existing132kV substation, there are now six (6) circuit breaker bays and seventeen (17) circuit breakers. Replaced 132kV substation shall extend two (2) circuit breaker bays, and then there shall be eight (8) circuit breaker bays and twenty-two (22) circuit breakers.
Circuit breakers shall adapt the load capacity. The normal specifications of circuit breakers are shown below.

- Rated Normal Current：1,250 – 1,600 A
- Rated Short Circuit Breaking Current：25.0 – 31.5 kA

(3) 230/132kV Bus-tie Transformer

230/132kV Bus-tie Transformer shall step down from 230kV substation voltage to 132 kV substation voltage.

The overview specifications of the Transformers are shown below.

Table I-5-5-8 Overview specifications of the 230/132kV Bus-tie Transformers

Transformer		230/132kV Bus-tie Transformer
Number		2
Rated Voltage	1st	230kV
	2nd	132kV
Rated Current	1st	565A
	2nd	984A
Rated Capacity	1st	225MVA
	2nd	225MVA
Phase Connection		Y-Y-Δ (Stabilizing Winding)
Cooling Type		ONAF (Oil Natural Air Forced)

5.5.16 Transmission Line

(1) Outline of connection with transmission line

The location of existing 230kV line that is connected with new Bheramara power station is shown in Figure I-5-5-3. Existing 132kV line is passing between existing 230kV line and new Bheramara power station, and it is necessary to cross over the existing 132kV line in order to connect existing 230kV line and Bheramara power station.

As for the tower that is modified to connect the existing 230kV line and new Bheramara power station, dead end tower near new Bheramara power station should be selected.

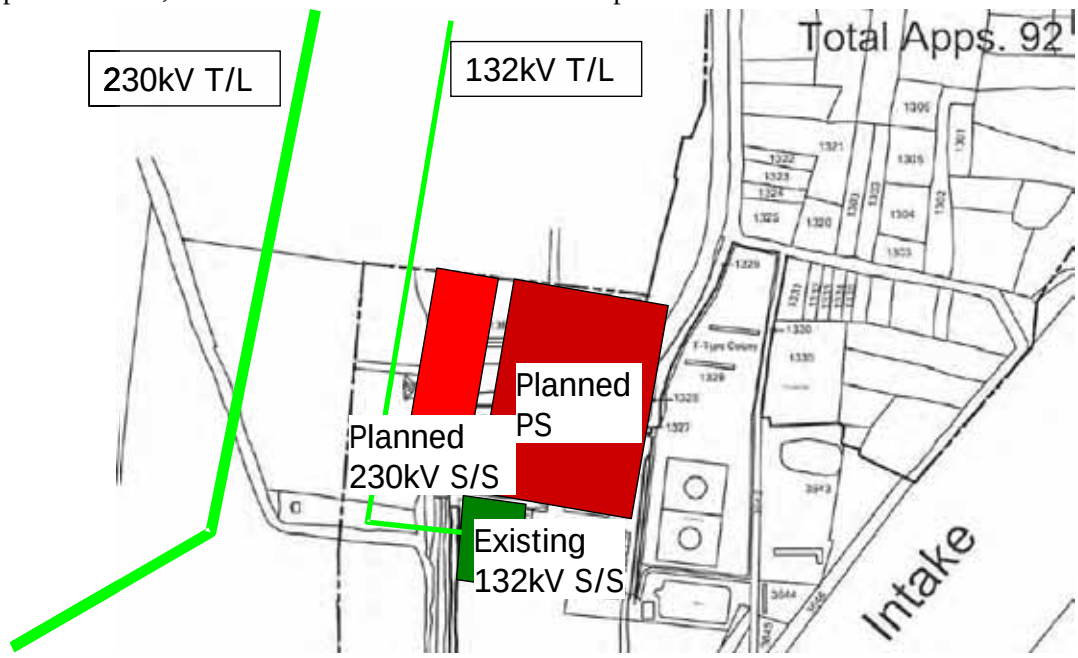


Figure I-5-5-3 Transmission system around Bheramara power station

(2) Condition of design of facilities

This project locates close to existing 230kV line, and weather and geological condition of this project is the same as the condition of existing 230kV. Therefore, design criteria of existing 230kV line should be applied for this project.

(3) Design of crossing point with 132kV line

The location of tower for this project line should be determined based on the cost, environmental aspect, above mentioned criteria and so on.

Figure I-5-5-4 shows the overview using special gantry.

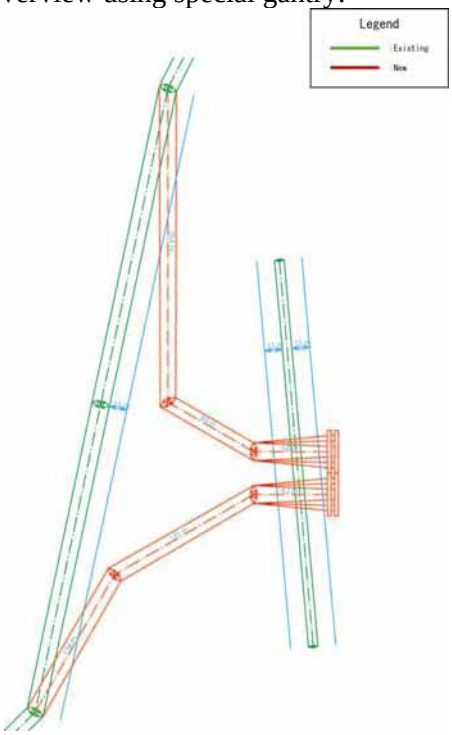


Figure I-5-5-4 Overview using special gantry

Figure I-5-5-5 shows the profile of existing 132kV line, and the height of ground wire is less than 24 meters.

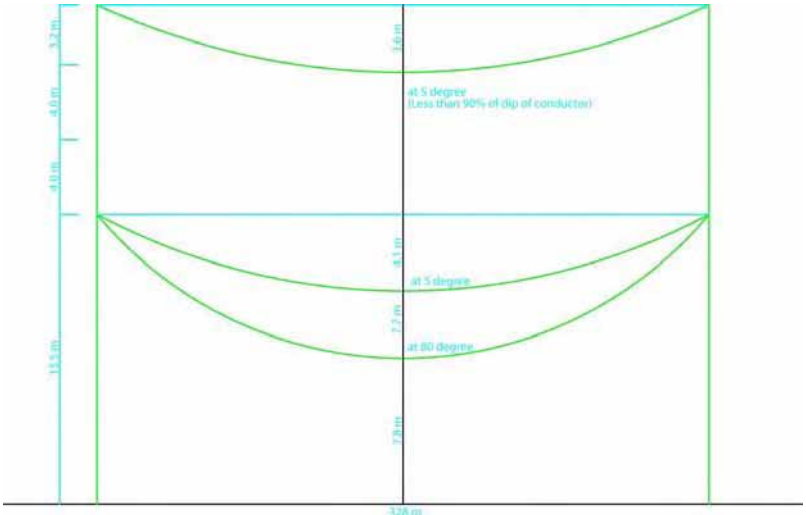


Figure I-5-5-5 Profile of existing 132kV line

The study of crossing point of existing 132kV line was carried out based on the above-mentioned results, and it was confirmed that leg extension of tower should be 9 meters and that the height of gantry should be 35 meters in order to satisfy the necessary clearance.

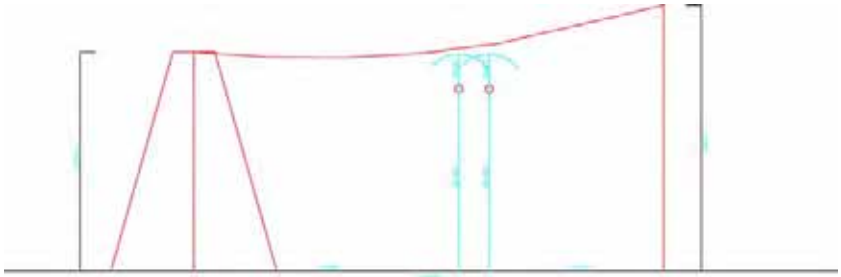


Figure I-5-5-6 Profile of 230kV line at crossing point of existing 132kV line

As for the type of tower between existing 230kV line and existing 132kV line should be 2DT6, because the deviation angle is more than 25 degree.

Chapter 6 Study of Construction Plan

6.1 Connection with Gas Pipeline

Gas will be supplied to the Bheramara CCPP through the gas pipeline constructed by the ADB loan and the gas pipeline branched off from the CGS.
The gas pipeline from the downstream side of the CGS to the Bheramara CCPP will be acquired related land by NWPGCL, constructed gas pipeline by the Contractor and managed gas pipeline by gas company after completion of the project. Figure I-6-1-1 shows the related site drawing of the CGS and Bheramara CCPP.

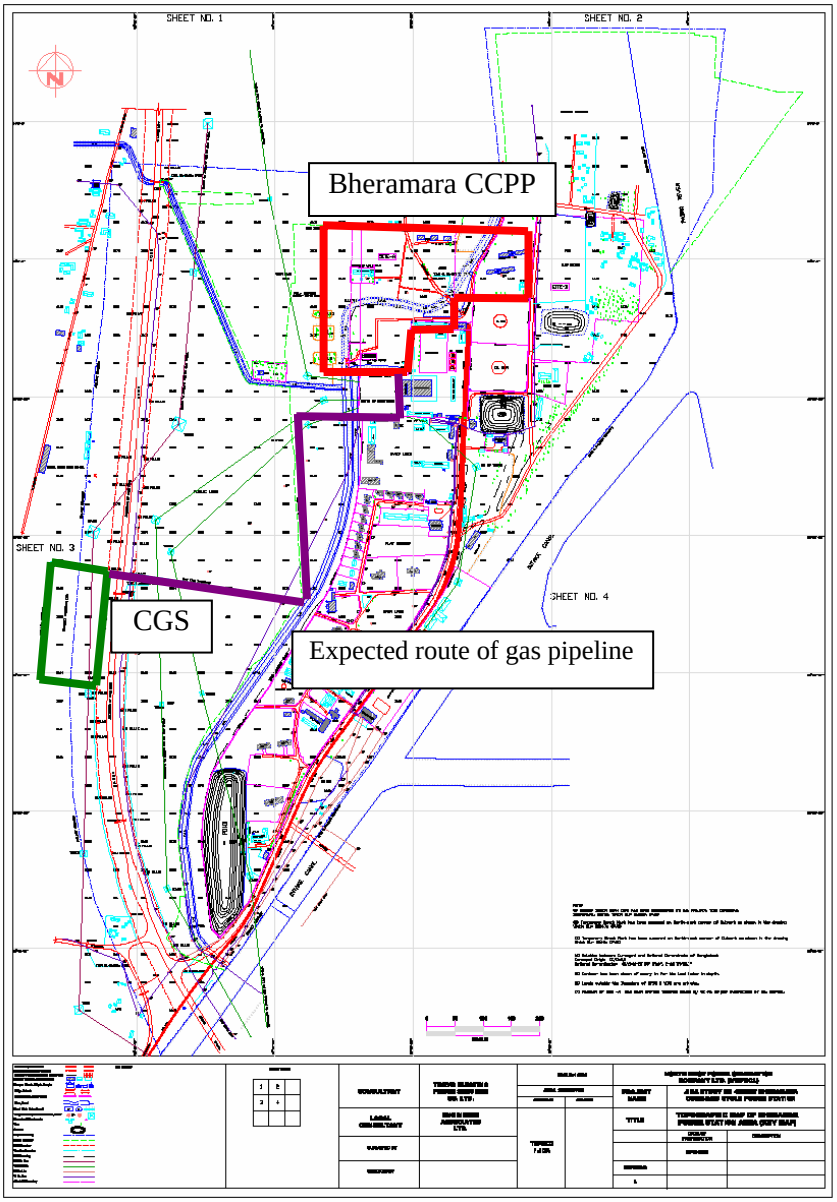


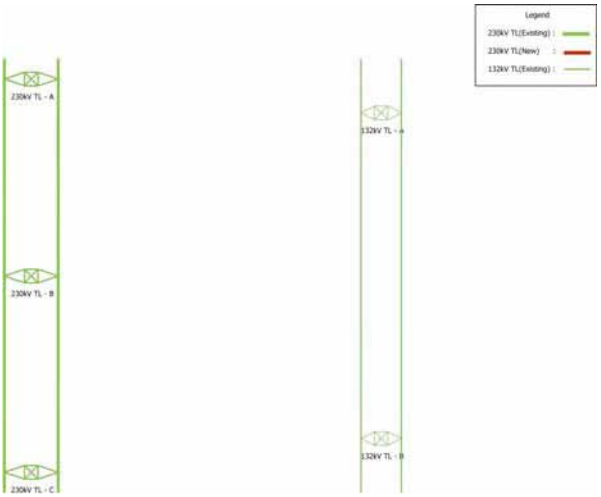
Figure I-6-1-1 Gas pipeline from CGS to Bheramara CCPP

6.2 Connection with Transmission Line

As described on section 5.5.17, the construction schedule is shown in case of selecting case 1.

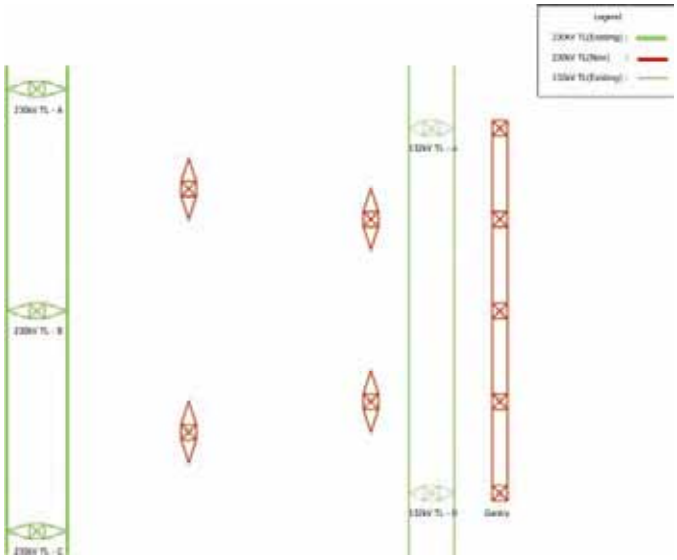
(1) Initial condition

Existing 230kV line and 132kV line are passing side by side around Bheramara power station. In order to connect existing 230kV line and Bheramara substation, 230kV line should cross over existing 132kV line.



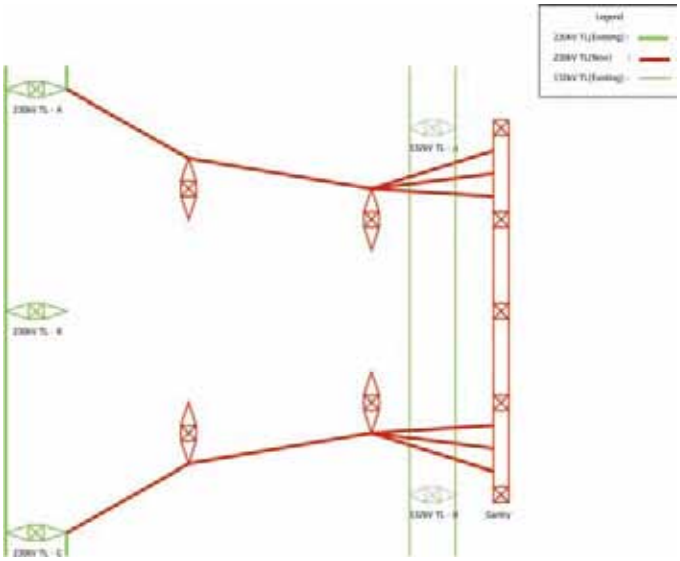
(2) Construction of tower and gantry to connect with Bheramara substation

Gantry as well as towers of 230kV line should be constructed.



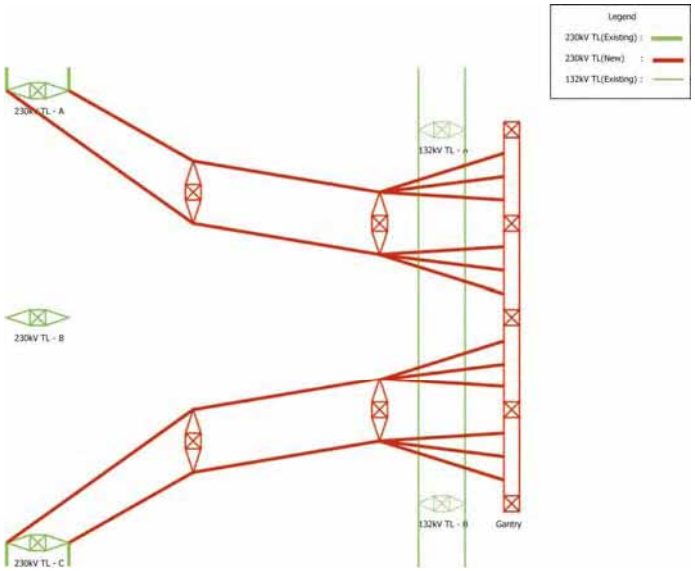
(3) Stinging and removal of one circuit

After stopping supplying power of the circuit under construction, the same circuit should be strung to connect with Bheramara substation. Then, power will be supplied by this circuit via Bheramara substation.



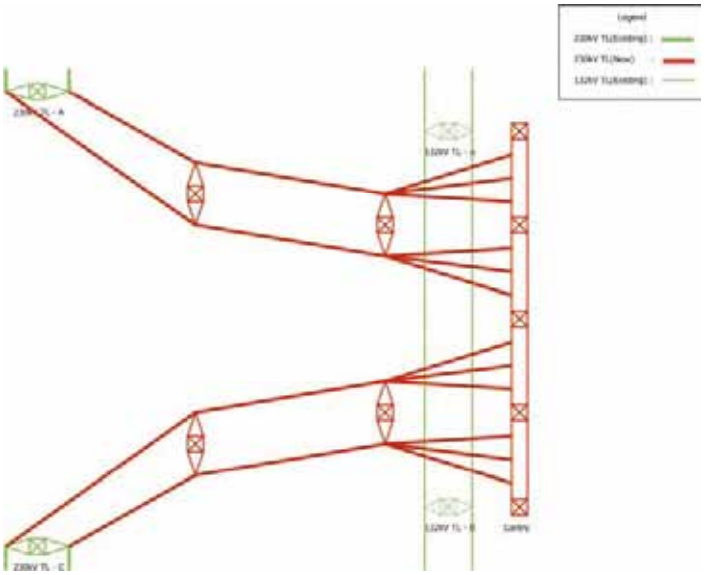
(4) Stinging and removal of another circuit

After stopping supplying power of the circuit under construction, the same circuit should be strung to connect with Bheramara substation. Then, power will be supplied by both circuits via Bheramara substation.



(5) Removal of existing tower

Finally, 230kV TL-b should be removed.



6.3 Facilities for Construction

(1) Jetty, storage yard, access road

Layout plan of jetty, storage yard and access road is shown in Figure I-6-3-1.

Construction facilities	Outline of plan
Jetty	・Jetty size has100m length×75m width. ・The structure is open type wharves on vertical piles. ・Jetty will be used as unloading facility for heavy weight equipments in construction stage and maintence after construction. Jetty will be constructed as permanent facility. ・Jetty will be also planned as a part of storage yard in construction stage.
Storage yard	・Necessary storage yard area is 38,000m^2. ・Storage yard is used as temporary facility in construction stage.
Accesss road	Overland transportation routes from jetty and highway to Bheramara site as access road will be constructed to keep overland transportation route.

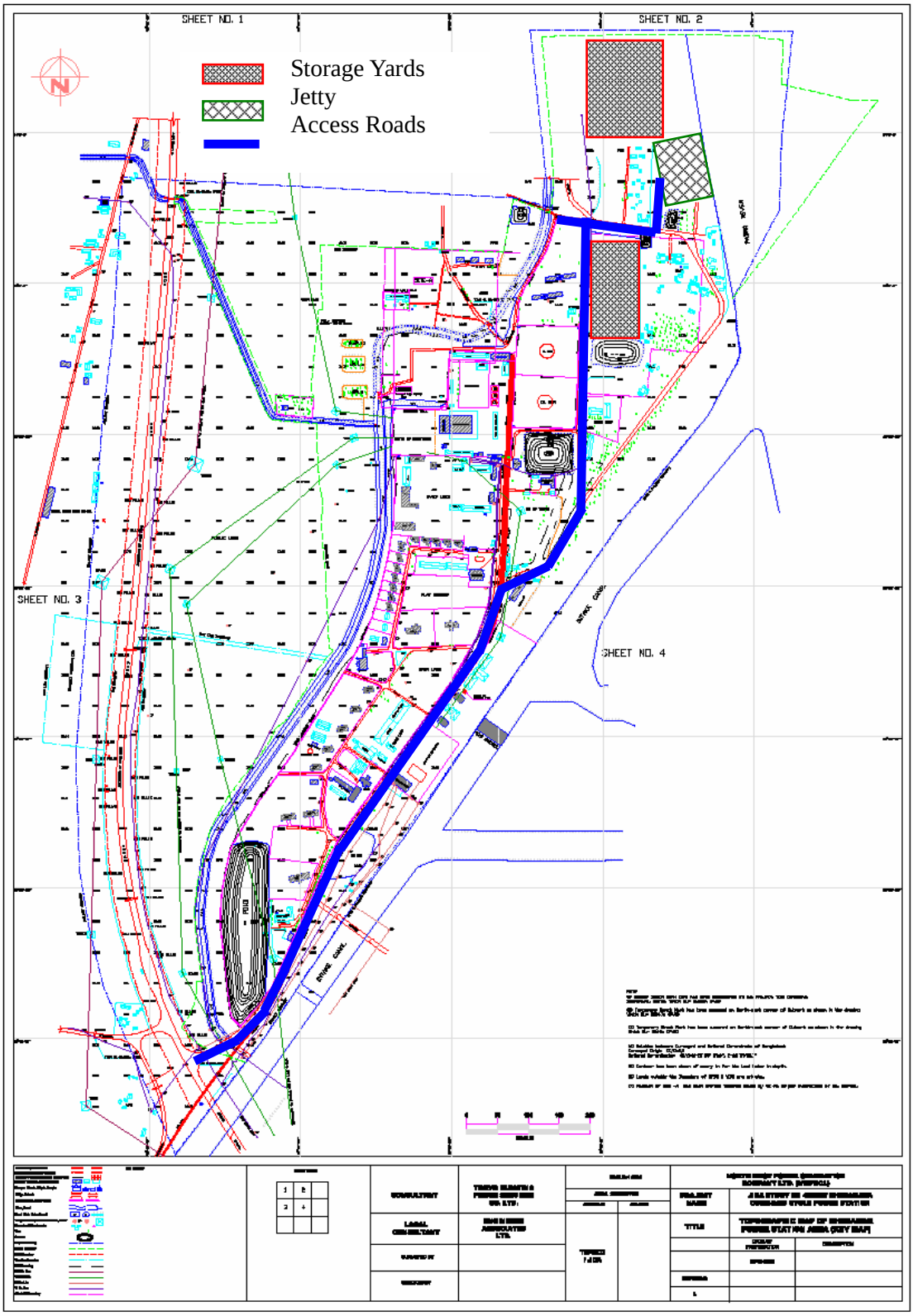


Figure I-6-3-1 Layout plan of jetty, storage yard and access road

(2) Others

The Contractor shall conduct as following during construction period.

- To construct temporary area in the new plant area.
- To arrange an outdoor storage space adequate for storage of new plant equipment and materials and for temporary site office during the execution of the Contract.
- To provide and maintain all temporary structure required including warehouse, change houses for workmen, sheds, etc.
- To provide his own field office complete with telephone so that the Employer can reach him or his official representative and/or the Consultant at all times.
- To provide his own watchman service to ensure security and safety of the equipment and materials.
- To provide and maintain his own laboratory facilities.
- Not to use the Employer's existing storage, toilet and washroom facilities.
- To provide but not limited to all rigging, planking, tools, supplies, scaffolding, guard batteries, warning lights, construction equipment, compressed air, testing apparatus and precision instrument required to complete his work.
- To move all temporary erection facilities described above after the completion of the works unless otherwise desired by the Employer.

6.4 Temporary Utility Supply

During construction period, the Contractor shall supply but not limited to all fuel, electricity, all raw materials, utilities, lubricants, chemicals, catalysts, facilities, services and other matters required for construction.

During commissioning period, the Contractor shall supply but not limited to all raw materials, utilities, lubricants, chemicals, catalysts, facilities, services and other matters required for commissioning.

Chapter 7 Environmental and Social Consideration

7.1 Outline of the proposed site

7.1.1 Location of the proposed site

The proposed sites regarding the survey on the environment and the social consideration are Khulna Division、Kushtia District、Bheramara Upazila、Bahirhar union and their surroundings.

7.1.2 Outline of the natural environment

(1) Climate condition

According to the results of a meteorological observatory in Ishurdi, 21 km northeast of the site, the seasonal change in temperature is almost constant throughout the year. In winter from December to February, the transition of temperature is kept within the range from 15 to 24°C. In the period from March to May, the temperature rises to 30°C. In the monsoon season from June to September, the temperature remains at a little below 30°C.

The annual precipitation reaches a level of 1,100 to 1,800 mm. The precipitation is mainly concentrated from July to September (October in 2005). Conversely, there is no rainfall in some of the months from November to February. As described above, there is a marked difference in the rainfall between the rainy season during the monsoon season and other dry seasons.

The north to northwestern wind is prevailing in winter from October to February. The south to southeastern wind is prevailing in the monsoon season from March to September.

The wind velocity tends to increase in the monsoon season from June to September. It is the highest in September when the south to southeastern wind is prevailing. In October through February, when the west to north wind is prevailing, the wind velocity undergoes an abrupt reduction.

(2) Topography and Underground water

The topographical features of Bangladesh can be broadly classified into the eastern hilly district centering on the hilly land of Chittagong, and the flood plain of the river accounting for the greatest proportion. The country is flat.

Chapter 4.6.4 and 4.6.5 shows geology, hydrology and underground water condition of the Bheramara site and the surroundings.

(3) Air quality, noise and water quality

a) Air quality

The survey results showed overall high value during the dry season compared to the rainy season. Sampling points at both dry and rainy season showed PM10, SOx and NOx to be far below the atmospheric environmental standard for the residential area. Even PM10 with relatively high value of concentration reached only half of its standard. From the seasonal aspect, Dry season showed overall higher value compared to the rainy season.

b) Noise Level

The survey results of all sampling points did not exceed the standard in the quiet residential area both day and night except of road side. However, there were some times when the maximum noise level exceeded the standard on the road side.

c) Water Quality

At the survey results of all sampling point, there was no item that exceeded the standard

value.
There was no organic contamination such as BOD, COD and DO from both seasons and from each sampling points.

(4) Ecological situation

a) Terrestrial Ecosystem

The site does not include any forests such as a natural forest or secondary forest. Fruit trees or flowers are planted. The survey was conducted at the site and in the surrounding houses, roads, and agricultural lands. Sixty-six species of trees, shrubs, fragrant herbs, and plants have been confirmed. The great majority of vegetation includes fruit trees such as mango, jack fruit and guava, and flowers, and plants for viewing.
The animals found 1 km around the site include a total of 46 species -- ten species of mammalian animals, 31 species of birds, two species of reptiles, and 36 species of amphibians. Of these, the animals given on the 2007 Red List of the International Union for Conservation of Nature (IUCN) contain two species of mammalians and two species of birds.

b) Aquatic Ecosystem

One of the oxeye, the swamp cabbage, the bush morning glory, one of the southern naiad, and the common water hyacinthhave been were observed in the fresh water area around the site. Also, the common duckweed, the water lettuce, and *Saipus articulatus* are commonly observed.
The Padma River abounds with fishes and crustaceans. They are the target of the fishing industry.
The crustaceans include the giant freshwater prawns, fresh water snails and mussels.

c) Protected Area（Sensitive Area）/ Rare and Endangered Species

Four types of natural protected areas including national parks are stipulated in Bangladesh. There is no nature conservation area, conservation forest, or protected forest, around Bheramara.
According to Dhaka DOE, rare or endangered species are not stipulated in the laws and regulations of Bangladesh.

7.1.3 Outline of the social environment

(1) Overview of Bheramara

a) Population

The site belongs to 12 Dag villages, and .there is 16 Dag villages in neighborhood.
Population of 12 Dag Village is1,420 people, and population of 16 Dag Village is 5,428 people for 2001.

b) Local Economy

Rice has huge share of area under cultivation and crop prpduction as main agricultural products in Kushtia District. Kushtia is famous for tabacoo which is also one of the main agricultural products.
The mainly fishing area in Padma River is around 2km up and down the streams of Hardinge Bridge. However,the main fishing areas in Bheramara Upazila are canals, ponds, and so on.
According to the interview done to the fishers, fish catch reaches the peak in October to November. Fishing methods used are mostly skimming net and trammel net with carp , cat fish as their main catches.

c) Utilization of Underground water

Sanitation Engineering Department at Kushtia carried out water test around the existing power station during the year 2000-2001. The arsenic value of drinking water standards in Bangladesh is 50ppb, and underground water in 13 places met the standards.

d) Education

Rate of school attendance in Bheramara Upazila is higher in the urban area compared to the rural area and the rate is higher for those older than 10 years of age.

e) Medical treatment

According to Bheramara Upazila Statistical Office, a total of 17 medical institutions including public institutions, private hospitals, and NGO clinics are found in Bheramara Upazila in March 2008.

f) Heritage

Kushita District has two cultural heritages, which do not belong to Bheramara Upazila but to another Upazila.

(2) Social environment around the Bheramara site

In the vicinity of the site, an interview survey was conducted to study more detailed social environments. The area in the vicinity of the site was divided into three blocks. The following households were assigned for each category.

Category A : All 8 households (workers at the existing power plant and their relatives) in the construction site were assigned

Category B : 72 households to the east of the construction site were assigned

Category C : About 300 households to the north of the construction site were assigned.

a) Land utilization and possession

Farm lands and paddy fields lie in the west and north side of the existing power plant. The construction site is located to the north of the existing power plant, with farmland and government quarters for workers engaged in work at the existing power plant.

Irrigation channel is connected to the construction site and there is a farm road at the embankment of the channel. The construction site is owned by BPDB. The north side of the site is private land and the area adjacent to the construction site in the west of the site is owned by BWDP. Any land further than that are all private land.

b) Utilization of Under Underground water

all use Tube wells for their drinking water.

There are two types of tube well around Bheramara site, one is Hand Tube Well (HTW), the other is Shallow Tube Well (STW). The depth of HTWs generally ranges from 8 to 16m, and these wells are widely used to procure potable water for domestic uses. The depth of STWs ranges from 40 to 50m, and these wells are used for with drawl of water for irrigation.

c) Employment and Incomes

Categories-A and B include a higher percentage of daily employees and Category-C includes the greatest number of regular employees. Categories-A and C include a great number of people engaged in the service business, and Category-C includes many farmers. The eight households in Category-A are engaged in the service business related to the power plant or daily employment.

Labor opportunities around the site are limited. In dry season, rice cultivation, vegetable cultivation and some home gardening are the main economic activities in agriculture. The poor mainly depend on daily wage labor.
The income is approximately the same as the expenses, however, one of the households in Category-B spends only 50% of its income. Generally, the income of Category-C is the highest, and that of Category-B is the lowest. One of the households in Category-B includes a household without income.

7.2 EIA related Laws and Regulations

The basis for the Environmental impact Assessment related laws and regulations is the Environmental Policy which is the major outline of the policy, stating the environmental policy, framework and system of laws in 15 fields. It also stipulates implementation of policy by the National Environment Committee and legal status of the Environmental Agency which implements EIA.

7.2.1 EIA Regulations and procedures

Under the Environmental Conservation Act, Environmental Agency divides the intended projects for screening into 4 categories. (Green, Amber-A, Amber-B, Red)
The construction of the power plant is categorized as Red which automatically requires IEE and subsequently, the comprehensive EIA. Based on the assumption that sufficient review on Environmental Assessment has been done, approval for the implementation of the project will be issued.
EMP is the main requirements by EIA on projects categorized as Amber-B and Red. The role of EMP is to give explanation to the Environmental Agency on ways of businesses to carry on the environmental performance assessed by EIA. EMP must state detailed scope of responsibility of the organization and the management, on how the mitigation measures to be implemented and on how the monitoring to be implemented. Even after obtaining approval from the Environmental Agency, businesses are required compliance with the environmental regulations.

7.2.2 EIA related organizations

The main government agency for administration on the environment of Bangladesh is Environment and Forestry Ministry （MoEF）, handling all issues related to policies and regulations on domestic environment.
DOE is a department of MoEF, represented by Director General (DG). DG is the head of DOE.
Followings are prerogatives of DG which is stipulated by law.
Upon development of new project, obtaining Environmental Clearance is necessary. The procedures of obtaining those permits are previously noted.

There will be no personal land acquisition since the suggested Bheramara site for the power plant is owned by BPDB and BWDB. Although, acquisition of small agricultural land (personal land) in order to install transmission line and gas pipeline is necessary. For these land acquisition, under the following laws and regulations, the above noted Ministry of Land is to compensate instead of the business operators in Bangladesh.

- The Land acquisition Act,1894
- The acquisition and requisition of immovable property ordinance, 1982
- The acquisition of immovable property rules, 1982
- The electricity act, 1910

According to the electricity act, 1910, compensation could be made for the standing crops only not for land of transmission line laying.
NWGPCL, therefore, dose not intend to compensate for land acquisition of transmission line. However, JICA study team recommends NWGGCL that compensation for land acquisition of transmission line should be made taking account of global environmental and social situation.
These laws stipulate that the amount of compensation for land acquisition by public project except a transmission line accounts for 1.5 times higher than the price of registered land at the local land office.
If the compensation price is lower than the market price, it does not constitute a reacquisition price.
The compensation should therefore be equivalent to the reacquisition price.

However, in order to ensure the compensation with reacquisition price under the limited information on land market price ,NWPGCL plans to proceed the acquisition of land with the process similar to the one used in the nearby ADB gas pipeline project. In the process for this gas pipeline project , the legal compensation price and reacquisition price are calculated, and if the latter is more expensive than the former, the balance is to be paid by the project operator. The calculation is conducted by the team consisted of business operator, local administrator, and NGOs, including invited local residents.

The acquired land will be restored entirely to the former condition except the footholds of the transmission line. Care will be taken so that the land will be reused for agriculture after completion of the project, which will minimize the interruption of agricultural activity only to the construction period.
The loss of agricultural crops caused by the construction activity will be compensated only for one time, and the decrease of income and livelihood due to the land acquisition and other project activity will be well considered. In Bheramara site, the land is still used by local people for agricultural activity, although it is owned by BPDB or BWDB. Here, the one-time compensation for the loss of crops is to be applied also in this case.

The decreased income of the local people who had been interrupted their agricultural activity by the construction is to be compensated by employment by priority on the construction site. the employment by priority will result in increased income, in place of decreased income.

7.2.3 Relation with the project

Project for the gas-fired power plant is categorized as Red. This category requires obtainment of Site Clearance and Environmental Clearance. Site Clearance is for construction and Environmental Clearance is for operation. Environmental Clearance is renewed every year. Site Clearance needs abridged edition of F/S report, IEE check list, and its attached material and IEE report. Environmental Clearance needs F/S report, EIA report, and EMP. No Objection Certificate NOC） from the local government is also required.
Gas pipeline and power line relating to the project are categorized as Red. Therefore, the same procedure is necessary with the power plant.

7.2.4 EIA Schedule

Procedure for permit approval has two stages. As previously noted, the first stage is site clearance which is submission of IEE for obtaining approval. Maximum of 60 business days are necessary. Following this, the construction can start.

The second stage is submission of EIA for obtaining approval. Maximum of 60 business days are also necessary. Than comes the environmental clearance including ECC environmental clearance certificate to be handled before the operation which needs maximum of 30 business days. Following this, the construction can start.
Application form for IEE is already submitted including the construction plan for gas pipeline, power line, and shallow draft quay. EIA is planned to be submitted in November.
DOE has pointed out that a formal document is required indicating the approval of BWDB for the transition of ownership of the land for the power plant from BWDB to BPDB. The document has not been approved as of the mid-December, as BPDB claimed that more time is needed for preparation.

The document will be immediately approved once it is submitted, as there is no problematic issue in the contents of IEE. EIA report is complete with the collaboration of BPDB, and is to be submitted immediately after the IEE approval.

7.3 Environment impact assessment and measures for avoiding or mitigating the impact

7.3.1 Environment impact assessment for selected method

The Bheramara CCPP is planning to install in the north of the existing power plant. This project will select a site where there is no need for relocation of the inhabitants, adopt a cooling tower as the cooling system and use underground water as make-up water or the like.
In association with construction of the power plant, gas pipelines and transmission lines will also be built. Since river traffic is used for the transportation of heavy objects, Jetty will be built in the riverside storage site, and an access road will be built to connect between the Jetty of the unloading yard and Bheramara site.
Impact assessment was implemented by picking up the factors affecting the environment at the time of construction and operation for all the related facilities.
For the impact assessment, reference has been made of the guidelines of Bangladesh and international organizations:
To implement impact assessment, the impacts anticipated from various projected activities were picked up, and measures for avoiding or alleviating such impacts were studied. The impacts assumed to be particularly serious were estimated on a quantitative basis whereby impact assessment was performed.
Whenever required, further measures for mitigating the impact were studied. Consideration was also given to the comments and views on the Bheramara CCPP presented by the inhabitants in the survey on the surrounding community and environment and at the stakeholders' meeting.
The selected assessment items are as follows.

- Construction period
  Environmental contamination －air pollution, water pollution, solid waste, noise/ vibration and odor
  Natural environment－underground water, ground subsidence, soil erosion, terrestrial ecosystem, river ecosystem
  Social environment－employment / livelihood, land utilization, local economy, river traffic, land traffic and infrastructure/service facilities
- Operation period
  Environmental contamination －air pollution, water pollution, solid waste, noise/ vibration and odor
  Natural environment－underground water, ground subsidence, terrestrial ecosystem, river ecosystem and global warming

Social environment－employment / livelihood, land utilization, local economy, river traffic, land traffic, infrastructure /service facilities and accident

7.3.2 Impact assessment and measures for avoiding or mitigating the impact

(1) Construction phase

The gas pipeline, transmission line pump house and unloading Jetty to be construction are not very large in size and, the construction work will be carried out adjacent to the plant. Thus, the impact is small in almost all items, and a big problem will not be raised in terms of the total construction work.

Some of the items where the need for impact assessment by construction work is assumed are separately described.

a) Environmental pollution

Air pollution

Periodic inspection and maintenance control will be conducted to reduce exhaust discharged from construction machines and vehicles. To minimize scattering of earth, sand and dust particles, protective covers will be provided, and washing of the vehicles and cleaning of the surrounding roads will be performed on a periodic basis, whereby impact of air pollution is reduced.

Water pollution

For the drainage, a settling tank will be installed on a temporary basis, whereby the supernatant will be removed.

To effluent resulting from washing the equipment, a tank will be installed on a temporary basis because chemicals may be used at the time of washing the boiler. For domestic wastewater, septic tanks will be installed .Then these waste water will be discharged after having been adequately handled.

In the dredging work for the construction of a Jetty, vertical pile method will be adopted for the Jetty structure and the size of the dredging area will be minimized wherever possible. The work will be conducted in the dry season of the year to mitigate the impact.

These measures will minimize the impact of contamination of river water and underground water.

Solid Waste

Metal chips, waste plastic, wood shavings, waste glass and waste oil. Basically, a waste management program including the plan for reduction in the amount of waste, reuse and recycling of waste will be worked out. Measures taken include adequate classification of waste and adequate disposal at the disposal site for each type of waste.

To reduce the amount of solid waste discharged from the workers during the construction work, efforts will be taken to employ the local workers wherever possible, so that the amount of household solid waste will be minimized.

The aforementioned measures will be taken to ensure that water pollution or sanitary problems resulting from waste do not arise.

Noise and vibration

All the aforementioned machines are assumed to be operating simultaneously. The noise level resulting from the operation of the construction machinery is 62.4 through 74.6 dB (A) on the boundary of the site, and 26.5 through 55.1 dB (A) in the inhabited area.

The estimated value for the site boundary partly exceeds 70 dBA stipulated in the Industrial Zone Standards of Bangladesh. In most positions, the Standards have been met.

Further, all the estimated values at three points on the inhabited area are below the level of 55 dBA, which is the standard value (during the daytime) in the inhabited area.
In the actual construction work, the schedule management will be performed to ensure leveling of the amount of construction work wherever possible, and the state-of-the-art low-noise equipment will be introduced. Thus, efforts will be made to minimize the noise impact.
Measures for reducing generation of noise such as requirements for installation of mufflers and speed reduction in the residential area will be taken wherever possible, whereby vehicle noise impact will be minimized.

Odor
Before starting the construction work, the workers will be instructed to classify and collect garbage. Garbage will be disposed on a periodic basis to ensure that odor is not produced by putrefaction. These measures will be taken to minimize generation of odor.

b) Natural environment

Underground water
For construction work, the maximum amount of the water taken is estimated at 2,000 m3 per day. This amount is very small, and is about 1/15 as much as the amount of water taken for the cooling tower during the operation.
It is estimated that groundwater can be taken without any substantial decrease of the water level even in the period of high water intake during operation.
For this reason, it is presumed that no significant decline of groundwater level at surrounding wells can be occurred due to water intake used for construction. Monitoring of groundwater levels of the wells for residential use will be conducted for confirmation.

Ground subsidence
There will be no substantial reduction in the underground water level of the surrounding wells as a result of underground water intake during the construction work. This indicates that there will be no ground subsidence as a result of underground water intake.

Soil erosion
Measures will be taken to avoid outflow of the earth and sand where a fence is installed against subsidence of earth and sand. The actual construction of the unloading yard will be implemented during dry seasons.

Terrestrial ecosystem
The Bheramara site and its surrounding areas have already been converted into the agricultural land and are used for artificial purposes. There is no natural forest in these areas.
The plants are restricted to fruit trees and ornamental plants.
The area to be modified by installation of transmission lines, gas pipelines and Jetty is small, and there will be not much impact on plants and animals.
Around the Bheramara site, there are four species falling under the category of the light concern species (LC) of the IUCN red list. They are a jangle cat, fox, pigeon and kite. They are all characterized by a high degree of mobility. The agricultural area is not their major living place for building nests, for example. Accordingly, they will not be much affected by the construction work.

River ecosystem
The measures indicated in the description of "Water pollution" will be taken against the

river water pollution resulting from drainage during the construction work and installation of the Jetty, whereby the impact on the river plants and animals will be minimized.
The Padma River is inhabited by fishes as precious species of this district. The impact of river water pollution will be minimized by the measures indicated with reference to "Water pollution".

c) Social environment

Employment and livelihood, Land utilization, etc

Before starting the construction work, priority will be given to employment of the local residents.
It is assumed that the inhabitants around the site are deficiency in technique level applied to the construction work. Measures are taken that prospective indigenous workers can acquire relevant skills for construction through preliminary education and training program in cooperation with local municipalities from an early stage of construction, so that local people are prioritized at employment opportunity.
The inhabitants harvesting the agricultural products in the power plant site owned by the BPDB and BWDB will receive compensations for the farm products according to the laws and regulations of Bangladesh.
The scope and processes of the construction work will be explained to the local people ahead of time, and efforts will be made to ensure that they will receive compensation.
If the loss of the inhabitants is estimated to reach a large amount, the aforementioned priority employment policy will be implemented to ensure that their livelihood will not be affected by the reduced income.
Regarding operating plan, the schedule will be explained to local fishermen at an early stage in order not to cause any effect to their fishery activities.
For the gas pipeline installation work, compensation for land acquisition will be given to the people according to the laws and regulations of Bangladesh. The construction work will be performed during the agricultural off-season wherever possible, so that there will be suspension of farming. As for compensation of land acquisition for transmission line, the Study Team recommends NWPGCL that such compensation should be made.

For Jetty construction work, efforts will be made to minimize the size of the work so that the suspension period for the work of earth and sand dredging workers will be reduced. Further, the scope and processes of the construction work will be explained so that relocation of the work site can be achieved quickly.
These measures will encourage the employment of the local people in such a way that their income will not be reduced.

Local economy

As described with reference to "Employment and livelihood", before starting the construction work, priority will be given to employment of the local residents.
Cleaning and catering services as well as materials will be provided by the local company.
In addition, compensation for land acquisition will be conducted complying with relevant national laws, in parallel with the mitigation measures so that income levels of local farmers, fishermen, and dredging workers will not be declined.
Moreover, it is important to corporate for the fostering of new local industries through consultation of local municipality.
The potential increase in income of inhabitants and local companies owing to this project may be contributed to local economic revitalization.

River traffic, Land traffic, Infrastructure and service facilities

For the transportation of large-sized heavy equipment by ship, an adequate and safe traffic schedule will be worked out through consultation with Bangladesh Inland Water Transport Authority (BIWTA) as an organization having jurisdiction over river traffic.
As a mitigation measure, the actual construction will be implemented during dry seasons that the volume of traffic is relatively low.
For the vehicles used to transport the material and equipment required for the construction work and to carry the workers, measures will be taken to use of bass, to ensure reduction of vehicle speed, installation of traffic signs and marks, and education on safe-driving practices in the school-commuting roads and residential areas.
Efforts are made to ensure that the medical facilities for the workers can be used by other than the workers.
These farm roads and channels will be formed to detour around the site.

(2) Operation phase

a) Environmental pollution

Air pollution

The Bheramara combined cycle power plant (CCPP) adopts the method of using natural gas for combustion of the gas turbine. Basically, this method reduces the load on the environment as follows.

- Sulfur content and ash are not included in the natural gas
- Basically, complete combustion of the fuel occurs in the gas turbine. Almost no CO or SPM is produced.
- A low-NOx burner is used to minimize generation of the nitrogen oxides. The exhaust concentration will be kept below 40 ppm and below the emission standard. This value is sufficiently below the guideline of the World Bank.
- A high smokestack having a height of 60 meters is adopted.
  Further, to minimize the chance of the building affecting diffusion, arrangement is so configured that high buildings will not be located to the leeward in the north and south as the main wind direction.

The maximum ground-level concentration of the nitrogen oxides is the highest when the atmospheric stability is B, and the wind speed is 3.9 m/s. The concentration is 7.91 mg/m3, which does not exceed 1/10 the environmental reference value of Bangladesh.
According to the current survey result in the dry and rainy seasons around the power plant, the highest concentration is recorded at the survey point on the north in the dry season when the existing power plant is operating. This concentration as the current concentration is added to the estimated value to assume the future concentration.
The future concentration is 30.16 mg/m3. This value is sufficiently lower than the environmental reference value of Bangladesh. Further, it is sufficiently lower than the guideline value of the World Bank.

Water pollution

To dispose of the waste water produced by operation of the power plant, waste water treatment facilities capable of precipitation by condensation, neutralization and oil separation and household waste water treatment facilities will be installed. To dispose of the blow waste water of the cooling tower, means will be provided, for example, to reduce water temperature by dilution.
When the aforementioned measures are taken, the waste water level will not exceed the waste water reference level of Bangladesh.
The newly installed tank will be provided with measures to protect underground water

against contamination by oil.

Solid Waste

For the waste produced in the process of operation of the power plant, the waste management program including the reduction, reuse and recycling of the waste will be worked out. To put it more specifically, the measures to be taken includes systematic solid waste collection at the worksite, prohibition of dumping contaminated substances, appropriate classification, and disposal at the disposal site determined for each class of waste.

Noise and vibration

The noise level produced in the process of power generation facility operation is 40.6 through 64.9 dB (A) on the boundary of the site, 46.6 through 51.7 dB (A) at a point 200 meters away in the direction of the inhabited area, and 44 dB (A) at a point 400 meters away.

The estimation value on the boundary of the site does not exceed the level of 70 dBA which is the reference value for the industrial zone in Bangladesh.

Further, at a place 400 meters away and close to the nearest inhabited area, the value does not exceed the environmental level of the inhabited area day and night.

In the field of more detailed designing for future, efforts must be made to achieve the estimated noise level resulting from the operation of the power generation facility, for example, by introduction of the state-of-the-art low-noise equipment.

Odor

Facilities or equipment that produce odor are not introduced into power generation facilities.

Garbage will be subjected to separate collection, and garbage will be disposed on a periodic basis to make sure that odor by putrefaction will not be produced.

b) Natural environment

Underground water

As is shown in the section of 4.6.5.(2), the lowering of groundwater level is 2m at the maximum, and therefore the pumping of groundwater will be conducted without causing serious lowering of groundwater level.

However, the existing less deep wells, the pumping may be interrupted in the dry season.

To prevent this, the groundwater level must be monitored. The wells that fail to supply a sufficient amount of groundwater will be subjected to additional excavation by NWPGCL.

Ground subsidence

It is estimated that there will be no substantial reduction in the underground water level in the surrounding area by the underground water intake.

Terrestrial ecosystem

The Bheramara site and its surrounding areas have already been converted into the agricultural land and are used for artificial purposes. There is no natural forest in these areas. The plants are restricted to fruit trees and ornamental plants.

The area to be used in the power plant and unloading Jetty is comparatively small and will have little impact on plants and animals. However, the buffer zone will be planted with trees.

Further, after the gas pipeline has been laid, the site will be backfilled, and the transmission line except for the scaffolding will be put back to the current state. There will be almost no

impact on the terrestrial ecosystem.

River ecosystem

The measures indicated in the description of "Water pollution" will be taken against the river water pollution resulting from drainage during the construction work and installation of the Jetty, whereby the impact on the river plants and animals will be minimized.

Global warming

About 888,000 tons of CO2 as a warming substance is estimated to be discharged from the power plant every year.

The present project uses a combined cycle power generation system characterized by high efficiency and a reduced amount of CO2 produced per unit of electricity produced. Further, as discussed in 4.7.2, the gas turbine type to be used is characterized by a further reduced amount of CO2 produced per unit of electricity produced.

c) Social environment

Employment and livelihood, Land utilization etc

It is assumed that the inhabitants around the site are deficiency in technique level applied to the construction work. Measures are taken that prospective indigenous workers can acquire relevant skills for construction through preliminary education and training program in cooperation with local municipalities from an early stage of construction, so that hiring is conducted within local area as many as possible.

In addition to this, local people (especially farmers cultivating within the site) are prioritized at employment opportunity in simple work like cleaning.

Moreover, the guideline for employment will be developed so as to assure fair opportunity as a mitigation measure.

After the gas pipeline has been laid, the site will be backfilled, and the transmission line except for the scaffolding will be put back to the current state. There will be no impact on the livelihood of the farmers.

Regarding operating plan, the schedule will be explained to local fishermen at an early stage in order not to cause any effect to their fishery activities.

After consultation with the earth and sand dredging workers, such measures as temporary relocation of the earth and sand storage yard or adjustment of the process will be taken to ensure that these workers will not be inconvenienced.

Local economy

As described with reference to "Employment and livelihood", even in the operational phase, local inhabitants will be prioritized at employment as many as possible.

Cleaning and catering services as well as materials will be provided by the local company.

Moreover, it is important to corporate for the fostering of new local industries through consultation of local municipality.

The potential increase in income of inhabitants and local companies owing to this project may be contributed to local economic revitalization.

River traffic, Land traffic, Infrastructure and service facilities

In the rainy season, the river width will increase and there will be little impact on the river traffic of the local inhabitants.

Measures such as use of bass, inspection of the traffic rules, introduction of the traffic signs and markings and education on safe driving will be taken to alleviate the impact.

The medical facilities installed for the construction work will be used on a continuous basis by the local inhabitants.

The existing farm roads and the channels within the Bheramara site will be formed to detour around the site.

Accident

The following measures are taken against possible accident:

- Creating and implementing a sanitation and safety education program
- Installation of emergency measure facilities and quick introduction of a transport system into the medical facilities
- Working out a management program for gas leakage prevention and setting up the leakage preventive equipment as part of the leakage risk management program
- Installation of fire prevention equipment and facilities at proper positions inside the power plant
- Installation of fixed type fire prevention equipment, fire hydrant, fire extinguisher, escape hatch, fire alarm, fire prevention zoning facilities and emergency exit
- Working out safety regulations

7.4 Environmental Management Plan and Monitoring Plan

7.4.1 The objective of the environmental management plan

The main objective of the environmental management plan (EMP) and environmental monitoring plan are worked out based on the following.

- Reduce the environmental impact to the permissible level by the mitigation measures during the period of construction and operation, so that a hazardous impact will not occur.
- Configure a responsible organization for the implementation of the mitigation measures.
- Implement the EMP and monitoring plan adequately during the period of construction and operation.

7.4.2 Work Plans and Schedules

(1) Construction phase

Before starting the construction work, the project manager (PD) of the BPDB or NWPGCL is required to give sufficient consideration to the details of the construction work, and to make sure that the required EMP and monitoring plans are thoroughly understood by the contractor. Thus, the project manager (PD) of the BPDB is required to form the required organization.

Especially, there is an active inflow of the workers and many construction-related vehicles during the construction. The details of the construction work, schedule and mitigation measures should be sufficiently explained to the communities in the surrounding area. The countermeasures should be altered as appropriate, based on the correct understanding of the views of the residents.

The administrative role of the project will be sequentially transferred from BPDB to NWPGCL following the split of the Project Company, and sufficient consultation and negotiation prior to the transfer is essential.

Employing workers from local areas during the construction phase will have a favorable impact on the local economy. Sufficient consideration must be given to the local employment, including implementation of the preliminary education and training program of the workers.

Table I-7-4-1 gives the basic information of the EMP during the construction phase, and Chapter 7.4.3 describes the environmental monitoring plan.

The EMP and monitoring plan should be worked out by sufficient discussions between the BPDB and the contractor. To confirm the implemented plan and to study further measures, a report schedule should be worked out in such a way that the contractor will report the current situation of implementation in the form of a written statement. This report should be submitted to the Khulna DOE for further discussion.

Table I-7-4-1 Major environmental impacts and mitigation measures during the construction phase

Factor	Potential impact	Planned environmental mitigation measures	Responsible person
Inflow of workers	Generation of sewage and refuse	- Installation of sewage treatment facilities - Can and bottle refuse is classified and are supplied to a third party for reuse - Disposal at a predetermined disposal site.	Contractor (BPDB or NWPGCL)
	Outbreak of diseases	- Installation of sewage treatment facilities - Installation of medical facilities and implementation of periodic health checkups - Education and training on health management of the workers - Prevention of epidemics among workers (HIV/AID, dengue fever, malaria, hepatitis A) - Elimination of potential breeding site for harmful insects, provision of preventive medicine as necessary	
	Safety, accident prevention, land traffic	Use of Bas for worker - Avoidance of the time when students travel between school and home - Reduction of vehicle speed in resident areas and close to schools	
		- Observation of traffic regulations, installation of traffic signs, and education on driving safety - Implementation of safety program(traffic sign, speed limit, lighting of track, load restriction, checkup of auto parts (brake, klaxon)	
	Employment, income, livelihood, vulnerable groups, uneven distribution of benefit	- Priority of employment for local residents, development of employment standard - Utilization of local service (cleaning, catering, materials) - Implementation of the preliminary education and training programs with local authority	
	infrastructure	- Installation of medical facilities	
Installation of construction equipment	- Safety, accident prevention, land traffic	- Avoidance of the school commuting time - Reduction of vehicle speed in resident areas and close to schools - Observation of traffic regulations, installation of traffic signs, and education on driving safety - Implementation of safety program(traffic sign, speed limit, lighting of track, load restriction, checkup of auto parts (brake, klaxon)	Contractor (BPDB or NWPGCL)
	Noise	- No traffic at night	
	- Gas emission, flying sand and dust particles from vehicles	- Periodic inspection and maintenance management - Periodic check of the concentration of vehicle emissions based on laws and regulations	

Factor	Potential impact	Planned environmental mitigation measures	Responsible person
		- Stop the engine when idling - Use of a cover to protect against dust, and periodic washing of vehicles -Periodic cleaning of the surrounding roads - Monitoring of resident areas	
	- River traffic	- BIWTA will be consulted to determine appropriate safety and/or scheduling standards to be followed.	
Excavating work and operation of construction equipment	- Emission gas from machinery/sand and dust dispersion	- Periodic watering of sediment disposition site and such - Monitoring in residensial area	Contractor (BPDB or NWPGCL)
	- Noise	- Operation in daytime only in principle - Use of low-noise machinery (silencer, muffler) - Construction of temporary fence around Bheramara site - Restriction of worker's prolonged exposure to noise - Use of Personal Protective Equipment (PPE)	
	Construction debris	- Waste management program consisting of reduction, reuse, and recycling of materials. - Prohibition on dumping of any contaminating material - Appropriate segregation of waste and disposal into designated disposal site	Contractor (BPDB or NWPGCL)
	Soil runoff, turbid water, waste water from equipment cleaning	- Installation of temporary settling tanks and sediment fencing - Water used for equipment cleaning is collected in the temporary tank and treated before discharge - Monitoring at the water outlet	
	Leakage of harmful substances	- Mitigation measures to prevent leakage, installation of cleaning facility	
	Loss of habitat of flora and fauna	- Installation of green buffer	
	Income, livelihood, vulnerable group	- The agricultural products growing on the site is compensated according to the Bangladesh regulation. - Explanation of the construction extent and procedure in the early stage. - Preferentially employ local people predicting decrease in income.	
	Safety, accident prevention, land traffic, infrastructure	- Develop a safety management plan and rules - Swift transport to medical facility - Observation of traffic regulations, installation of traffic signs, and education on driving safety - Reduction of vehicle speed in resident areas and close to schools - Installation of bypass for farm road and waterway within the site	
Water intake	Lowering of underground water level	- Monitoring of underground water level in the surrounding wells - Dig deeper wells as necessary	Contractor (BPDB or NWPGCL)

Factor	Potential impact	Planned environmental mitigation measures	Responsible person
	Ground subsidence	- Monitoring of underground water level in the surrounding wells	
Installation of gas pipeline and transmission line	Loss of farm land	- Compensation of the expropriated land for the gas pipeline according to the national regulation - Compensation of land acquisition for transmission line mentioned above	Contractor (BPDB or NWPGCL)
	Livelihood	- Construction conducted during agricultural off-season.	
Jetty construction	Sediment outflow, turbid water	- Construction of jetty will adopt vertical piles type to minimize the dredging area - Dredging activities will occur during dry season when water levels and flow are the lowest. - Adoption of dredging method that minimizes environmental effect - Use of the floating siltation curtains where appropriate. - Dredged materials will be landed and dried on-site. - Installation of sediment fencing	Contractor (BPDB or NWPGCL)
	River traffic	- Conduct dredging activity during dry season with less traffic	
	Income and Livelihood	- Minimization of jetty construction area - Explanation of the construction extent and procedure in the early stage.	
Pump house construction	Income and Livelihood	- Explanation the of the construction extent and procedure to the sand dredging workers in the early stage.	Contractor (BPDB or NWPGCL)

(2) Operation phase

During the operation phase, the NWPGCL is responsible to form a required organization for environmental management. This organization is responsible for receiving the complaints from the residents of the surrounding area during the operation phase and to take appropriate measures, so that the complaints of the residents will be correctly understood and necessary measures will be taken.

The basic idea is to establish a relationship with the local communities. It is important to sufficiently explain the environmental management procedures taken at the power plant. It is also important to invite the residents and school children to observe the power plant.

The operation workers are required to have specialized knowledge. It will be difficult to hire workers from the local area. However, employing local workers will have a favorable impact on the local economy. For the comparatively easy work, sufficient consideration must be given to local employment, including implementation of the preliminary education and training programs for workers.

Table I-7-4-2 gives the basic information on the EMP during the operation phase, and Chapter 7.4.4 describes the environmental monitoring plan.

NWPGCL should prepare a report on the implementation of the EMP and monitoring plan and should submit it to the Khulna DOE and related organizations for further discussion.

Table I-7-4-2 Major environmental impacts and mitigation measures during the operation phase

Factor	Potential impact	Planned environmental mitigation measures	Responsible person
Power generation	Generation of gas emissions	- Adoption of a high stack - Installation of a continuous monitoring system for gas emissions - Adoption of pre-mixing method and a low-NOx combustor - Monitoring of atmospheric air - Periodic maintenance and management	NWPGCL
	Generation of waste water	- Installation of a wastewater treatment system capable of coagulation sedimentation, neutralization, and oil separation - Monitoring of waste water - Monitoring of the river or local water - Blow-off water from cooling tower is cooled by dilution	
	Generation of noise and vibration	- Planting trees around the power station - Adoption of low-noise type machinery and installation of soundproofing covers - Installation of low-vibration type machinery and the use of rigid foundations - Periodic maintenance and management - Monitoring around the border of the site and residential area - Distribution of ear protectors to employees	
Water intake	Lowering of Underground water level Ground subsidence	- Monitoring the underground water level in the surrounding wells - Did wells of appropriate deepness as necessary	NWPGCL
Generation of waste	Generation of sludge from the wastewater treatment system Generation of waste oil Generation of domestic waste	- Waste management program consisting of reduction, reuse, and recycling of materials. - Systematic collection and protected-storage on-site - Prohibition on dumping of any contaminating material - Waste away from the site and their appropriate disposal in a designated municipal dumping site.	NWPGCL
Presence of power station, inflow of workers	Loss of habitat of flora and fauna	- Provision of vegetated buffer - Preferential employment of local people	NWPGCL
	Employment, livelihood, vulnerable people, uneven distribution	- Utilization of local service (cleaning, catering) and materials - Implementation of the preliminary education and training programs	
	Land traffic	- Use of Bas for worker - Observation of traffic regulations, installation of traffic signs, and education on driving safety - Speed limit in residential- and school area	
	Social foundation Diseases	- Provision of emergency medical facility - Medical facility and periodical health checkup - Education and training on health management of the workers	
	Accident and safety management	- Tank storage areas will be equipped with oil spill bank and countermeasure for underground oil seepage and	

Factor	Potential impact	Planned environmental mitigation measures	Responsible person
		designed as physical containment area. - Implement gas leakage prevention procedures and have available on-site all preventive equipment and materials as part of the process of developing emergency plan. - Fire protection equipment and facilities shall be made available at suitable locations in power station including fixed fire protection system, fire hydrants, portable fire fighting equipment, fire vents, alarm system, fire compartments and fire exit signs. Preparation of safety standard.	
presence of gas pipeline and transmission line	Land e acquisition	- Guarantee for the continuance of agricultural activity after construction.	NWPGCL
Presence of jetty	River traffic, land utilization, livelihood	- Develop an appropriate maintenance and management schedule	NWPGCL

7.4.3 Environmental Implementation and Training

During operation phase, NWPGCL is responsible for the system organization of environmental management of the power plant and its implementation. The environmental manager, who is a senior environmental engineer, should take charge of the management of the system to ensure environmental management and monitoring described hereinafter.
The environmental manager should be responsible for reporting the planning and implementation of environmental management plan and environmental monitoring plan to the manager of the power plant through all the phases of the project, and the director should take the final responsibility.
The environmental manager provides preliminary training on environmental management to the staffs prior to the beginning of the operation. The environmental manager should also provide appropriate updated training all through the operation phase.
The environmental manager is also responsible for reporting about the negotiation with local residents and issues of environmental management and monitoring and training to Khulna DOE, JICA and relevant organization.

7.4.4 Environmental Monitoring Plan

Tables I-7-4-3 and I-7-4-4 show the monitoring during the construction and operation phases.

Table I-7-4-3 Monitoring schedule during the construction phase

Item	Parameter	Place	Frequency
Air quality	SPM, SO_2, NO_2	Residential areas and schools	Monitor SPM every two weeks, and SO_2 and NO_2 every two months.
Water quality	TSS	Drain outlet	Every month
Noise	Noise level	Residential areas and schools	Every week when the amount of construction work is maximized
Underground water	Underground water level Water temperature, heavy metals（As, etc）	Residential area	Twice/year (dry season and rainy season)

Table I-7-4-4 Monitoring schedule during the operation phase

Item	Parameter	Place	Frequency
Gas emission	SPM, SO_2, NO_2	Flue	Monitor SO_2 and NO_2 on a continuous basis (by a continuous monitoring system), and SPM every month.
Air quality	SPM,SO_2, NO_2	Residential areas and schools	Monitor SO_2 and NO_2 every month, and SPM every two months.
Waste water	Water temperature, DO, SS, oil, BOD, and heavy metals	Drain outlet	Every two months
Water quality	Water temperature, DO, SS, oil, BOD, and precious metals	River or Canal	Twice a year (dry and rainy seasons)
Noise	Noise level	On the border of the site and in the residential areas	Twice a year
Underground water	Underground water level Water temperature, heavy metals（As, etc）	Residential areas	Twice a year (dry and rainy seasons)

7.5 Stakeholder consultation (explanation to local residents)

7.5.1 Purposes

Stakeholder meeting is aimed at hearing the opinions of individuals and organizations having stake in the implementation of the project and appropriately reflecting them to the decision making. The administrative organizations and power generation companies are headquartered in Dhaka. Since exchange of options can be made in a workshop, stakeholder consultation will be made mainly with the local government and residents.

7.5.2 Implementation

The contents of the stakeholder consultations are as follows.
The first stakeholder meeting was held with the local organizations only, since the details of projects such as the site and equipment overviews were not yet determined. The second and third meetings were held with local residents and NGOs in addition to the local organizations. The content of the meetings is shown in Table I-7-5-1.

Table I-7-5-1 Contents of the stakeholder consultations

Item	1st meeting	2nd meeting	3rd meeting
Planned agenda	Explanation of the project overview Explanation of scoping Explanation of the survey objective, background, contents, and schedule Views and comments on the project	Explanation of summary of facility Explanation about method of environmental impact assessment Explanation of basic policy of environmental management plan Views and comments on environmental management	Explanation of the environmental impact assessment result Explanation of the environmental management plan and monitoring plan Reply to the views and comments
Relevant organizations	Local Administrative organization, etc.	NGO, residents and fishers around the project site, local administration, local people and stakeholders of the land acquisition for transmission line and gas pipeline.	
Place of meeting	Around the existing power plant	Around the existing power plant	
Notification of the time of opening the meeting	Notification letter was sent 1~2 weeks before to the related organizations and the director of the existing power plant.	Notification letter was sent 1~2 weeks before to the related organizations and the director of the existing power plant, and handed directly to the leader and sub-leader of the local village 1 week before, asking notification to the village people.	
Method of disclosing the Minutes of the Meeting	Copies are sent to the related organizations.	Copies are sent to the related organizations and NGOs. Copies will be kept at the existing power station and the leader and sub-leader of the village for public access.	

7.5.3 Result of the consultations

(1) The First stakeholder consultation

Date: 10:00 to 12:00, June 16

Meeting place: School inside the existing power plant

Attendants: 64 persons

《Major opinions》

・Are there any impacts on fishes by the warm waste water discharged from the power plant?

・Is the school not affected by noise?

(2) The second stakeholder consultation

The first day

Date: 10:00 to 13:00, September 21

Meeting place: School inside the existing power plant

Attendants: 75 persons

《Major opnions》

・Is there a possibility that the existing wells become unusable due to utilization of underground water? Is there any countermeasures?

・Will the waste water discharged from the power plant have environmental impact?

・Local residents are expecting to be employed not only in the construction phase but also in the operation phase.

・Plantation of fruit trees for greening would benefit the local residents' life.

・The installation of medical facility for construction workers is expected.

The second day
Date: 10:00 to 12:00, September 22
Meeting place: School inside the existing power plant
Attendants: 96 persons
<< Major opinions >>
- There was a demand for alternative land for expropriated land, while some demanded for compensation payment to buy new land
- There is complaint from the local residents about the noise from the operation of the existing power station.

(3) The third stakeholder consultation

The first day
Date: 11:15 to 14:30, November 30
Meeting place: School inside the existing power station
Attendants: 66 persons
<< Major opinions >>
- Is there a possibility that the existing wells become unusable due to utilization of underground water? Is there any countermeasures?
- The impact of noise from the power plant should be prevented throughout the operational phase.
- Is there the possibility of acid rain resulting from the exhaust gas from the power plant, and the impact on agriculture?

The second day
Date: 10:45 to 14:00, December 01
Meeting place: School inside the existing power station
Attendants: 92 persons
<< Major opinions >>
- Is no relocation of the local residents necessary?
- Will the land expropriated for installation of transmission line compensated?
- The residents of 12 Dags and 16 Dags villages near the power plant will be impacted. Will they receive any benefit from the implementation of the project?

7.5.4 The Focus Group Discussions

The Focus Group Discussions were held four times for Category-B area and the areas inside and outside the projected site, with the male members and female members separated into different groups. Separation of the male members and female members into different groups was intended to make sure that female members' views and comments would be made more explicit and more clearly understood.
There were no views or comments which were strongly against the project. They took an affirmative attitude to the construction of the power plant if there will be appropriate compensation for the land expropriation.
They expected new employment to be created by the construction of the power plant.

7.5.5 Opinions from the local residents at social environmental survey

In the social environmental survey conducted in June 2008, the overview of the power plant construction project, including the undetermined Bheramara site and the cooling system, was explained to the interviewed residents and their opinions were collected.
The attitude of the residents toward the project is generally affirmative, with large expectation

for improvement of the electricity crisis, and also for regional benefit and improved employment.
On the other hand, negative opinion includes the big concern for the loss of residence in Category-B, and some concern for noise in Category-C.

Chapter 8 Project Cost and Economic and Financial Analyses

8.1 Operational Condition of the Bheramara CCPP

In this Chapter, the SCC5-4000F of Siemens whose price is expected to be the middle out of the four models of F-class CCPP shown in Table I-4-7-8.
Table I-8-1-1 shows the technical assumption under the site condition of the Bheramara CCPP by Siemens SCC5-4000F used for the economic and financial analyses.

Table I-8-1-1 Technical Assumption of Bheramara CCPP

C/C Model	Siemens SCC5-4000F
Gross Power Output @35^{o}C,1013hPa, RH60%	365,600 kW
Net Power Output @35^{o}C,1013hPa, RH60%	355,100 KW
Net Thermal Efficiency (LHV)	54.2%
Net Heat Rate (LHV)	6642 kJ/KWhr
Construction Period	42 months
Plant Load Factor	70 %
Project Period	30 years

8.2 Project Cost

8.2.1 Trend of FOB price for F-class CCPP

Hot parts of the gas turbine (hereinafter referred to as "GT") of which major component is mainly made of rare metals such as nickel, chromium, and cobalt. Therefore there has been a drastic increase in the production cost due to an increase in the price of rare metals and other steel materials in recent years. Further, because of a steep rise in energy price, a demand for highly efficient CCPP has increased over the supply and this is regarded as one of the causes for a steep rise in the price of CCPP.
According to the Gas Turbine World GTW Handbook, FOB price of the F class 1 on 1 CCPP started to rise steeply in about 2004 and has been rising about 1.66 times (about 18%/yr) in the following three years. In 2008, the price has raised more steeply and it is expected to reach 300 million USD in June 2008.
However, the World Bank's report "Study of Equipment Price in the Energy Sector" established in June 2008 indicates that the projected escalation rates are lower than the past three years due to the slowdown in the U.S. economy. CCPP market situation is going to be changed and the price of CCPP is expected to be moderated.

8.2.2 Contract Records of F-class CCPP

From the contract records of F-class CCPP, Alstom registers an average of 427 million USD in terms of the EPC cost without a long-term service agreement (LTSA), while Siemens records an average of 425 million USD in terms of the EPC cost with LTSA during the period of 10 to 25 years.

8.2.3 Estimation of Project Cost

The project cost includes the EPC cost, consultant fee, contingency, various taxes and duties, interest rate during construction and direct administrative expenses incurred on the BPDB. Of these costs, the EPC cost, consultant fee, contingency and others as of June 2008 are shown in Table I-8-2-1.
A price hike for the latest several months was taken into account to get the costs given in Table I-8-2-1 considering the price escalation rate of this year is around 20 to 40 %.
The Project cost was estimated at June 2008 when world market of raw material like iron was very high. As described Sub-section 8.2.2, since world economy is facing crisis, it seems that the project cost may decrease in near future.

Table I-8-2-1 Estimated Project Cost for Bheramara CCPP (as of June 2008)

1 TK= 0.65 JPY

Category	Local Portion		Foreign Portion	Total	
	MTk	Eqv. MJPY	MJPY	MJPY	Eqv. MTk
A. Power Plant Construction and Associated Works	4,331	6,713	36,445	43,158	27,844
A1. Power Plant					
(1) FOB Price of Imported Equipement	-	-	31,457	31,457	20,295
(2) Marine, Freight and Insurance	-	-	790	790	510
(3) Inland Transportation and Insurance	255	395	-	395	255
(4) Construction, Erection, Commissioning and Insurance	3,821	5,922	1,974	7,896	5,094
A2. Fuel gas brunch pipeline	5	7	43	50	32
A3. 230kV Substation	138	214	1,517	1,731	1,117
A4. 132kV Substation (Replace)	111	172	601	773	499
A5. Transmission line (230kV main T/L to 230kV S/S)	2	3	64	67	43
B. Consulting Services					
incl. Price Escalation and Physical Contingency	197	305	1,911	2,216	1,429
C. Contingency					
C1. Physical Contingency on A (5% of A)	217	336	1,822	2,158	1,392
C2. Price Contingency on A (Foreign:4.1%/yr, Local: 5.4%/yr)	1,216	1,884	7,560	9,444	6,093
D. Custom Duties, Tax, and VAT					
D1. Custom Duties (15% of Foreign portion of A and C1)	3,703	5,740		5,740	3,703
D2. VAT (15% of A and C1)	4,385	6,797		6,797	4,385
D3. Income Tax (4%) and VAT (4.5%) for B	121	188		188	121
		-			
E. Interest During Construction on A	132	205	2,420	2,624	1,693
A-E. Sub-Total (Construction Portion)	14,302	22,168	50,157	72,326	46,662
F. 6-year LTSA Cost for Gas Turbine	-	-	6,807	6,807	4,392
F1. Initial Spare Parts for LTSA	-	-	2,397	2,397	1,546
F2. Maintenance Fee	-	-	4,410	4,410	2,845
G. Contingency					
G1. Physical Contingency on F (5% of F)	-	-	340	340	220
G2. Price Contingency on F (Foreign:4.1%/yr, Local: 5.4%/yr)	-	-	2,844	2,844	1,835
H. Customs Duty, Tax, and VAT					
H1. Custom Duties (15% of Foreign portion of F and G1)	692	1,072		1,072	692
H2. VAT (15% of F and G1)	692	1,072		1,072	692
				-	-
I. Interest During Construction on F			27.30	27.30	17.61
F-I. Sub-Total (LTSA Portion)	1,383	2,144	10,018	12,162	7,847

8.2.4 Justification of the Project Cost Estimation

For justification of the project cost estimation, the comparative study with the expected cost for a project, which was opened the bid in July 2008, was conducted and the result was shown in Table I-8-2-2.

Project A is exempted form custom duties, tax and VAT as IPP project. On the other hand, Bheramara CCPP requires 136 million USD for custom duties, tax and VAT and such difference affects on total project cost.

However it is evaluated that the substantial project cost is almost same level comparing that of Project A. Therefore it is concluded that the estimated project cost of the Bheramara Project is feasible.

Table I-8-2-2 Comparison with other project cost

Unit: Million USD

		360 MW Bheramra CCPP (Cost estimation as of June 2008)	450 MW A CCPP Project (Expected Cost as of July 2008)	360MW B CCPP Project (Budget as of 2007)	Remarks
A	**Direct Cost**				
A1	FOB cost	294	300	193	FOB Price in 2007(GTW2007-8) Siemens E-CCPP : 223 MUSD Siemens F-CCPP : 217 MUSD
A2	Transportation, Insulance, Construction and Comissioning	85	165	77	Including Risk premium for Project A
A3	Related facilities (T/L, S/S, gas pipeline etc.)	24	40	17	
A4	Consulting Service	13	N/A	13	
	Sub-Total (Sum of A)	416 (1,155 $/kW)	505 (1,122 $/kW)	299 (831 $/kW)	
B	**Indirect Cost (1)**				
	IDC / Financial Charge	61	143	34	
C	**Indirect Cost (2)**				
	Custom Duty, Tax, VAT	136	N/A	93	
D	**Contingency**				
D1	Physical Contingency on A	24	N/A	17	Bheramara CCPP: 5% of A
D2	Price Contingency on A	91	N/A	20	Bheramara CCPP: Foreign:4.1%/yr, Local: 5.4%/yr
	Sub-Total (Sum of D)	115	N/A	37	
E	**LTSA Cost**	64	N/A	15.7	Bheramara CCPP: 6yrs B CCPP Project: 3yrs
	Total Project Cost (A+B)	477 (1,325 $/kW)	648 (1,440 $/kW)	333 (925 $/kW)	
	Total Project Cost (A+B+C+D+E)	791	648	478	

8.3 The Basis of Economic and Financial Analyses

(1) Commissioning Date and Useful Life of the Project

The project is planned to start its construction in 2010, to be completed and commissioned in October 2014. The project will continue its commercial operation for 30 years till 2044. For the sake of analytical convenience, the economic and financial analyses assume the project to be completed in June 2014 and start its commercial operation at July 1, 2014. All the costs and benefits to be evaluated are to be expressed in terms of the constant price as of the end of June 2014. Should it happen that any data to be evaluated is captured prior to the end of June 2014, such data is to be converted to the constant price of 2014 by using the inflation indexes of the mother countries of the currencies.

(2) Inflation

The inflation of the country is predominantly discussed by using CPI. We, too, use CPI for the analysis. The average rates of inflation during past 10 years are found to be 4.63% in Bangladesh, -0.9% in Japan and 2.54% in U.S.A. In developing the future rates of inflation, we are to assume the rates of inflation in Bangladesh and U.S.A will keep the past trends to continue during the years to come. For Japan, the past rate is deemed distorted That makes us to assume the future rate based on the inflation in the country of immediate preceding months and assume an annual average rate of 1.0% for the future.

(3) Foreign Exchange Rate

Based on the empirical data, the analyses adopt the assumption that the exchange rates will take the pattern of its historical trend in its direction and magnitude. It is learnt that the exchange rate between US Dollar and Bangladesh Taka is expressed by the linear function of $Y=2.3906X + 43.732$ and the one for Japanese Yen and Taka is $Y=0.023X + 0.3655$, whereas Y represents the exchange rate and X represents the number of years starting at 1998=0. By using the functions, we are to assume the exchange rates for the future years to come.

(4) Fund Raising

The entities in the power sector rely on the bilateral as well as the international donor agencies for raising the funds necessary for capital investments. The ODA Yen Loan from the government of Japan will be lent to the government of Bangladesh and on-lent to the executing agency, NWPGCL for the project. The standard terms and conditions of ODA Yen Loan to Bangladesh are, as of present, with the rate of interest at 0.01% p.a., for the repayment period of 40 years including the grace period of 10 years. The ODA Loan can cover up to 100% of the total project cost with exception of the cost items including, land acquisition, taxes and fiscal levies that are not eligible for the Loan. The ceiling limit of the ODA Yen Loan is the total cost of the project less the amount of the non-eligible items. The standard terms and conditions of on-lending within Bangladesh is indicated in the Guideline issued by the Ministry of Finance[1] which prescribes that the funds shall be provided in the combination of the equity and debt=60:40; the terms of the loan is 25 years including 5 years of grace period; the rate of interest to be 4.0% p.a. for the foreign currency and 3.0% p.a. for the domestic currency. The analysis assumes that ODA Loan from Japan covers 80% of the total project cost, though the actual ceiling amount of the ODA Loan from Japan will be determined by deducting the non-eligible items from the total estimated cost. The remaining gap of 20% is assumed to be financed by the government through equity (60%) and loan (40%) as is tabulated in the following table;.

[1] Ministry of Finance, “Lending and Relending Terms of Local Currency and Foreign Loans”, March 7, 2004

(5) Debt Service

The repayment of the principal and interest is assumed to be made twice a year on June 30 and December 31 every year. The grace period of the principal is assumed to be 5 years after the commissioning date.

(6) Electricity Tariff

The prevailing electricity tariff has been in force since March 1, 2007. The wholesale part of the tariff has been revised upward by 16% on September 29, 2008 with the approval of BERC that took effect immediately. In the financial analysis, we are to adopt the actual level of tariff whereas in the economic analysis, the prices shall be replaced by the economic price of electricity using the quantified level of the willingness-to-pay in order to make a valid assessment of the economic value of the benefit.

(7) Useful Life and Depreciation

The analysis assumes to adopt the straight line depreciation while setting up the residual value of 10% and useful life of 30 years. The residual value shall be recognized as the benefit of the project at the final year of project life.

(8) Interest during Construction

For calculating the interest on the loan during the construction period, the rates specified in the item (4) above shall be adopted and used. The interest accrued during construction shall be booked into the account of capital project in progress and shall be capitalized at the time of account transfer to the fixed assets.

(9) Contingencies

The price contingency incorporated in the project cost shall be disregarded from the economic and financial analyses. On the other hand, the physical contingency is to cover any of the shortcomings of the project plan that has to be complemented with additional material, parts or works. Such parts of the project are deemed to be indispensable to the project and, therefore, should be incorporated as an integral part of the project cost when conducting the economic and financial analyses.

8.4 Financial Evaluation

8.4.1 Method of Evaluation and the Basic Parameters

The purpose of the analysis is to check and verify that the project would be financially sustainable under the framework constructed. The method of the evaluation is to compare the financial cost (expenditure) against the financial benefit (revenue) of the project by calculating the financial internal rate of return (FIRR). The FIRR calculated shall be checked against the weighted average of the capital cost (WACC) mobilized for the project.

8.4.2 Financial Cost

(1) Scope of the Project

The project is to construct a combined cycle gas turbine power generation plant in Bheramara Thana of Kushtia Zilla. The plant is to be operative as the base load supplier. The construction site of the plant is the property owned by BPDB for its existing Bheramara Power Plant. The fuel gas is to be supplied by Petrobangla through the Bheramara-Khulna trunk pipeline which is being constructed by Petrobangla. For transmission of the power, the project is to utilize the existing transmission facilities of BPDB.

(2) Project Cost

The cost presented is estimated as of and in the constant price of June 2008. In order to create the basis which is fit for the financial analysis, all the estimated costs are converted into the constant price as of June 2014. The project cost based on the 2014 constant price is now presented in the following table.

Table I-8-4-1 Project Cost for Economic and Financial Analyses (2014 constant price)

	Foreign currency (JPY Million)	Local currency (Tk million)	Total（Tk million）*1
A. Power Plant Construction	38,688	5,823	31,907
B. Consulting Services	1,634	313	1,414
C. Contingencies			
C1. Physical Contingencies	1,934	291	1,595
C2. Price Contingencies *2	8,801	849	6,872
D. Custom Duties, Taxes & VAT	0	9,826	9,826
E. Interest during Construction (IDC) *2	1,135	72	1,766
Total Cost	51,935	19,078	54,170

(note) *1: JPY 1 = 0.67Taka (estimated for 2014)

*2: The price contingency and IDC shall be excluded from the total cost used for the economic and financial analyses.

(source) JICA Study Team

(3) Fuel Price

The prevailing tariff of natural gas is the one revised as of January 1, 2005. The level of gas prices are extremely low ranging at about 10-20% of the international price. The tariff of gas for the electricity is set at Taka 73.91/mcf[2] which is the second lowest after the fertilizer (Taka 63.41/mcf).Based on the actual price during the fiscal year 2008, this analysis estimates the price of gas in 2014 by applying the inflation factor.

(4) Operation and Maintenance Cost

With respect to the maintenance of the plant which is adopting a sophisticated technology, the project plans to hire a specialized service provider by entering into a long term service agreement which is to cover the initial six years (2015 – 2020) after commissioning. Beyond the expiry of the long term service agreement, NWPGCL will take over the maintenance jobs on its own.

(5) Fiscal Levies

The taxes and duties that are levied on judicial person include the income taxes, value added taxes, custom duties, etc. The taxes and fiscal levies are deemed as the domestic unrequited transfer of revenue that plays no contribution to national economy in the value addition and are disregarded in conducting the economic analysis. In the financial analysis, on the other hand, they represent legitimate expenditure for the project. The fiscal levies are counted as a part of the project cost.

[2] Mcf stands for 1,000 cubic feet.

(6) Weighted Average of Capital Cost (WACC)

Once the FIRR is calculated, the rate obtained is to be compared with the weighted average of capital cost to verify if the FIRR calculated is sufficiently covering the cost of the funds including the equity and borrowed funds. The assumptive figures of the project are inserted into the formulae to draw the output rates for WACC (after tax) for which we obtain 3.11%.

On the other hand, the economic analysis is conducted on the basis of evaluating the project on the perspective of national economy and, therefore, the criteria of viability for the economic feasibility rests upon whether the EIRR clears the opportunity cost of capital in the country. The opportunity cost of capital is normally represented by the yields of the treasury bills The yields of the short term treasury bills (3-6 months of maturity) in Bangladesh is captured as 8.0% which is adopted as the opportunity cost of capital for the project to clear.

8.4.3 Financial Benefit

(1) Definition of Financial Benefit

The financial benefit is defined here as the revenue to be raised through the sale of electricity. For the purpose of conducting the financial analysis, the study assumes the existing tariff converted into 2014 constant price will prevail and tests the financial sustainability based on such electricity tariff.

(2) Electricity Tariff

The retail tariff which is prevailing now is the one revised as of March 1, 2007. The wholesale tariff has been revised by 16% on September 29, 2008. The appraisal for the revision conducted by BERC has been based on the actual cost incurred during the fiscal year of 2007/08, based on which BERC has come up with the wholesale price level which would have been sufficient enough to cover the actual cost incurred while allowing no return of equity. The average of the wholesale tariff stands at Taka 2.37/kWh which can be construed as the break-even price for the fiscal year of 2007/08. The price thus calculated is converted into the constant price of 2014 by using the inflation index between 2007/08 and 2013/14. The unit price for the year is obtained as Taka 3.22/kWh.

8.4.4 Financial Analysis

(1) Financial Internal Rate of Return (FIRR)

Based on the assumptions stated above, the analysis has constructed an analytical model for obtaining FIRR. The FIRR is calculated as 5.87%. The WACC (after tax) stands at 3.11% and we hereby conclude that the project is financially viable.

(2) Profit and Loss Analysis

The model analysis indicates that the earnings before interest and tax (EBIT) are shown to be positive from the very first year of operation through the end of the project. For the net profit after tax, the project will take the deficit on the first year but will turn to be positive on the second year and will keep going through the final end of the project. To be also learnt from the model, the project will have profits from the second year of operation and thus will be subject to the income tax. The ,model analysis also indicates that the level of the profit after tax will be sufficient enough to declare the dividend of 9% (equals to 15% before tax) from the second year till the end of the project.

8.4.5 Sensitivity Test

The analysis moves to the next task that, should any of the basic assumptions adopted for the

project happen to change to a significant extent, what extent of impact to be felt by FIRR, is to be examined. The factors considered here are; 1) construction cost; 2) fuel cost; 3) billing rate of electricity; 4) operation and maintenance cost; and 5) plant factor. Among the 5 parameters selected for the analysis, there is no one whose change deprives the project of its financial viability, so long as the changes remain within 20% of the base case condition.

8.5 Economic Evaluation

8.5.1 Methodology of Evaluation and Basic Assumptions

Whereas the financial analysis has focused on the viability of the project from the standpoint of the sponsor of the project, the economic analysis considers and evaluates the optimal and/or efficient allocation of the resources utilized for the sake of the national economy. The methodology of evaluation is to compare the economic benefits that will be produced from the resources input for the project under the environment of "With Project" and that of "Without Project" through which the economic internal rate of return (EIRR) is to be drawn out. The analysis verifies whether the EIRR is sufficient in covering the opportunity cost of the capital mobilized. The costs and benefits need to be expressed in terms of 2014 constant price.

8.5.2 Economic Cost

(1) Capital Cost

The economic analysis uses the project cost expressed in 2014 constant price and prepares the spread sheet of the economic cost and the benefit for 30 years of project life.

(2) Fuel Cost

The gas price in Bangladesh has been kept at a low price for a long time in comparison with the international standard price and is in no way economically rational. The fuel gas and electricity are the two most predominant factors whose prices are artificially suppressed by the government and are way out of the rational pricing. We are in need of adjusting the prices into the economically rational ones so that they will be aligned for the economic analysis.

With respect to the international prices of various energies, Energy Information Administration (EIA) of Department of Energy in U.S.A. is making an extensive survey and analysis and is releasing the demand and supply conditions, actual prices through its Natural Gas Monthly and future demand and price outlook every year through its Annual Energy Outlook (AEO). The former reports the prices of natural gas traded at US$ 9.56/mcf in March 2008 and the average price during January through March 2008 as US$ 8.96/mcf based on which the price in 2014 is obtained as US$ 9.10/mcf which is equivalent to US$ 10.58 in terms of GJ[3].

(3) Operation and Maintenance Cost

The operation and maintenance cost that has been used in the financial analysis is utilized again for economic analysis by excluding the taxes and fiscal levies.

(4) Standard Conversion Factor and Shadow Exchange Rate

While it is often found that project costs are converted into the international prices by using the standard conversion factor and/or shadow exchange price, we will stay away from applying those factors on the grounds that we deem the foreign exchange shadow price has no

[3] The equation for conversion is: 1 mcf=0.950MMBTU and 1 BTU=1.055KJ.

validity as of date in view of the foreign exchange market which has been liberalized and that the conversion factor being not a single but varies by a wide margin depending upon the category/kind of goods and services and extent of quality and tend to aggravate distortion if not used correctly.

8.5.3 Economic Benefit

(1) Definition of Economic Benefit

The economic analysis compares the economic cost and benefit in comparison with the environments of "With Project" versus "Without Project". The parties to receive the benefit of the project are defined as; 1) those who are not connected to electricity now will become the user of electricity owing to the implementation of the project; 2) those who are connected to electricity but is not able to use the power as much as they need due to the constraint of supply will become possible to expand their consumption. The benefit of the project will be composed of the incremental volume of power supplied to those beneficiaries.

The contemporary method of economic appraisal is to define and directly quantify in monetary terms and evaluate the benefits arising from the project which is compared against the economic cost of the project in obtaining the economic internal rate of return. In the instances where the measurement and quantification of benefits are difficult, the analysis assumes an alternative project which would generate the same quality and amount of the benefit but could be constructed at the least cost next to the project for appraisal. The economic analysis compares the cost of such least cost alternative project against the project for appraisal by quantifying the saving of cost as the benefit of the project. We have resolved to adopt the direct quantification method.

(2) Willingness to Pay (WTP)

Willingness-to-Pay (WTP) is the maximum amount consumers are prepared to pay for a good or services. WTP represents the economic value that consumers assess in their consumption pattern. The area below the demand curve and the price that represent current equilibrium is called "consumer surplus". WTP is the aggregate of the total amounts that are currently paid by the consumers and the consumer surplus. WTP can be calculated by using the following formula. The curvature of the demand curve is found varying among different analysts This analysis adopts the curvature which is the elasticity of demand as 1/3.

WTP = WTP minimum + 1／3 X (WTP maximum – WTP minimum)

With respect to the WTP minimum value, most analysts rely on the average billing rate of electricity. We, too, follow and adopt the methodology as our own. The average billing rate is the price the consumers are actually paying for the electricity and is obvious that the average consumers are agreeing to pay. For our analysis, the average wholesale rate of BPDB in 2007/08 which is known to be Tk 2.37/kWh is to be converted in 2014 constant price. Out of such efforts, Tk 3.22/kWh is obtained which is the price including the mixture of generation, transmission and distribution. The cost of generation that occupies the cost of BPDB expressed in 2014 constant price, the generation cost is derived to be Tk 3.01/kWh.

The WTP maximum, on the other hand, can be calculated from the consumers' operation of the captive diesel generation. The consumers who fail to obtain sufficient volume of electricity turn to the captive diesel generation. The consumers are paying for the capital cost, operating expenses as well as the fuel cost for such operation. Consumers are found to be paying for such which evidently demonstrates the willingness to pay. The analysis treats the investment cost as the sunk cost and assumes the expenses other than fuel as zero. WTP counts the fuel cost only and is captured as Taka 27.16/kWh.

Heretofore, both of WTP minimum and WTP maximum are solidly established and we now turn to calculate WTP by using the formula defined before. We are now in possession of WTP 11.06/kWh in our hands. Using the figure obtained as the unit price of the economic benefit and multiplying the total volume of generation can quantify the value of the generated electricity. The quantified benefits are compared to the capital cost and the operational cost calculated by the international price of natural gas for our ultimate purpose of calculation of EIRR.

8.5.4 Economic Evaluation

(1) Economic Internal Rate of Return (EIRR)

In utilization of the basic assumptions that we have so far made for economic costs and benefits, we have deployed the streams of economic cash inflow and outflow in constructing the EIRR analysis model through which we obtain the EIRR, the ultimate output of the analytical work. The EIRR is found to be at 20.64%. The output obtained is exceeding the opportunity cost of capital we have defined before (=8.0%) and is surpassing the threshold of 10-12% which international donor institutions generally conceive as the feasibility line. It also goes beyond the discount rate of 15% which the government of Bangladesh instructs its agencies for preparation of capital projects. We now conclude that there is no doubt as to the economic viability of the project.

8.5.5 Sensitivity Test

The analysis moves to the next task that, should any of the basic assumptions adopted for the project happen to change to a significant extent, what extent of impact is to be felt by EIRR, is examined. The factors considered here are; 1) construction cost; 2) fuel cost; 3) price of electricity (=WTP); 4) operation and maintenance cost; and 5) plant factor. Among the 5 parameters selected for the analysis, there is no one whose change deprives the project of its economic viability, so long as the changes remain within 20% of the base case condition.

8.6 Key Performance Indicators

The following operational and effect indicators shall be set for monitoring the power plant performance, supervising the management of operation and maintenance and confirming the effect of the Bheramara CCPP.

Each target shall be checked and reviewed based on Table attached herewith. The indicators above are set based on “Operational and Effect Indicators Reference, 2nd Edition, established by JBIC, October 2002”.

Table I-8-6-1 Operational and Effect Indicators

Name of Indicator	Target	Check Interval*1	Review Interval*1	Comments
Operational Indicator				
Maximum Output*2	360MW	Monthly	Yearly	GT output will be in decline because of the degradation so that CCPP also will be in decline in the future. Therefore this is a significant indicator for check and review.
Plant Load Factor*3	70%	Monthly	Yearly	= Annual Amount of Gross Generated Output / (Rated Output x 24 x 365) x 100 Assumed base load operation case. This might be decreased in case of partial load operation. The maintenance period greatly influences the plant load factor. Its period shall be carefully considered when setting the target.
Availability Factor*3	90%	Monthly	Yearly	= Annual Operation Hours / (24 x 365) x 100 Assumed base load operation case. This might be decreased in case of partial load operation. The maintenance period greatly influences the availability factor. Its period shall be carefully considered when setting the target.
Gross Thermal Efficiency*2	54%	Monthly	Yearly	= (Annual Amount of Gross Generated Output x 860) / (Annual Amount of Fuel Consumption x Fuel Lower Heating Value) x 100 The gross thermal efficiency shall be evaluated on the terms and conditions, based on manufacturer's evaluation guideline, taking the result of the commissioning into consideration.
Outages Hours by Human Errors	0	Yearly	Yearly	
Outages Hours by Machine Errors	438	Yearly	Yearly	Outage days by machine errors are assumed for 18 days. Unforeseen outage by machine errors is unavoidable because of the operation records of CCPP.
Planning Outages Hours	192	Yearly	Yearly	Assumed Combustor Inspection year. Combustor Inspection: 192 hour x 4 time / 6 year, Hot Gas Pass Inspection: 360 hour / year, Major Inspection: 720 hour / year

Name of Indicator	Target	Check Interval*1	Review Interval*1	Comments
Effect Indicator				
Maximum Output *2	360MW	Monthly	Yearly	GT output will be in decline because of the degradation so that CCPP also will be in decline in the future. Therefore this is a significant indicator for check and review.
Net Electric Power Production*2	2,141 GWh	Monthly	Yearly	The target of net electric energy production is calculated as follows. 360MW x 8760 hour x 0.70 x (1 – Auxiliary power ratio: 0.03)

1) The target of each indicator shall be checked based on the “check interval” above, and reviewed based on the “review interval” above.
2) The target of the “maximum output”, “gross thermal efficiency” and “net electric energy production” specified above shall be set based on the guaranteed specifications of an EPC contractor.
3) The “plant load factor” and “availability factor” specified above are subject to operation order from the Bangladesh dispatch center.

Part II

Proposal
for
Corporation Plan and Organization
of
NWPGCL and Bheramara CCPP

Chapter 1. Introduction

1.1 Objectives

As a case example, this report will examine, with Company Act 1994 based on the power sector reform program in Bangladesh, an organizational structure and management system of the corporatized companies, in generation, transmission and distribution. Considering BPDB corporatization plan, and the preceding corporatized cases, the corporate management plans for North West Power Generation Company (NWPGCL) and Bheramara power station are proposed to contribute to promoting a self-reliant, and efficient management system.

1.2 Terms of Reference (TOR)

The terms of reference is covered to support reinforcing the management foundation for NWPGCL and Bheramara power station. The contents of the TOR are as follows;

(1) Support for the institutional setup of Northwest Power Generation Company Limited (NWPGCL)

(a) Support for developing corporate management

Support for developing the corporate management plan, contributing promotion of self-reliant, and efficient management system.

1) Organizational Structure: Organizational chart, Duty and powers for each division and class
2) Human capital Management: Compensation and bonus system, Welfare programs, Human capital development policy, Employment schedule (plan)
3) Finance/Accounting system: Financial and accounting system, Investment and budget plans, Accounting process
4) IT Management system: system operation policy and plan, system investment plan
5) Legal Affairs: Subsidiary loan agreement, Power Purchase Agreement (PPA), Fuel Supply Agreement (FSA), Operation and maintenance Agreement

(b) Identification of risks and proposal for risk mitigation measures

In consideration of the business practice in Bangladesh, business risks are identified and countermeasures for these risks are proposed.

(c) Support for the development of Mid-term management plan for NWPGCL as a whole

In accordance with the BPDB corporatization plan and preceding cases, the corporate management from the perspectives of the mid-term time range (3years) is proposed.

(2) Support for developing the business plan for the Bheramara power station

Support for developing the management plan for the power station, including required rules and system, and contracts and agreements with service providers in order to functionalize the power station activity.

1) Organizational Structure: Organizational chart, Duty and powers for each division and class, P/S service rule
2) Human capital Management: Compensation and bonus system, Welfare programs, Human capital development policy, Employment schedule (plan)
3) Finance/Accounting system: Financial and accounting system, Investment and budget plans, Accounting process
4) IT Management system: system operation policy and plan, System investment plan
5) Operation and Maintenance Management System
6) Legal Affairs (Subsidiary Loan Agreement, Power Purchase Agreement (PPA), Fuel Supply Agreement (FSA), Operation and maintenance Agreement)
7) Mid-term management plan (sales, costs, repayment of debt, etc.)

Chapter 2. NWPGCL Corporate Directivity

2.1 Phase-wise Roadmap

From now on, the management of NWPGCL shall proceed with both the construction of Bheramara thermal power station and corporatization of NWPGCL in a simultaneous and parallel manner. In doing so, they must accurately deal with various issues. Different problems will come up to the surface according to the progress level of the corporatization. Therefore, the time frame is divided into 4 phases in line with corporatization of NWPGCL and the Bheramara power station. Issues are identified and countermeasures for these issues are proposed for each phase.

An explanation of each phase follows;

(a) Phase 0: Preparation period:
From the present to Loan Agreement (L/A), expected to be concluded by June 2009.
Proceed with basic design of Bheramara power station, and place concrete foundation of NWPGCL corporatization.

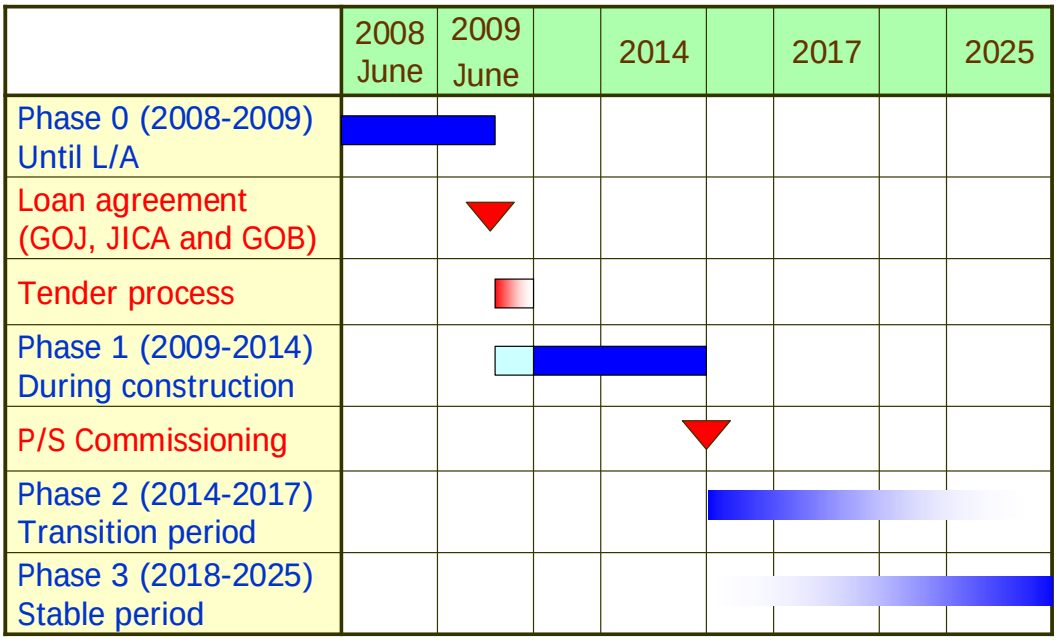
(b) Phase 1: During construction period:
From the conclusion of L/A and tender process, and to the construction stage.
No operation revenues from the Bheramara power station are expected during phase 1.

(c) Phase 2: Transition period (about 3 years from the commissioning)
For about 3 years from the commissioning, unstable conditions in operations at the power station and the management system at the administrative office will be identified frequently due to initial troubles.

(d) Phase 3: Stable period (3 years and more from the commissioning)
When initial troubles are solved, a stable condition in operating and managing will be secured.

Considering the conditions above, a phase-wise corporatization schedule is shown as follows;

Table II-2-1 Time Schedule for Corporatization of NWPGCL



2.2 Phase-wise Ideal Figures of NWPGCL

Carrying out efficient management and human capital development is required in order to develop a company with sustainability. As indicated in the following table, there are few power sectors, or companies, in Bangladesh, which simultaneously attain Independent management and Human capital development. The directivity of NWPGCL is to simultaneously attain both Independent management and long-term human capital development for sustainable development.

Table II-2-2 Case of power sector corporatization in Bangladesh until now

	Independence of management	Long-term human capital development
BPDB P/S	It is completely under the rule of BPDB and all the judgment is based on decision-making by BPDB.	Although maintenance personnel are employed, a training program is not established.
IPP	It is completely based on decision-making by IPP.	Since a long-term maintenance service agreement is established with manufacturers, the maintenance personnel are not employed.
Ashuganj P/S	It is a subsidiary of BPDB and important decision-making, such as scheduled outages for inspections, is completely under BPDB control.	Maintenance staff is secured and personnel training which was only a system has started.
PGCB	Although it is a subsidiary of BPDB, the accounting system is clearly divided, and management authority is delegated to the management.	Since it requires special expertise, training programs have been established.
DESCO	Although it is a subsidiary of BPDB, the accounting system is clearly divided, and management authority is delegated to the management.	Major O&M for distribution line works are outsourced.

Considering the conditions discussed above, the following shows the directivity of NWPGCL, showing the relationship between Independent management and long-term human capital development.

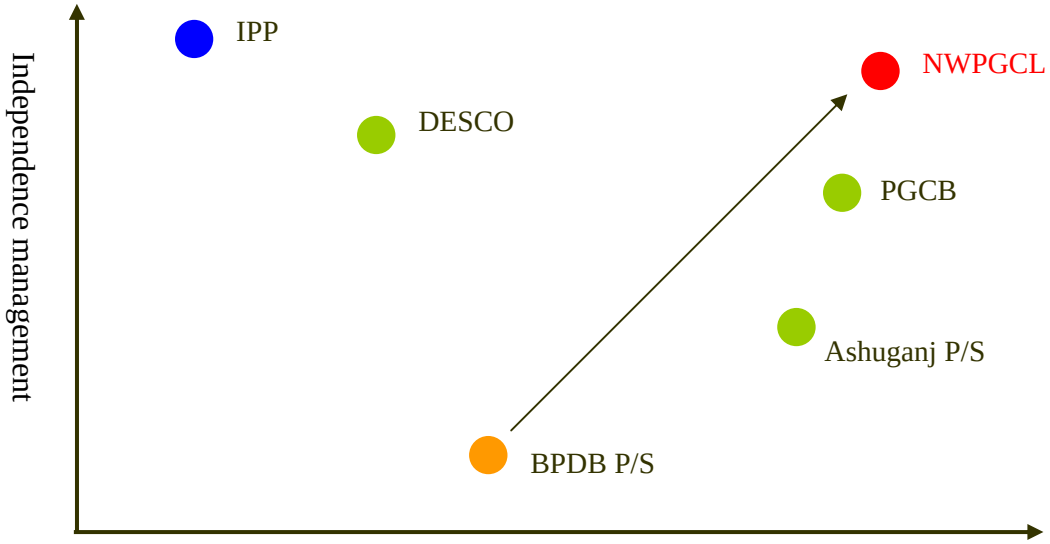


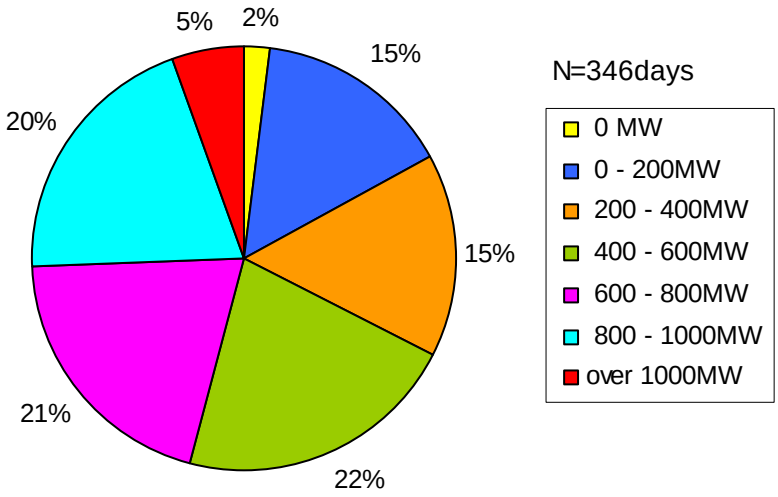
Figure II-2-1 Directivity of NWPGCL

2.3 Factor Analysis of Power Crisis

(1) Status of load shedding

Due to the shortage in power supply, Bangladesh is currently facing a continuous power crisis. Frequency distribution of days when load shedding was conducted in 2007 is indicated below.

As the maximum power output in 2007 was 4130MW, load shedding was conducted for over 400MW of power, equivalent of 10% of the maximum output, across 70% of the year. In addition, for close to 90 days, i.e., a quarter of the year, over 800MW of power, the equivalent of 20% of maximum output was load shedded. The number of days with no load shedding was less than 10. During most of the year, load shedding was done for two to three hours every day during the peak consumption period of late afternoon. The situation has not improved as of October 2008.



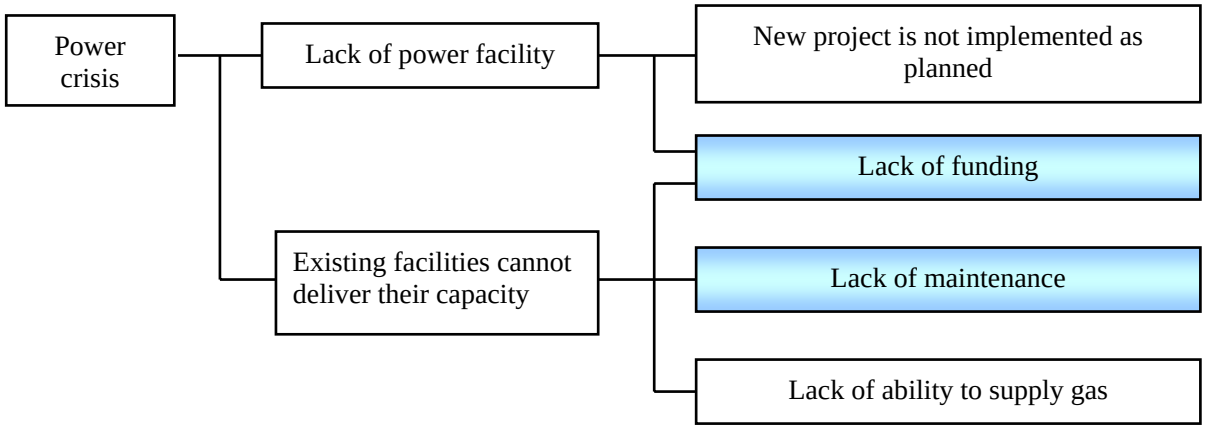
*Prepared by the Investigation Team based on the data obtained from BPDB website

Figure II-2-2 Frequency distribution of days when load shedding was conducted in 2007

(2) Factor Analysis of Power Crisis

As a member of the Power Sector in Bangladesh, NWPGCL is required to play a role in overcoming this ongoing power crisis.

In consideration of the perspectives stated above, factors related to the current power crisis have been analyzed as follows:



Of the factors listed above, such factors as “lack of funding” and “lack of maintenance”, which can presumably be improved within NWPGCL, are further analyzed as follows:

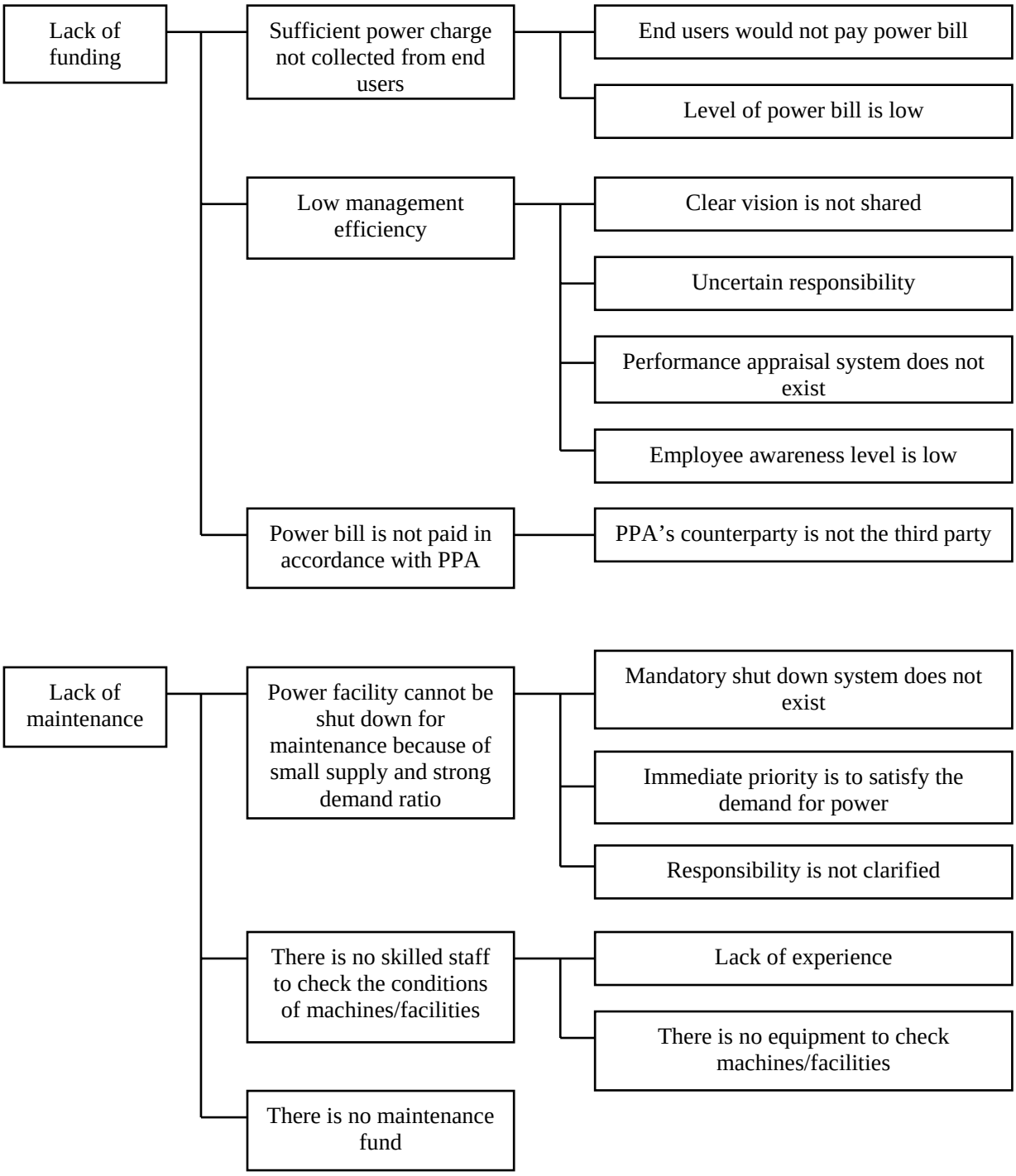


Figure II-2-3 Factor analysis of power crisis

Based on the result of factor analysis, an NWPGCL corporate plan will be proposed to minimize the effect of these constraints.

2.4 Vision Statements for NWPGCL

The corporate structure requirements for NWPGCL are first and foremost to develop a Vision Statement for NWPGCL. Vision statements for NWPGCL as a power utility company which have been formulated based on discussion with a key stakeholders of NWPGCL are described as below:
NWPGCL holds up the three pillars of "independence of management", " Highly reliable power supply", and " Sustainable development" as corporate visions, and NWPGCL aims at realizing these pillars with sufficient balance. The relation of the three pillars of corporate vision is shown in the figure below.

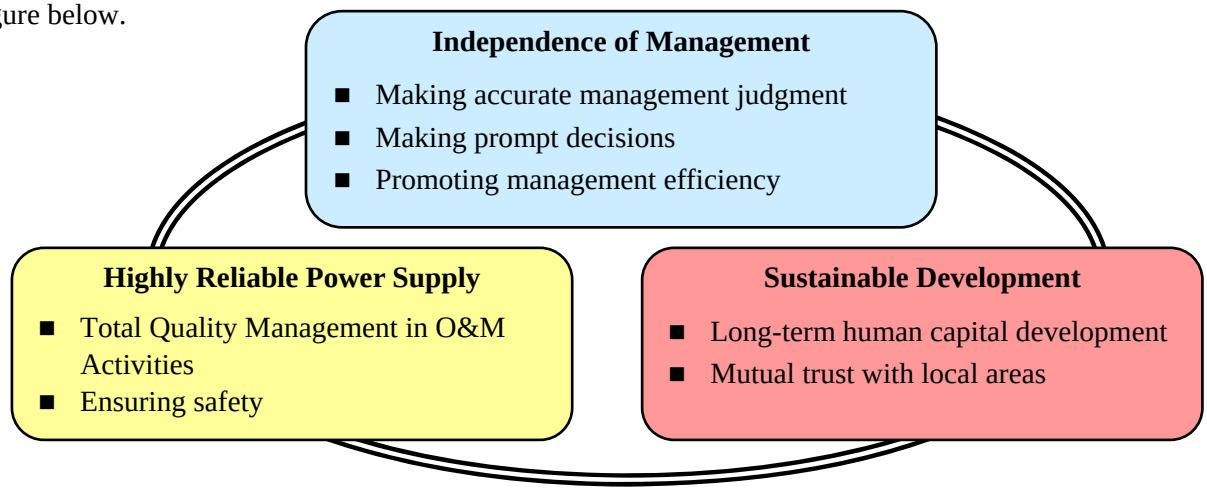


Figure II-2-4 Three pillars of corporate vision

(a) Independence of Management

In order to realize independence of management, the management needs to make accurate management evaluation, and make a prompt decision. In order to do this, employing excellent personnel having a progressive spirit as a secretary to the top managements is important. Also, establishing a management information system (MIS) which extracts important operation and management data at any time for their management decisions, is essential.
Furthermore, the necessary investment should be done at the appropriate time. For this, it is necessary to realize a financial structure that makes it possible to secure revenue and expense balance at an early stage.

(b) Highly reliable power supply

The reliability of power supply in Bangladesh is by no means high. A big reason is due to lack of the absolute number of generation facilities. Another reason is the low awareness of the personnel who belong to the power sector. At NWPGCL, each worker must be very aware and conscious of delivering highly reliable power. In addition, all the workers shall put Total Quality Management (TQM) to practical use in order to establish O&M management system based on fact control. This means the technical judgment shall be determined by actual data. Furthermore, considering equipment and human safety, establishment of a safety management system is a key issue to prevent accidents.

(c) Sustainable development

It is very important for sustainable development and from a long-term viewpoint, that maintenance experts shall be raised in the company, and these personnel shall handle small-scale maintenance work by themselves. Moreover, if NWPGCL takes into consideration owning the power stations located in the western region of the country where economic development is behind, it is necessary to think about contributing to promotion of regional economic development. Therefore, NWPGCL needs to aim at promotion of local employment and at building good relations with neighbors and the local area.

Chapter 3. Corporate Governance

3.1 Establishment of Fundamental Framework in Corporate Governance System

Based on the as-is findings by corporatisation review and the study of the various recommendations of the Consultant in various Corporatisation Reports and soliciting feedback from the NWPGCL management team and key BPDB counterparts, we have firmed up our recommendations for the Corporate Model for NWPGCL.

3.1.1 Principle of Segregating Execution and Supervisory Functions of Management

Separating the execution and supervisory functions of management creates independent management, and promoting decision-making and accelerating operating activities become increasingly important. Usually, a board of directors consists of directors and non-executing directors. A non-executing director is a director who does not take charge of execution of day-to-day operations. Their main responsibility is to supervise the director's activities. The director is the only person who belongs to the board of directors, and has full responsibilities for the management activities of the company on a daily basis, giving instructions to employees. The corporate officers are not a member of the board of directors, but give appropriate instruction to employees as a head of each department, having responsibility for each operating activities under the director.

Moreover, the execution function of management and the ownership function of the company shall be clearly separated. At the early stage of corporatization, when the company is still small in scale, an owner of the company is a director of the management of the company, so the owner function of the company and execution function of management is done together. However, for seeking sustainable development of the company, which is one of the corporate visions, the owner of the company shall delegate all the administrative powers to an administrative professional. This is because the administrator is expected to have great knowledge and experiences.

(1) Activation of internal control system
Introduction and reinforcement of internal control system is essential for the company. Management transparency shall be improved. Appropriate and accurate information for the person concerned, such as a stockholder, an employee, and consumers, shall be provided. Moreover, it is necessary to grasp an employee's activity, and to perform operations efficiently, prevent loss, prevent injustice or illegal acts, and accurately produce financial statement.

(2) Audit function from outside the company (a role of an external director's monitoring function)
An external director will have two functions; a role of an expert who provides the board of directors with accurate and appropriate advice for the company, and a role of an audit function to monitor director's activities. In particular, it is important to have an incentive system so that external directors can monitor management activity properly based on information provided by internal board members.

(3) Clarification of the role of board of directors, and strict observance of rules
The board of directors is an organization made up of individual board members of which installation is imposed by the Bangladesh company law. The board of directors represents the company and makes important decisions for the company. In particular, the point to notice is that the board's function is to discuss and make decisions regarding a large scale of management issues from a macro point of view. This includes selection of the board members and changes in capital and debt. The CEO or MD shall handle the operating management issues, not the board members. This is in line with the principle of the separation of corporate possession and management

execution function so the board shall not take part in the decision-making process regarding operation management issues.
The resolution of fundamental board of directors is explained below.

- To select board members including the position of chairman
- To change capital, debt (capitalization of reserve, debenture issue, etc.)
- To determine an important investment plan (the injection of capital, and participation, requires a large amount of money)
- To transfer and dispose of important property, assets
- To establish a new company, etc.

(4) Establishment of the decision-making section regarding important operational management matters (operating-management committee)

When CEO or MD performs operating management, all the necessary judgments shall be discussed and made at the operating-management committee whose head is the CEO. This committee shall be held once a week, and members of the committee are composed of CEO, CFO, COO, CHCO, and two corporate secretaries, totaling 6 executive staff. Although the resolution of the committee is shown below, the CEO will make a final decision based on the discussion on the committee.

- To make management policy and operation plans
- To determine individual operating matters
- To determine the matter about comprehensive grasp of management
- To determine the important reporting matters

(5) Introduction of fixed term of employment system for the board members

In order to clarify a director's responsibility for management, the term of office, or fixed term of employment should be introduced. Fixed term of one year is appropriate, and the reward and penalty system in line with objectivity of remuneration, and transparency, shall be introduced by reflecting performance basis.

3.1.2 Reorganization to Clarify Management Responsibilities

In order to successfully implement corporatization, a large portion of authority of power from the headquarters to the power station shall be delegated, and when the managerial resources are categorized into three components: human, operational and financial, the organizational structure as indicated in Figure II-3.1 shall be established in order to clarify managerial responsibilities for each activity of human, operational and financial issues. Therefore, the creation and utilization of chief officer positions, such as of CEO, CFO, COO, CHCO is recommended, so that each chief shall take its responsibility for their each management activity with clear definitions.

(1) Capacity Building for Human Capital Management

Human capital is one of the most important management sources among the three components (human, structural (facilities), and financial). The key issue is for the personnel manager to have full responsibility for developing and maximizing the personnel capability. However, under the current BPDB power station, the position of Personnel Manager is a relatively low position, below that of the technical and finance directors. Therefore, capacity building for human capital management is recommended via the creation of the Chief Human Capital Officer (CHCO) position as a core leader, by introducing a human capital management system (Performance evaluation system, and Human capital development).

(2) Capacity Building for Financial Management

Due to the transition to the corporatization, the power station shall transform to Profit Center to produce profits. When the power stations become Strategic Business Unit (SBU), the plant shall implement not only cost and earning management, but also capital control, since the plant will need to evaluate financial feasibility of investment activity, including rehabilitation and repairs,

independently. Therefore, in order to cope with these environmental changes, capacity building for financial management is recommended via the creation of the Chief Financial Officer (CFO) position as a core leader.

(3) Capacity Building for Information Management

The individual division manages information and data regarding the human, structural (facilities), and financial resources, so that no specific division comprehensively manages such dispersed data in a cross-sectoral manner. In addition, since only a few personal computers exist at the plant, most of the data is managed via paper-based documentation. Therefore, such dispersed data is not well utilized for management activities. The company secretary should have full responsibility to strengthen information management capability. In order to clarify responsibility for Information Management, the position of Chief Information Officer (CIO) should also be created. Therefore, the company secretary will have the ability to gather, analyze, and compile managerial information and data regarding human, structural (facilities), and financial resources in a comprehensive manner via a database. The company secretary should also be responsible for providing such information promptly and adequately to not only the directors, but to other departments upon request.

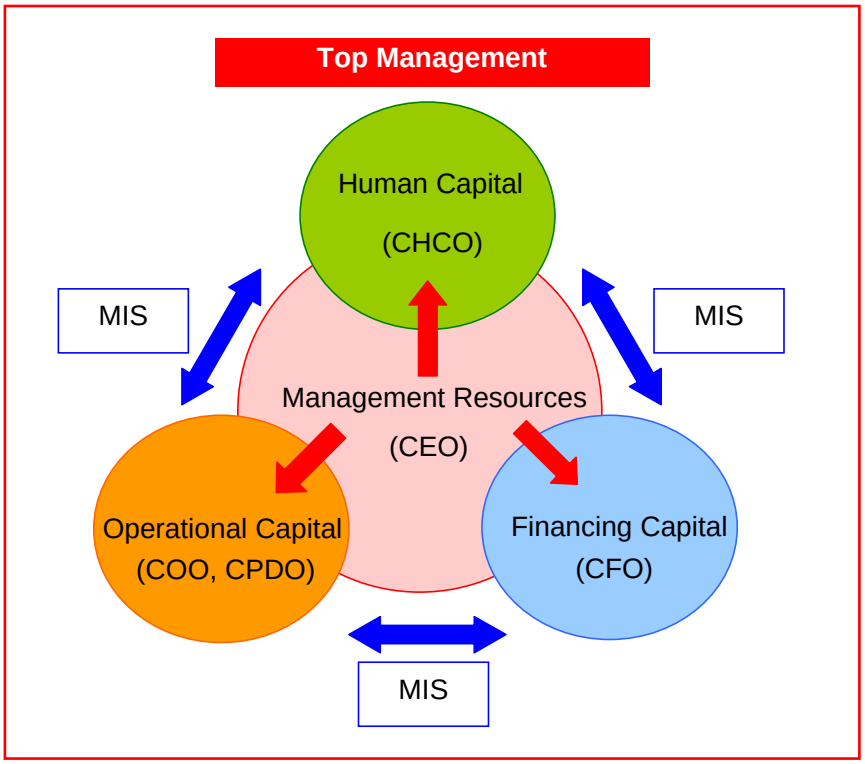


Figure II-3-1 Management Resources

3.1.3 Reinforcement of Audit Function

It is important to understand well the functions of the supervisory function centering on the chairman, and the management execution function centering on the managing director, and to implement the separation of these functions into practice.

Moreover, for reinforcement of the supervisory function of the company, there is the board selection committee, which appoints the board members, and the benefit committee, which discusses remuneration, and the audit committee which judges achievements of operating activities from a neutral position. In addition, each committee shall be made of three or more persons, and more than half the members shall be from the external directors and experienced or academic experts in order to secure management transparency.

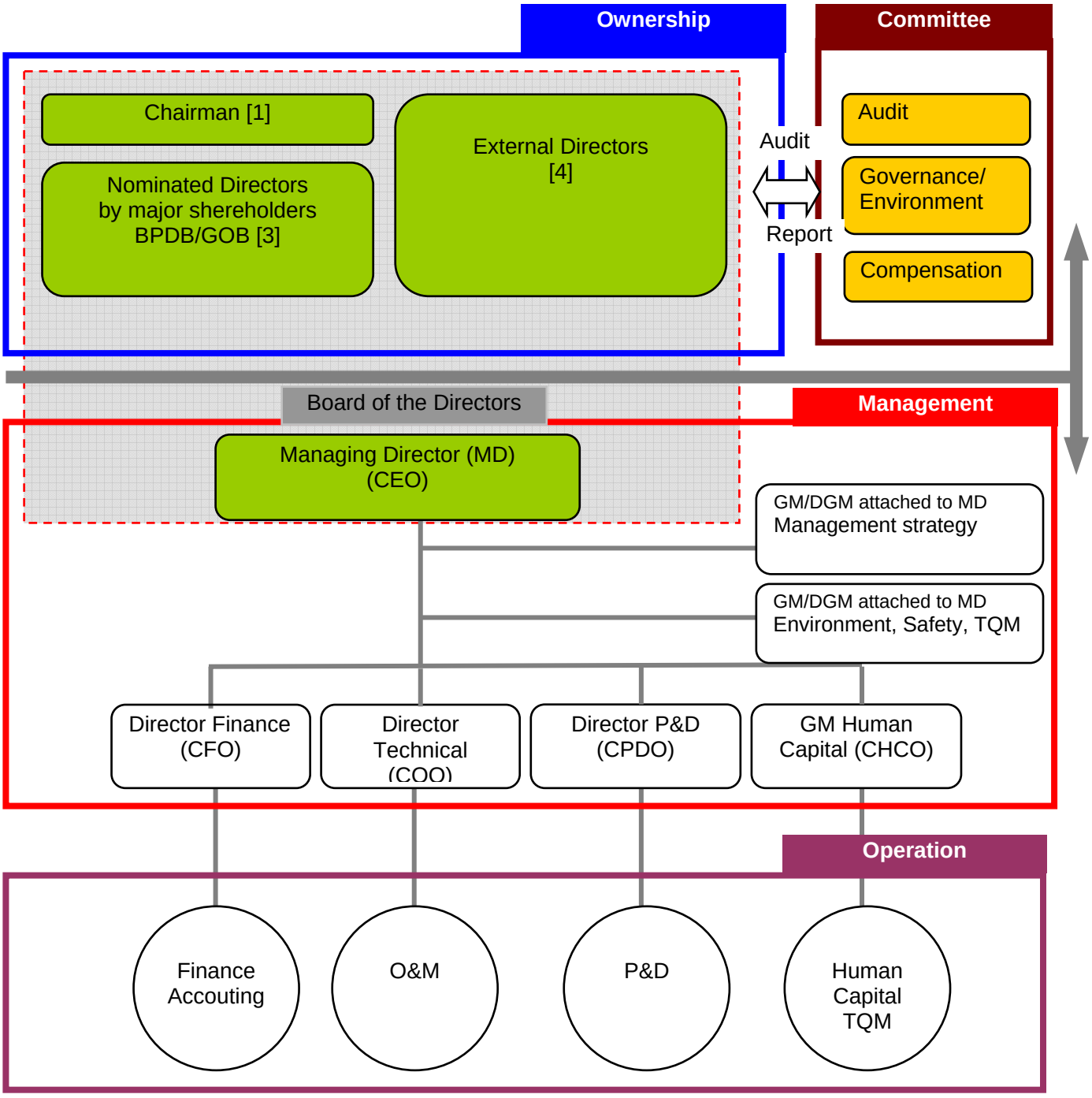


Figure II-3-2 Recommendation of corporate governance system based on the Principle of Separating the Execution and Supervisory Functions of Management

Chapter 4. Human Capital Management

4.1 Directivity of Human Capital Management

4.1.1 Direction in Human Capital Management which should be Aimed for by NWPGCL

We believe that the direction of human resource management aimed for by NWPGCL should not place an emphasis on rather "quick-in-running-away business" like IPP which focuses on pursuit of efficient management and light-weight business operation with as little as possible asset; we believe that it should keep an eye on growth potential of human resource in order to secure independent business operation and to perform management as an organization having high management power and technology, which is based on local community. Therefore, we believe that the human resource management of NWPGCL should be based on the position that, under the concept of human capital management, it must clarify the role and responsibility of each individual, evaluate the working performance through transparent and fair process, pay compensation properly according to the evaluation, see the human resource as an asset, invest to and maximize the asset and thus maximize the organization.

4.1.2 The Job Description concerning the Career Development Program of the Head Office and Power Station

A career development program consists of four systems shown in the following figure. These 4 systems, such as what kind of talented person being secured, they being arranged to the right man in the right place, and what kind of standard evaluating capability and achievements, and proper remuneration based on the evaluation results, collaborate each other and enable to achieve and realize management visions. Among these, as a head office function, from the viewpoint of a broad view, a personnel training plan and an employment plan are to be established, and arrangement of the personnel, performance evaluation, determination of remuneration, and implementation of training are performed as a power station function. All the data regarding human capital shall be kept and managed by the head office.

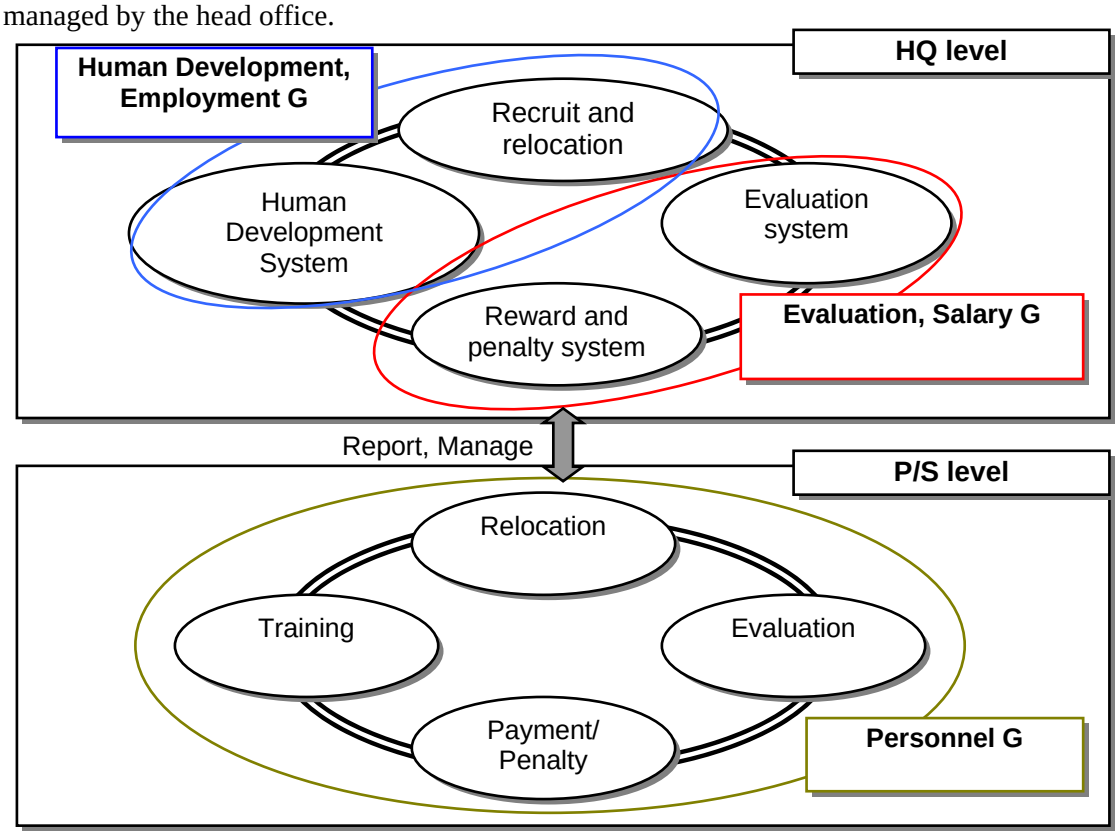


Figure II-4-1 Functions between HQ and P/S for HCM

4.2 Organizational Management System

4.2.1 General Concept of Organization Structure

Organization restructuring is a management tool to align the organization with the changing organization goals and strategy. Organization design involves activities that are undertaken to put in place an organization to achieve the Strategic Objectives identified in its Business Plan effectively and efficiently. Organization design is much more than structures alone, it also includes encompassing the roles and accountabilities of organization units and their people, the measurement of organization performance, the definition of how workgroups will operate together and the mechanisms required to support their effectiveness.

4.2.2 Corporate Level Structure

As for the head office function, the management capitals are divided into three parts, [Human], [Operation] and [Finance], and the basic policy of it is to construct the incentive mechanism and the business management system so that each resource can be maximized.

In the following table, the organization of head office function and the number of required staff are examined. In Phase 0, a small number of member system which consists only of top management and key management personnel of O&M will be organized. During the construction in Phase 1, the number of staff will be increased gradually and, in Phase 2 in which Bheramara P/S starts the operation, 40-member system will be organized.

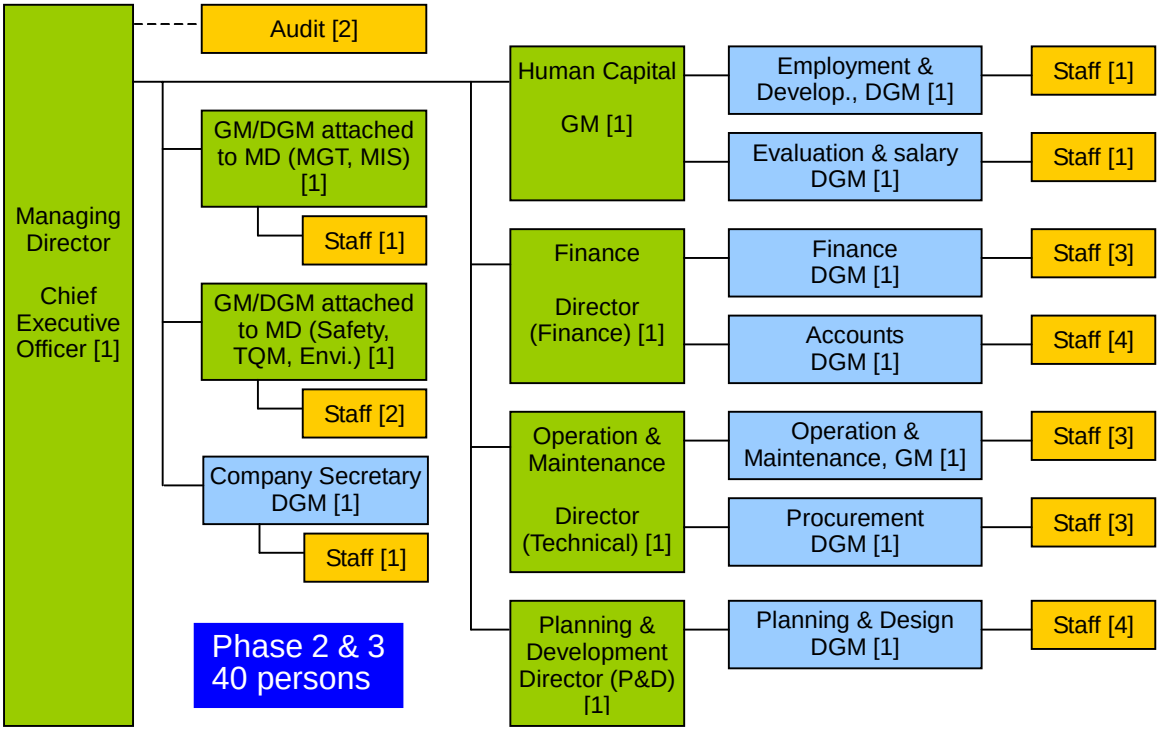


Figure II-4-2 Organogram for NWPGCL Headquarters

4.2.3 Plant-level Structure

The organizational framework at P/S management level should consist of vertical organization including personnel affairs, finance and accounting, operation and maintenance on one hand, and the lateral organization on the other, which coordinates the information provided by these groups laterally. As a line post to support the P/S manager, it is proposed to assign a P/S secretary in charge of management strategy and information management, and a P/S secretary in charge of environment, safety, and total quality management. As shown in the Figure below, 94-member system at the power station in Phase 2&3 is proposed.

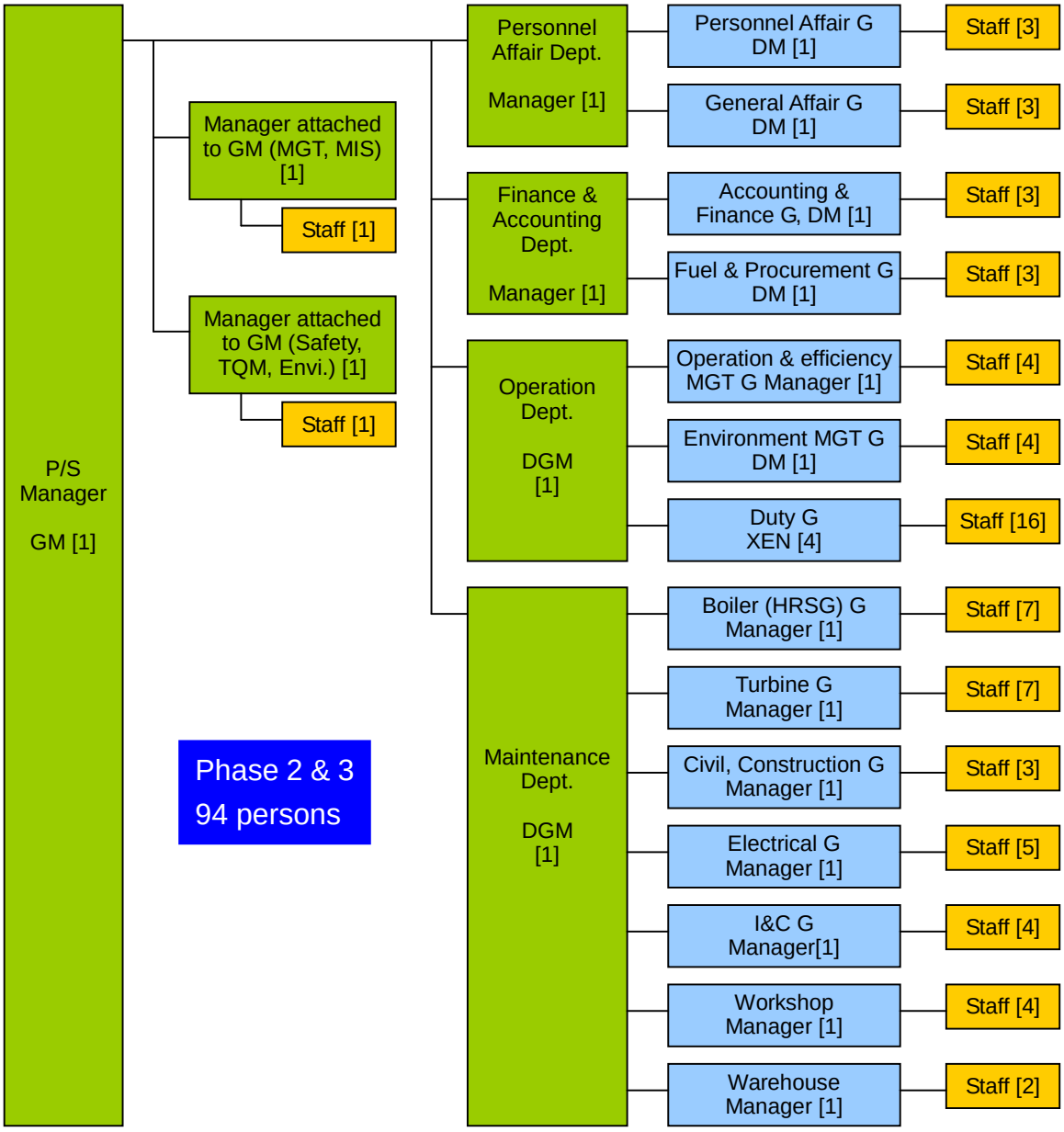


Figure II-4-3 Organogram for Bheramara Power Station

4.3 Recruitment and Relocation Management

4.3.1 Qualification requirements

Since new Bheramara power station is the newly constructed plant, all the plant workers are to be employed as a new employment policy in principle. Therefore, a preferential treatment, special to the existing Bheramara power station worker is not given, but provides all the applicants with the chance of equal adoption including other existing BPDB plant and IPP plant workers. The applicant should be hired newly through fairness and the high selection process of transparency.

4.3.2 Employment policy

An employment type has two, "recruiting on potentiality recruitment" which raises a new graduate from a long-term viewpoint over many years, and is raised to future core and management leader, and another is "work-ready capability recruitment " which employs a person who can step in and be effective immediately by mid-career recruitment. Since this new Bheramara power station is a newly established work place, most of management class employment will be done based on "work-ready capability recruitment. For general worker level, a combination of both recruitment systems shall be taken place in term of long-term human capital development, through On the job training, or OJT.

4.3.3 Employment system

In employment system, a trial employment period for one year shall be made for the first time, and the employment agreement for three years as a full-time employee shall be concluded when a trial employment of one year has successfully been completed. After 3 years, the employment contract will be renewed depending on performance evaluation results.

Under the existing BPDB employment policy, lifetime employment is fundamentally guaranteed. If some existing BPDB power stations are determined to transfer into NWPGCL, it is likely that many workers advocates lifetime employment as well as the BPDB employment policy.

However, in order to provide employees with working place by the company, the company has to have existed and grown continuously, and from the viewpoint of independence of management, and sustainable development as indicated in the management visions, implementation of an efficient management in human capital management is an inevitable way. Therefore, from a viewpoint of an employee's mindset for their working environment, a performance based employment contract for 3 years shall be introduced, and only person who work for the company shall be taken for not only company’s sustainable development, but also employee’s sustainable development.

4.3.4 Strengthen partnership between the Labor and Personnel Division and the Business and Affairs Division

It is essential to establish partnership with the business and affairs division (on site side) in order to place the right person in the right job or to use job rotation as part of human capital development. This is because the content of job to which a person to be appointed and the ability of the person must be evaluated. To make the recruitment and personnel distribution system function, it is absolutely necessary for the labor and personnel division to draw up a long-term human capital development plan from the macro perspective, for every division to design a short-term career path for the person concerned from the micro perspective, and for the administrative division and the implementation division to share information and work together. For that purpose, NWPGCL needs to develop information infrastructures to enable sharing of personnel data and to establish a structure to implement personnel distribution and human capital development from both the long-term and short-term perspectives through partnership and collaboration.

4.3.5 Realize the personnel distribution system that makes people grow (job rotation)

To place the right person in the right job, the person is required to develop the ability to do that job. This means that it is necessary to develop a person to secure human resources required for the job. People develop their ability through their jobs. Not only on-the-job training but also being placed in the job with more responsibilities help them increase their awareness and bring about their potential. Therefore, NWPGCL should introduce a concept to develop human resources through job rotation in order to evaluate both the ability of human resources that is constantly changing and their current and future potential.

4.3.6 Formulate a career path plan (Clarify a career path for all staff)

NWPGCL should draw up a career path for all staff from the perspective of long-term human capital development and use the personnel distribution system as a way to help them achieve their respective career path. All staff at P/S should consult their immediate superiors to decide on their career path. When consulting a superior, staff must discuss their career including what they should be doing one year, three years, five years and ten years later and their targets. An immediate superior prepares a report on his subordinate's career path and submit it to Assistant General Manager of the Labor and Personnel Division at P/S. Assistant General Manager and General Manager at P/S prepare a report on career path of all staff at P/S and submit it to Chief Human Capital Officer (CHCO) at the head office in the form of "P/S career path plan". The head office conducts a "career path conference", in which CHCO acts as Chairperson and Assistant General Manager of Human Capital Development and Employment Plan Group, Assistant General Manager of Evaluation and Compensation Group, General Manager of Labor and Personnel Division at P/S act as members of the conference, to establish a career path for all staff. The career path conference formulates an action plan to help staff achieve the career path and use on-the-job training, individual training and job rotation as appropriate. The conference should be held once a year and information should be updated annually. The degree of achievement should be monitored and all staff should be given feedback.

4.4 Performance evaluation system

4.4.1 Performance evaluation system in line with the Corporate visions

The following are the key highlights of Performance evaluation system in line with the Corporate visions

- First and foremost, based on the Vision of NWPGCL, company strategies should be formulated.
- Based on the strategies, organization level KPIs should be formulated.
- Identification of Critical Success Factors & the goals of the organization – which would be the target for the MD & Directors
- Define the business plan to achieve those goals
- Identifying measurable Key Result Areas and the corresponding measures / Performance Indicators for each department which would lead to achievement of those goals through the steps in the business plan (Functional KPIs)
- Define the departmental targets for those measures
- Define individual (Individual KPIs) measures & targets from the departmental targets using the Job Descriptions
- Mid term evaluation of performance against the targets and corrections for the later term
- Evaluation of annual performance
- Final performance appraisal in joint concurrence of appraiser and appraisees
- Feedback for development & improvement for the next year

4.4.2 Clarification of office regulation

It will become necessary to clarify job content and roles of individual employees and responsibilities that come along with their jobs by preparing rules and regulations on authority and job description. NWPGCL must introduce a mechanism to appropriately and multilaterally evaluate employee performance as to how well the employee fulfilled their responsibilities and to pay appropriate compensation.

4.4.3 Performance evaluation under the principle of a PDCA Cycle

Whereas evaluation is implemented on a monthly basis, the Performance Evaluation System shall function as a check against the Plan based on the Plan-Do-Check-Action (PDCA) Cycle by right. Therefore, implementing performance evaluation two times per annum at a maximum is recommended based on the PDCA Cycle.

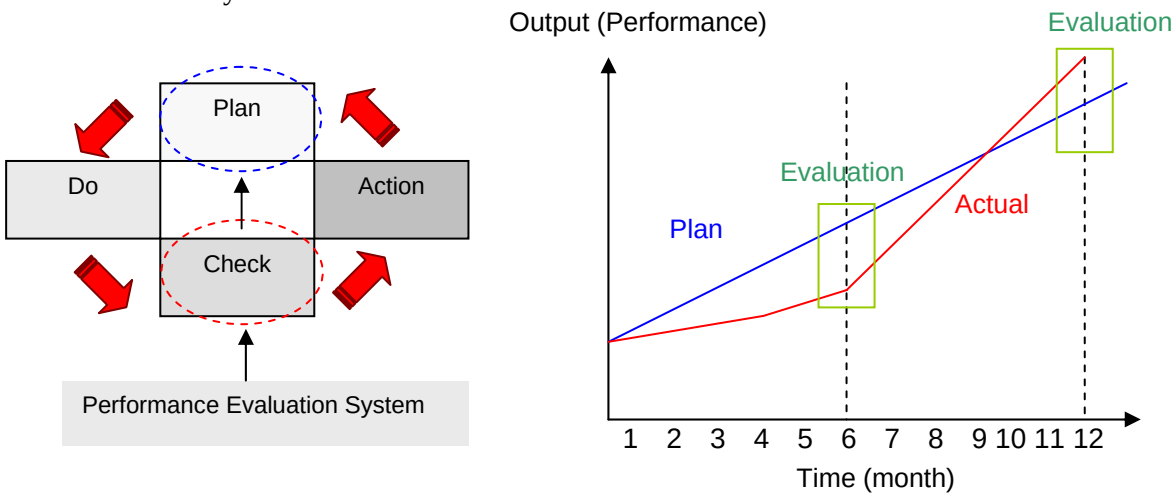


Figure II-4-4 Performance Evaluation based on the PDCA Cycle

4.4.4 Performance evaluation as a function of human capital management

Human Capital Management (HCM) consists of three components: Performance Evaluation System (PES), Human Capital Development (HCD), and Delegation of Authority. Human Capital Management is worked out only when such three components are interconnected. Therefore, the performance evaluation system shall play a key role as one function in Human Capital Management.
However, at the BPDB plants, the performance evaluation system for individuals has not been carried out. Therefore, under this system, the three components (PES, HCD, and Delegation of Authority) are not related to each other as part of Human Capital Management.
As a result, it is necessary to restructure the performance evaluation system such that it reflects on human capital development as feedback.

4.4.5 Introduction of personal achievement evaluation system based on self-certification, multilateral evaluation and Management by Objective (MBO)

BPDP P/S has the division evaluation system. It has not established a system to evaluate personal achievement. Fair and appropriate evaluation of personal achievement creates incentives for employees to work hard, thereby improving business performance of P/S. In the meantime, evaluation of business performance will make it easier to formulate a human resource development plan. Therefore, personal achievement evaluation plays the most important role in the human resource management cycle (business performance, evaluation, reward and penalty, and human resource development). When introducing personal achievement evaluation, it is important to use not only

objective evaluation but also subjective evaluation to determine how the employee evaluates himself and identify the gap between objective assessment and subjective assessment as the figure below shows.

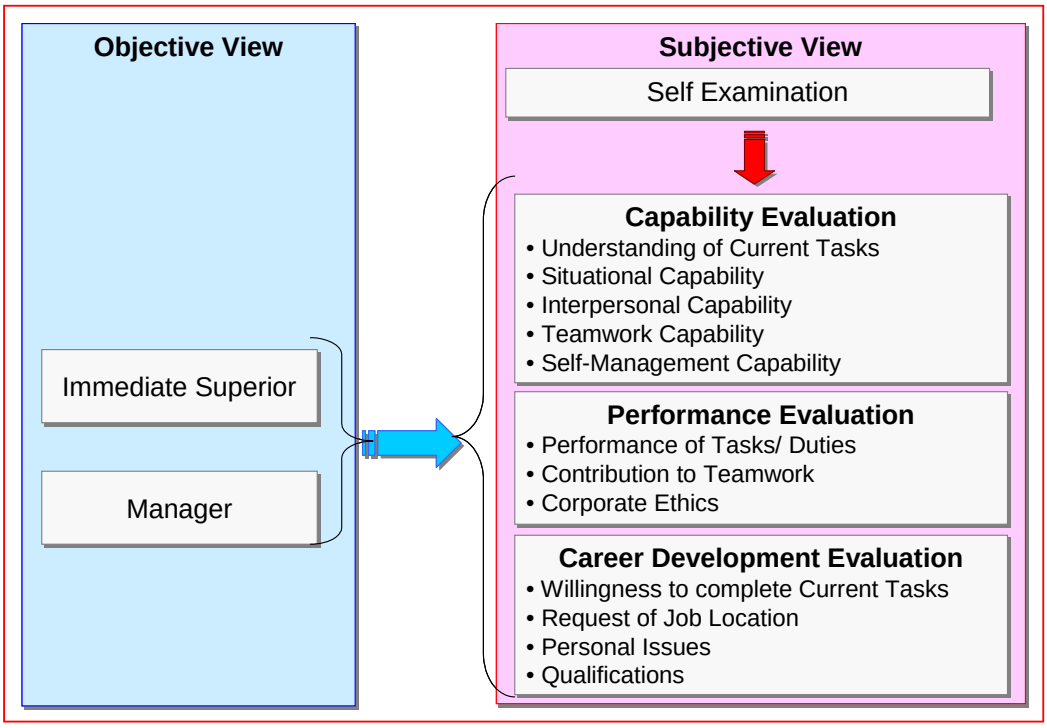


Figure II-4-5 Performance Evaluation System

4.5 Compensation and Incentive System

4.5.1 Introduction of compensation system linked to personal performance

Responsibilities must be proportional to compensation and that the ratio of base pay and that of pay linked to the individual's performance should change depending on the individual's position. For general staff and management (middle), the ratio of base pay should be about 80% and the ratio of pay linked to the individual's performance should be about 20%. For management (upper), the ratio should be 60% for fixed, and 40% for performance baisi. Fixed portion of pay consists of base pay, merit pay, seniority wage and other pays.

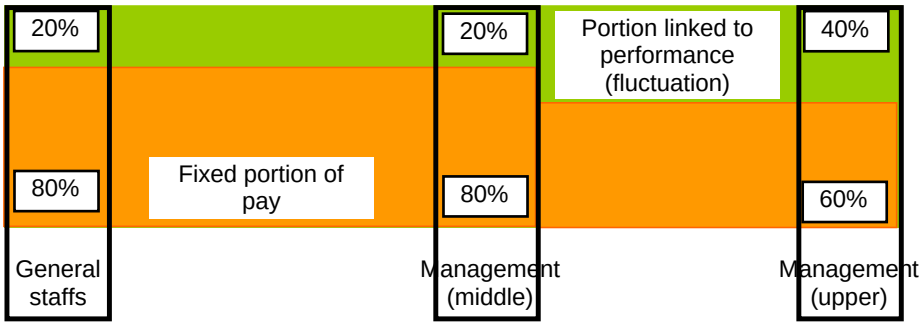


Figure II-4-6 Compensation system linked to personal performance

4.5.2 Examination of Adequacy of Pay Standard

The table below shows pays standards for several companies. As for those converted to a joint stock corporation, the pay standard for employees in the chief engineer class is about 2.4 times more the pay standard at BPDB. As described in Chapter 6, the number of personnel required at Bheramara P/S is estimated at about half of that at BPDB P/S. In view of the high level of performance required and heavy responsibilities, sufficient incentives should be provided. The pay standard at Bheramara P/S therefore should be about three times more the existing pay standard at BPDB P/S. In this regard, however, and as described above, more responsibilities mean that a larger portion of pay is linked to performance. Thus, more responsibilities do not necessarily guarantee high pay.

4.5.3 Retirement Benefit Plan

BPDB adopts three benefit plans, including Pension Plan, Contributory Provident Fund, and Gratuity Fund. The structure of each plan is described below.

(1) Pension Plan

The type of pension plan which BPDB adopts is a defined benefit plan. BPDB employees are obliged to participate in the plan and make certain payments of pension premium every month to the Pension Fund or the Government continuously during their period of employment. The amount of premium is calculated based on the salary of each employee (the rate of pension payment is determined by the Pension Fund by actuarial method). In the same manner, the employer makes contributions of certain amount calculated on the basis of employee's salary (by not necessarily the same rate as that of individual pension rate).

(2) Contributory Provident Fund

The contributory provident fund is a lump-sum payment system. Usually, employee participation is on a voluntary basis. In case the employees participate in the system, they declare and pay the amount of contribution within a limited amount to be deducted from their salary by the employer. Whereas the employer makes certain contribution based on the amount employees pay and in line with a certain standard (in case of BPDB, the amount of contribution to be made by the employer is the same as the amount employees pay) and deposit the contributions in the trust account specified by the Fund. At the time of retirement, employees will receive the total of their own contribution, company contribution and any profits earned from fund management.

(3) Gratuity Fund

The gratuity fund is a lump-sum payment system. The employees join the system automatically at the time of employment. They are not required to make any contributions.

When the employees who satisfied the set period of service retire, they will be granted the gratuity fund equivalent of certain months' last salary, the amount of which is determined according to their years of service.

The pension plan is a defined benefit plan, while the rest of the two plans is a lump-sum payment system. With respect to a defined benefit plan, it is essential to carry out actuarial valuation based on the forecast of pension payout in the future and calculate required sum of contribution in order to balance out the difference between the contributions made so far and the required amount. However, BPDB does not adopt actuarial valuation nor does it forecast the total amount of contribution in the future. Therefore, in the process of aging society, BPDB may encounter payment burden on an unexpected scale.

In the preparation of basic accounting policies, it is critical to take into consideration the following principles and develop policies in line with them.

Retirement Benefit Plans are structured usually either by defined benefit scheme or defined contribution plan. In case of adopting a defined contribution plan, a financial statement should report the amount of net assets deposited for the benefit plan and related contribution policies in order to satisfy the reporting requirements.
The "International Accounting Standards" and "Bangladesh Accounting Standard," which Bangladesh adopts stipulate that a financial statement should comply with either one of the following principles, in case a defined benefit plan is adopted.

- The amount of net assets deposited for the benefit plan, present value of total benefit and excess or shortage of deposits resulted from the difference between the deposited amount and paid-out amount should be reported on the statement of account.
- The amount of net assets deposited for the benefit plans should be reported on the statement of account. The present value of benefit obtained by actuarial valuation and committed to employees should also be reported on the statement of account or an explanatory text on the actuarial valuation report should be inserted.

The present value of committed pension benefit through actuarial valuation is calculated in consideration of the employment period up to the end of current period and based on the current level of salary or projected level of salary at the time of concerned employee's retirement. The amount of contribution to retirement benefit funds will be reported in market value. In case the retirement benefit obligation reported on the balance sheet does not present the current value of projected pension payments, the company should disclose that it does not satisfy the accounting standards. Actuarial valuation of retirement benefits is an essential step in principle.
It is important for the management to acknowledge that retirement pension is a contingent liability which may become a management risk, and to take appropriate measures to manage pension plans. APSCL, a preceding model case, manages gratuity funds and provident funds but does not adopt a defined benefit plan. Similarly, IPP adopts only two lump-sum payment plans and postponed the introduction of defined benefit plan. Also the trend in developed countries is for the companies to terminate and shift from defined benefits to defined contribution. It is advisable that corporate management should strive for ways to avoid uncontrollable risks as much as possible.

4.5.4 Transition of benefit to incentive system

As the figure below shows, compensation consists of fixed pay, pay and bonus that are linked to performance, and benefits.
Like other companies that are already providing benefits excluding pension and retirement allowance which has been discussed in the previous clause, company housing, financial aid to cover medical cost and electricity should be offered to follow the cultural habit of Bangladesh and to provide the same level of benefits as other companies to employees. However, an employment contract does not guarantee lifetime employment and the period of employment is, in principle, five years. In addition, some portion of the base pay is proposed to be a performance basis. For this reason, introducing a mechanism to reduce benefits and place increased focus on incentives is considered an option.

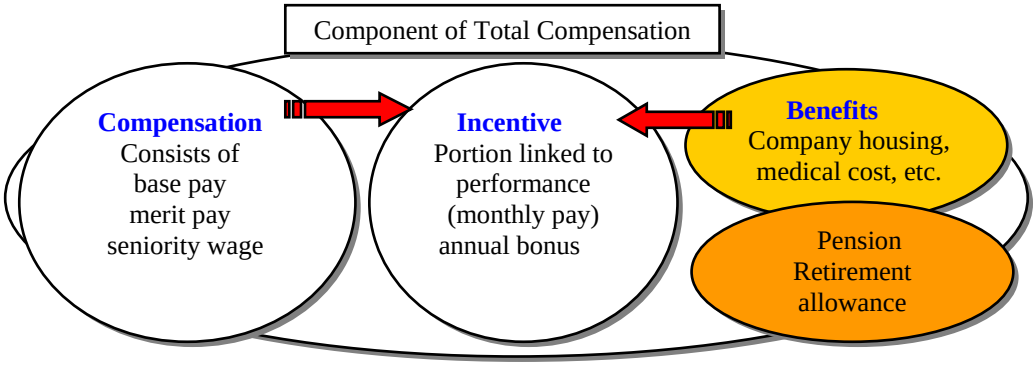


Figure II-4-7 Component of Total Compensation

4.6 Career Development

4.6.1 Long-Term Human Development Planning/ Human Capital Portfolio

Under the current status of BPDB power stations, a majority of Human Capitals is likely to belong to Category 4, implementing routine work accurately and efficiently within the existing framework. Therefore, the power station focuses on developing operation and maintenance personnel.
When the plant becomes under NWPGCL, and delegation of authority is enhanced, not only a degree of freedom in management is enhanced, but also responsibility and self-autonomy in management will be required. At the same time, the business management plan should be prepared based on thoughts regarding management. Hence, adapting such changes to the business environment will diversify Human capital not only from a technical aspect, but from the aspect of management capability as well.

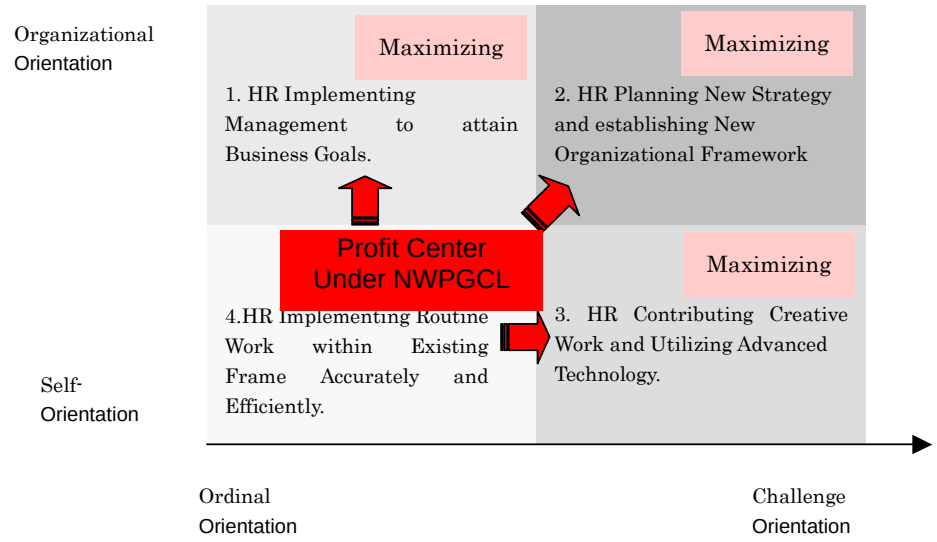


Figure II-4-8 Human Capital Portfolio

4.7 Acceptance of Existing Power Stations and Simulation of Manpower Planning

4.7.1 Simulation of manpower forecast

(a) Basic case
The simulation of manpower forecast of a basic case is indicated below.

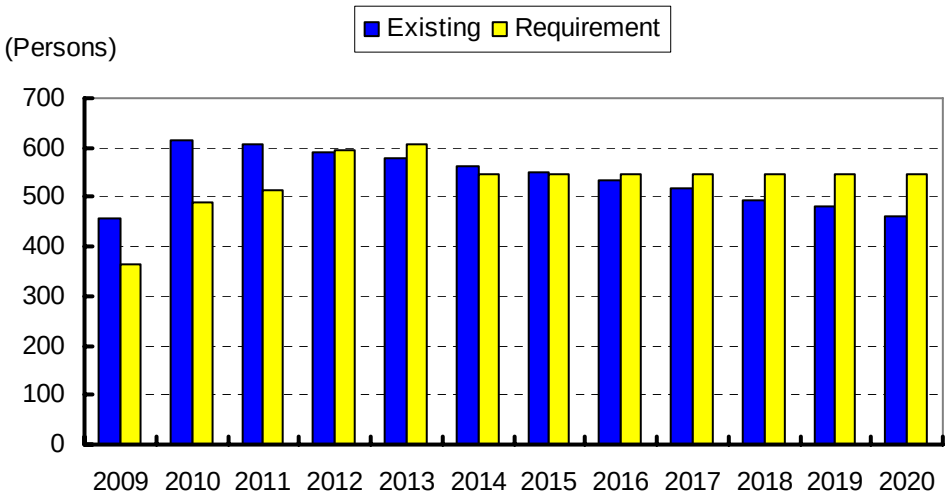


Figure II-4-9 Result of simulation of manpower forecast (base case)

When the Barapukuria and Baghabari power stations are transferred (to NWPGCL) in 2009, the number of manpower working at the existing power stations will be drastically reduced, creating about 100 unfilled positions. In 2012, however, as the new Sirajganj and Khulna power stations start operation, a demand for required manpower will arise and open positions will be filled in just proportion. Yet, this number will be balanced out with natural retirement and in time, manpower demand will increase gradually.

(b) The case in which the existing Khulna power station is also transferred to NWPGCL (2012)

The result of the manpower simulation in the event the existing Khulna power station is also transferred to NWPGCL in 2012 is shown below.

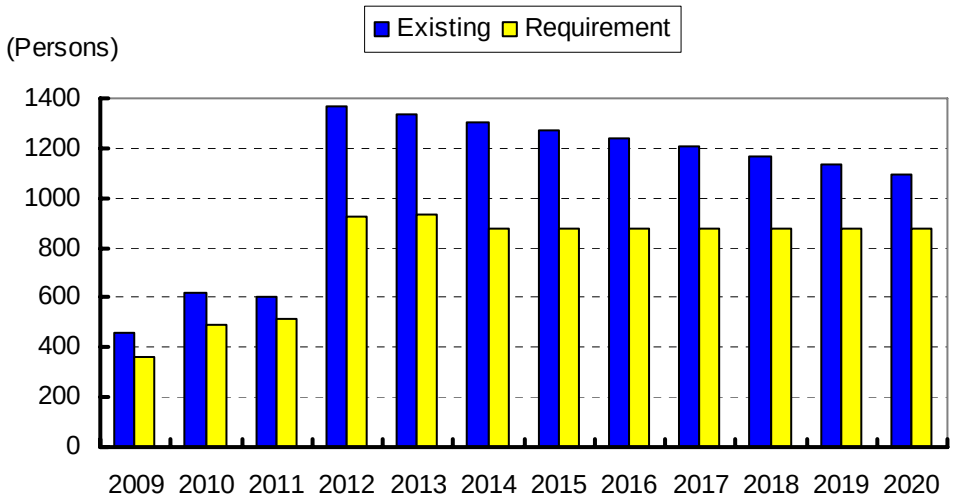


Figure II-4-10 Case in which the existing Khulna power station is also transferred to NWPGCL

There is a big gap between the current and required manpower at the existing Khulna power station. Thus during the period between 2012 and 2016, there is assumed to be a large redundancy with more than 400 excess personnel. Though in the following years, retirement creates natural decline in the workforce, yet large excess will not simply be eliminated.

(2) Recommendation based on the simulation result

Based on the result of manpower simulations, the NWPGCL manpower planning including that for existing facilities to be transferred to NWPGCL is proposed as stated below.

(a) Secure manpower with required skill level

The current simulation assessed simply the excess and shortage of manpower. The result indicates that there will be an excess in total manpower. Practically, however, the required manpower is determined for each area of specialization and/or by level of positions. Therefore, in some cases, there is a potential shortage of manpower in certain areas of specialization or level of positions. To secure the manpower which requires expertise, it is preferable to recruit the talent with required knowledge from a broad range of employment markets, without moving the personnel working at the existing facilities to other locations by changing their job.

(b) Personnel assignment at the existing facilities

Many of the personnel working at the existing facilities are fully familiarized with the characteristics of existing facilities. It is not possible for newly hired workers to operate and maintain the existing facilities transferred to NWPGCL by themselves. Thus it is essential to secure the manpower currently working at these existing facilities to some extent. In addition, no matter if the manpower who knows the characteristics of the existing power stations is gathered, reducing the number of personnel to a required level immediately after the transfer may bring about the possibility of

lowering operational and maintenance skills, unless the performance and skill levels of each person improves. To cope with this problem, it is preferable not to reduce manpower to the required level for the time being but secure a slightly excess level of manpower, and then reduce the number gradually, after the performance and skill levels of each person has improved.

(c) Transfer of existing Khulna power station

As indicated in the simulation, the existing Khulna power station retains many personnel with a large gap between the current and required numbers of staff. Upon the transfer, many challenges concerning the treatment of excess personnel are expected to arise. Because of this, it is recommended not to incorporate the existing Khulna power station into NWPGCL, if it is feasible.

(d) Continuous acquisition of freshman employees (imbalances in age structure)

There is a high possibility of creating large imbalances in age structure, if recruitment relies only on screening from among the adaptable workforce potentials who are currently working at the existing facilities and on open recruitment from employment markets in accordance with the area of specialty and level of positions. To avoid such situations, it is necessary to continue hiring and training new graduates, who cannot be an immediate workforce, but have a large potential ability.

4.7.2 Considerations on the Acceptance of Existing Power Stations

The advantages and disadvantages of the acceptance by NWPGCL of the existing power stations located in northwestern Bangladesh, during the period when the Bheramara power station is being built are summarized below.

(1) Advantages

(a) Existing power stations bring about income while new Bheramara power station is being built

Managing existing power station(s) and obtaining income from selling power establish a financing framework. With corporate efforts, a virtuous cycle will be created to obtain greater profit.

On earning and expense, the management of existing power station(s) is inefficient as there are more personnel than necessary. Under the current system, however, the sum of necessary expenditure and compensation is assured as an income of power sales, it is assumed that NWPGCL can secure profit, if it takes over any existing power stations as they now stand.

(b) Scale of NWPGCL operations become larger at an early stage

By accepting existing power stations, NWPGCL's asset and employee number will increase and its operational scale expands. Larger operational scale streamlines the structure and system of the administration departments at the headquarters.

(c) The actual entity as a corporation shall be established at an early stage

Since production activities can be begun by accepting existing power stations, the actual and visual corporate entity can be established.

(2) Disadvantages

(a) There will be necessity to prepare conditions concurring transfer as NWPGCL at an early stage

1) Preparation of manuals

In concurrence with the transfer of power production facilities, workers are also transferred from BPDB to NWPGCL. Thus original manuals need to be prepared by NWPGCL before transfer.

- Organization structure
- Compensation package
- Employment conditions
- Job descriptions
- Service rules
- Delegation of power

It is possible to use the BPDB manuals for these without change. However, originality as NWPGCL cannot be emphasized in this case, and it is highly likely that the BPDB corporate culture may also be succeeded entirely. On the other hand when original NWPGCL manuals are to be developed, the current BPDB manuals shall be examined sufficiently to make improvements. Originality of NWPGCL may not be delivered if sufficient time cannot be ensured for manual examination and preparation and transfer is implemented too speedily.
Furthermore, the above manuals are the least necessary manuals. It is possible to use the BPDB manuals as other manuals (such as safety manuals) for the time being, but it is necessary to prepare the NWPGCL original manuals eventually.

2) Necessity to settle the employee retirement benefits concurring with transfer

According to BPDB Service Rules, the employees are entitled to retirement benefits at their retirement. All employees who will be transferred to NWPGCL at facility transfer will retire from BPDB and become NWPGCL employees. Therefore, BPDB will require a large amount of cash in one time as retirement benefit at the time of transfer. It is an extremely serious problem for BPDB which has little cash at hand, and it may take a long time before this issue is solved.
If transfer is implemented without solving this issue, retirement benefit liabilities may also be transferred to NWPGCL and cause serious adverse effects on the NWPGCL management environment. It is thus necessary to discuss the methods of settlement regarding retirement benefit for employees with BPDB before transfer and solve this issue.

3) Necessity to start consultation on contract as soon as possible

It is necessary to conclude the following contracts in concurrence with the transfer of power stations:

- Vender's Agreement (BPDB)
- Power Purchase Agreement (BPDB)
- Fuel Supply Agreement (Fuel company)

Regarding Vender's Agreement, it is necessary that all assets to be transferred be assessed. BPDB implements Identification Verification Valuation Recording (IVVR) on all existing power stations. This process is planned to be completed in December 2008, and the asset values for all power stations will be determined at that point. Thus it is expected that conclusion of Vender's Agreement will be concluded smoothly.
Regarding PPA, it is expected that it can be concluded relatively easily if conclusion of Vender's Agreement is completed smoothly and the direction of the contract between APSCL and BPDB is followed. However, the operable output shall be checked properly regarding the dependable capacity specified by PPA before transfer, and measures such as reduction of the asset value need to be taken depending on the values if the operable output is smaller than the facility output.
Furthermore, FSA has already been concluded between the fuel company and BPDB and thus there is no need for special discussion on its details. It will be sufficient only by changing the contracting party from BPDB to NWPGCL.

(b) Building a unique NWPGCL corporate culture becomes difficult

NWPGCL aims at recruiting highly motivated employees publicly and managing self-reliant power stations run by a small group of elite staff.
If it takes over existing power stations at an early stage, many of BPDB personnel working at the existing power stations will join NWPGCL before it builds its own corporate culture. As such, there is a danger of NWPGCL taking over the current BPDB culture as is, which in turn may be rooted in NWPGCL, negatively influencing the process of building NWPGCL's own culture.
As a method to avoid these risks, it is desired that the director of the power station and several top supervisors be employed by public recruitment and that a new employee of NWPGCL shall be placed at the top of the power station to nurture the original corporate culture of NWPGCL.

(c) Securing competent human resources as the new manpower at the Bheramara power station is difficult

The new Bheramara power station is located in northwestern Bangladesh. If the personnel are publicly recruited, it is highly possible that a majority of the applicants might be those already engaged in power industry in north western Bangladesh (i.e., those who are currently working at the existing power stations in north western Bangladesh). If NWPGCL takes over the existing power station(s) before it starts public recruitment for the new Bheramara power station, the personnel who have worked at the existing power station(s) will already be an NWPGCL employee, making them less motivated to apply for the positions at the new Bheramara power station. Thus it becomes difficult to select the best human resources from among the potentially many applicants for the new Bheramara power station.

(3) Proposed treatment of staff at the existing power stations

There may not be a serious problem if only the owner of the power facilities changes at the time of transfer. In the event of personnel cut or lowered level of welfare program, however, a large problem including labor related issues such as accelerated union activities and filing of law suits may develop.
It is not a good idea for NWPGCL to accept the existing power station(s) as is, as it may takeover the makeup of BPDB without modification. Thus NWPGCL will take some action to streamline the old system. It is advisable to make a soft landing on the treatment of staff rather than to implement a drastic change at the time of transfer, while ignoring temporary inconveniences.
The result of manpower simulation shows that in case the existing Khulna power station is not taken over by NWPGCL, simply observed, the number of personnel will be balanced out around 2017. Including this point and above-mentioned background, following recommendations are submitted:

(a) Establish transfer period

There is a high risk with selecting required personnel by a single interview at the time of transfer. It is advisable to set up a transfer period (of about three years), during which a generous number of staff should be secured for the same salary level as that of BPDB. It is recommended to reduce the number of personnel to the level of required staff, after the transfer period and in consideration of the performance of personnel during the transfer period. If the transferred employees are aware that their performance during the transfer period is one of the measures for a continuous employment after the transfer period, their work attitude may change during that period. In addition, they will gain motivation to improve business performance, which is expected to become crucial to improve the ability of all the existing staff.

(b) Ensure freedom of choice

At the time of transfer, all personnel should be given an option whether they will be transferred to NWPGCL or remain as BPDB staff. In this selection, to promote proper selection and avoid the future troubles, all conditions for transferring to NWPGCL (labor conditions, contract years, wage levels, welfare program and so forth) shall be presented. To enable this, compensation package, employment conditions, service rules and so forth need to be prepared before facility transfer.
If it is decided that the personnel are transferred back to BPDB as a BPDB employee, since their former work place is already incorporated into NWPGCL, they cannot be assigned to their former station and are obliged to change their position of duty. However, The power stations are scattered in location, and it may require moving of residence instead of simple work transfer. Considering such situations, it is necessary to discuss the employee working conditions with BPDB in advance so those who choose to stay as BPDB employees can be presented with the selections regarding transfer destinations and so forth.

(4) Proposed personnel transfer process

Based on the conditions stated above, following personnel transfer process is proposed in relation to the treatment of staff working at the existing power stations:

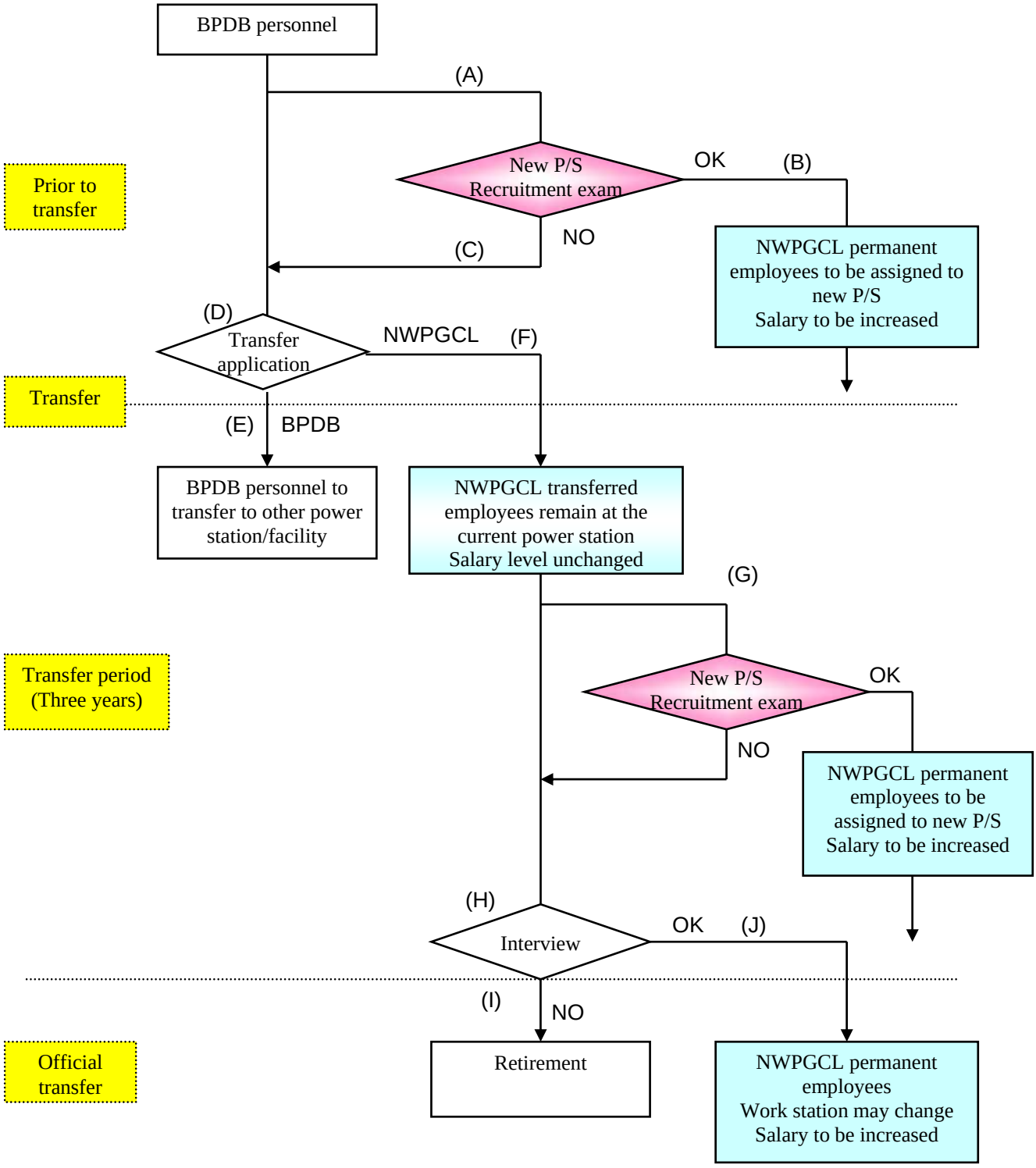


Figure II-4-11 Proposed personnel transfer process at existing power stations

(5) Issues related to proposed transfer process

(a) During the transitional period, there will be double standards for the compensation package

During the transitional period, there will be the gap in the salary between the permanent employees who passed a regular recruitment exam and transitional employees. However, the transitional employees are always given an opportunity to take an exam to be conducted by NWPGCL for the recruitment at the new power stations. Thus in mid-course of transitional period, there is still a change for them to become a permanent employee if they make efforts.

The double standard for the compensation system will be eliminated after the transitional period of three years.

(b) Measures for increased salary at the time of official transfer

The salary level of the transitional employees, who passed recruitment interview at the termination of the transitional period, will increase as they become a permanent employee.

A reformation of awareness is implemented for targeting all personnel adoption, if the reformation is successfully implemented and staff work ethic is sufficiently reformed during the transitional period of three years. Since most of the transitional employees are expected to make efforts during the transitional period, the higher pass rate of recruitment interviews at the termination of transitional period is predicted at over 90%.

The total personnel expense will increase to a large extent, as the salary level rises sharply at this point in time. On the other hand, as the processing ability of employees improves during the transitional period, operational efficiency becomes higher than before the transition, so cost reduction can be expected. The reserves stored as a result of cost reduction will be put aside to respond to an extensive increase of total personnel expense to occur at the termination of transitional period.

(c) Treatment of those who are to leave the company at the time of official transfer

The employees who failed the recruitment exam and were not hired at the time of official transfer must leave the company eventually. The employees who did not demonstrate any potential to improve during the transitional period will not be recruited since the company offers much opportunity to promote awareness reformation for them during transition period. The proportion of such employees is projected at less than 10% of all applicants. Rejection of hiring such employees would not cause a serious problem as the transitional employment agreement stipulates this point clearly when it was concluded between the company and the transitional employees.

Chapter 5. Accounting and Financial Management

5.1 Accounting and Accounting Policies

5.1.1 Recommendation for Accounting System and Processing at NWPGCL

(1) Bangladesh Accounting Standard and International Accounting Standard.
In Bangladesh, Institute of Chartered Accountants of Bangladesh (ICAB) reviews and discusses IAS and IFRS to assess whether the international standards should be adopted for Bangladesh and issues the adopted ones as the Bangladesh Accounting Standards (BAS).

(2) Company Act 1994
NWPGCL is the company established based on the Company Act 1994. The Company Act prescribes that the balance sheet of a company shall be in the forms set out in the attached schedule of the Act or in such other form as may be approved by the government. The financial statements are stipulated to be composed of balance sheet, profit and loss statement, board of directors' report, and audit statement. The financial statements defined by BAS are the five documents being exactly same with what is defined by the Securities Exchange Regulation. However, there exists a difference in defining the financial statements between the Company Act and BAS.

The Securities Exchange Regulation is mandating the listed companies to file its annual report with the Securities Exchange Commission which contains the balance sheet, income statement, cash flow statement, footnotes for the items appearing in the financial statements and audit report. The financial statements have to be finished within 120 days of the final date of the reported fiscal year and be filed with the Commission within 14 days of finishing the report.

NWPGCL, on the other hand, is the judicial person founded on the base of Company Act and need to comply with the Act. The form and contents of the financial statements required under the Company Act is different from the ones required by the Securities Exchange Regulation. The company needs to have a clear understanding of the issue and make its own decision which standards to follow and comply.

(3) Internal Control
The management should clearly define its role, the audit committee, internal and external auditors, and other parties involved. Internal control is a process designed to provide reasonable assurance that the company is achieving its objectives by helping to[1];

- Protect its assets and shareholders' investments,
- Ensure it is not overly exposed to risks,
- Improve the reliability of internal and external reporting,
- Promote compliance with applicable laws and regulations, and
- Improve the effectiveness and efficiency of operation.

NWPGCL management should consider the following basic control procedures:

- Authorization of transactions,
- Segregation of duties,
- Adequate documentation and recording of transactions and events,
- Safeguards over access to, and use of, assets and records, and
- Independent checks on performance and proper valuation of recorded amounts.

[1] The Conference Board Inc., U.S.A., "Corporate Governance Best Practices: A Blueprint for the Post-Enron Era", 2003

5.2 Accounting Policies

5.2.1 Accounting Policies

Accounting policies refer to the manner in which financial transactions which will be recorded in the books of account of any entity. Financial policy, on the other hand, is the one that regulates the receipt, disbursal and utilization of funds. One of the most important requisites is NWPGCL need to have clear and consistent accounting and financial policy in line with the accounting standards and reporting formats as prescribed under Bangladesh Accounting Standards and the Companies Act 1994. A complete set of financial statements comprises of:

- a balance sheet;
- an income statement;
- a statement of changes in equity;
- a cash flow statement; and
- Notes, comprising a summary of significant accounting policies and explanatory notes.

5.2.2 Recommendation for Establishing the Accounting Policies

(1) Guiding Principles of Financial Statements

Guiding principles for preparation of financial statements

- Going Concern basis
- Statements are to be prepared on 'Accrual' basis rather than 'Cash' basis.
- Matching principle.
- Consistency
- Materiality and Aggregation
- Offsetting
- Comparative information
- Accounting measurements

(2) Presentation of Financial Information and the Basis of Accounting

BAS provide some guiding principles on fair presentation of financial statements viz.:

- Fair presentation,
- Wrong cannot be right by disclosure,
- To achieve fair presentation, an enterprise should comply with all the requirements of the currently operative standards along with interpretations,
- In case the deviation from accounting standards becomes necessary to avoid a misleading presentation of financial statements, then the financial impact of the deviation on the enterprise should be disclosed,
- A complete set of financial statements comprises of: 5 documents. (See Section 5.2.1)

5.3 Financial Policy and Management

5.3.1 Financial Management

(1) Financial Policy and Financial Plan

Financial Policy is basically a high level overall plan with general goals, definitive course of action chosen from among alternatives in light of given conditions that determine the present and future decisions. Financial planning or policy involves analyzing the financial flows of the company, forecasting the consequences of various investments and financing decisions and weighing the effects of various alternatives. Since investment and financing act together, they cannot be made independently.

Financial planning is a process of:

- Analyzing the financing and investment choices open to the firm;

- Projecting the future consequence of the present decisions – to avoid surprises and also to understand the link between present and future decisions;
- Deciding on the alternatives to undertake;
- Preparation of financial plan; and
- Measuring subsequent performance against the goals set.

Planning horizon can be anywhere between 1 year to 5 years. The 1 year plan will be more detailed, whereas the 3 to 5 year will be based on more general trends. For projects having long lead time (e.g. of transmission projects or generation projects), the planning horizon needs to be longer of say 10 years.

(2) Use of Cash Flow Statement

While entities (including BPDB) do prepare periodic cash flow statements, the power utilities continue to be cash starved and as such, fire fight for cash management on a day to day basis. Accordingly, in addition to a cash flow statement, it may be useful if NWPGCL prepares a 'cash flow statement' at regular intervals which can actually help it forecast its cash position in advance.

(3) Creating Accountability

Accountability means the ownership of conferred responsibilities combined with an obligation to report to a higher authority on the discharge of these responsibilities and on the results obtained. Accountability includes:

- Answering to the consumers/ public;
- Quality decision making;
- Strong internal controls;
- Knowledge of policies and procedures, with effective communication of this;
- Knowledge throughout the organization; and
- Development and implementation of risk management practices.

5.3.2 Delegation of Power and Internal Control

(1) Defining Roles of Departments Concerned

Departments play a critical role in carrying out day to day management of the business in the organization. There must be a clear delegation of authority to ensure that public money is controlled. Delegation of authority provides specific responsibilities and powers to the department exercising it. When delegating financial authority, restrictions must exist in order to maintain sufficient control and reduce risk proportionate with responsibility and level of knowledge. Delegation should be made to appropriate officials where responsibility can be most effectively exercised and where accountability for results can be readily established. Functions that are delegated to departmental staff must be clearly communicated to those staff members. Departments must establish policies and procedures to ensure an adequate level of control over delegated authorities.

Included in these functions are:

- Uniform Classification of Accounts Preparation,
- Budgetary Control,
- Accounting and Control of Expenditures,
- Accounting and Control of Revenue,
- Financial Reporting,
- Financial Audit,
- Inventory Control,
- Fixed Asset Control, and
- Approval Control.

(2) Financial Delegation of Power

Being an independent entity, NWPGCL should have the operation and corporate structure for its own and should be wise to establish its own rules including the delegation of power. The delegation of power involves the authority to approve expenditure, authority to make procurement (after the decision of purchase has been made), authority to make payment. It is prudent to have the structure in which plural number of functions shall not be appointed to one person but to be functionally demarcated so that the internal check and balance shall work.

(3) Internal Control

Internal control is comprised of the control environment, accounting systems and financial control policies and procedures established and maintained by management to assist in achieving the orderly and efficient conduct of affairs of the organization. The management should ensure they meet at least four main objectives when designing and implementing effective internal controls:

- Maintaining Reliable Control Systems: Management must have reliable control systems to have accurate information for carrying out operations and producing reliable, timely financial information.
- Safeguarding Assets: Management must provide for the security of physical and non-physical assets by controlling access and by comparison of assets with records of those assets.
- Optimizing the Use of Resources: Management must ensure there is no unnecessary duplication of effort or waste, and discourage inefficient use of resources.
- Preventing and Detecting Error and Fraud: Management must ensure procedures are in place to reduce errors and prevent misappropriation of organization's assets or other fraudulent activity.

The management should consider the following basic control procedures as part of the internal control processes in their departments:

- Authorization of transactions,
- Segregation of duties,
- Adequate documentation and recording of transactions and events,
- Safeguards over access to, and use of, assets and records, and
- Independent checks on performance and proper valuation of recorded amounts.

Besides, the directors of the company are required to provide a "Directors' Responsibility Statement" covering among other aspects that proper and sufficient care has been taken for safeguarding the assets of the company and for preventing and detecting fraud and other irregularities.

5.3.3 Risks and Preventive Measures

The risk and preventive measures which are outlined below will ensure NWPGCL to avail free cash flow. Free cash is always required for a company to ensure its operational obligation and liability along with other debt service requirements. The availability of cash flow after meeting the day to day expenses and debt service will be required by NWPGCL to meet future investments requirement.

(1) Inauguration with Clean Balance Sheet

NWPGCL is resolved to own and operate the Bheramara 365MW CCGT to be newly constructed and two more new plants of Simple Cycle Gas Turbine for 150MW each to be constructed at Khulna and Sirajganj for the peak hour generation. In addition, NWPGCL reveals to take over the existing generation plants owned and operated by BPDB in the western part of the country, i.e. the Barapukuria Coal Thermal Plant for 2x125 MW and Baghabari Gas Turbine Plant for 71MW plus 100MW[2]. For the transfers of those existing plants, NWPGCL will enter into the Vendor's Agreement and take over the fixed assets together with the remaining balance of the debts that have financed those fixed assets. The fixed assets to be transferred are to be evaluated under IVVR (Identification, Verification, Valuation and Recording) Program being undertaken by BPDB. It is

[2] NWPGCL, "5-Year Road Map/Business Plan", June 2008

presumed that the fixed assets are entailing a mess of entangled assets and liabilities which NWPGCL should not be forced to accept but should be separated and disposed by BPDB so as to enable NWPGCL to inaugurate with the clean balance sheet with zero balance at the outset of its operation of the acquired plants.

(2) Avoidance of the Negative Legacy

Taking the examples of preceding corporatized cases from BPDB, the Vendor's Agreement is seen to have been signed as the Provisional Agreement. This is due to the fact that the value of the assets transferred is not updated and properly evaluated but has been transferred in such state of conditions. What have been transferred in the preceding cases are the fixed assets and the unpaid balance of the associated loans taken for the construction of the plants. The difference between the value of fixed assets and the transferred balance of loan is defined as the value to be paid by the receiver company to BPDB. The payment is not made in cash but the value is treated as the equity investment by BPDB to the receiver company. A problem is identified in relation to the transfer of the debt which includes the overdue arrear of principal and interest that BPDB failed to pay on due dates. BPDB classifies such portion of loans as Debt Service Liabilities. The fixed assets have been depreciated by BPDB during the period BPDB's ownership and the funds generated from the depreciation should have been appropriated for the repayment of principal and interest of loans on their due dates. Apparently, the funds generated have been used for the purposes other than the debt servicing. A gap has been created between the depreciation and debt servicing. What is to probably happen at the new company is that the new company will continue charging depreciation but the actual amounts to be generated through the depreciation shall not be sufficient enough to fully repay the loan transferred. Theoretically, the new company may not be able to repay the loans with insufficient amount of funds. It is construed that the transferring the Debt Service Liability to the newly created subsidiary company is nothing but the transfer of the negative legacy which should not be enforced.

(3) Management of Other Risks

(a) Vendor's Agreement for Transfer of Fixed Assets

At APSCL we have encountered with a typical example of asset transfer accompanying some problems worth to be reviewed and to learn lessons there from. APSCL has entered into the Vendor's Agreement for the transfer of the fixed assets and took over the fixed assets. The contract provisionally agreed to pay for the fixed assets which is fixed at the net book value after depreciation and less the amount of the debt transferred which includes the Debt Service Liabilities. The contract stipulates that prior to the commencement of the commercial operation, a Dependable Capacity Test is to be conducted. Based on the contract BPDB did test the plant for its capacity which has failed to reach the rated capacity contracted. Due to the failure in reaching the rated capacity, the amount of the capacity payment has been unilaterally reduced by the purchaser of the power, BPDB. In normal business practices for the sale of plant and equipment, the seller provides the buyer a certain level of performance warranty, based on which, should the plant fail to meet the rated capacity, the seller concedes for fixing the plant and/or pays compensation. This is to give a caution to NWPGCL to make sure that the acquisition of plant asset from BPDB shall not involve similar problems as APSCL and to cause measures to appropriately cope with the similar event of the case.

(b) Cost Recovery in the Power Purchase Agreement

NWPGCL is selling all the electricity generated to the single buyer, BPDB under a Power Purchase Agreement (PPA). The selling price is composed of two parts; the capacity payment and the energy payment. The capacity payment is to recover the fixed cost invested and spent for the construction, maintenance and operation whereas the energy payment is to recover the variable expenses the company spent for the operation and maintenance of the generation plant. The price agreed should be sufficient to recover the investment and the operational expenses including the funds for maintenance and repairs. The tariff of BPDB is subject to approval of BERC and The cost to be approved by BERC is having the ceiling limit above which the cost shall be declined in the

structuring of the tariff. The selling price of NWPGCL shall be reflecting the BERC's guideline as the basis for negotiation. If the company operates with inefficiency, the part of the expense exceeding the ceiling limit in such items as return on equity, working capital, inventory, advance payment, etc. may not be honored. The fuel price is allowed to be reflected in the selling price. The shut down period for regular maintenances and accidents are allowed up to the certain number of days without affecting the capacity payment. At APSCL, the plant shutdown is allowed at normal years for 876 hours (equivalent of 36.5 days) whereas at every three years, longer period is allowed for 1,440 hours (equivalent to 60 days) for an overhaul maintenance[3]. In order for the NWPGCL to operate its plants to be profitable and self sustainable, it has to improve the efficiency of operation so that the operation and maintenance cost shall be contained with in what is prescribed in the PPA.

(c) Accounts Receivable

NWPGCL will sell all the power generated to the single buyer, BPDB and the accounts receivable of power shall be limited to those against BPDB. At APSCL, the seller of the power shall prepare and send a monthly invoice to the buyer within 7 days of the final date of the covered month and the buyer shall pay the invoice within 45 days of the date of invoice. The account receivable shall not exceed two months. On the other hand, BPDB is selling the electricity both in wholesale as well as retail. BPDB is faced with the delays in payment of the bills by the end consumers or by the distribution company. If the delays accumulate, the arrears will pile up gradually starting at the distribution companies to BPDB and going upstream to the generating companies. NWPGCL should not forget about the control of the accounts receivable. Several methods have been taken to cope with the mounting arrears of account receivables. One of such means is found in stipulating in the PPA for the deposit of a certain amount of cash by the buyer to the seller that can be forfeited upon the buyer's delay in payment beyond a prescribed number of days or provision of letters of credit or revolving letters of credit issued by commercial banks for the buyer that could be drawn by the seller against the buyer's delay in payment. Another preventive measure can be found in establishing escrow accounts system under which a generation company, a distribution company and a commercial bank sign an escrow agreement and nominates the escrow agent to keep the funds collected from the consumers are deposited into the escrow account and payments thereof would be made by the escrow agent in accordance with the predetermined priority order of various invoices.

(d) Foreign Exchange Risk associated with the Foreign Currency Denominated Loan

NWPGCL will be resorting to the foreign donor for future capital investment. The loans are borrowed by the government of Bangladesh as the primary borrower who, in turn, on-lend the loan to the executing agencies. The generation company has no means to earn the foreign currency denominated revenue and will be exposed to the risk of fluctuating foreign exchange rate. The loans to finance the power projects normally run for the long period of 20-40 years which will make it virtually impossible to hedge the risk in the foreign exchange market, to say nothing of the enormous cost for hedging. The generating company is allowed to pass through the exchange fluctuation onto the selling price of power. The company has no means to recover the loss incurred before the acceptance of revised selling price. On the part of the generating company, there is no reason that the company wants to take the risk and is natural that it averts such risk. The government is adding a considerable margin in on-lending the funds to the executing agency and such margin could be used for a part of the absorbing cushion for the government to take the risk and the on-lending shall be allowed in the risk free domestic currency.

(e) Pension Liability

BPDB runs three kinds of retirement benefits for the employees, i.e. the Defined Benefit Pension Plan, the Gratuity Fund and the Contributory Provident Fund. The pension plan is the defined benefit which will be paid at a certain prescribed amount that is based on the salary levels of the retirees after the retirement for the retirees' lives. The Gratuity Fund pays the retirees having service

[3] The expression adopted here suggests as if the contract will be extended before it will mature at the fulfillment of 3 years and the contract term would be longer in its substance.

record of a certain minimum years or longer a lump sum which is calculated based on the retirees' salary and is paid at the time of retirement. The Contributory Provident Fund, on the other hand, is the fund established and managed by the trustee. The fund is contributed by the employees for a fixed percentage of the monthly salary and the employer contributes the same amount of matching funds. The funds contributed and accumulated are paid to the retirees. The gratuity fund and the contributory provident fund are of less risk to the company while the defined benefit plan is. For the maintenance of the defined benefit pension plan, BPDB has to conduct an actuarial valuation which will estimate the future payment obligation of BPDB converted into the present value. The employer has to make the contribution up to the total amount of present value of such actuarial valuation. There is no record of the actuarial valuation conducted at BPDB and there exists no estimate of future payment obligation. As the average life expectancy tends to extend, the pension liabilities could happen to inflate unexpectedly. The management should have a good insight of the future potential liability and takes appropriate precautionary steps. At the precedent case of APSCL, the company runs the Gratuity Fund and the Employee Contributory Provident Fund but not the defined benefit pension plan. Same story is heard at Pendekar Energy Company who has not introduced the defined benefit pension plan. Taking a look at the examples in the developed countries, the mega trend of the retirement benefit system is while the companies are shifting its systems from the defined benefit plans which make commitments on the amount of benefit payment to the defined contribution plans which commit the amounts of employee contribution and the companies' matching contribution and the pension shall be paid to the retirees within the amount accumulated and the return on investment accrued. The management needs to be prudent in making the best efforts to avert the risks which is not controllable or is beyond the limit of calculated risk.

5.4 Budget

5.4.1 Significance and Purpose of Budget System

Budget essentially lays down the physical and financial operating plan/targets for the budget period and lays down the standards/yardsticks for inputs and the outputs associated with the various activities. It is an important tool for managerial appraisal and control. It also provides an estimate of internal generation of funds from operations, which would be available for financing the capital expenditure, meeting the loan repayment obligations, etc.

The main objectives of the budgeting system are to ensure that:

- Specific budgets in physical and financial terms are laid down for all activities and the respective budget/responsibility/cost centres are held accountable for them,
- Co-ordination in planning so that all the inputs necessary to achieve the physical targets are available in time,
- There is a basis of control over operational expenses and working capital and to inculcate greater cost consciousness in the organization,
- A basis for forecasting profitability and planning for cash/ funds is provided, and
- Standards and yard sticks are laid down for measuring performance in physical and financial terms, ascertain variances, identify responsibilities for under-performance, to analyze contributory reasons thereof and determining corrective actions

The expenses in respect of developmental expenditure for improvements, additions, replacements, renewals, balancing facilities which are capital in nature are budgeted for in the construction budget.

5.4.2 Recommendation for Establishing Budget System

(1) Budget Time Table

There exists no pre-established time schedule for compilation of the capital budget. Every year, the compiling process is initiated by the concerned ministry issuing circulars for launching the budget compiling process. Budget procedure and time table must be built around budget flow, in sequential

manner. It is recommended to have budget time table with milestones so as to enable the companies to have better discipline in budget preparation and adherence.

(2) Preparation of Capital Budget

A comprehensive budget process that can be adopted by NWPGCL in a market environment is furnished below:

Step 1: Issue of guidelines for initiation of budget process
Step 2: Project assessment
Step 3: Project identification phase
Step 4: Assessment of feasibility
Step 5: Choosing the project
Step 6: Identifying sources of funding
Step 7: Inclusion of projects in Budget document
Step 8: Communicating approval for Budget Document
Step 9: Monitoring of Projects
Step 10: Post completion audit

(3) Involvement of senior management

Decisions once taken to invest money in capital projects are irreversible. Any wrong investment decision will have a far reaching impact n the performance of a company. Hence for any budget system to be effective active participation of the senior management is indispensable. The management must participate from the very beginning for preparing, compiling, executing and reviewing of the budget. Periodical review meetings, monitoring the progress by physical inspections to the work spot etc. will help the management to closely follow up the progress and avoid time and cost overruns.

(4) Preparing a Budgeting Policy Manual

Budgeting exercise involves a lot of procedures, processes and assumptions to be followed. It is prudent to have a formal Budgeting Policy Manual, in which formal procedures and rules are established to assure that all proposals are reviewed fairly and consistently. In outline, the policy manual should include specifications for:

- an annually updated forecast of capital/revenue expenditures
- the appropriation steps
- the appraisal method(s) to be used to evaluate proposals
- the minimum acceptable rate(s) of return on projects of various risk
- the limits of authority
- the control of capital/revenue expenditures
- the procedure to be followed when accepted projects are subject to an actual performance review after implementation

(5) Revenue and Expense Budget

The revenue budget needs to concentrate in the estimate of revenue from electricity sale. The volume of sale needs to be estimated accurately. Then comes the selling price of power which can produce the estimate of total revenue. The expense budget will include the items such as; personnel expense; maintenance & repair; depreciation; interest on loans; general administration; etc. The evaluation of performance on budget management should not only be done at the level of power station but also at the smaller units whom the responsibility budget will be allocated. It is of extreme importance to secure the sufficient budget for the operation and maintenance and to proceed with the prudent execution of the maintenance activities. For the efficient operation of the generation plants, the company undertakes to execute the scheduled maintenance and implements the repair works found to be indispensable as the result of the scheduled periodical checking of the plants. On the other hand, the budget of the company will be decided within the restriction of the total revenue and expense framework. Then, the budget determined for each category will be allocated to each generation plant in accordance with the quantified yard stick.

In order to address the issue of the trade-off relationship that exists in between the improvement of the profitability and periodical execution of appropriate maintenance and repair, we hereby recommend the company to introduce and utilize the yard stick system. Under the yard stick system, the conditional status of plants and equipment at the generation plants are checked and quantified numerically, based on which the budget will be allocated to such category of the generation plants out of the total pre-determined allocation for the category. The quantifying indicators are to be consisted of the following ones;

- Dependable capacity,
- Number of starts and stops (annual and cumulative),
- Equivalent operation hours (annual and cumulative),
- Number of forced outages, and
- Others, e.g. the extent of the seriousness of the mechanical trouble which are difficult to be quantified.

The total budget allocated to each generation plants should be entrusted to the plant manager who would be the incumbent top of SBU for a certain extent of flexibility as to its usage.

5.5 Management Accounting

5.5.1 Recommendation for Establishing the Management Accounting System

Management accounting is the study of managerial aspects of accounting. The top management of NWPGCL can use the management accounting tool and function to make plans, execute, evaluate and control the whole of a part of the corporate entity and enable to make the most effective use of managerial resources of funds, materials and human resources through the delivery of accounting information from its initial recognition, measurement, aggregation, analysis, interpretation and conveyance. These will help NWPGCL management to prepare the financial reporting to the parties outside of the company which include shareholders, creditors, regulatory authority, tax agency, etc. The management accounting has several unique characteristics as below mentioned that differentiate itself from the financial accounting;

- Management accounting collects data not necessarily for the whole company but for the segments or product specific data.
- Management accounting measures its objects not only by the monetary value but by other means of measurement.
- Management accounting captures financial data not only for the whole company but for the segments and product wise amount of sales, expenses incurred and profits earned.
- Management accounting does not stick to the accrual basis accounting but may employ different basis for recognition.

In order to establish the management accounting system, the company has to establish its policy on the following points and develop the organization for implementing and maintaining the system as planned and on-going.

- Media for reporting
- Timeliness of reporting
- Format of reporting
- Contents of reporting
- Distribution of reports

5.6 Financial Simulation

5.6.1 Assumptions

The financial model adopts a large number of assumptions whose details are forthcoming in Table 5.6, albeit, out of which the important ones are as shown in the following table;

Table II-5-1 Assumptions for Financial Simulation

	Bheramara	Khulna	Sirajganj
Completion of Plant	October 2014	April 2011	April 2011
Rated Capacity	360MW	150MW	150MW
Type of Operation	Base Load	Peak Hours	Peak Hours
Capital Cost (Tk million)	59,356	7.416	6.856
O&M Expense	2.5% of the Gross Fixed Assets （inflation at 7% p.a.）		
Fuel Price	Tk 73.91/1,000cft （inflation at 4.50% p.a.）		
Working Capital	Account Receivable: 2 m/s of sales, Fuel and Inventory: 1m/s of sales, and Rate of Interest on Short term BNorrowing: 13% p.a.		
Return of Equity	14% p.a.		
Price of Power based on the Cost	Taka 3.68 in 2012; 3.70 in 2013; 3.71 in 2014		

5.6.2 Financial Simulation

The Financial Model has been established to estimate the financial conditions of NWPGCL by preparing the financial statements covering the period up till 2026. The financial model indicates the financial features of NWPGCL as follows;

Table II-5-2 Ratio Analysis

Financial Ratio	Average for NWPGCL (2011-2020)	Average of Power Companies in Japan FY2006）	Assessment of NWPGCL Ratio	Particulars
Return on Assets	1.9%	1.7%	Fair	The ratio keeps fluctuating within the low level of range between 0.7-2.6% during FY2011-2020
Return on Equity	13.2%	7.1%	Excellent	The model is constructed on the assumption of ROE: 14.0%.
Net Profit/Total Revenue	9.2%	4.4%	Excellent	Increase of fuel cost and O&M are passed through to the electricity tariff.
Debt/Equity Ratio	3.0 times	3.15 times	Fair	The ratio stays above 3.0 times up till 2017 due to the fact that initial fund raising of the projects are heavily relying upon borrowings from donors and GOB.
Current Ratio	9.5 times	33.7%	Excellent	Comfortable coverage
Quick Ratio	2.5 times	21.6%	Excellent	Comfortable coverage
Debt Service Coverage Ratio	1.86 times	n.a.	Excellent	Sufficient cash flow is generated through the operating activities and the cash generated clears the generally conceived safety level of 1.3 times with comfortable margin.
Sale of Electricity per Employee（MW）	52.6MW	n.a.		
Sale of Electricity per Employee （Tk Million）	Tk 86.1 million	n.a.		

(source) Average for Japanese Power Companies are taken from the website of Federation of Electric Companies, Japan.

The ratios are generally found satisfactory with exception of a few cases. The fact is partly due from the fact that the assumption adopted at the beginning considers the ROA being at the high level, the fuel costs and O&M expense to be reflected to the selling price of electricity as the pass-through items. Conversely, the management has to secure those assumptions realized in order for the above stated results to materialize. The key of such points are; 1) to contain the account receivable within 2 months of electricity sales; 2) to contain O&M expense within 2.5% of the gross fixed assets; 3) to secure the return on equity at 14% in negotiating PPA.

To be noted at the same time are the facts that; 1) the ROA stays at a low level throughout the project life; and 2) Debt/Equity Ratio stays at rather high level in comparison with the excellent ratios found for the other items. The stagnant level of ROA and D/E Ratio are stemming from the fact that the projects of the company raise the funds heavily through borrowings from the donor and the government of Bangladesh. The funds to be provided by the donors are subject to certain limitations and the funding gap between the project cost and the funds covered by the donors is financed by GOB with the combination of equity for 60% and loan for 40%. The loan portion of GOB funding pushes up the overall borrowing position of the projects. Nevertheless, the ultimate level of those ratios during the period up till 2026 are showing no tendency of aggravation but are in the upward trend.

Chapter 6. Operation and Maintenance Management

6.1 Strengthening of Cause Analysis Ability

6.1.1 Selection of Maintenance Management Method

(1) Improvement of maintenance management level (Necessity of shift from Level 1 to Level 3)
The maintenance management is sorted into three types as shown below. Each characteristic is shown below.

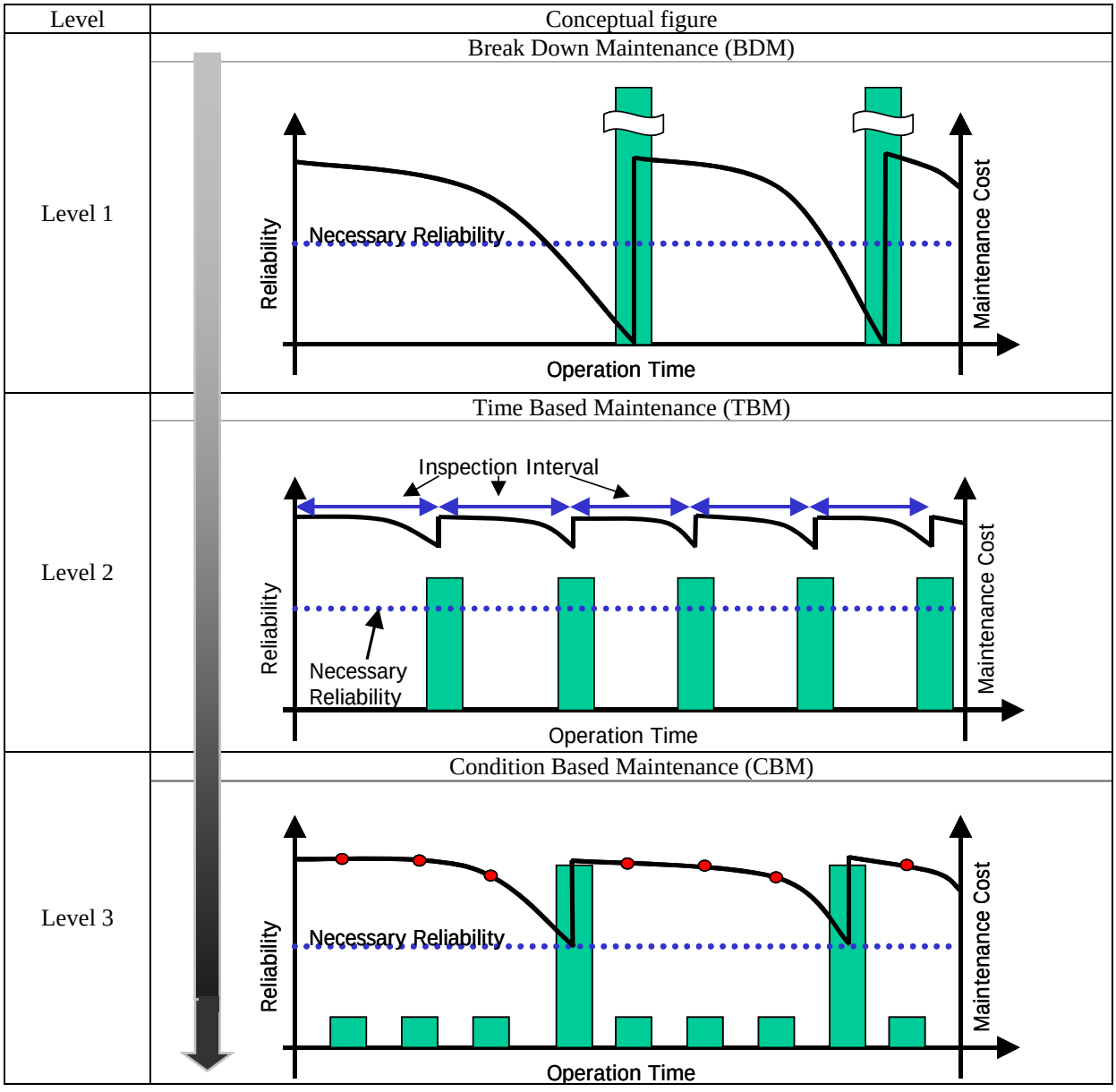


Figure II-6-1 Conceptual figure of maintenance management (level-wise)

In many P/Ss, the condition of "Level 1" in which the equipment is operated until it breaks is kept. In case of Japan, as the periodic legal inspection was established by the regulatory authority, time-based maintenance (TBM) which is "Level 2" was mainly used.. However, electric power supplier has conducted maintenance activities and the inspection style by regulatory authority has been studied energetically, and in the result, the condition is shifting to the maintenance method of "Level 3" in which CBM is used with TBM (the interval of periodic inspection is extended while keeping the current safety). Therefore, it is desired that, in Bangladesh, organizational power and technical capabilities are to be strengthened so that the flexible maintenance management in which TBM and CBM are used together like in Japan.

In the case of the shift of the maintenance management method from Level 1 to Level 3, it is necessary to acquire the ability to judge the situation accurately and to ensure the reliability and safety of our facility. Defiantly, the followings are required.

- Comparison between operating state value and reference value (temperature, pressure, current, vibration)
- Periodic diagnoses of leaks, abnormal sound, corrosion, deformation, discoloration, expansion and others problems by your five senses on patrol (sight, smell, hearing, touch etc.)
- Quantitative diagnostic technology in overhaul during periodic checks and maintenance

One of quantitative diagnostic technologies to judge the situation accurately is a nondestructive test. The followings are included in nondestructive tests.

- Liquid penetrante test (Detection limit – Surface flaw of approximately 20 μ)
- Magnetic Particle test (Detection limit – Depth of approximately 0.5mm)
- Ultrasonic test (Detection of inside flaw in thick member – 0.2mm – 0.3mm)

Among them, only the Liquid penetrante test is often used in Bangladesh. In Japan, as for engineers of nondestructive tests, the national examination system is implemented in each inspection method and only qualified persons are engaged in the inspection.

(2) Obstruction for shifting

(a) Internal cause

The operator of P/S enters the operation record in the log sheet according to O&M manual. However, the log sheet in which data has been recorded is not converted into electronic data, is not utilized again and is preserved in a warehouse.

The aim of recording in the log sheet is to conduct trend analysis using the recorded data to find the bud of accident. But in many cases, it is not conducted. As a result, the condition of equipment is not understood, it is impossible to understand the symptom of accident previously and the situation may lead to serious accident. (Preventive maintenance is impossible = only ex-post maintenance)

Therefore, the following countermeasures are proposed to improve the level of maintenance management method.

- Strengthening of organization: To strengthen the organizational function to conduct information analysis (trend analysis)
- Strengthening of infrastructure for management information system (MIS): To introduce MIS, convert paper data into electronic data and establish the infrastructure for management information system where the trend management can be conducted. (Refer to Chapter 8)
- Strengthening of technical capabilities: To establish the system in which the flexible maintenance management according to deterioration condition of equipment is conducted by strengthening the inspection ability of nondestructive test and others and understanding the equipment condition based on the trend management. (Shift to the flexible maintenance system by using TBM with CBM)

(b) External cause

In case of Japan, in Article 55 of Electricity Enterprises Law, it is stipulated that, as legal inspection, the periodical voluntary inspection should be conducted within 2 years since previous periodical voluntary inspection as for boilers and gas turbines, and within 4 years as for steam turbines, and all electric power suppliers are required to check them periodically regardless of the condition of equipment.

In Bangladesh, the law to stipulate such legal inspection does not exist, and it is said that periodic inspection is left to the voluntary of electric power suppliers. However, in fact, because of urgency of demand and supply, if the equipment is in "the condition where operation is possible", the government does not permit them to suspend the operation in many cases. So to speak, the condition of "Level 1" in which the equipment is operated until it breaks is kept forcibly. If, under the circumstances, the limit level is exceeded, the equipment stops suddenly, and the facility does not function as a supplier, the responsibility is not clarified.

In Bangladesh, IPP accounts for more than 25% of the installed capacity of the whole country and the percentage is high. The following case example is also confirmed. According to the results of field investigation in Haripur IPP by JICA management team, it was found that IPP kept strong posture to conduct voluntary inspection in order to hold its own valuable operating assets, and after the patient negotiation, the stop permission was given finally.

Therefore, the following countermeasures are proposed to improve the level of maintenance management method.

- To develop legal environment under the government initiative so that the legal inspection can be conducted in order to improve the existing supply capability.
- To identify the responsibility of the government and electric power suppliers.

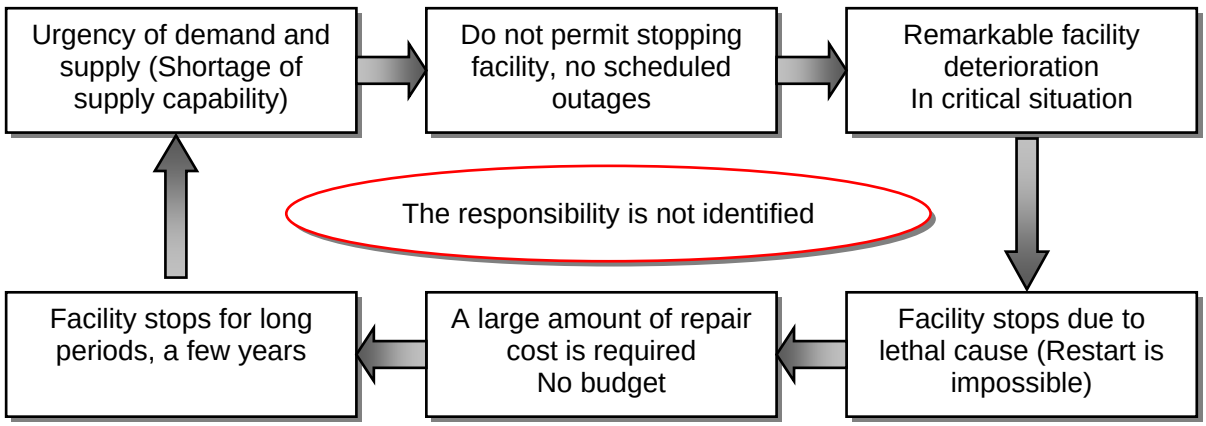


Figure II-6-2 Negative spiral of shortage of supply capability

6.1.2 Proposal of Concrete Management Method

(1) Standard management flow based on PDCA

(a) Monitoring and checking during the operation

It is important to always monitor temperature, pressure, flow rate, water level and the level of oil and others of various parts and check that they are within the predetermined reference value in the operation of P/S. Also, to conduct "realization of equipment function", "holding of heat efficiency", "reduction of equipment wear" and "reduction of creep and fatigue degradation in high temperature member", the operation within the predetermined reference value (steam condition, burn condition and others) is always carried out strictly.

In the process computer, transfer the data relating to the actual performance of electricity generation and heat efficiency to the computer for the management of operation, create the data of actual performance of electricity generation and that of heat efficiency for management, conduct the trend management in the situation of various parts and find the symptom of abnormality in the early stages. At the same time, conduct the daily inspection tour and find the symptom of abnormality, such as slight difference of vibration, noise, odor and color which are difficult to be measured and a tiny quality of oil leak and water leak (exudation), in the early stages

(b) Prevention of trouble

If the symptom of abnormality is found, analyze the data to specify the cause. If the need arises, stop the operation urgently and temporarily, and conduct the necessary inspection and diagnosis. Based on the results, estimate the current difficulties and decide the policy of countermeasures.

(c) Repair, inspection and maintenance

Before conducting the periodic inspection, in addition to the contents of the periodic work, clarify all work which should be conducted at the time of shutdown, including the repair of abnormal parts which have been found during the operation, create the detailed work plan, and get necessary parts in advance, if any if the parts are required.

As for the abnormality, which is found in the inspection, basically it is repaired during the periodic inspection. Estimate the difficulties of abnormality and the lead time in preparing the parts and decide the policy of countermeasures (emergency measure, permanent measure). As for small-scale abnormality which is carried over to the periodic inspection after the next and the abnormality which was repaired temporarily, the countermeasures such as setting of special measuring equipment are taken to understand the status of the progress of the abnormality as the concern management.

The contents of inspection, measurement results and others are recorded in the predetermined format, the trend management is conducted in each inspection and they are used in the remaining life assessment

(2) Maintenance management

(a) Daily maintenance

It is the most important in the maintenance management of equipment of P/S to perform the daily maintenance carefully. In the “Heinrich’s Principle” shown below, it is said that 29 disasters with light injury occur and there are 300 events where sudden fear is felt (bud of disaster cause) behind an occurrence of serious injury. This is an experimental rule in the work accident, but it can also apply to the daily maintenance.

The base of daily maintenance is to pick many buds of trouble in the early stages and take measures. The buds of trouble hide in various places and cover a widespread area. Detection of abnormality (vibration, noise, bad smell, oil leak and others), change of operation state value, and frequent alarm generation in the daily inspection tour. And the daily visual check is main. It is the technique based on guess, knack and long experience, and it is the technique, which is developed in the site OJT by building up the cooperation of experienced persons and young people.

And also, in the daily maintenance, it is important to check monitoring instruments, and there is no point in conducting the daily maintenance if the monitoring instrument does not function normally. Therefore, it is necessary to calibrate the monitoring instruments correctly in the early stages.

(b) Periodical inspection

The periodic inspection is mainly divided into simple inspection and full-scale inspection. The both should be conducted in the best time in view of time (total operation time*number of start) and the condition of plant.

As for the parts whose materials deteriorate due to creep*thermal fatigue damage, crack and fissure, such as hot parts of gas turbines, inlets of main steam / reheated steam of steam turbines and others, the inspection of each part is required. As for other parts, the targets spread widely and are large in number; so selected parts are inspected due to the problem of cost and time. The priority order and development chart of the inspection of selected parts are created based on the operation status value, heat efficiency and the first inspection data. It is important not to leave undisputed parts.

Especially, as for the setting of schedule of periodic inspection and maintenance, in consideration of the actual performance of precedent IPP plant, ensuring of safety on site (avoidance of vertical work, open inspection and maintenance place and work environment), operation rate of overhead crane and others, the streaming of work and shortening of process in the object which parallel decomposition can be conducted are promoted. And also, it is important to boost the morale of workers and make them compete against each other in the improvement of the improvement of quality control by adopting the bonus and financial incentives system if the construction period can be shortened.

And also, at the time of planned stop, it is important to conduct the visual inspection during the time of to P/S such as check of the remaining work of daily repair which is planned to conduct during the stop of unit, the condition of the parts which were repaired temporarily in the previous periodic inspection and maintenance work, and the parts which are left unprepared and whose change is observed, and reflect the repair time to the next stoppage plan and that after the next.

(c) Maintenance of Accident

In case of occurrence of urgent accident (during the operation and the inspection), the site investigation is conducted and the situation is understood. In addition to them, based on the database such as the past operation record and the record in the previous periodic inspection, the true cause is understood. As for the trouble parts, which are found during the periodic inspection, if the materials cannot be prepared, emergency measure is taken. As for this emergency measure, if the reliability till the next periodic inspection and maintenance is not secured, the permanent measure is taken in the use of the next planned stop work. On the other hand, if the part where the emergency measure is taken is operated till the next periodic inspection and maintenance work, the relevant part is checked at the planned stop time, and the investigation is continued to check how the trend of data of each investigation changes.

(d) Maintenance plan

In consideration of the time of exchange of consumable parts, exchange of deteriorated parts, and exchange of hot parts of gas turbines where EOH (Equivalent operation hour) recommended by manufacturers is used as a guide, NWPGCL establishes the medium- and long-term repair plan. In that, the type of maintenance, the stop time and the number of days when it stops should be included. The real time and number of days when it stops are decided in coordination with the central power feeding center in consideration of the situation of demand and supply, but basically it is important to hold the schedule which is predetermined in the medium- and long-term repair plan from viewpoints of keeping of reliability of equipment and efficient maintenance management. If the repair which is predetermined in the medium- and long-term repair plan is postponed, due to the growth of deterioration, expansion of inspection range, expansion of repair range and parts where unexpected damage are found, additional order of spare and urgent exchange are required, which may lead to lengthening of construction period and expense of huge additional cost.

(e) Budgeting of maintenance

At the creation time of medium- and long-term repair plan, approximate construction cost is calculated based on the exchange parts in each unit, parts which are GT hot parts and are reused in the repair after removing, the cost of construction which is planned in the periodic inspection such as replacement of equipment (purchase cost of equipment + transportation cost + installation cost) and others.

However, there is always a risk that securing of workers becomes impossible due to price change and prolongation of construction period, so it is necessary to discuss among the persons involved (staff on duty of P/S, repair department, budget department, construction company) one year before the planned periodic inspection of the relevant unit and establish the detailed implementation plan. The meeting of the last double check is held three months before the inspection. Then, the inspection and investigation of the part where trouble occurred after the creation of plan are added.

(In Haripur IPP, they conclude contracts of TLSA and LTPM with equipment manufacturers. This is a contract that equipment manufacturers provide spares and consumable parts over a long period of time as for GT hot parts, and large contract deposit is paid for long-term collateral. In this contract condition, gas turbine engineers and repair technicians are difficult to be cultivated).

(3) Operation management

It is the base of operation management to strictly keep the reference value operation. If the operation statue value deviates from the reference value, the engineers of electricity generation group and repair staff pursue the cause and take reform measures.

(a) Standard process

The base is the reference value automatic operation by process computer. During the automatic operation, keep security devices and protection circuits normal. The unit trip is the last measure to protect the equipment and do not remove the trip circuit.

If you have to inspect the circuit when the unit output is constant, decide the inspection range, who conducts the inspection and who conducts manual trip. If the output should change and big change may affect other equipment, create the operating procedure, decide division of roles and deployment of staff and then launch it.

(b) Management of security devices and protection circuits

In security devices and protection circuits, the sequence at the completion of test operation is the base. (What P/S approves in the application for approval, which a manufacturer submits) As for the part where the alarm device operates frequently, check it immediately, pursue the cause of abnormality and take reform measures. However, if the sequence is changed or the set value of each alarm is changed, top-level technical staff of P/S discusses and the range, which is approved by them, is changed. In this case, it is important to immediately change the original drawing of sequence and the list of set values and inform operation staffs on duty and staff in charge of repair.

(c) Fuel management

It is important that executive of P/S attends the orifice test at the setting of gas receiving flow meter (The gas supplier side sets) and examine the data. And also, the both beforehand decide the interval of checking of the change with time and the test method.

And the gas composition is the main element, which affects the heat efficiency. To check the change of gas composition due to the change of gas supplier (mined well) and others, set Gas chromatography at the outlet side of flow meter and check the gas composition always.

(d) Efficiency management

Send the data required for the heat efficiency management from the process computer to the computer for operation history management, and establish necessary LAN so that it can be controlled in the heat efficiency management workstation.

In the heat efficiency management workstation, the documentation function such as daily report, monthly report, quarterly report and yearly report is also added with the function required for the heat efficiency management such as individual operation of gas turbine, combined cycle operation and heat balance check.

(e) Management of water and lubricating oil which are used in P/S

To operate P/S stably, lots of water, lubricating oil, hydrogen gas and nitrogen gas are used daily. Based on annual consumption of pure water, rate of HRSG makeup water, name and amount of injected agent in HRSG feed water, exchange of resin in the manufacturing equipment of pure water, name and amount of injected agent in HRSG boiler water, amount of cooling water of accessories, GT/ST lubricating oil, other lubricating oil for accessories, exchange of agent of the fire extinguisher, amount of hydrogen gas for cooling the electric generator/nitrogen gas for substitution, consumption during the normal operation, and exchange amount in periodic inspection and maintenance, establish the medium- and long-term consumption plan.

(4) Cause analysis in unscheduled outage trouble

Unplanned stop trouble occurs due to some sort of cause. It is important to certainly conduct the cause analysis and take measures to remove the true cause in order to avoid the occurrence of similar one since the occurrence of trouble. So, in the occurrence of unplanned stop trouble, if it is small-scale trouble, it is important to certainly create the sheet and accumulate the trouble information as database.

6.2 O&M Implementation System

As NWPGCL, in the future implementation of O&M of P/S, we propose the form of relation with manufacturers, which have detailed know-how of technology and the desirable implementation system inside NWPGCL.

(1) Maintenance of combined cycle

The combined cycle consists of a gas turbine which is operated with high-temperature combustion gas, HRSG, steam turbine and a generator. Seen from the viewpoint of the interval of periodic test, the main is the gas turbine, so it is practical to conduct the periodic tests of the steam turbine, the generator and HRSG when the gas turbine is inspected.

And also, in the gas turbine, severe cracks, corrosion, oxidation, deformation and detachment of coating occur in the hot parts such as combustor, stationary blade, moving blade, impeller blade (shroud segment) and others. So, the aging deterioration level is not estimated based on the total operation hours and the total number of start/stop which are adopted in the steam turbine, but the time of periodic test is estimated based on EOH (Equivalent operation hour). Based on EOH, the deformation and the high-temperature creep fatigue life in the time of start/stop, the number of load rejection, the number of trip and others are estimated and the safety is confirmed. Each GT manufacturer adopts this method.

Generally, LTSA (Long Term Service Agreement) is concluded between suppliers to plants and users.

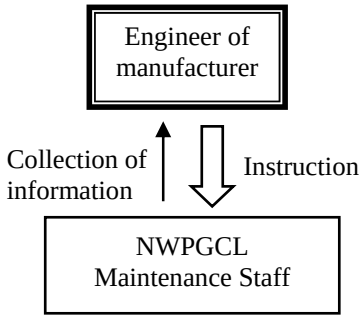
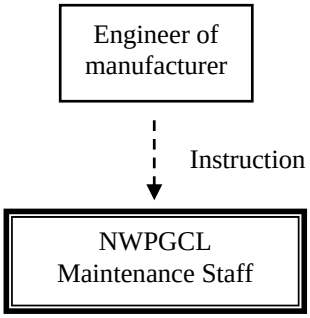
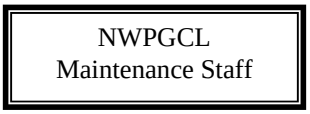
The following schedule pattern is developed: Minor inspection is repeated after every 8,000 hours of operation (EOH) after the commission date, the Major inspection is conducted after 25,000 hours of operation from the commission date, Minor inspection is repeated after every 8,000 hour after and Overhaul of the Hot gas component is conducted after 50,000 hours of operation from the commission date.

The contract period of LTSA is 6 years (approximately 50,000 hours of operation) because the cycle in which the parts that are removed and repaired in each Minor inspection and the high-temperature parts that are replaced in Major inspection (after 25,000 hours operation) are replaced and reused in the overhaul of Hot gas component (after 50,000 hours operation) is considered.

During the contract period of LTSA, the manufacturer supplies GT high-temperature parts and dispatches instructors for disassembly, assembly and test operation to the site. In this case, the workers of power plant conduct the operation under the supervision of the instructors from the manufacturer onsite.

After the LTSA expires, generally, under an LTPM (Long Term Parts Management) agreement, the unit-price contract of high-temperature parts is concluded. As for the repairs of GT after the 7th year from commissioning, if the workers of the power plant are experienced in the disassembly, the assembly and test operation for 50,000 hours from the commission date and GT maintenance skills are settled in NWPGCL, GT maintenance and quality are ensured by purchasing and stocking spare parts under LTPM after that. If the request for dispatch of an instructor from manufacturer is required after that, the way where the number of dispatched instructors during the contract period of LTSA is reviewed and the instructors of necessary jobs in necessary process are dispatched can be selected.

(2) Direction of maintenance implementation system in NWPGCL
NWPGCL has the management vision "Continuous Development", and tries to develop human resources based on a long-term perspective.
The direction of maintenance implementation system in NWPGCL is shown below.

Early period (for 6 years after commissioning)	Middle period (7^{th} ~ 12^{th} year)	Long period (after 13^{th} year)
		
LTSA contract (6 years) is concluded and the periodic checks during this period are mainly conducted by the engineers from the manufacturer. Then, the maintenance staff of NWPGCL tries to improve their technical capabilities by collecting information.	The periodic checks are conducted mainly by the maintenance staff of NWPGCL. When necessary, the dispatch of engineers from the manufacturer can be required for guidance.	The maintenance staff of NWPGCL conducts the periodic checks solely by himself. The department of maintenance in NWPGCL is developed to SBU and the periodic checks of other companies are accepted and conducted, when possible, by using the technical ability which they have acquired.

Although it is inevitable that the instructors and inspectors from the manufacturer are asked to conduct periodic checks in the early period (first and 2nd check), then, the maintenance staff should take part in the checks and others and should try to acquire the technology. And they should aim to establish a system in which the periodic checks can be implemented by only the staff of NWPGCL at the earliest possible stage. We propose the direction in which the technical capability is improved into the level where the periodic checks of other power plants can be undertaken by accumulating the implementation experience of periodic checks and they aim to accept orders from other power plants in Bangladesh. One of measures is to develop the department of maintenance in NWPGCL to SUB and implement the construction management of maintenance by a group of professional engineers and technicians, and from this protocol it is expected to maintain and improve equipment quality, eliminate injury or accidents and ensure personal safety.

(3) The technological level which will be required in the maintenance department in the future and how to acquire the technology

To implement the periodic checks by only company staff, it is necessary to cultivate the technicians who have the same level of technical knowledge as technical instructors, special inspectors (nondestructive test, remaining life assessment and others) and specialist labor (special processing and welding, low-alloy steel – SUS dissimilar metal joint welding, welding of large diameter pipe, annealing operation of welding area and others) in NWPGCL.

The methods to acquire these technologies are as follows.

(a) General information

The basic technical capability should be settled mainly by the staff of maintenance department who trained in the assembly and test operation during the construction works and accompanied the instructors from the manufacturer during the period of LTSA learning the skills of disassembly, assembly and adjustment.

The set protocols are as follows: Write the source of acquired technology in the manufacturer instruction book and add photographs if needed to clarify operational methods. At the same time, write a memo about the technical information which is acquired in the field onsite, and add it to the manual as needed to complement the manual. At the completion of the periodic checks and maintenance, checked equipments, contents of checks, used equipment, check result data, judgment (good or bad) based on the data, difference between planned man-hours and real man-hours and others factors should be written in the construction report without any omissions. And also create the report in which the issues (number of days of operation, used equipment, used measuring instruments and results of the introduced nondestructive test) that should be reflected in the next periodic check, including maintenance and the parts that should be rechecked as soon as possible in the area which was inspected in this periodic check are included. Construct a system in which the persons who need the information can search anytime by digitizing the report.

(b) Disassembly and assembly of GT and ST

During the periodic check which is conducted in the early period by the engineers from manufacturer, take video pictures and photographs of the operation of disassembly and assembly, collect necessary information of the engineers from manufacturer and create a manual for disassembly and assembly procedures. Also note one methods of receiving training of disassembly and assembly of GT and ST is at the training center of manufacturer.

(c) Nondestructive test

As for the nondestructive test, it is possible to cultivate the engineer’s knowledge for a short period by purchasing the inspection equipment and receiving the training by foreign experts who are invited to Bangladesh for a short period. During the construction work, they never fail to conduct the check with the inspection equipment at the welding site, so there are many chances to acquire their knowledge and expertise. We can say that it is also an effective method to promote the cultivation of their knowledge by appointing staff who will be in charge of the inspection department in the future, and sending him or her to the site of the nondestructive test.

As for UT inspection, besides a simple measuring instrument in which the measured results are displayed digitally such as an instrument for measuring the wall thickness of a boiler tube, TFD method (angle beam technique, use of plural sensing terminals) in which the inside flaw of a material is judged, the radiograph examination and others are adopted. Now, no one in Bangladesh can use these technologies, and they completely depend on overseas experts in relation to this technology. As one of the methods used to judge the life of equipment, the photomicrography of metal structure is also a necessary technology to harness. The long- term vision about how much the diagnosis technology used in electric power facilities in Bangladesh will be developed in the future is required.

(d) Specialist labor

It is not easy to cultivate specialist labor such as a special in-house welder. Temporarily, the system in which staff who possess the qualifications and skills of specialist labor (special processing and welding, low-alloy steel – SUS dissimilar metal joint welding, welding of large diameter pipe, annealing operation of welding area and others) is ensured contractually is adopted. If it is planned that the maintenance department will be developed to SBU and the periodic checks of other companies will be undertaken, it is necessary to cultivate the engineers in NWPGCL.

(4) Maintenance method in and the middle period

To aim at effective maintenance management, in daily maintenance (small-scale maintenance which can be conducted during the operation, for example, tightening of leak of valve gland, tightening of flange leak, refill of a lubricant, calibration of instruments, replacement of automatic control card and others), urgent response is required to ensure the reliability of electric power facilities, so the department of daily maintenance of the power station which can adapt quickly is in charge of it.

Three months prior to the periodic check, the maintenance department holds a joint conference with the operation department and the daily maintenance department. The maintenance department explains the contents of the next periodic check and maintenance construction, obtaining agreement from the operation department and the daily maintenance department. Total agreement should be reflected in the program for the next periodic check and maintenance construction. Then, to avoid any oversights in the contents of construction, about areas whose value of operating state deviates from the planned values, frequent alarms and others, the staff in charge of each field reports their current situation. Especially, about untreated lapses among the daily maintenance lapses, which are issued by the operation department of power station, the value which is close to the limit value judging from the operating state value, for example, the vibration value of rotating equipment, the point where the metal temperature of hot area is close to the warning value, the system in which the differential pressure between the front pressure gauge and the rear one is large and others, the current situation is checked by all three departments.

One month prior to the periodic check, the three departments hold the conference again to conduct final confirmation on whether there are any additional checks and maintenance required. The maintenance department rechecks ordered spare articles, parts which should be ordered newly, consumable supplies (general- purpose articles such as gasket packing, sheet packing, each valve gland packing, packing of pump shaft seal part and others, special components) and confirms that there are no omissions.

Furthermore, the situation of creation and procedure of the construction schedule, schedule of worker deployment, number of outsourced workers in each job, equipment for construction, nondestructive test, equipment for special welding and others in each part, GT, ST, HRSG, generator and I&C are confirmed.

6.3 Long-term Human Capital Development

6.3.1 Development of Staffs during the Construction Period

Before launching the construction work, select the leaders of O&M and cultivate them on the side in the construction. In the construction work, the structure of the equipment in P/S which can not be checked during the operation can learn in detail. And, moreover, the knack in installing of equipment can be checked. The leaders collect the data in each point, such as assembly of equipment, opening measuring method in assembling and acceptable value, the sequence check before the single test after assembly, general security test, load test and others, and take photographs with digital camera about the range of which they are in charge. Attach them to the instruction book which is provided by the manufacturer to visualize them. They are used for the education of O&M staff in the P/S and OJT materials of young staff. The documentation and data, which are accepted during the period of the construction work, should be stored on OA server. (The data and document are also accepted in the form of electronic file.)

The contract system with manufacturer is not decided yet. Even if full-turnkey system is adopted, the P/S composes the electric generation preparation group, is subject to manufacturer start-up, and receives OJT of practical operation. Especially, the sequence test provides the chance to check the circuit and function, and not only the members of the electric generation preparation group but also those of the electricity group and I&C group in the repair department attend it.

In the unit testing of accessories, after conducting the inching test in the condition where coupling is separated, the unit testing after direct coupling is conducted. The record is stored on OA server because the centering record in coupling becomes the pace of subsequent maintenance.

To promote the automation, in many systems, motor valves are used, and the records of setting positions of torque switch and limit switch is stored. It is necessary to accurately take over the know-how of manufacturer because the full closed position in cold is different from that in warm.

And as for “burning adjustment”, “start stop test”, “runback test”, “load control test”, “load rejection test”, general test of system”, “AC,DC power-off test” and others which are conducted in the stage of HRSG water pressure test and load test after unit testing of accessories, the staffs of P/S attend all of them. All data, drawings and others relating to test plan, preparation measures for test, command structure of test, responsible persons in decision of stop of test and operation of fuel shutoff valve switch are stored and used as reference in the security test after subsequent MOH.

6.4 Support for the Implementation of Environment Management Planning and Monitoring

6.4.1 Corporate Level

(1) Organizational framework

As described in Chapter 3 on corporate governance, the JICA management team proposes to establish the internal functions to supervise implementation by management of duties, including the auditing committee, governance/environment committee, and election/benefit committee. Setting up the governance/environment committee composed of external members of experts and intellectuals enables NWPGL to obtain advice and directions for environmental measures from these experts and reinforce its environment control initiatives.

(2) Management structure

The Corporate Governance Code 2004, the corporate governance law in Bangladesh stipulates that one third of potential committee members should be elected outside the Company. NWPCGL is strongly recommended to comply with this code and apply directions and advice from external experts and intellectuals in its environmental management.

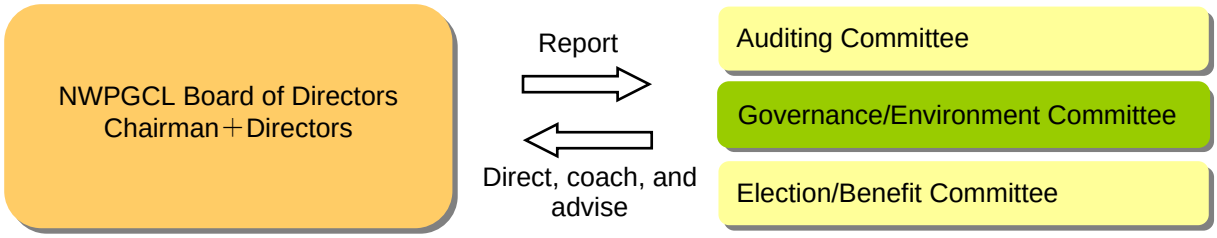


Figure II-6-3 Environmental Management System (Corporate Level)

(3) Support measures

Environmental preservation measures include specifically the air quality conservation measures, prevention of nitrogen oxide, water quality conservation measures, water discharge, prevention of oil leakage, prevention of noise and vibration, proper assignment of machinery and equipment, measures

to harmonize the facilities with surrounding environment in terms of scenic balance and greening. The management should actively seek advice and technical guidance from external experts and intellectuals to build and manage facilities complying with all the requirements stipulated in the related Bangladesh laws and regulations.

With respect to the existing agreement with the community on the acquisition of land, the management may need to respond to adverse claims, which might arise upon the operational start of power station. In such a case, solving disputes through dialogues with local residents is essential.

6.4.2 Management Level

(1) Organizational framework

As described in Chapter 4, the organizational framework at management level should consist of vertical organization including finance, operation and maintenance, planning and development, and human resources on one hand, and the lateral organization on the other, which coordinates the information provided by these groups laterally. As a line post to support the CEO, it is proposed to assign a chief officer in charge of corporate strategy and information management, and a chief office in charge of environment, safety, and quality control.

(2) Management structure

The chief officer in charge bears total responsibility for environmental management. It is an extremely important post that should hold all the great responsibilities in promoting environmental measures at each power station, setting environmental goals, assessing and reviewing performance, obtaining and analyzing environmental data, and disseminating and reporting the information to the members of Board of Directors (including external experts and intellectuals) and the management team.

(3) Support measures

In order for environmental management to be implemented on a regular basis, it is also essential to apply environmental indicators for management goals so that satisfactory environmental controls would lead to the achievement of management goals.

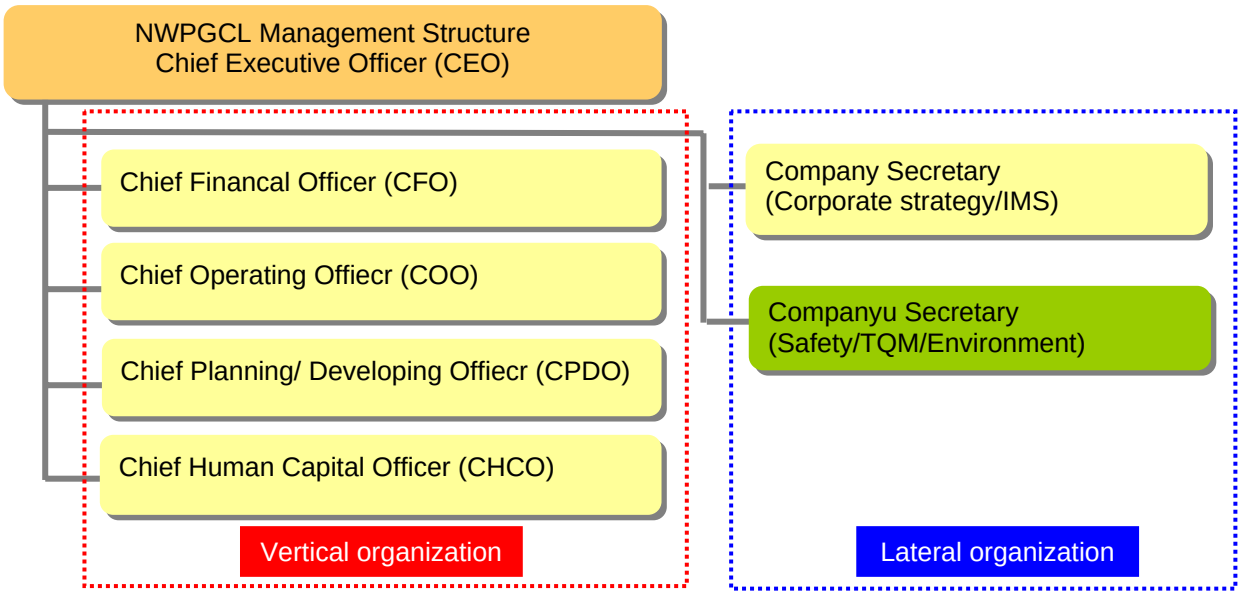


Figure II-6-4 Environmental Management System (Management Level)

6.4.3 Plant Level

(1) Organizational framework

In the same manner as management level, it is proposed to introduce a position of deputy director in charge of environment, safety, and quality control, within the organizational framework on a plant level, who laterally collects and coordinates information that exist in the organization.

(2) Management structure

The aforementioned position is critical in that it plays an important role in gathering and analyzing environmental data through day-to-day operations such as setting the goals of power station and assessing and reviewing performance, and because it has complete responsibility in the immediate provision of information to the director and executive officers of the power station as well as to the Chief Officer in Charge of Environment at the headquarters.

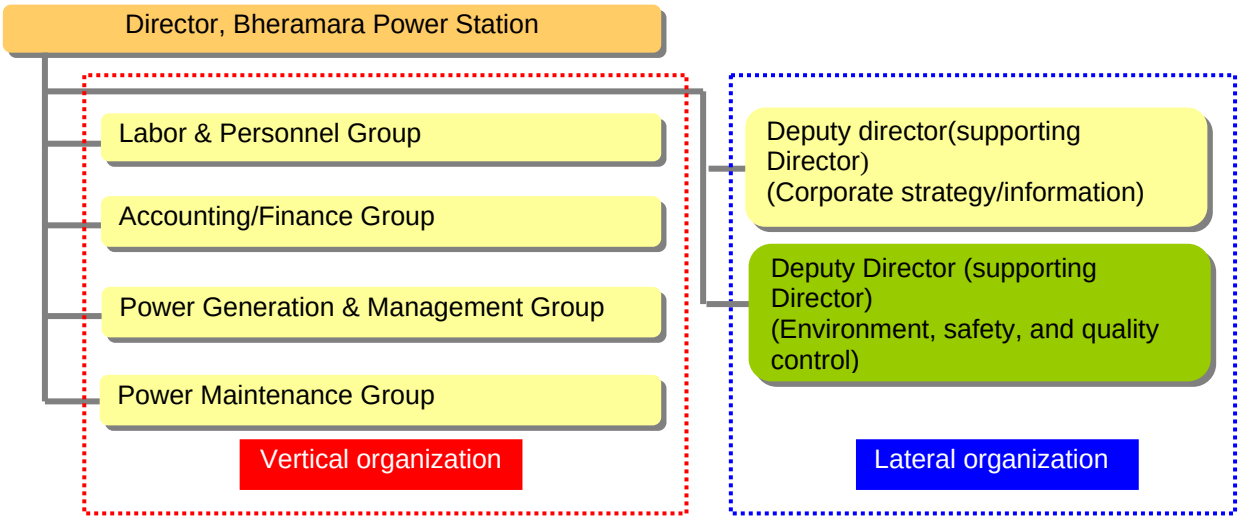


Figure II-6-5 Environmental Management Systems (Plant Level)

6.4.4 Public Level

(1) Implementation of active information disclosure

Because of the business characteristics of constructing power facilities in the region(s) and supplying power to local residents, it is extremely important for the power business to build a relationship of mutual trust with the stakeholders (including shareholders, business partners, and local community, etc.). In addition to implementing an appropriate and responsible reporting to regulatory agencies, it is essential to build a relationship of mutual trust with local communities through active information disclosure of daily operations, environmental data, and immediate countermeasures against accidents to stakeholders including general public, in the annual report or via website.

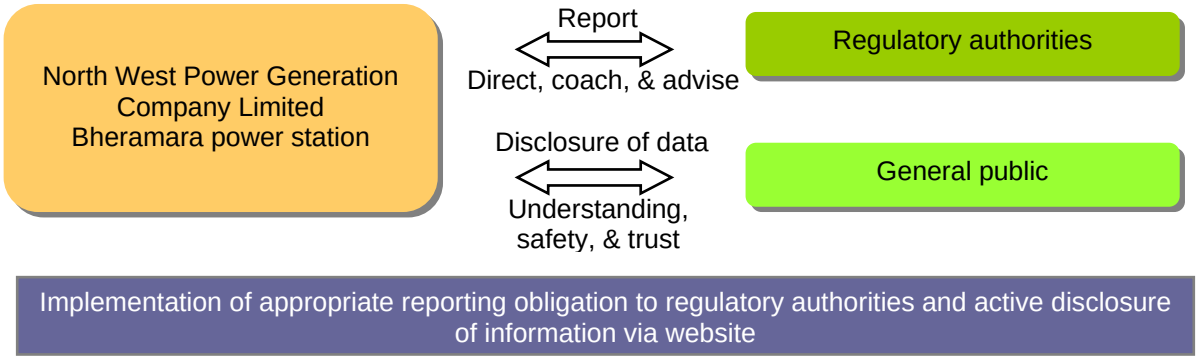


Figure II-6-6 Environmental Management System (Public Level)

(2) Harmonious coexistence with the local community

As regards too the site location for Bheramara power station, it is recommended to adopt the basic policies for environmental preservation by participating in community minded building "by constructing a popular power station", making the power station open to public, i.e., "construction of a usable power station", and harmonizing with local community "with an expansive power station", and implement these policies in all construction and operation.

In the construction of power stations, it is essential to preserve and create the natural environment by conserving the existing green spaces as much as possible and planting trees onsite to coexist with the local community. The specific measures to achieve these goals are:

- Build a popular power station: by planting many trees onsite and aiming at developing a power station with lots of greenery contribute to the expansion of building a healthy and productive environment for the community as a whole, in cooperation with local residents.
- Build a usable power station: by creating green spaces, water features and opening a part of the premises as a community park, aimed at developing the power station to be used by local community.
- Build a power station with open atmosphere: by making the inside of power station open to general public on a regular basis, therefore constructing a power station with open atmosphere.
- In terms of coexistence with the local community, a positive employment promotion from the local community for the logistic works position such as drivers, cleaning, and cooking is highly recommended.

Chapter 7. Safety Management

7.1 Recommendations

7.1.1 Approach for Achieving Reduction of Risk

(1) Disaster Occurring Mechanism

A disaster is caused by unstable conditions and unsafe behavior. P/S does not consist of machine alone. It always consists of humans and machine. And other elements stand between humans and machine, including media and manual such as work method and environment, and management such as management structure. If we perceive these basic elements as Human Machine System (HMS) of P/S, we need to approach disaster occurring mechanism from the 4M aspect, namely, Man, Machine, Media and Management.

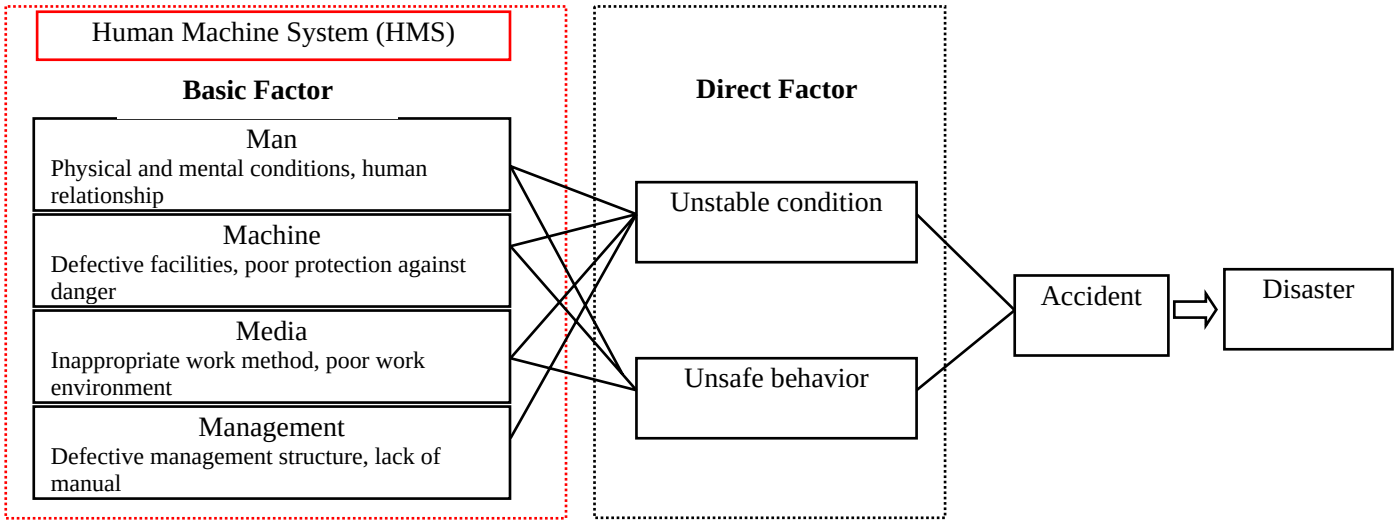


Figure II-7-1 Human Machine System (HMS) and Disaster Occurring Mechanism

(2) Concept of Disaster Risk Reduction

The concept for reducing the number of disasters shall be based on a very simple formula as follows.

Number of disasters	=	Number of tasks performed that may lead to disaster	×	Probability of getting errors per task performed

Figure II-7-2 Concept of Reducing the Number of Disasters

This means that it will be necessary to reduce either the number of tasks performed or the probability of getting errors per task performed. However, it is difficult to reduce the probability to zero. Therefore, it is also important to think that errors could occur at any time and to be prepared to prevent them from developing into an accident or disaster.

7.1.2 Organizational and Institutional Aspects

(1) Establishment of Organizational Structure for Safety Management and Identification of Safety Responsibility

A safety committee shall be established within Bheramara P/S by appointing its head as the chairperson to strengthen safety management and identify the organizational responsibility structure

for safety management. The committee shall consist of union representative and management level employees. To improve safety measures within P/S, the committee shall continue to implement its annual activity plan, including safety meeting plan, solicitation of report on Hiyari Hatto (near accident) incidents, solicitation of posters to improve safety activity (a medal of honor shall be awarded to excellent work), periodical patrol, and 5S awareness campaign.

In addition, the "prior safety evaluation committee" shall be held to evaluate safety of tasks prior to the adoption of a new work or construction method, commencement of a work with explosion or fire hazard, lifting and moving of large equipment with large-size heavy machinery, and shutdown of protection circuit to conduct circuit inspection or replace relay during operation within P/S.
Chairman of the safety committee shall select members of all committees each time. Those who used to work for a construction company and external knowledgeable persons may be asked to participate in a committee as necessary. At the safety committee, the person who is in charge of safety and who is Deputy Director of P/S supervises all committees and events to be held within P/S.

The Secretariat is headed by deputy chief of the personnel division and its members are managers of each division. In case a large number of workers visit P/S because of regular inspection or other reasons, a safety conference shall be organized for all workers including those from construction companies and manufacturers. During regular inspections, a construction site patrol shall be conducted once a week and instructions shall be given to improve an unsafe behavior and poor work environment. The first and second warnings on unsafe behavior are "caution". Without strict disciplinary rules that stipulate, for example, that the first and second warnings shall constitute a "caution" and the third warning shall result in dismissal, safety will never become established. It is important for Head of P/S and other executives to improve their attitude, as they are constantly compared with one another.

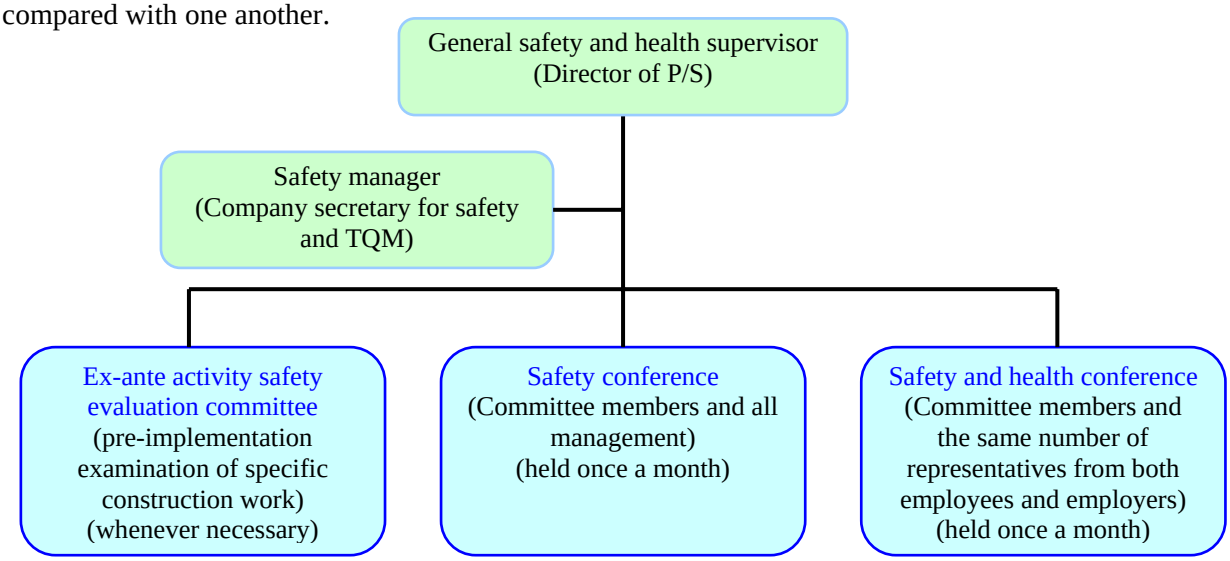


Figure II-7-3 Safety and Health Management Structure

(2) Introduction of Reward and Penalty System

Those who finished on-premise safety precaution training shall be given a sticker which is to be put on a helmet. (Those who conduct welding operation shall also be given safety training and those who finished safety training shall be given a sticker.) It is necessary to establish a structure to enable experts to educate workers so that they will be able to acquire skills required for jobs for which Labour Standard Bureaus of Japan grant a license to managers who finished training. These jobs include scaffolding work, crane operation with wire rope, gas welding, prevention of oxygen deficiency and handling of specified chemical substances. This is the work that the government must do. However, P/S needs to ensure safety on its own in the foreseeable future.

(a) Safety Award

Award to an improvement proposal that clearly ensures worker safety, including the one that aims to install a sign to prevent erroneous operation, install a tag plate on valve station valve, or improve a patrol route. (Create an atmosphere in which anyone can submit a proposal any time. Offer different cash rewards to different proposals that have been adopted depending on the content.)

(b) Penalty, Re-education and Recommendation on Resignation

If those who finished safety precaution training and who do not wear required protective equipment, ignore instructions for safe operations, continue to engage in unsafe behavior (was instructed to improve behavior by the safety committee patrol), or ignore on-premise safety precaution did engage in unsafe behavior, the worker concerned shall be suspended from work from the following day.

(3) Safety Training

Video pictures of actual operations shall be taken and used as teaching materials for workers at P/S for training. These operations include the correct procedures to put on fatigues, protective footwear and protective helmet during construction work, high-place work (fall prevention measures), work that requires the use of fire (fire, explosion, spark), heavy-duty lifting (fall of heavy goods, contact with goods during lifting operation), ventilation measures for closed work site (oxygen deficiency, hydrogen sulfide), electric shock prevention measures (use of protective equipment, voltage detection), and restricted areas within work area and display.

A fire company for self-defense shall be organized separately for work hours during daytime hours of work and for holidays and nighttime, with the latter consisting of duty persons. These fire companies shall repeatedly conduct drills, including water-discharge exercise, fire extinguishing training, and emergency call exercise on holiday and during nighttime.

As part of extinguishing and water-discharge exercises, fire companies shall use an electric pump and engine-driven pump alternately.

(4) Safety Manual

Every business establishment has a safety manual. However, BPDB P/S does not use it at all. It is therefore necessary to create and distribute a portable, easy-to-understand, pocketable manual in a local language to all staff. In addition, it is necessary to review the system of the existing manual as shown in the figure below, and to formulate concrete rules that are more appropriate for job site to carry out rules and measures for each division.

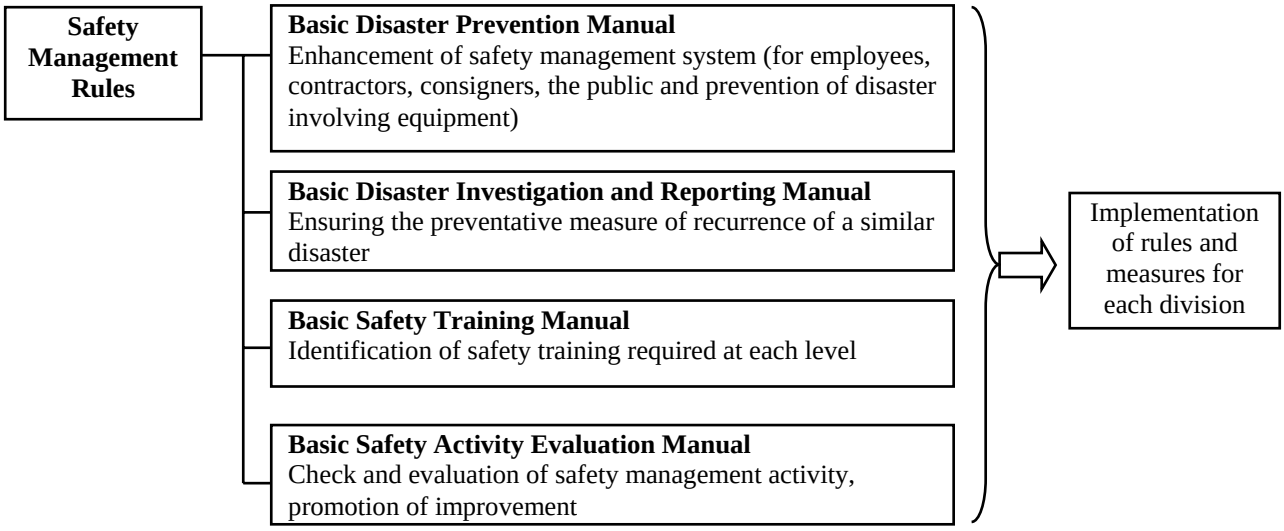


Figure II-7-4 Safety Management Manual System

7.1.3 Ex-ante Activity (Preventive Activities)

(1) Clarification of dangerous areas

In the P/S, there are storage areas of dangerous goods that can induce fire and explosion. To enter this area or to do repair work at facilities in this area, an application for prior authorization shall be made, by which the work under authorized condition is permitted. Especially, the patrolmen of gas receiving station shall carry a gas detector to check for gas leaks at flange joints, detector joints and valve glands. The P/S entrance gate shall be provided with an overall layout plan of the premises which shows the dangerous areas and the locations of fire hydrants / fire extinguishers with distinction of types (large or small type with tires or not and types of articles to be extinguished). Let workers who enter the area for the first time confirm the regulations restricting the entry and an emergency phone number (to the chief duty person in the central control room). A supervisory board capable of detecting activation of fire alarm, smoke detector and gas leak detector shall be provided in the security office and central control room. Smoking shall be prohibited in all areas in the P/S and the signs shall be posted in various places. The P/S employees shall leave cigarettes and lighters at their desk when they leave for the workplace. The same rule shall be applied to workers.

- Dangerous areas to keep out:
- Gas receiving/metering stations and piping
- Emergency diesel fuel tank and piping
- Station boiler fuel tank and piping

(2) Security and disaster prevention

- Provide a layout plan of the premises next to the guard station where check-in procedures are performed.
- Show dangerous areas, firefighting equipment, fire hydrants and emergency contact on the layout plan.
- Alert those who enter the premises by car or truck for the first time to keep out of and away from the dangerous areas.
- Hydrogen collecting equipment for cooling the power generator

(3) Fire protection/preventive equipment in P/S

- Lay a looped fire-fighting pipe all around the P/S. Install water-in taking hydrant boxes (with fire hose) at pivotal points.
  Install both electric-driven pump and engine-driven pump.
- Install powder fire extinguishers and foam fire extinguishers at pivotal points for initial firefighting of possible fuel gas/oil fires and electric facility fires. The typical fire extinguishers are shown below by function. Put serial numbers on fire extinguishers that are always equipped at the P/S to prevent them from being transferred or lost. Check twice a year if they are stored in place.
- Fire extinguisher types
  Oil: Gas fire, powder (ABC) fire extinguisher, 8L type, large types 100L/200L
  Normal fire: Foam fire extinguisher, 6L type, 20L type
  Electric fire: Carbon dioxide fire extinguisher, 6L type
- In Japan, the Fire Defense Law specifies which firefighting equipment to use; a fixed type or portable type, discharge time, amount of medical agent contained, etc. according to an object of facilities to extinguish a fire. (Administrative direction is provided.)
  Also, check the installation status, appearance and functional capability of the fire extinguishers at least once every 6 month to maintain the functions. The expected life is 8 years.

(4) Collecting near-miss cases and compiling them into brochure
Even if an incident was a “near-miss” case that did not end in disaster, there are many cases that even the slightest mistake leads to a serious disaster. Thus, it is necessary to clarify any danger in the workplace as a risk factor even if it is a minor disaster, assess it as a risk and develop it in the form of rule or measures that act as preventive measures of reoccurrence and outbreak of disasters.

(5) Clarification of TBM-KY activity and work instruction
Before the start of work, it is important that all workers jointly clarify risks associated with their work to be done on the day to prevent accidents, which is called the TBM-KY activity. Every work instruction needs to be given not verbally but in the form of paper to mutually confirm the steady communication among the workers.

7.1.4 Ex-post Activity

(1) Ex-post reporting system
A person responsible for response to disasters shall be the safety personnel. The assistants shall be an assistant (staff) to the chief officer and a person in charge of labor management in the administrative department. (Responds to daily repair work and disasters for construction company workers.)
If an accident occurs, lifesaving is given the highest priority. In case of fatal disaster, the area shall be designated as a no-go zone to preserve the scene. In case of disasters resulting in minor or serious injury, victims shall be transported first and then the area shall be designated as a no-go zone to preserve the scene.
Also, the accident shall be reported to the associated external organizations (police, the Labor Standards Inspection Office and hospitals) as well as the associated departments of electricity producers and BPDB.

(2) Emergency responses
In case of large-scale disasters such as the one producing plural victims and the one affected by explosion/fire during plant operation or scaffolding, the accident countermeasure headquarters shall be set up with the P/S chief officer as the chairman. The measures shall be taken mainly by the countermeasure task force consisting of the safety personnel, assistant to the chief officer, the associated people in the administrative department, power station department and repair department and a chief officer of the construction company.
If a disaster accident occurs during the power plant operation, designers of the manufacturer and external academic experts shall be invited to pursue the cause and develop preventive measures of reoccurrence.
When a disaster occurs, the first person to find it shall report it to the central control room first. Then, the central control room shall communicate it urgently based on a contact chart which shows who to contact at the time of disasters.

7.1.5 Safety Equipment

The safety equipment owned by the P/S shall be functionally checked regularly.
The safety equipment brought by a construction company to the P/S shall be checked with the presence of both parties to confirm if there is any risk of activation failure, damage or functional inhibition. The equipment permitted for use shall be attached with an emblem for identification.
(The refused equipment shall be taken out of the P/S immediately.)

7.1.6 Strengthening Safety Management System during Construction Period

The daily repair department and the construction company shall make a work plan of the following day, discuss it with the equipment management section and the construction management department, through which all members can know the construction information.

On the day of work, the central control office and the repair department in charge of the work shall be informed of the start of the work before it is started.
The work instructions of the day shall be confirmed by all members of each work group in the field, followed by TBM-KY before the start of the work. Never conduct an unscheduled work or a work based on workers' random thought. At the end of work, all members shall make the workplace clean and tidy and inform the central control office and the repair department of the end of work. Particularly when the work using fire is completed, the workplace shall be sprinkled with water to prevent fire caused by embers.

The workers who work in the P/S for the first time shall be given a beginner's training based on the P/S compliance manual. Also, it is necessary to create separate manuals such as "Work instruction manual for use of fire", "Work instruction manual for preventing oxygen deficiency in closed workplaces", "Work instruction manual for handling of specified chemicals" and "Safety manual for welding work" in sequence, which are routinely used at a thermal P/S.

Chapter 8. Information Management

8.1 Concrete Strategy

8.1.1 External information transmission

(1) Establishment of Website

Establishment of the Website for NWPGCL is proposed as soon as possible to ensure external communication, “clarify” the management and gain more awareness of exterior persons by positive information transmission.

(2) Transmission of varied information

Transmit information positively by using the media such as newspaper, TV and radio. Is recommended. Especially, it is important to disclose not only positive and correct information but also any negative information openly. It is necessary to accurately report environmental emissions and others to authorities concerned and local governments based on given standards.

The power station is basically a hateful facility for the residents living in the vicinity of it. In view of this point, it is necessary to open the power station to the public and establish the system in which the ordinary citizens can tour our facilities if they wish.

8.1.2 Internal information transmission

(1) Information needed in management accounting

(2) Information on daily operation conditions

8.1.3 Application in O & M

(1) Trend management

The functional overview of the operation data processing computer (computer for management) among the operation information management is required. Based on this information, monitor the change of daily condition by the trend management and prevent the outages caused by accidents and others.

(2) Establishment of a check plan, Management system

By introducing the following Maintenance planning & Management system with use of the general-purpose software will improve functionalization, labor cost savings and reliability of the facility.

Chapter 9. Risk Management

In this chapter risks, which NWPGCL will face, are clarified. With this in mind, the frequency rate and influence degree of these risks are estimated and risk mitigation measures are proposed.
Risks are classified by considering occurrence periods such as; Preparation/ during construction stage (Phase 1), Immediate operation stage (Phase 2: up to 3 years from commissioning), and Stable operation stage (Phase 3: 3-10 years form commissioning).

9.1 Relevant Contract

Risk level varies to a large extent by the text of related contracts. It is preferable for NWPGCL to conclude the contracts favorable for NWPGCL to reduce risks.

9.1.1 Power Purchase Agreement (PPA)

BPDB is to purchase all the generated electricity from NWPGCL. Power Purchase Agreement (PPA) is made between BPDB and NWPGCL to determine the purchase price. Payment for electricity is paid based on the PPA from BPDB to NWPGCL. Therefore, PPA is of considerable significance for the NWPGCL management system.

A key position of PPA between BPDB and Ashuganj Power Station Company Ltd. (APSCL) is shown below;

(1) Payment conditions

- Payment consists of two portions, Capacity payment and Energy payment
- APSCL sends the bill for the previous month to BPDB by the 7th of every month, and BPDB pays the charge within 45 days after receiving the bill.

(2) Capacity payment

- Capacity payment is determined by dependable capacity.
- Dependable capacity is determined based on the dependable capacity test, which is carried out within one month after an annual periodical maintenance. However, when the result of the dependable test is different from the actual value the company has the right to claim a re-test.
- Dependable Capacity Test measures 12 Net Energy Output continuously every 30 minutes in a power transmission end (delivery point). Dependable capacity is taken as the average value.
- Capacity payment consists of depreciation, cost of capital, return on equity, Operation & Maintenance, and administrative expenses. For O&M and Administrative expenses, the predetermined escalation rate (consumer price index) is to be taken account.

(3) Energy payment

- Energy payment is proportional to the generated electric energy (Net Energy Output).
- When the gas price fluctuates, the unit price of energy payment also changes according to the amount of such changes.
- Since the unit price of energy payment for every unit is determined taking into consideration the efficiency of each unit, the unit price at each unit differs. (The unit price of the inefficient unit is high.)

(4) Penalty for outage in operation

- As stopped operations, forced outages, maintenance outages, and scheduled outages are specified.

- In the sum total of the three outages specified above, an annual total of 876 hours (36.5 days) is allowed. In addition, every 3 years an annual total of 1440 hours (60 days) is permitted.
- When the outage hour exceeds the permitted period, APSCL needs to pay a penalty according to the number of hours which exceeded the allowable hours. The unit price of a penalty is the same as those of the capacity payment.

9.1.2 Gas Sales Agreement (GSA)

The fuel cost occupies the largest portion in expenditure of NWPGCL. NWPGCL pays the fuel cost of gas to Gas Transmission Company Limited (GTCL) based on Gas Sales Agreement (GSA) between NWPGCL and GTCL. Thus, establishment of GSA is an important factor for the management of NWPGCL, in terms of risks.

A key position of GSA between TGTDCL and APSCL is shown below;

(1) Gas rate

- Gas rate consists of two portions, a charge which is proportional to the amount of gas usage, and lease fee for a gas station (RMS: Regulating and Metering Station).
- The unit price of gas is based on those determined by the governmental institutions.
- The lease fee for RMS is a flat monthly rate (payoff period of 20 years is assumed)

(2) Amount of gas supply

- The gas supply amount, an upper limit of supply is determined by hourly, daily, and yearly amount.
- The annual amount of gas supply, the minimum amount of supply, which is equivalent to half of the annual upper limit, is determined.

(3) Payment of charges

- Even when the annual usage of gas is less than the minimum value, the gas rate equivalent to the minimum value needs to be paid. (Take or Pay provision)
- TGTDCL sends the monthly bill to APSCL by the 10th every month, and APSCL pays the charge within 27 days after receiving the bill. If APSCL does not pay the charge within 90 days after receiving the bill, TGTDCL is able to stop gas supply without any advance notice.

9.1.3 Maintenance Management Contract

LTSA’s largest characteristics are twofold as follows:

- Equalization of cost burden is obtained as the payment is made at a monthly fixed blanket price.
- The cost on unexpected repair and replacement is covered by supplier.

9.2 Preparation/ during construction stage (Phase 1)

9.2.1 Risks which the Construction is not as Planned

(1) Increase of construction cost

Currently, the global gas turbine market is a sellers' market, and the demand surpasses its production capability. Moreover, metal prices such as rare metals keep rising. Considering such circumstances, there might be the risk that due to hikes in construction costs, tender would be suspended after reaching a loan agreement (L/A). In order to mitigate such a risk, it is necessary to proceed with the tender process as soon as possible immediately after L/A. Therefore, NWPGCL has to start preparation of tender documentation before L/A, so that NWPGCL is able to promptly start tendering after conclusion of a loan agreement.

(2) Delays of construction period
There would be the possibility of delays of the construction period due to time-consuming tasks in tender and procurement processes. When a construction period becomes longer than planned, a no-operating revenue period continues and the construction costs increases. These business circumstances adversely affect revenue aspects in management. Cause of these risks is due to lack of coordination capability by the project management during constructions. For the mitigation of these risks, a well-experienced engineering company shall be hired in order to implement proper project management.

(3) Financial risks
During construction, the situation of no operating revenue continues. Only when existing power plants are taken over, the operating revenues would go into NWPGCL. During such a no-revenue period, all expenditures shall be paid by debt from BPDB. Approximately 80% of the total construction cost is applied by a yen loan between the government of Japan and Bangladesh, so that the financial risk regarding unprocurable financial resources is thought to be small.

(4) Risks regarding failure to meet the deadline for transmission construction
The length of a newly constructed transmission line is just 1km, and there seems to be no difficulty in acquiring land for a power line tower. Therefore, risks regarding failure to meet the deadline for transmission construction seems to be low. However, connecting a new line requires an operational outage of the existing transmission line, and there needs to be coordination of the outage period. Therefore, construction time allowance is required for outage coordination.

(5) Risk of gas not being delivered by P/S commissioning
Although Khulna Peaking plant is scheduled to start operation in 2011, construction of gas supply will not be complete. Therefore, the plant will use diesel oil as an alternative fuel option until gas is supplied. For the gas supply at Bheramara Power Station, the power station is located 100-km upstream of the Khulna power station and there seems to be a low risk of gas not being delivered by P/S commissioning if the gas supply project will be on schedule.

9.2.2 Risks which incur at the Time of Transfer of Existing Power Station(s)

The issues related to transfer of existing power stations are described in detail in Chapter 4.10. Management risk varies to a large extent by the method to be adopted for hiring and transferring the personnel at the time of transfer of existing facilities. In Chapter 4.10, it was recommended that the intention of personnel should be respected and a three-year transitional period be established to facilitate the soft-landing so that the personnel transfer takes place smoothly. If the compulsory measures such as drastic lay-off are selected without setting up a transitional period, following problems may break out.

(1) Activation of a Labor Union
Because Bheramara, Khulna Peaking, and Sirajganj Peaking plants will be newly developed, hiring employees will be done under the newly established employment policy and rule. On the other hand, for the case of existing power plants such as Barapukuria and Baghabari plants, present employees will be transferred to the new company of NWPGCL. Since those employees have been hired under the BPDB employment policy and rule, NWPGCL has to have a double standard in their employment policy.
The gap in the salary level between ex-BPDB and newly joined workers will be large. There will be the risk that ex-BPDB members might activate a labor union and it may be difficult to operate the power plant at normal conditions.

In order to avoid such risks, existing BPDB power stations shall be transformed to the Strategic Business Unit (SBU) and introduce a bonus and penalty system based on the performance evaluation

system. Also for ex-BPDB workers, NWPGCL would make the employment agreement of only 3 to 5 years under BPDB employment policy and the same payment conditions when NWPCGL takes over personnel from BPDB. When the previous contract expires, all workers have to take an employment examination. Only qualified employees will be hired based on the examination. For newly hired workers, salary conditions will be improved.

(2) Submission of dispute

When APSCL was inaugurated, it was decided to send all the manpower who was then working at the Ashuganj power station on loan to APSCL from BPDB and when temporary transfer period was over, they were to transfer to APSCL. Those who objected to this measure raised a dispute claiming that mandatory transfer at the completion of temporary transfer period would be unjustifiable. As a result, the High Court gave a decision favorable to laborers.

If NWPGCL ignores the intention of the personnel currently working at the existing power stations and decides on the transfer, there is a possibility that the same type of dispute is raised.

To avoid this risk, it is important to disclose the information related to transfer conditions to all the personnel currently working at the power station at the time of facility transfer, confirm their intention, conclude an individual employment agreement with those who chose to transfer, and confirm the post-transfer employment framework in detail.

9.3 Immediate Operation Stage (Phase 2: Up to 3 Years from Commissioning)

9.3.1 Forced Outage/Accidents due to Initial Troubles

(1) Poor quality at construction

When the quality control at the time of construction has not been fully performed, there will be the possibility that troubles resulting from the defect of quality will occur frequently, and operating availability ratio stays at a low level.

In order to avoid these kind of risks, a well-experienced engineering company for quality control shall be hired in order to implement proper quality control during construction. At the same time, NWPGCL has to implement quality control by itself, not relying on the engineering company.

(2) Lack of spare parts

If spare parts are not properly prepared when an accident happens, the parts which caused the trouble must be re-ordered from the manufactures. For some parts, lead-time is required for procurement, and this results in prolonging the outage period. This causes aggravation of the company's income-and-expenditure situation. With this in mind, parts which might require time for procurement shall be stored as spare parts at an earlier stage of commencement of commercial operation.

In terms of gas turbine, a 6 year LTSA is scheduled to conclude. With the conclusion of this agreement, the cost on unexpected repair and replacement of spare parts is covered by supplier. Therefore, there is no risk of extended outage hours due to the shortage of spare parts.

(3) Unpredicted error

At the earlier stage of commencement, there is a high possibility that unpredictable troubles will occur. Since gas turbines have been widely introduced and operated in the world, possibilities that unpredictable troubles will occur seems to be low. However, since peripheral equipment, such as fuel and cooling-water are manufactured according to the actual condition of the site, it might be possible that unexpected troubles may occur. In order to mitigate such risks, sufficient examinations in the design stage is required, and a well-experienced engineering company for quality control shall be hired.

9.3.2 Gas Depletion

The possibility of gas production being terminated in Bangladesh is a critical issue for the NWPGCL management. In particular, the western region where the power stations under the NWPGCL are

located, are the furthest regions form the gas filed. Therefore, the priority of supplying gas to NWPGCL power stations might be low compared to other power stations. As countermeasures, provisions such as dual-fired facility or the guarantee of assurance of gas supply shall be stipulated on GSA.
However, gas issues are not a simple matter which the NWPGCL can solely solve. It is a major matter and necessary for the whole nation of Bangladesh to handle.

If the dual-fired system is introduced at the new unit of the Bheramara power station, there is a large gap between gas and oil fuel prices. Generation costs would be extremely high if oil is used instead of gas. Hence, in order to minimize fuel cost risk the PPA between the NWPGCL and BPDB shall contain the provision that the unit price is determined based on the actual fuel cost. In this case, an increase of supply cost by a usage of high fuel price will increase the public's financial burden. Therefore, it is highly doubtful that the BERC will easily accept this PPA system.

As a reference, the result of economic evaluation of competitive edge of gas supply to Bheramara power station is described below.

The key messages obtained from this evaluation are summarized below:

(1) Key messages

- In accordance with the gas supply scenario provided by MoPEMR in September 2008, if the development level of 80% is maintained, the problem of gas shortage is expected to be resolved between 2014 and 2015 and the possibility of supplying gas to the power stations as planned is secured. Risk of gas shortage to be supplied to Bheramara power station scheduled to start operation in 2014 will be reduced.
- It is impossible to ensure supply capacity that will satisfy even the Low Demand in the ADB Electric Power Development Master Plan 2006 (hereafter referred to as ADB-MP2006) with only the gas thermal power that is currently planned. To satisfy the ADB-MP2006 Low Demand, further power generation facilities need to be developed. Gas supply capacity will be insufficient even at 80% development level if its development is to be provided only with gas thermal power.
- If gas development plan is not processed as planned in the scenario causing the gas supply shortage, prioritizing gas supply to highly efficient Bheramara power station will contribute to the reduction of supply cost by about 90 million USD annually throughout Bangladesh.
- From the viewpoint of the risk of delayed gas development and assurance of energy security, departure from dependence on gas is essential and securing a source of electric power by the use of domestic resources including coals from the long term perspective is necessary.

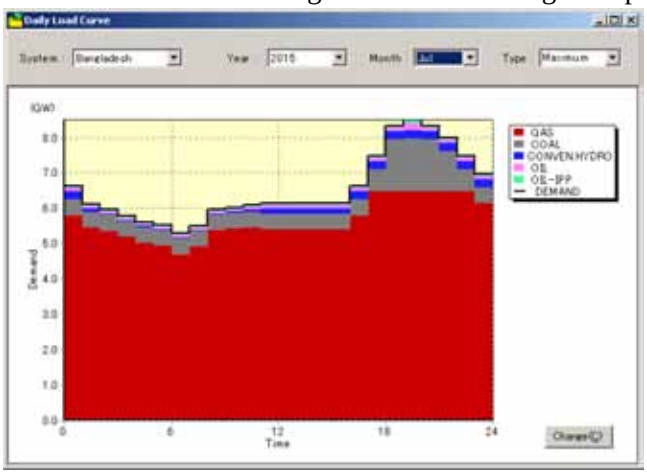
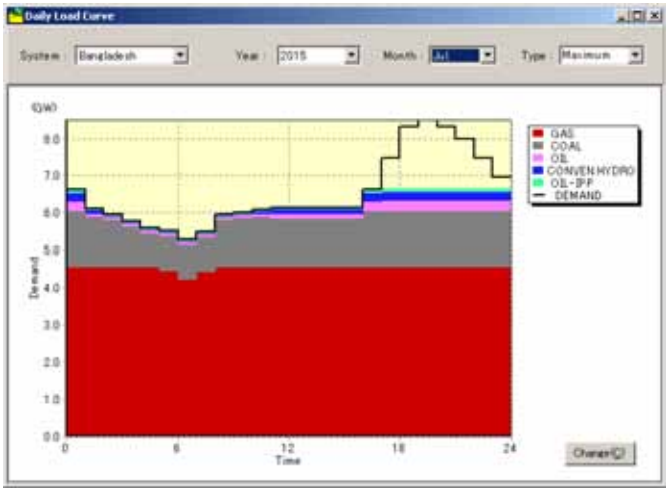


Figure II-9-1 Estimated daily load curve at maximum power generation (2015)
[Case 0 Rate of gas supply development 80%, Bheramara power station operated by gas]

(2) Recommendation

The result of simulation indicates that preferential supply of gas to highly efficient Bheramara power station facilitates effective utilization of fuel on a country level and contributes to the reduction of supply cost at the end. Thus it is recommended to prioritize the supply of gas to Bheramara power station even in the environment where the gas supply is limited.

Case 1 Bheramara power station run by gas



Case 2 Bheramara power station run by light oil

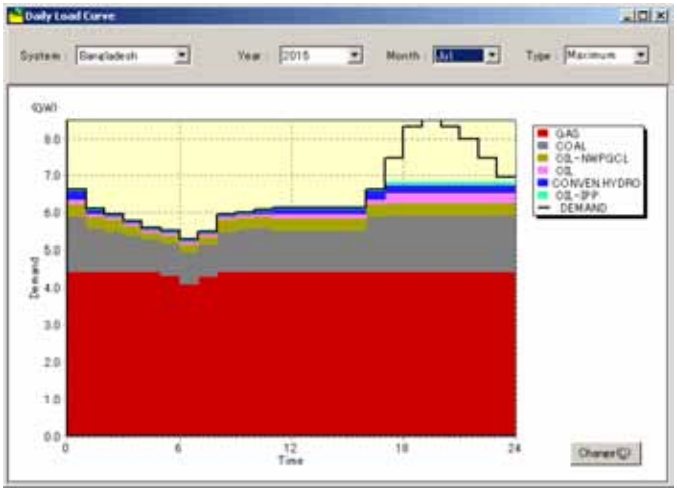


Figure II-9-2 Daily load curve at maximum power generation (2015)

9.4 Stable Operation Stage(Phase 3：3-10 Years form Commissioning)

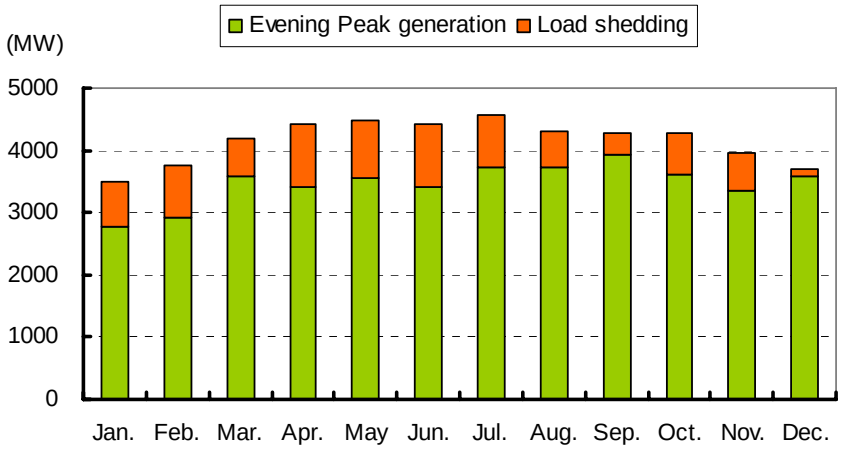
9.4.1 Risks of not being able to carry out Periodic Inspections on Schedule

In Bangladesh, the power supply has been in a constant serious insufficient condition. Under such circumstances, the power stations are not permitted to stop their operations in order to carry out periodic maintenance for preventive measures. Therefore, all power stations under the command of BPDB shall continuously operate even when periodical maintenance is required unless they face critical conditions. Even though the power station is unable to generate at the maximum capacity level, it would not be regarded as a serious condition and the power stations would be ordered to operate at a controllable capacity level. If the power station continuously operates under such conditions, it might face serious problems or accidents, resulting in loss of control. The power station finally carries out major maintenance work only after facing severe conditions, and operation will stop for a long term, and this results in a power crisis, not having enough power supply.

Although ASPCL is an independent power generation company, the generation units are forced to operate until it breaks down or face serious problems. The reality is, the company faces a shortage of cash due to a lot of account payable. Therefore, the company has to comply with BPDB's wishes. On the other hand, the Haripur IPP coordinated the maintenance period with BPDB for half a year and has successfully stopped operation to carry out periodic maintenance as planned.

Based on these observations, we strongly recommend that the NWPGCL shall establish a maintenance management system; planning periodic maintenance like IPPs, negotiating with BPDB to stop operation in line with the maintenance plan, and carry out such maintenance work at regular intervals. In order to carry out periodic maintenance as scheduled, the NWPGCL shall not only secure enough funding, but also select maintenance periods during the off-peak season when demand is rather small, and make unprecedented efforts to shorten the maintenance time.

The feasibility of implementing periodic testing is analyzed below. One of the factors causing a negative spiral of supply shortage is chronic electric shortfall. At present, as there is an extensive supply shortage, load-shedding is carried out almost every day in several locations in the country.
The amount of load-shedding is not necessarily the same every day, while no load-shedding is implemented on other days.
The actual maximum power demand for each month in 2007 including load shedding is estimated in the Figure below[4].



(Established by the JICA Team based on BPDB Web page)

Figure II-9-3 Estimated monthly maximum power demand in 2007

Maximum power demand occurs in July, while the difference in the demand from March to October is not large. During the period between December and February, power demand is eased slightly, with the level of less than 80% of annual maximum power demand. As such, if the power station can generate power in a stable manner throughout the year, it will have a reserve supply capability for a period of December through February, meaning that about 20% of the facility can be stopped during this low demand period.
The Power System Master Plan(June 2006) envisages that the power demand in 2014 when Bheramara power station starts operation is 7970MW even in the low case. Based on this power demand, it is assumed possible to stop the power facility of about 1600MW scale for the period of three months from December to February on a country level in Bangladesh.

9.4.2 Risks regarding Deterioration of Management Environment

Risks regarding deterioration of management environment are regarded as both the decrease of revenue and increase of expenditure. A large portion of operating revenues consists of electricity sales and major expenditure is for fuel procurement, which accounts for 80% of total expenditure.

(1) Challenges regarding revenue
(a) Risks for revenue
In case the agreement is the same as that of PPA concluded between APSCL and BPDB (See Section 9.1.3), large scale risks regarding revenues will not occur. In order to avoid risks for revenues, the NWPGCN shall adhere fundamentally to the PPA conditions similar to those of APSCL.
Presuming that the contents of the PPA are those mentioned above, there is likely to be risks. However, those risks could be controlled if O&M works are strictly carried out.

[4] Since an amount of load shedding has been recorded at the substation, actual maximum power demand is estimated by adding 1.1 times of recorded load shedding value in consideration of transmission losses.

1) Risks of capacity payment decreasing

Because of certain trouble, supply capacity and dependable capacity decrease, and as a result, the capacity payment decreases. In addition, a gas turbine has the characteristic that when inlet air temperature becomes high, the generation capacity decreases (or less output). Considering this characteristic, a dependable test is carried out at the time when outside temperature is high, and collective calculation shall be made.

2) Risks of having to pay the penalty at the time when operation is impossible

The NWPGCL shall pay the penalty fee for unscheduled outages such as serious problems, and prolonging periodic maintenance, which results in making operation impossible.

When the generation unit is stopped by the order of the load dispatch center, these outages might not be a target for penalization. In addition, PPA shall stipulate that the outages due to fuel supply and transmission troubles will not be penalized.

(b) Risks of electricity bill not being paid by BPDB

APSCL has Accounts Receivable (A/R) to BPDB, of which is equivalent to 1 year of sales amount. Even if a Profits and Losses statement (P/L) has remained in surplus, it might cause cash deficiency due to a large amount of A/R, so that the company might face difficulty for spare-parts procurements to manage the power station. On PPA, since the due date of payment (within 45 days) is clearly specified, the NWPGCL shall stress the importance of correcting A/R within the due date, and strive to correct A/R from BPDB in line with PPA conditions.

(2) Challenges for expenses

(a) Risks of expenditure

In case the agreement is the same as that of GSA concluded between APSCL and TGTDCL (See Section 9.1.4), the following risks are feared.

1) Risks for paying penalty in line with take-or pay provisions

When power generation units stop for a long period of time due to facility troubles and accidents, it becomes impossible to use even the minimum amount of gas, and the NWPCGL has to pay the penalty. As a countermeasure to the penalty payment, instead of making a separate GSA with each power station, it is better to make one packaged contract of GSA with NWPGCL. This is to work as a buffer for NWPGCL company as a whole. However, Khulna and Sirajganj power plants are for peak hours, and the amount of gas usage and generation is expected to be small.

Therefore, it is necessary to take this point into consideration and to determine the minimum amount of gas usage on GSA.

2) Risks for gas supply being stopped and continuation of operation becoming impossible

When gas supply stops suddenly, naturally the units of the power station cannot operate and has to be stopped. In this case, the power station has no revenue resources at all since there is no penalty clause on GSA. When this situation of no gas supply continues, the NWPGCL will suffer severe financial difficulty. As a measure to cope with this issue, the New Bheramara power station is designed also to utilize oil-fired system, so the risk of operational shutdown is low.

9.4.3 Risks of Decline in Capacity Factor

Due to the following conditions, a reduction of capacity factor at power stations results in a reduction of energy payment. Because the expenditure to fuel consumptions may also decrease, it is assumed that it will not affect the NWPGCL management. However, this is based on the premise that it is conditional that capacity payment income can definitely be secured. If this premise is not followed, it will pose a big problem for management of NWPGCL.

(1) Cooling water risk (insufficient water)
The Bheramara power station plans to utilize well water for cooling. Under the present circumstances, it is assumed that there is plenty of well water. The neighboring residents are also using well water. If there are some effects on the well water when the power station starts to use it, there is the possibility that the neighboring residences may not allow the station to use it anymore. In this case, in the least the steam turbine must be stopped and the capacity factor will decline.

(2) Long term stoppage accompanying an occurrence of a big accident
When a serious accident occurs a long time is required for repairs, and it is forced to stop for a long period of time. In this case, repair costs can be more than expected and be a major problem for management. Moreover, if it is expected that there will be a cut in supply power for a long period of time, there is a high possibility that BPDB will request reducing capacity payment. This results in a major problem for management of the generation company.
In addition, when the deficiency of large-scale facilities arises (eg. GT), it is presumable that they cannot be repaired locally and has to be transported to the appropriate factory. And the means of transporting heavy load from Bheramara power station is basically by river.
As the water level of the rivers nearby Bheramara power station changes greatly in the rainy and dry seasons and the landing pier cannot be used at all during the dry season, the situation where heavy load cannot be transported continues for some time. If a deficiency occurs in the beginning of dry season (around October), transporting the load to the factory would have to wait until the beginning of rainy season (around June), enabling the shipment totally for 8 months and lowering the utilization rate to a large extent.
For this reason, it is important to carry out O&M activities on a routine basis, and to take preventive actions to avoid major accidents.

Chapter 10. Management Plan

10.1 Policy Management

10.1.1 Significance of Policy Management

The management visions of NWPGCL are 3 pillars of "independence of management", " High-reliability power supply", and " Sustainable development", as stated in the previous chapter. These visions are the direction which should be aimed at as a company. However, even when abstract words are lined up as a vision, each employee's own direction and level may be different.
For this reason, in order to effectively realize these visions the management of NWPGCL needs to extract the item which should be carried out clearly and specify the level of the direction which should be aimed at, expressed as a numerical target.

10.1.2 Flow of Policy Management Activity

The figure below explains the flow of policy management activity.

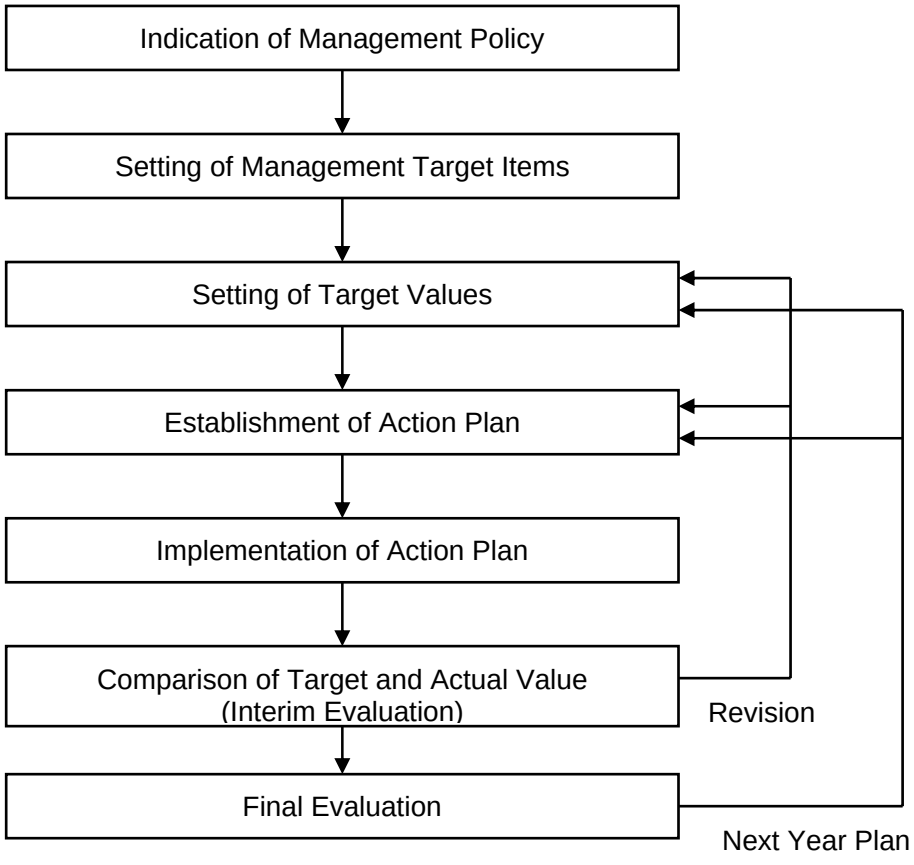


Figure II-10-1 Flow of Policy Management Activity

First of all, the Top management indicates the Management Policy of the company as a whole and sets the management target items in accordance with the policy.
Each management team sets the target value for each target item within their authority, and the action plan to achieve the target in the beginning of the fiscal year. Daily work will be done based on the

action plan, and the target and actual value will be compared in the interim comparison half a year later. The target value and action plan will be revised if necessary based on the result of comparison. At the end of the fiscal year, final evaluation will be carried out and the target and action plan of the next fiscal year will be established based on the evaluation result.

10.1.3 Activity Schedule of Target Management

The following Table shows a concrete image of the activity of one year.

Table II-10-1 Activity schedule of target management

	May	Jun.	Jul. – Dec.	Jan.	Feb. – Jun.	Jul.
Submission of Management policy						
Hearing for Next year plan	△				△	
Corporate Targets Setting Group Targets Setting		△			△	
Implementation			◄———	———	———►	
Interim Check				△		
Final evaluation			△			△

(1) Submission of Management policy
Top management will submit the Management policy. It is not recommended to revise the Management policy very frequently, but considering the changes of time, it shall be revised once in about 3 years.

(2) Hearing for Next year's plan
Middle management explains and discusses the action plan of their group. In this hearing, Corporate Targets and Group Targets shall also be discussed.

(3) Corporate Target Setting, Group Target Setting
Based on the discussions in the hearing mentioned above, Corporate Office sets the items and the target value of the target year as a Corporate Target.
After acknowledgement of the Corporate Targets, Middle management will set their Group Target and revise their action plans.

(4) Implementation
Each group performs their work based on their action plans.

(5) Interim Check
After about 6 months, Corporate Office discusses with each group and checks the deviance of the plan and the actual results at the interim phase. If the deviance is large, Corporate Office will give suggestions on revision of plan or methodology. Top management shall also attend this meeting whenever convenient.

(6) Final evaluation

Based on the annual achievement of each group, Top management will conduct hearings regarding the level of achievement towards the target.

Corporate Office will attend this hearing as the secretariat of the target management activity and give rewards or penalties to each group according to their achievements.

10.2 Performance evaluation system

(1) Proposal of a performance evaluation system for NWPGCL

The power station under the NWPGCL has to perform efficient management, and has the obligation to work for the public's benefit as well. For this reason, when the NWPGCL evaluates the performance of each power station, the stance of supplying inexpensive and stable electricity is important. That is, from this viewpoint, NWPGCL shall evaluate management and operation conditions properly, and provide appropriate instructions to each power station as required.

Based on the performance evaluation system at the Baghabari power station, the performance evaluation method for the SBU-power station under NWPGCL is proposed. As indicated in the table below, evaluation is made based on the 9 management targets, and total points become 100 points as the maximum.

Table II-10-2 The performance evaluation method of each plant in NWPGCL (proposal)

Category	Target	Definition	Points
Business Efficiency	(a) ROA: (Return on Assets)	Return/Assets (%)	25
	(b) Fuel consumption rate	Gas consumption/Sales electricity (m^3/kWh)	10
Soundness of Facilities	(c) Number of forced outage	Number of outages due to trouble in generation facilities	15
	(d) Contents of periodic inspections	Number of actual inspection items /Planned item number	10
Customer Satisfaction	(e) Duration of outage	Duration of outage (Forced + Planned)	15
	(f) Availability	Dependable capacity/Rated capacity (%)	10
Basic Business Infrastructure	(g) Number of injury accidents	All accidents which result lost work time or 3 or more days	5
	(h) Record of Training	Record of Training (Man-Days)	5
	(i) Environmental emissions	Emission and discharge level to air and water	5
Total			100

A target value is set up beforehand. When the actual value greatly exceeds the target value, full marks are obtained. When the actual and target values are the same, 80% to 90% is to be obtained on the proposed evaluation system. If the calculated points are more than 50%, a bonus will be paid according to the points. However, if it is less than 50%, a penalty is to be given by measures such as a salary cut.

(2) Preparation of environment for putting performance evaluation system into practice

(a) Setting up a virtual PPA

In order to create financial statements as the SBU every year, it is necessary to conclude a virtual PPA between the NWPGC and each power station. Each power station differs in its characteristic in generation operating patterns because the types of generators and fuel are quite different. For this

reason, if the same purchase price is equally employed to all the power stations, there will be some power stations which are able to easily earn profits. On the other hand, some plants will go into the red even if they try to work very hard. Considering these circumstances, a different unit price shall be carefully considered for each power station. This results in creating a level of profits for all stations. In addition, when external factors such as fuel prices and the inflation rate fluctuate in the middle of a year, the equation for compensation calculation is built virtually so it is not necessary to change the contract every time external factors change.

(b) Precise evaluation for the contents of periodic inspections

As an index, which measures the long-term soundness of power generation facilities, the implementation items, or contents of the periodical inspections are employed, and defined as (number of actual implementation items) / (the number of planned items). However, this numerical conversion includes a large variation in importance for each item and it is difficult to simply quantify and evaluate numerically. For this reason, it is necessary that the person in charge of safety and quality management at NWPGCL shall have full responsibility to precisely evaluate the contents of the periodic inspection and revise the marks. Thus, it is required that they have the ability to make such a precise evaluation.

(c) Method for Target Setting

As a method for performance evaluation, this study proposes to evaluate the achievement against the target value. In adopting this method, NWPGCL is required be able to determine a fair and adequate target value for each power plant. The Study Team will propose to adopt yardstick method. Based on yardstick method, purchase price, level of repair work cost, personnel cost (or no. of employees), etc. can be determined and target value can be set based on the various indicators. In doing so, actual data from other companies (BPDB、APSCL、EGCB、IPP, etc.) will be examined for reference.

10.2.2 Delegation of Authority to the Director of Power Plant and Evaluation Method

(1) Delegation of Authority to the Director of Power Plant

In order to enable all power plants including Bheramara TPP to operate autonomously and efficiently, a large portion of authority shall be delegated to each power plant by means of manpower, facility, and financial power.

(a) Allocation of budget, expenditure, procurement of materials

All authority regarding expenditure excluding large-scale repair works, which shall affect the balance of payment of the power plant, shall be delegated to the Director of the power plant.

In the power plant, the scale of budget shall be determined considering the revenue & expenditure forecast. Based on the determined scale of budget, a detailed budget plan shall be established and be approved in the Top Management Meeting of the power plant.

If this method is adopted, the HQ of NWPGCL does not need to grasp all of the information of small-scale maintenance works and large amount of workload can be reduced.

(b) Personnel planning

NWPGCL shall assign only a few management class people (about 3 members) for each power plant. The authority of personnel planning shall come under jurisdiction of the Director of the power plant. As a matter of course, the Director shall delegate its authority to the middle-class management accordingly to their appointments.

(c) Operation of the power plant

Regarding the operation of the power plant, each power plant shall generate power accordingly to the hourly dispatching orders submitted from the Central Load Dispatching Center the day before.

Scheduled outages for maintenance works etc. shall be determined after mutual consultation with the Central Load Dispatching Center and HQ of NWPGCL.

(d) Procurement of Fuel and Conclusion of Gas Supply Agreement (GSA)

Fuel is an important property of the country and usage shall be planned based on the government policy. Therefore, procurement of fuel and conclusion of GSA shall be done by HQ of NWPGCL.

(e) Conclusion of PPA (Negotiation of Purchase price)

Negotiation of Purchase Price and Conclusion of PPA shall be done by HQ of NWPGCL.

Chapter 11. Roadmap for Corporatization

11.1 Short-term Roadmap

Table II-11-1 Short-term Roadmap

Phase 0 [from June 2008-June 2009 (L/A)]

				2008								2009											
				1	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
		[Key Benchmark] Conclusion of Loan agreement														L/A ▲							
		[Preparation of Corporate Governance System]																					
1	CG-3	Determination of Job Description and Terms & Conditions for the chaireman, and the board of directors	Board of Directors [BD]																				
2	CG-4	Determination of Job Description and Terms & Conditions for Top Management [TM]	Advised by the JICA Team																				
3	CG-5	Formation of Compensation Committee	Board of Directors [BD]																				
4	CG-7	Finalization of Selection Criteria & Selection Process for Top management Team (TMT)	BD (Selection Committee)																				
5	CG-8	Execution of Selection Process (Advertisement, Initial Screening, Interviews and selection finalization)	BD (Selection Committee)																				
6	CG-13	Formation of Audit and Governance/Environment Comittees	Board of Directors																				
7	CG-15	Holding 1st general shareholder's meeting	Board of Directors																				
8	CG-14 FA-5	Selection of external auditor	Board of Directors																				
9	CG-10	Establishment of Corporate Visions	Board of Directors, NWPGCL TMT																				
10	CG-17	Establishment of web site	NWPGCL TMT																				
		[Selection of Key Executive Managers (KEM)]																					
1	HC-4	Determination of Job Description and Terms & Conditions for KEM and AO	NWPGCL TMT																				
2	HC-7	Finalization of Selection Criteria & Process for KEM, AO	NWPGCL TMT																				
3	HC-8	Execution of Selection Process (Advertisement, Initial Screening, Interviews and selection finalization)	NWPGCL TMT																				
4	HC-9	Conclusion of employment agreement	NWPGCL TMT																				
		[Establishment of Corporate Office]																					
1	CG-16	Establishment of Corporate Office (Head office)	NWPGCL TMT																				
		[Application of Legal Procedures]																					
1	CN-1	Preparation of Gas Supply Application seeking Commitments with Gas Company (Fuel Supply Clearance)	NWPGCL TMT																				
2	CN-2	Issuance of Gas Supply assurance letter from the Government	MoPEMR, NWPGCL TMT																				
3	CN-3	Transfer of new Bheramara Project from BPDB to NWPGCL	BPDB, NWPGCL TMT																				
4	CN-4	Completion of FS(D/D), JICA Study (Viability Assessment by lender)	JICA																				
5	CN-5	Submission of EIA including with SIA and Approval of EIA and SIA from Directorate of Environment	NWPGCL TMT																				
6	CN-6	Preparation/Submission of Detailed Project Proposal and Approval of DPP by planning commission (ECNEC)	NWPGCL TMT																				
		[Preparation of Loan Agreement]																					
1	CN-7	Implementation of Project Appraisal	JICA																				
2	CN-8	Finalization of Loan Agreement (L/A)	JICA, GOB																				

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Result → ← Plan

11.2 Mid-term Roadmap

Table II-11-2 Mid-term Roadmap (first half)

Phase 1-1 [from January 2009-December 2010]

				2009												2010											
				1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
		[Key Benchmark] Transfer of existing P/S from BPDB					Baghabari ▲					▲Barapukuria						▲Bheramara									
		[Preparation of Loan Agreement]																									
1	CN-7	Implementation of Project Appraisal	JICA																								
2	CN-8	Finalization of Loan Agreement (L/A)	JICA, GOB																								
3	CN-9	Conclusion of Subsidiary Loan Agreement	GOB, NWPGCL																								
		[Preparation of Tender and Construction Phases]																									
1	CN-10	Preparation of competitive selection of Consultant by NWPGCL	NWPGCL KEM																								
2	CN-11	Selection procedures for consultant	NWPGCL TMT																								
3	CN-12	Preparation of tender (EPC) by NWPGCL	NWPGCL KEM, Consultant																								
4	CN-13	Selection of EPC contractor	NWPGCL TMT, Consultant																								
		[Preparation of Corporate Governance System]																									
1	CG-18	Issue of Annual Report	Board of Directors																								
2	CG-21	Holding general shareholder's meeting	Board of Directors																								
		[Taking-over Existing BPDB P/Ss]																									
1	TF-1 MG-2	Formulation of Mid-term management plan(management objective and numerical target)	NWPGCL TMT																								
2	TF-2 MG-3	Determination of Performance evaluation method for P/S	NWPGCL TMT																								
3	TF-3 MG-4	Determination of sharing roles between HQ and PS	NWPGCL TMT																								
4	TF-4 MG-5	Determination of delegation of power (Administration)	NWPGCL TMT																								
5	TF-5	Determination of personnel transfer method	NWPGCL TMT																								
6	TF-6	Organization structure at P/S	NWPGCL TMT																								
7	TF-7	Determination of top management at P/S	NWPGCL TMT																								
8	TF-8	Determination of Performance evaluation method for individual	NWPGCL TMT																								
9	TF-9	Preparation of Job description and Service rules	NWPGCL TMT																								
10	TF-10	Preparation of Compensation package and Employment conditions	NWPGCL TMT																								
11	TF-11	Conclusion of Power Purchase Agreement between BPDB and NWPGCL	BPDB, NWPGCL TMT																								
12	TF-12	Conclusion of Fuel Supply Agreement	Fuel company, NWPGCL TMT																								
13	TF-13	Conclusion of Vender's Agreement	BPDB, NWPGCL TMT																								
14	TF-14	Agreement of retirement benefits between BPDB and NWPGCL	BPDB, NWPGCL TMT																								
15	SF-1 SF-7	Establishment of Safety policy & Safety Committee	NWPGCL TMT																								
16	OM-2 OM-3	Establishment of Environment management system	NWPGCL TMT																								
17	FA-9	Determination of delegation of power (Finance)	NWPGCL TMT																								
18	FA-10	Determination of Budget management system	NWPGCL TMT																								

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Table II-11-3 Mid-term Roadmap (latter half)

Phase 1-2 [from January 2011-December 2014]

				2011						2012						2013						2014					
				1	3	5	7	9	11	1	3	5	7	9	11	1	3	5	7	9	11	1	3	5	7	9	11
		[Key Benchmark] Commercial operation of new P/S									Khulna ▲ Sirajganj ▲																
		[Preparation of Tender and Construction Phases]																									
1	CN-13	Selection of EPC contractor	NWPGCL TMT, Consultant																								
2	CN-14	Construction	NWPGCL, EPC Contractor																								
3	CN-17	Installation and trial run	NWPGCL, EPC Contractor																								
		[Selection of New Employees]																									
1	HC-16	Establishment of manpower planning and employee policy	NWPGCL TMT																								
2	HC-17	Determination of new recruits number	NWPGCL TMT																								
3	HC-18	Determination of pay standard	NWPGCL TMT																								
4	HC-19	Determination of recruitment method for new employees	NWPGCL TMT																								
5	HC-20	Execution of Selection Process (Advertisement, Initial Screening, Interviews and selection finalization)	NWPGCL TMT																								
6	HC-21	Conclusion of employment agreement	NWPGCL TMT																								
		[Operation & Maintenance]																									
1	OM-4	Implementation of OJT training during construction	NWPGCL																								
2	OM-5	Conclusion of O&M (LTSA) contract	NWPGCL TMT																								
3	OM-6	Negotiation with PGCB(responsibility area, command method)	NWPGCL TMT																								
4	OM-7	Implementation of performance guarantee test	NWPGCL																								
		[Application of Legal Procedures]																									
1	CN-15	Conclusion of Power Purchase Agreement between BPDB and NWPGCL	BPDB, NWPGCL TMT																								
2	CN-16	Conclusion of Fuel Supply Agreement	Fuel company, NWPGCL TMT																								
		[Reinforcement of Corporate Framework]																									
1	HC-22	Establishment of incentive and benefit scheme	NWPGCL TMT																								
2	HC-23 HC-24	Formulate training policy, Establishment of training system	NWPGCL TMT																								
3	MG-12	Establishment of TQM Steering Committee	NWPGCL TMT																								
4	MG-13	Establishment of TQM Promotion Office	NWPGCL TMT																								

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11.3 Long-term Roadmap

A long-term roadmap, related to those items which are to be implemented soon after the commissioning of the Bheramara power station (after 2015) as set out below, is proposed.

(1) Public offering of stocks
Although the Bheramara power station is a wholly owned (100%) subsidiary of BPDP, part of the station will be opened to the public as part of the management practice in which the company is conscious of the opinion held of the general stockholders.

(2) Move of headquarters
The address of the headquarters is Dhaka for the time being because procedures to between our headquarters and government offices occur frequently. However, from the viewpoint of coexistence with the location of the power station, the address of our headquarters will be moved to the western part of Bangladesh over time.

(3) Improvement of information infrastructure
Planned installation of a dedicated communication line between headquarters and each power station, and improvement of software such as MIS, ERP and others to share information between headquarters and each power station, will promote operational labor cost savings.

(4) Development of the maintenance department to the profit center
For six years after commissioning, the engineers from the equipment manufacturer mainly implement maintenance based on the agreement of the LTSA. During this period, the staff from the maintenance department improves their technical capabilities and in the future, the maintenance departments of all power stations will be integrated, the profit center will be created independently.