The People's Republic of Bangladesh
Ministry of Power, Energy & Mineral Resources
The Coal Power Generation Company Bangladesh Limited

Preparatory Survey Report
for
the Construction and Operation of Imported Coal Transshipment Terminal Project in Matarbari Area
in
the People's Republic of Bangladesh
(PPP infrastructure project)

Final Report

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Japan International Cooperation Agency

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Abbreviation

ADB	Asian Development Bank
BBS	Bangladesh Bureau of Statistics
BERC	Bangladesh Energy Regulatory Commission
BFD	Bangladesh Forest Department
BNBC	Bangladesh National Building Code
BOT	Build-Operate-Transfer
BOO	Build-Own-Operate
BOOT	Build-Own-Operate-Transfer
BPDB	Bangladesh Power Development Board
CCEA	Cabinet Committee on Economic Affairs
CFPP	Coal Fired Power Plant
COD	Commission Operation Date
CPGCBL	Coal Power Generation Company Bangladesh Limited
CTSA	Coal Transshipment Services Agreement
CTT	Coal Transshipment Terminal
DAM	Department of Agricultural Marketing
DOE	Department of Environment
DOF	Department of Fisheries
DWT	Dead Weight Ton
ECA	Ecologically Critical Area
ECC	Environmental Clearance Certificate
ECR	Environmental Conservation Rules
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMP	Environmental Management Plan
EMoP	Environmental Monitoring Plan
EPC	Engineering, Procurement and Construction
FIRR	Financial Internal Rate of Return
GOB	Government of Bangladesh
GRC	Grievance Redress Committee
ICC	International Chamber of Commerce
IEE	Initial Environmental Examination
IFI	International Financial Institutions

IPP	Independent Power Producer
IMF	International Monetary Fund
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
JV	Joint Venture
LAO	Land Acquisition Officer
MoPEMR	Ministry of Power, Energy and Mineral Resources
MOU	Memorandum of Understanding
ODA	Official Development Assistance
O/M	Operation and Management
PPP	Public-Private Partnership
PSPGP	Power Generation Policy of Bangladesh
PSIF	Private Sector Investment Finance
PSMP	Power System Master Plan
RAP	Resettlement Action Plan
RFP	Request for Proposal
RFQ	Request for Qualification
RSMC	Regional Specialised Meteorological Centre
SDR	Social Discount Rate
SIAC	Singapore International Arbitration Centre
SPC	Special Purpose Company
TOR	Terms of Reference
UNCTAD	United Nations Conference on Trade and Development
USAID	United States Agency for International Development
USC	Ultra Super Critical
WASA	Water Supply and Sewerage Authority
WB	World Bank

Summary

(Background of the Project)

As Bangladeshi economy grows, its demand for energy has steeply increased. The domestic energy supply in 2013 is about 180% of the supply in 2000. According to the draft of Power System Master Plan 2015 (draft PSMP2015), Bangladeshi economy is estimated to grow at 6.0-6.5% per year toward 2041. To cover this economic growth, the power source needs to be developed progressively. The draft PSMP2015 estimates that the power demand will grow from 15,475 MW in 2015 to 57,000MW in 2041. The draft PSMP2015 also estimates that the total demand for coal in 2041 will be 80,728 thousand ton, of which 97.5% i.e. 79,500 thousand ton will be imported. However, it is difficult to import fuel coal to each coal fired power plant (CFPP) directly by large-scale coal carrier since most of the coastal area of Bangladesh has a shoaling beach. It is also inefficient to transport imported coal by small vessels which can pass through existing channels to each power plant in terms of economy and stable coal supply. Therefore, the construction of a coal transshipment terminal (CTT) that can accommodate large-scale coal carriers is indispensable to the realization of the above-mentioned CFPPs. As the Matarbari area in Cox’s Bazar District in Chittagong Division is the only promising site that has easy access to the deep sea area and has limited adverse impact on the surrounding environment, construction of the CTT with deep sea-port that can accommodate large coal carriers at the Matarbari area and realising the economic and efficient imported coal supply to the CFPPs constructed in the country are considered imperative.

This study aimed to improve the stable supply of imported coal by constructing CTT as a common infrastructure for Bangladesh where many CFPPs are planned to be constructed. This study also aimed to develop the assistance plan assuming the participation of Japanese investor and to develop a project implementation program in which the utilisation of official development assistance (ODA) loan and the Japan International Cooperation Agency (JICA) overseas investment loan was considered. For these aims, this study focused on the following two issues;

(1) To develop the coal logistics system to satisfy the imported coal demand for planned CFPPs

(2) To formulate the CTT plan to secure the returns of the investment from the CTT operation and to make this investment as a meaningful investment.

(Coal Demand)

Annual coal handling volume at CTT was estimated based on the future development plan of CFPPs. The Power System Master Plan 2015 (draft PSMP2015) Study, which is being studied under JICA, estimates the total electric power demand in 2041to be 52,000 MW. According to the draft PSMP2015’s scenario, the proportion is as follows: natural gas: 35%; coal: 40%; oil: 5%, and others (nuclear: 8% and imported power: 12%). The draft PSMP2015 estimates that the total demand for coal in 2041 will be 80,728 thousand ton, of which 97.5% i.e. 79,500,000 t will be imported. It also

estimates that 86.5% of coal will be used for the power sector. The coal demand was also considered based on the draft PSMP 2015.

The maximum annual coal handling volume was determined based on the planned CFPPs using imported coal for which the Bangladeshi government has signed a memorandum of understanding (MOU). Development of CFPPs using imported coal started in 2012 with a capacity of 1,320 MW and consuming 3.82 Mt of coal per year. The capacity will reach 23,691 MW with 68.7 Mt of coal per year in 2041. However, it is difficult to make a precise estimate of the commencement date of operation. Therefore, phased development plan of CTT was recommended to have enough flexibility, i.e., to expand the CTT when the power generation program develops and the realistic commission operation date (COD) becomes certain.

As the first phase of the CTT will commence operation in 2025, the object of the 1st Phase will include these power stations that will commence operation by 2029 and use the CTT. The total generating capacity of these units will be 3,800 MW. The following 2nd Phase, which is planned to commence operation in 2030, targets those plants with COD later than 2030, and the total generating capacity will be 5,240 MW.

(Coal Logistics)

It was assumed to procure coal from Australia and Indonesia in the CTT project, although procurement plan of coal for CFPPs has not been decided and loading ports have not been specified yet. Australia and Indonesia are main supplying countries of coal and the distances from Australia and Indonesia are more efficient than from other coal producing countries. Transit time from Australian coal loading ports to Matarbari is about 19 days, and transit time from Indonesian loading ports is about eight days.

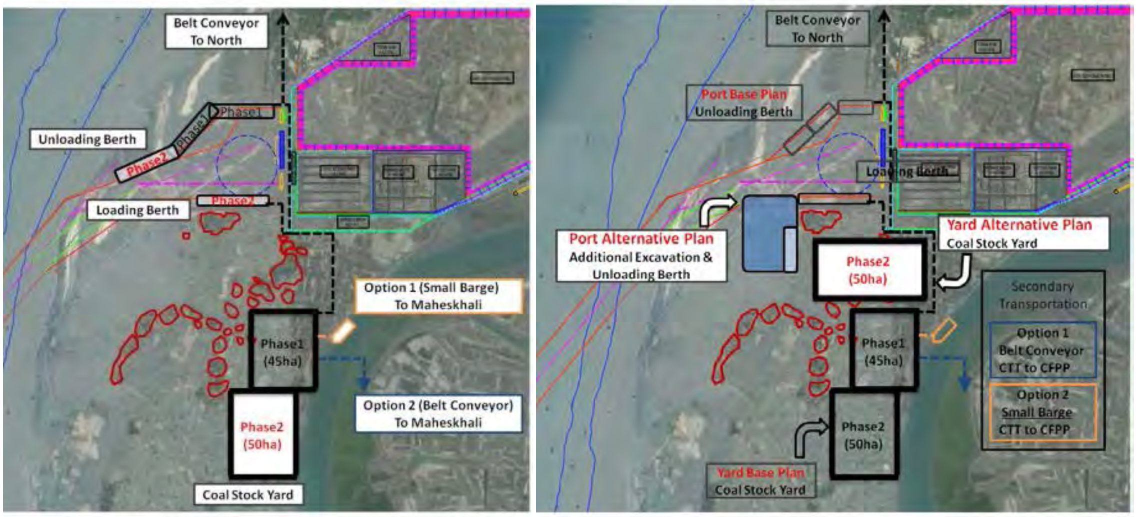
From the view-point of loading operation and chartering vessels, vessel size for imported coal is Panamax size which is the acceptable maximum size for channel of Matarbari CFPP. Considering the current conditions of canal, secondary transportation through conveyor is used in the 1st Phase, and secondary transport vessels of 5,000 DWT are considered in the 2nd Phase.

(CTT Layout Plan)

The capability of expansion, impacts on the surrounding environment, construction cost, construction work impact and others were considered for the determination of the layout of CTT. The CTT facilities include coal unloading berth, coal loading berth, expansion of inner harbour for Matarbari CFPP, coal stock yard and belt conveyor from unloading berth to coal stockyard. Secondary transportation facilities to the surrounding CFPPs are not within the scope of CTT but under the CFPPs.

The layout plan in the 1st Phase was mainly considered to minimize the effect to the surrounding society and environment, since early start of operation is required in Bangladesh.

There are several options for the determination of the layout plan in the 2nd Phase depending on the existence or non-existence of resettlement before the implementation of the 2nd Phase. In this study, the case where resettlement has not been conducted until the start of the 2nd Phase study is employed as the base case. If resettlement has been conducted based on other applicable studies, alternative plan is also considered.



Source：JICA Study Team

Figure CTT Layout Plan (Left：Base Plan, Right：Alternative Plan)

(Port Plan)

The above mentioned coal import ships and secondary transport ships were considered for the determination of the port plan. Survey results of existing facilities and dimensions of coal transport ships were considered for the determination of the capacity of the coal unloader and two continuous coal unloader of 2,500 t/h per berth with unloading efficiency of 75% were selected. Based on a similar study, one loader of 1,500 t/h per berth with loading efficiency of 90% was selected. Considering the existing CTT, annual operation days of 350 days and working hours of 18 hours were considered.

The recommended berth occupancy ratios shown in “Port Development – A handbook for planner in developing countries” issued by the United Nations Conference on Trade and Development (UNCTAD) as well as the above mentioned conditions were considered for the determination of the required number of coal unloading berths. Average waiting time of vessels computed by queuing theory and other factors were also referred for the determination of the required number of unloading berths.

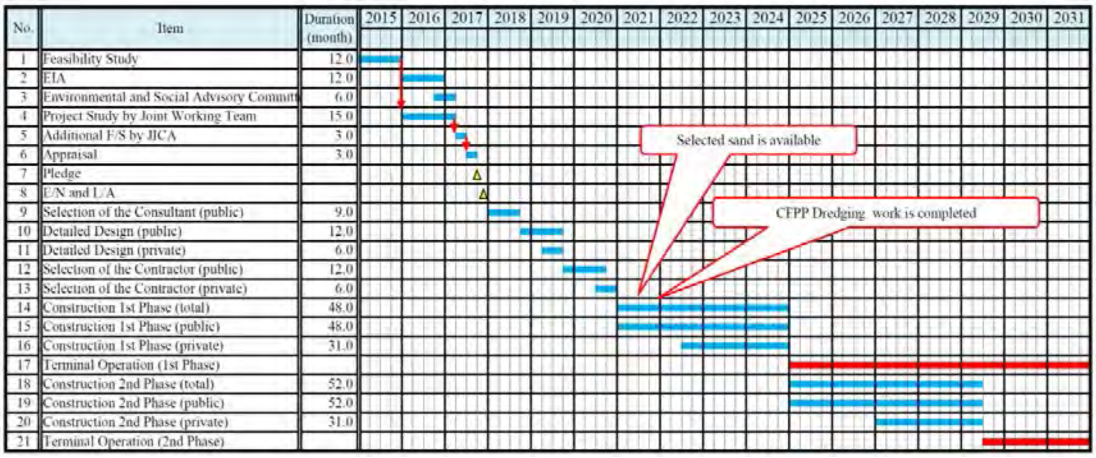
(Terminal Plan)

The outdoor coal storage was proposed as the coal storage type in this study from the perspective of safety control against spontaneous combustion in handling sub-bituminous coal because it may cause serious damage by fire accident unless appropriate measures against spontaneous combustion are provided. The outdoor coal storage such as that involving stockpile, stackers, and reclaimers is used for piling and delivering the coal because of its advantage in terms of expenses and handling operation convenience, including its measure against spontaneous combustion. However, it requires appropriate coal dust control such as installation of dust-control fence and sprinkling of water because it may affect the surrounding environment.

For general operation in the CFPP, 1 to 2 month's coal stock is required in the CFPP stockyard. In this study, one month stock is necessary to operate stably. The effect of rough wave conditions during the monsoon season on berth working ratio was considered in determining the necessary coal stockyard area for the case of offshore unloading berths without breakwater.

(Outline of Execution Plan and Schedule for Construction Works)

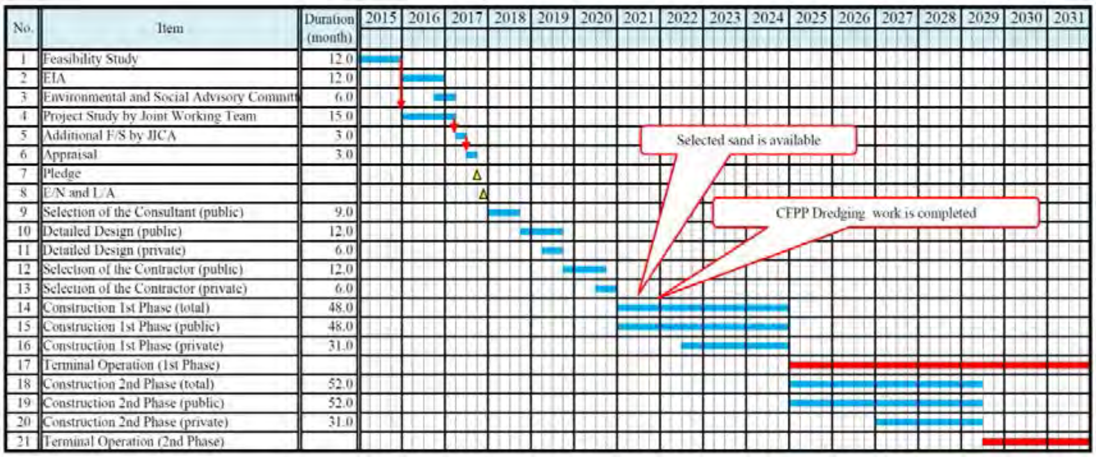
The outline of execution plan for the construction works was prepared based on the proposed phased development plan of this project. Outline of construction schedule was prepared based on the conceptual design for each development phase as well as the above mentioned execution plan. Tentative overall project schedule was also presented based on the phased development plan and outline of execution plan and schedule of construction works.



Source：JICA Study Team

Figure Tentative Overall Project Schedule (Original Plan)

The possibility of earlier opening of CTT was studied according to the request of the Coal Power Generation Company Bangladesh Limited (CPGCBL). The recommended countermeasures were mentioned for the construction stage and preparation stage. When all the countermeasures are applied, it is possible to open half of the area of the CTT after 36 months from the commencement of construction, which is 12 months earlier than the original plan. Construction schedules and the project schedule as a result of the study shown in this section are the earliest schedules and the actual required time of opening CTT is not considered. Reasonable time of opening and the possibility of the recommended countermeasures shall be studied in the next stage.

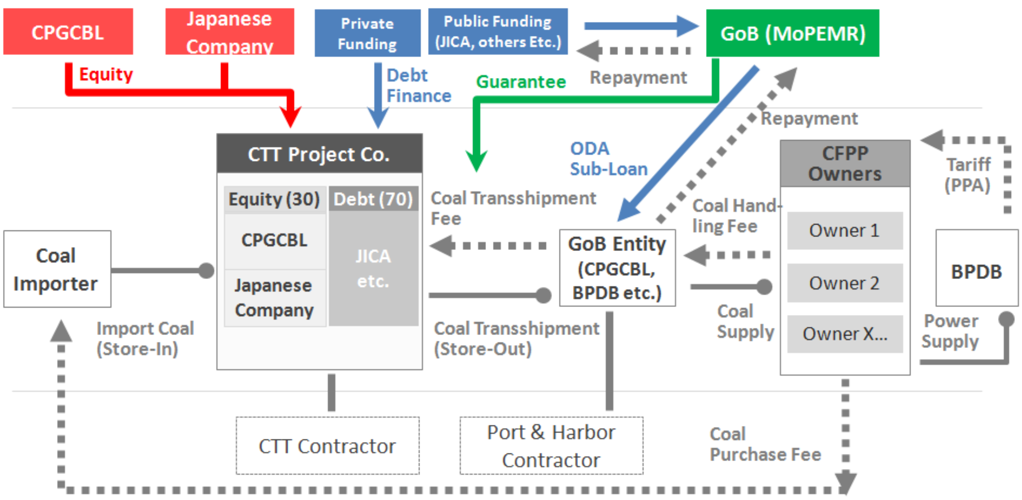


Source：JICA Study Team

Figure Tentative Overall Project Schedule (Shorter Plan)

(Terminal Management)

In order to make the project successful, it is important to determine the project risk assignment between the government and the private sector. For this reason, the application of Japanese ODA, which the government manages, is expected for the lower part of the infrastructure for unloading berth, loading berth, and coal stockyard, and for the CTT project including the investment for the upper part of the infrastructure, the private sector consisting of both Japanese and Bangladeshi firms shall set up a special purpose company (SPC) and invest and operate the terminal. For the performance of each work, it was expected that reliable companies will be selected for each work and the work will be performed under subcontract arrangement. For the organisation of SPC, the following scheme was investigated.



Source: JICA Study Team

Figure Relation of SPC and other related organization and firms

The running cost of CTT operation was obtained from personnel expenses, utilities expenses, water charge, depreciation cost, maintenance cost of coal handling equipment, insurance cost, land usage fee, maintenance cost for the lower infrastructure and other necessary expenses which were obtained by considering the anticipated project scheme and the features of the organisations and the port and terminal.

(Financial Analysis)

Construction cost, maintenance cost and operation cost for each phase have been obtained and financial and economic analysis has been done. Several general conditions such as application of normal market price at the project site, negligence of price fluctuation and interest of rent money, and inclusion of consultant fee for detailed design and supervision of construction works were applied for obtaining the construction cost. The estimation of terminal operation cost is obtained from above studies. Feasibility is evaluated by calculating terminal handling charge (THC) per tonne which fulfills the equity internal rate of return (IRR) of the special purpose company (SPC) required by the public investor. It is common to calculate the minimum rate of return on a capital investment project (hurdle rate) for investment as “capital cost plus spread between domestic and overseas interest rates”.

The term of the project is from 2021 to 2055, and the financial analysis was considered from the commencement of the construction work. Thirty percent of the total project cost was assumed to be financed by the investors’ equity from both Japan and Bangladesh and the rest of the project cost was assumed as loan under the JICA “Private Sector Investment Finance (PSIF)”.

The THC is assumed to be based on take or pay mechanism, which consists of capacity charge (fixed charge for installed capacity of CFPP) and variable charge. Fluctuation of capacity charge, which includes the cost of compensation for the financing cost, its interest and capital cost including dividend and tax cost, and compensation for the fixed operation and management (O/M) cost such as labour cost and periodic maintenance during the project period, was considered based on the idea that phased development is employed in accordance with the increase of coal demand. The THC is based on the assumption that the capacity charge guarantees the agreed income amount of SPC as long as CTT maintains its performance, which is mutually agreed in advance. In other words, the price in each phase was obtained based on the assumption that the coal demand in each phase will not increase during the project term.

(Economic Analysis)

The “With Project Case”, wherein the CTT project will be conducted, and the “Without Project Case”, in which coals from Indonesia and Australia will be imported and transshipped form large vessels to small barge offshore, and transported up to 5,000 DWT for other CFPPs, were considered in the economic analysis. The benefit is considered as the difference between the total project cost for the “With Project Case” and “Without Project Case”.

An economic internal rate of return (EIRR) of more than 12% was obtained from the economic analysis and this is larger than the social discount rate (SDR) of 12%, which is employed in similar study in Bangladesh indicating that the project will be feasible from the perspective of the national economy.

(Concerned Local Laws and Regulations)

Currently, projects developed jointly by the private and public sector, whether as build-operate-transfer (BOT), build-own-operate (BOO), build-own-operate-transfer (BOOT) or otherwise, are generally subject to Bangladeshi Law. Whilst exemptions may be negotiated with the government on a project by project basis, e.g. with respect to public procurement, transfer restrictions, and foreign exchange rules. there is currently not yet a dedicated legal regime for public-private partnership (PPP) projects. Based on the indicative time schedule of the project, it is likely that the PPP Law would have been passed by the time the CTT project is being tendered, but it is uncertain to what extent secondary legislation would have been promulgated at that point.

Implementing a large infrastructure project such as the CTT project will involve various kinds of project risks such as country/political risks, natural risks, legal risks and commercial risks. These are the typical types of risks which investors would carefully consider and which should be carefully allocated between the government and the private investor in order to ensure the commercial viability and bankability of the CTT project.

(PPP Project Plan)

The SPC is supposed to be formed through the joint investment of the government entity and private company to fund the construction of the upper infrastructure of the CTT. It was recommended that the SPC, which raises funds, constructs, manages, and operates the upper infrastructure of the CTT, should have an experience of operating and managing the CTT in Bangladesh or some other countries and of procuring and supplying coal domestically and internationally and is a coal user, such as independent power producers (IPPs) operators.

Debt financing under the JICA private sector investment finance (PSIF), which is long term and low interest non-recourse project finance is the most probable option to improve the profitability of the project. Then, SPC will be responsible for its management and operation after completion of the construction.

(Proposed Plan of CTT)

The recommendation plan was proposed for the efficiency of the CTT project. The plan is to manage the coal handling facilities of Matarbari CFPP No.1 and No.2 and the CTT integrally. The Matarbari CFPP No.1 and No.2 plan to construct coal unloading berth and coal stockyard whose capacity has leeway for operation. Therefore, it is possible to make the operation more efficient through the unified management of the CFPP and CTT.

(Environmental and Social Considerations)

The current study was categorised by JICA as category B because the environmental impacts are not significantly critical adverse impacts and they are site specific and mitigable by normal mitigation measures. Considering the case with small-scale resettlement at the planning stage, the study covers the environmental study at the initial environmental examination (IEE) level and the framework of the resettlement action plan (RAP) and the terms of reference (TOR) for the required study such as environmental impact assessment (EIA) and RAP. The environmental study to meet the requirement under the official process for the EIA should be continued by the implementation agency after the current JICA study through the submission of the IEE report and TOR for EIA to obtain the approval of the Department of Environment (DoE).

Chapter 1. Introduction

1.1. Background of the Project

As Bangladeshi economy grows, its demand for energy has steeply increased. The domestic energy supply in 2013 is about 180% of the supply in2000. As a result of development of natural gas fields since 2000 and production of domestic coal since 2005, the domestic energy production also increased considerably. The domestic production is about 190 % of that in 2000. According to the Power System Master Plan (draft PSMP2015), Bangladeshi economy is estimated to grow at 6.0-6.5% per year toward 2041. To cover this economic growth, the power source needs to be developed progressively. The draft PSMP2015 estimates that the power demand will grow from 15,475 MW in 2015 to 57,000MW in 2041.

Bangladesh has mainly depended on thermal power generation using domestic natural gas. As the domestic natural gas production is believed to decrease in the near future and increase of domestic coal production is difficult, Bangladesh has a plan to raise the proportion of thermal power plant using imported liquefied natural gas (LNG) and imported coal. Although the draft PSMP2015 does not show the balance (proportion) of future energy source at this moment, it is estimated that no single energy source will be more than 50% and that coal and natural gas will cover 70%-75% of power source in 2041. Based on this basic principle, many thermal power generation plants are planned by power generation companies under the Ministry of Power, Energy and Mineral Resources (MoPEMR) and independent power producers (IPPs) and some other joint investment plants with other countries. The total electric power generation capacity of 22,260 MW by many coal fired power plants (CFPPs) is planned.

However, it is difficult to import fuel coal to each CFPP directly by large-scale coal carrier, since most of the coastal area of Bangladesh has a shoaling beach. It is also inefficient to transport imported coal by small vessels which can pass through existing channel to each power plant in terms of economy and stable coal supply. Therefore, the construction of a coal transshipment terminal (CTT) that can accommodate large-scale coal carriers is indispensable to the realisation of the abovementioned many CFPPs.

As the Matarbari area in Cox's Bazar District in the Chittagong Division is the only promising site that has easy access to the deep sea area and has limited adverse impact on the surrounding environment, construction of the CTT with deep seaport that can accommodate the large coal carriers at the Matarbari area and realising the economic and efficient imported coal supply to the CFPPs constructed in the country are considered imperative.

In Japan's official development assistance (ODA) policy for Bangladesh, "*accelerating sustainable economic growth with equity and bringing people out of poverty towards becoming a middle-income country*" are mentioned as basic principles of the assistance, and "*to increase electricity supply* *through the development of power plants and transmission and distribution grids"* is promoted as one of the priority areas. Actually, Japan has supported the feasibility study (F/S) on the implementation of the Haripur Combined Thermal Power Plant near Dhaka, Bheramara Combined Thermal Power Plant located southwest of Dhaka and Matarbari Coal Power Plant located south of Chittagong and made positive contribution to the elimination of power shortage in Bangladesh. Because the major objective of this project is to supply imported coal efficiently to the CFPP and to contribute to the stable electric power supply in the country, this project corresponds to the Japanese and JICA's assistance policy to the power generation sector in Bangladesh.

The "Policy and Strategy for Public-Private Partnership (PPP), 2010" is an infrastructure-related legislative system in Bangladesh. Related infrastructural fields of coal supply and electric power generation were considered as one of the priority sectors in this legislative system and the CTT project that supplies imported coal to the CFPP is considered to be in line with the basic policy of this legislative system. So far, no port infrastructure project has been undertaken under the PPP scheme; this CTT project would be the first PPP infrastructure project in Bangladesh.

1.2. Objectives of the Study

This study aims to improve the stable supply of imported coal by constructing CTT as a common infrastructure in Bangladesh where many CFPPs are planned to be constructed. This study also aims to develop the assistance plan assuming the participation of Japanese investor and to develop a project implementation program in which the utilisation of ODA loan and JICA's overseas investment loan will be considered. For these aims, this study will focus on the following two issues:

(1) To develop the coal logistics system to satisfy the imported coal demand for the planned CFPPs.

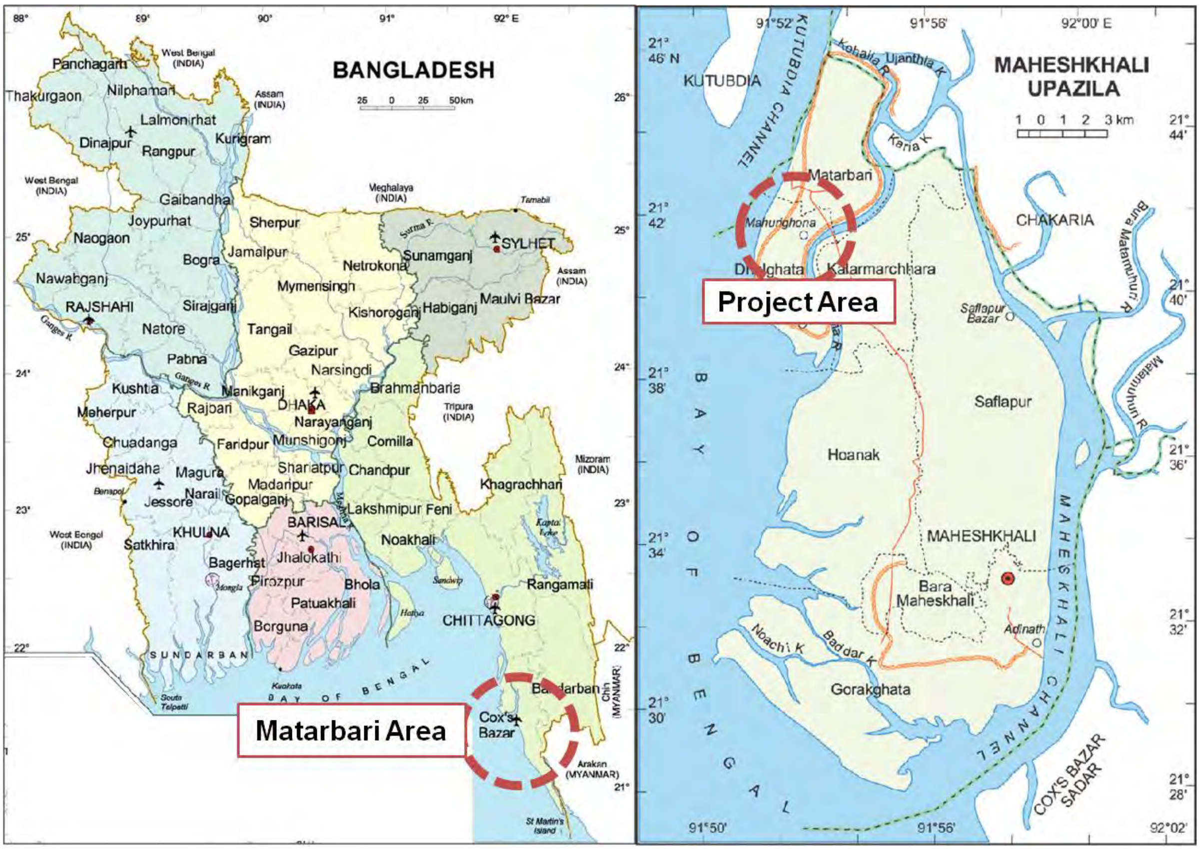
(2) To formulate the CTT plan to secure the returns of the investment from the CTT operation and to make this investment a meaningful investment.

Annual handling volume of coal supply at CTT will be studied in this F/S and applicability of phased development plan of CTT will be studied by considering the gradual increase of coal demand.

1.3. Project Site

Country: Bangladesh; District: Matarbari

Currently, the construction of Matarbari CFPP No.1 and No.2 and deep seaport for accommodating large coal import ships is in the planning stage. In this study, use of this deep seaport for importing coal and secondary transport of coal to the anticipated CFPP by CTT were assumed. Ship operation for coal import to Matarbari CFPP No.1 and No.2 and future land use concept of this region were also considered in the study.



Source：http://www.in2bangla.com/upazilaMap.php?id=293

Figure 1.3.1 Project Site

Chapter 2. Current Status of the Region

2.1. Natural Conditions of the Region

2.1.1. Topographical Feature

The People's Republic of Bangladesh is located at the east side of the Indian subcontinent facing the Bay of Bengal. Most part of Bangladesh is located in the world's biggest delta of the Ganges River (Padma River in Bengali), the Brahmaputra River (Jamuna River in Bengali), the Meghna River, and their distributaries. The project area is located about 150 km south of Chittagong in the southeastern part of Bangladesh, and on the coast near Cox's Bazar.

2.1.2. Climate

(1) Outline

Bangladesh has a tropical climate which changes by season. During the summer season from March to June, it is hot and humid and the maximum temperature is about 24-35 ℃, and occasionally over 40 ℃. During the monsoon season from June to October, the temperature decreases due to rainfall. The winter season from October to March is warm. The yearly average rainfall in Bangladesh is about 2,300 mm and the rainfall from June to September accounts for 80% of the total rainfall.

(2) Temperature

Weather observation stations are located in Cox's Bazar and Kutubdia near the project area. Annual changes of temperature in both areas are not so different, and seasonal change is nearly fixed. The temperature in January is 19-21 ℃. After January, the temperature is getting higher and higher and it is 28-29 ℃ in April. During April and October, the temperature remains at 27-29 ℃. However, the temperature during July and October gets cooler than that during April and June. During November and December, the temperature is getting cooler and the temperature in December is 21-23 ℃. The maximum monthly average temperature in Kutubdia is 29.4 ℃ in May 2010, and that in Cox's Bazar is 29.9 ℃ in April 2010. On the other hand, the minimum monthly average temperature in Kutubdia is 18.9 ℃ in January 2003, and that in Cox's Bazar is 19.6 ℃ in January 2003.

(3) Rain fall

The yearly average rainfall in Kutubdia is 4,321-5,905 mm, and that in Cox's Bazar is 5,286-6,707 mm. Most of the rainfall is during May and October. On the other hand, it has never rained in some months such as November and April. In this way, the rainy season is obviously different from the monsoon season.

(4) Humidity

Annual change of humidity in Kutubdia and Cox's Bazar is calm, and seasonal change is nearly fixed. Throughout the year, the humidity is 65-90%. In the rainy season from May to October, the humidity is 75-90%. And in the other season from November to April, the humidity is 65-85%.

(5) Wind

In Cox's Bazar, the wind is usually "calm (less than 0.5 m/s)". Especially during September and March, the wind is "calm" for more than 50% of the day. However, in the other points, the features of wind directions are same in both areas. In January and February, prevailing wind direction is northerly. However, there is no especially strong wind. During March and October, prevailing wind direction is southerly, and it is significant especially during April and September. In July and August, the wind speed of southwesterly is slightly strong. Apart from it, however, the speed of strong wind is not significant. In October, wind direction changes from south to north, and the wind speed of southwesterly tends to be strong. In November and December, prevailing wind direction is northerly. However, wind speed of southwesterly tends to be strong.

2.2. Socio-economic Condition of the Project Area

2.2.1. Location

Project site is located between Matarbari Union and Dhalghata Union in Maheshkhali Upazila in Cox's Bazar District of Chittagong Division.

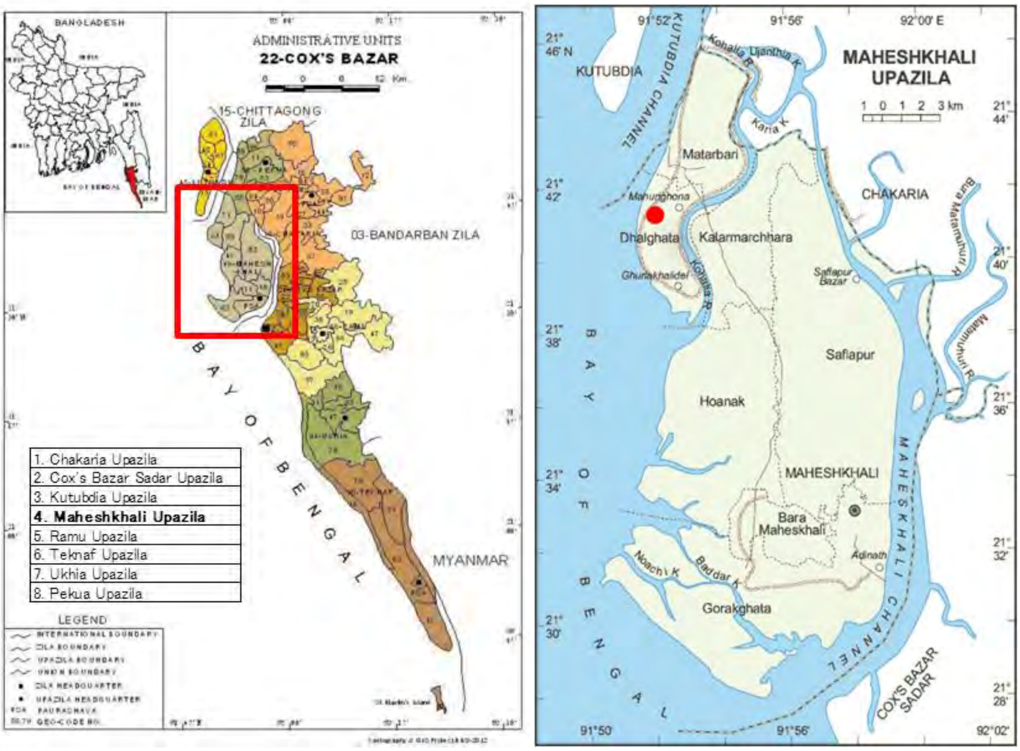


Figure 2.2.1 Cox's Bazar District

2.2.2. Population

The population of Bangladesh is 142 million people, and the population density is very high at about 1,000 people/km^2 (March 2011, Bangladesh Bureau of Statistics). Almost all of the people in Bangladesh are Bengali, but in the Chittagong Hill tracts next to the border of Myanmar, there are minority Buddhist people, e.g., Chakma people. The official language is Bengali. Literacy rate of adult (over 15) is 56% (2011). The state religion of Bangladesh is Islam (89.7%). Other religions of Bangladesh are Hindu (9.2%), Buddhism (0.7%), and Christianity (0.3%).

According to the Census of 2011, the population of Matarbari Union is 8,168 households (44,936 people, 5.5 people/household). Population density is about 1,662 people/km^2. The population of Dhalghata Union is 2,250 households (12,877 people, 5.7 people/household). Population density is about 6,441 people/km^2. Table 2.2.1 shows the population and number of households in Cox’s Bazar District in 2011.

Table 2.2.1 Population of Cox’s Bazar District in 2011

Upazila	Household	Population			Average size of household	Density per sq. km.
		Male	Female	Total		
Chakaria	88,391	239,198	235,267	474,465	5.4	942
Cox's Bazar Sadar	82,683	241,637	217,445	459,082	5.3	2,011
Kutubdia	22,587	64,093	61,186	125,279	5.5	581
Moheshkhali	58,177	165,693	155,525	321,218	5.5	887
Pekua	31,944	86,310	85,238	171,538	5.4	1,229
Ramu	47,904	135,000	131,640	266,640	5.5	681
Teknaf	46,328	133,106	131,283	264,389	5.7	680
Ukhia	37,940	104,567	102,812	207,379	5.4	792
Total	415,954	1,169,604	1,120,386	2,289,990	5.5	919

Source: Bangladesh Bureau of Statistics District Statistics 2011

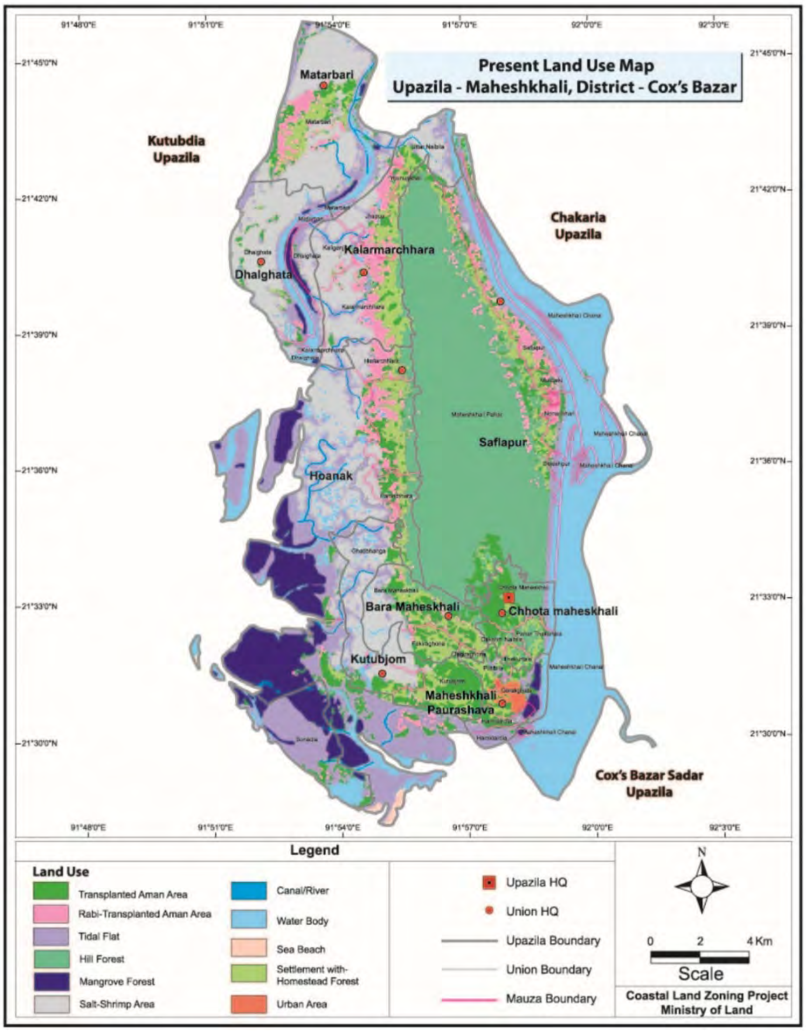
2.2.3. Land Use

Table 2.2.2 shows the land area of Cox’s Bazar District. The area of Bangladesh is 147,000 km^2 and the area of Cox’s Bazar is 2,500 km^2. Figure 2.2.2 shows the land use in Moheshkhali Upazila. Over 50% of the land use of the proposed area is for salt field and cultivation area of shrimp.

Table 2.2.2 Area of Cox's Bazar District

Upazila	Total Area (km^2)	Land Area (km^2)	Reserve Forest (km^2)	Riverine Area (km^2)
Chakaria	503.83	327.06	136.25	40.47
Cox's Bazar Sadar	228.23	196.05	-	3.50
Kutubdia	215.79	199.15	-	-
Moheshkhali	362.18	249.80	-	112.38
Pekua	139.68	135.41	2.25	2.02
Ramu	391.71	246.42	145.29	-
Teknaf	388.66	227.60	159.80	1.36
Ukhia	261.80	137.77	155.14	0.91
Total	2,491.85	1,719.26	598.73	160.61

Source: Bangladesh Bureau of Statistics (BBS) District Statistics 2011



Source: Ministry of Land's Land Use Map

Figure 2.2.2 Land Use of Moheshkhali Upazila

2.2.4. Industry

Fishery, salt production, and shrimp aquaculture have been developed.

In Maheshkhali Upazila, many people work in salt marsh. Usually, they are poor, and do not own the land. Thus, they usually rent the land. The average area of salt marsh is about 0.62 ha. The elevation of the area is so low that storm surge often occurs. Storage facilities of salt are insufficient. Hence, salt is often lost due to heavy rain and storm surge.

Chapter 3. Coal Demand Forecasting

3.1. Overview of Energy in Bangladesh

As Bangladeshi economy grows, its demand for energy has steeply increased. The domestic energy supply in 2013 is 33,870 thousand ton of oil equivalent (toe), which is about 180% of the supply in2000 (18,602 thousand toe). As a result of development of natural gas fields since 2000 and production of domestic coal since 2005, the domestic energy production also increased considerably. The domestic production is 28,727 thousand toe in 2013, which is 190 % of that in 2000. Natural gas production is 18,957 thousand toe, which occupies 66% of the total production. Table 3.1.1 shows the Energy Balance of Bangladesh (International Energy Agency). (Note: JCIA's Power System Master Plan 2015 (draft PSMP2015) will cover the country's primary energy growth estimate. However, the examination work started in December 2015, and the estimate will be available only in June 2016. This subchapter, therefore, uses the data of IEA.)

Table 3.1.1 Energy Balance in Bangladesh

Unit: thousand ton of oil equivalent (1,000toe)

		2000	2005	2010	2011	2012	2013
Production							
	Coal	–	–	385	333	417	427
	Oil	97	98	93	242	239	254
	Naturai Gas	7,271	10,806	16,490	16,745	17,574	18,957
	Hydro	76	111	63	75	67	77
	Biofuel and waset etc	7,603	8,296	8,730	8,785	8,890	8,999
	Total (a)	15,048	19,311	25,760	26,180	27,187	28,727
Net Imports (Note)							
	Coal	330	350	519	415	486	508
	oil	3,321	4,624	4,570	4,764	4,974	4,843
	Total	3,554	4,876	4,996	4,937	5,221	5,640
(Total Primary Energy Supply)	Coal	330	350	904	748	903	988
	Oil	3,321	4,624	4,570	4,764	4,974	4,843
	Natural Gas	7,271	10,806	16,490	17,320	18,338	18,950
	Hydro	76	111	63	75	67	77
	Biofuel and waset etc	7,603	8,296	8,730	8,785	8,890	8,999
	Total(b)	18,602	24,187	30,756	31,692	33,172	33,870
	Self Supply ratio (=(a)/(b))	1	1	1	1	1	1
Total Final Consumption							
	Coal	330	350	654	516	666	652
	Oil	2,824	3,957	3,754	3,938	3,960	3,631
	Natural Gas	3,538	5,436	6,693	7,532	7,637	7,875
	Electricity	951	1,686	3,014	3,167	3,719	3,667
	Biofuel and waste etc	7,603	8,296	8,730	8,785	8,890	8,835
	Total	15,246	19,726	22,846	23,938	24,872	24,660

Note: Net Imports include stock change.

Source: IEA, Energy Balances of Non-OECD Countries

According to the draft PSMP2015, Bangladeshi economy is estimated to grow at 6.0-6.5% per year toward 2041. To cover this economic growth, the power source needs to be developed progressively. Regarding the natural gas, which currently plays a key role in domestic energy production, the production of the current gas fields in eastern part of the country is declining, and the development of offshore gas fields is planned. Regarding the development of the coal, which will be explained in detail in following sections, there are five prospective mine fields, but only Barapukuria Mine will continue operation in future. It is not expected that the other four sites will be developed due to strong opposition by residents, difficulty of mining, high cost and so on.

draft PSMP2015 estimates that the power demand will grow from 15,475 MW in 2015 to 57,000MW in 2041 and that the incremental power source will rely on import of natural gas (LNG) and coal, while domestic gas production will be developed. Although the draft PSMP2015 does not show the balance (proportion) of future energy source at this moment, it is estimated that no single energy source will be more than 50% and that coal and natural gas will cover 70%-75% of power source in 2041.

3.2. Coal Industry in Bangladesh

3.2.1. Coal Reserve and Utilization in Bangladesh

In Bangladesh, coal deposit exists in the north-west of the country between Jamuna River and Padma River. The coal, called Gondwana Coal, is bituminous originating in the Paleozoic and Cenozoic eras, or sub-bituminous in the Tertiary era or lignite. According to the exploration result, the deposits are observed in five coal mines.

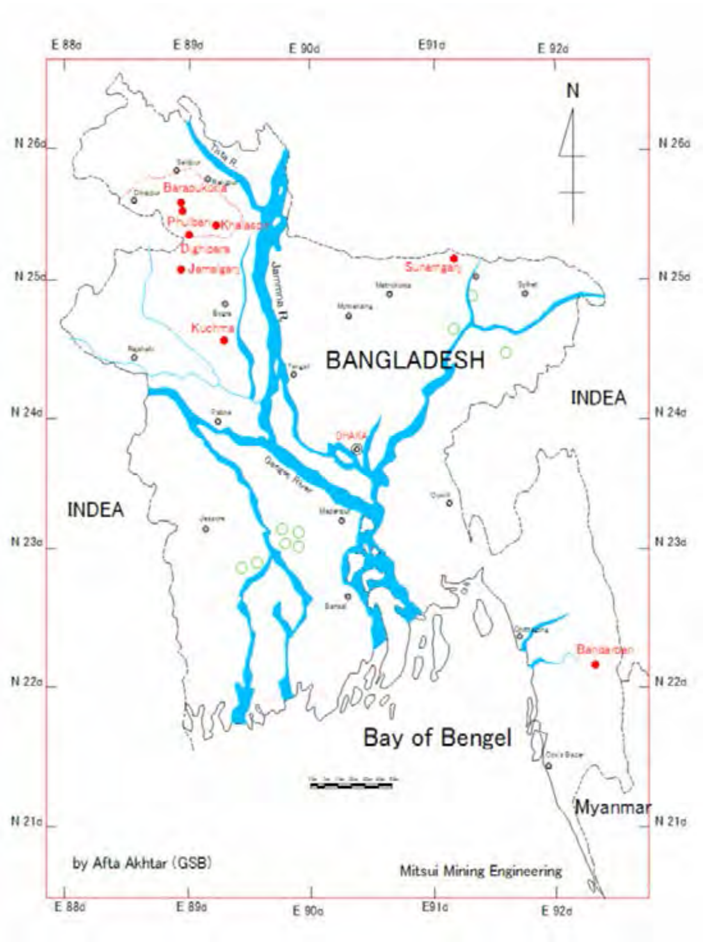
Coal in Bangladesh is characterized as low ash and low sulfur, and thus is of high quality with small environmental impact. Most of the coal is bituminous and has similar characteristics as the coal used in Japanese power plants. Bangladeshi coal is also used in the steel industry, and this coal has quite high commercial value.

The confirmed and estimated reserve of coal is 3,300 million tones (Mt). The Draft Coal Policy published in 2007 estimates the confirmed coal reserve at 1,168 Mt, which can be explored in the near future, whilst the policy excludes Jamalgonji Coal deposit because it is comparatively deep. As more new coal mines will be explored in the future, the coal reserve will increase. Table 3.2.1 shows the total coal reserves in Bangladesh, and Figure 3.2.1 shows the location of the coal mines.

Table 3.2.1 Coal Reserves in Bangladesh

	Coal field name	Exploration Year;	Depth(m)	No. of Layers	Average Thickness(m)	Confirmed Amount (in million ton)	Confirmed and Estimated Amount (in million ton)
1	Barapukuria(Dinajpur)	1985 -87	118 -506	6	51	303	390
2	Phulbari, (Dinajipur)	1,997	150 -240	2	15-70	572	572
3	Khalaspir, (Rangpur)	1989 -90	257 -483	8	42	143	685
4	Dighipara,(Dinajipur)	1994 -95	328 -407	5	62	150	600
5	Jamalgonji, (Bogra)	1,962	640-1158	7	64	1,053	1,053
6	Kuchma, (Bogra)	1,959	2,380-2,876	5	52	–	0
Total						2,221	3,300

Source: draft PSMP2015 (as of Jan 2016)



Source: Petrobangla

Figure 3.2.1 Location of Coal Mines

(1) Production of Domestic Coal

The only coal mine developed in Bangladesh is Barapukuria Coal Mine. The mine uses underground mining method, and the coal is bituminous with low ash and low sulfur, which means that it has environmental advantage.

Based on the management, production, maintenance and provisioning services (MPM&P) contract, signed between Petrobangla and XMC-CMC, a Chinese corporation, XMC-CMC started mine exploration in 1994. By introducing mechanized long-wall top coal caving (LTCC) production method, the corporation has achieved stable production in this first coal mine with underground mining technology in Bangladesh. The first contract was for 71 months starting from September 2005, during which the production amounted to 3.65 Mt ton whilst the contractual target was 4.75 Mt. Furthermore, the second contract was awarded to XMC-CMC and MPM&P, and was signed in December 2012 (available retroactively from August 2011) as a result of international bidding. The second contract targets 5.5 Mt production. This contract also applied LTCC technology, which enables thick layer production.

As the second layer production technology for thick layers, which has long been a problem, becomes stable by introduction of LTCC since 2012, coal production in 2014 was 950 thousand ton. In 2015, the production reduced considerably because of facility trouble. However, the trouble was already recovered, and it is expected that the production level will soon reach the targeted of 1 million ton per year. Table 3.2.2 shows the recent annual production of Barapukuria Coal Mine.

The current mining facility is made in China. With the vertical shaft of 300m and skipping capacity of 3,300 t/day, this production is at the full level at the moment, and the maximum annual production could reach up to 1.2 Mt. It can be increased to 1.5 Mt if the facility is reinforced, for example, by increasing vertical shafts.

Table 3.2.2 Recent annual production of Barapukuria Coal Mine

Year	Production (t)
2005-2006	303,016
2006-2007	388,376
2007-2008	677,098
2008-2009	827,845
2009-2010	704,568
2010-2011	666,635
2011-2012	835,000
2012-2013	854,804
2013-2014	947,124
Total	6,382,647

Source: Barapukuria Coal Mining Co.Ltd

(2) Usage of Domestic Coal

Most of the coal produced in Barapukuria Mine is supplied to Barapukuria CFPP (125 MW x 2 units), which is owned by the Bangladesh Power Development Board (BPDB) and is next to the mine, and some amount is supplied for industries including brick factories. The Barapukuria Power Station consumes 400,000-500,000 t/yr, depending on load factor. BPDB plans to construct the third unit. The production and usage of domestic coal, i.e., Barapukuria, are shown in Table 3.2.3.

Table 3.2.3 Production and Usage of Domestic Coal

Year	Production (t)	Sale (t)	
		BPDB	Others
2005-2006	303,016	209,235	45,603
2006-2007	388,376	460,231	6,523
2007-2008	677,098	491,354	11,630
2008-2009	827,845	532,488	259,244
2009-2010	704,568	501,132	320,368
2010-2011	666,635	463,923	108,616
2011-2012	835,000	499,972	333,360
2012-2013	854,804	643,687	289,398
2013-2014	947,124	524,143	338,618
Total	6,382,647	4,326,458	1,850,560

Source: Petrobangla Coal Mining Co.Ltd

The BPDB column in Table 3.2.3 denotes the sales to Barapukuria CFPP. As mentioned earlier, Barapukuria Coal Mine always stores coal for two to three months. The mine increased production through the LTCC facility since 2013, and the production is stable now. The mine, with the current facility, is expected to achieve the original goal of 1 Mt/yr soon.

The selling price of coal is USD 130/t for BPDB’s power stations (available from May 2015) and BDT 13,680/ton (about US$175, assuming 1 US$=78BDT) for other local buyers. These prices are higher than Australian coal of similar quality at mine mouth, which is currently USD50-60/t in March 2015. The prices are set high because the prices include the fee for coal mining technology transfer and because there is no other competitor in the international bidding.

In response to the increasing demand for electric power, it is necessary to plan and develop new power stations. Since domestic natural gas, which is currently a major energy resource in Bangladesh, will be depleted, it is estimated that coal will be an important energy source. However, since domestic coal is expensive and new development of coal mines is unlikely, it is estimated that the coal-fired power stations using imported coal will be the major power source.

3.3. Utilization of Imported Coal in Bangladesh

The only coal currently used for power production in Bangladesh is the coal from Barapukuria Mine. Since it is not expected that this coal mine will increase production drastically, the CFPP to be constructed in the future will have to rely on imported coal. Current usage of imported coal is explained below.

According to Bangladesh Bureau of Statistics (BBS), Bangladesh imports 4-5 Mt of coal per year, whilst domestic production is several hundred tonnes per year. Table 3.2.1 shows the amount of imported coal. As all the imported coal is used for industries, no imported coal is used for power generation.

Imported coal is categorised into two kinds. One type is coke and semi-coke that are used in foundry (casting) and smithery (forging), and the other is for brick factories and charcoal briquettes for household use.

Bangladesh is a major delta region with some rivers flowing in a few countries. Since the land is flat in most areas of the country, it has abundant sand with small diameter, but it is difficult to collect aggregates (stones and gravels with larger diameter).

These aggregates are used for high strength concrete and are inevitable materials for the surface of roads. They are produced from natural stones in the northeastern mountain area and carried to flat areas like Dhaka, but transportation distance and price are some of the concerns.

Thus, bricks once made in brick factories are crushed into pieces and used for materials for strengthening of ground and for road surface.

Comparing the natural stone-oriented aggregates with high transportation cost and the crushed bricks, the latter is more economical. As more roads are developed in accordance with economic growth, the demand for brick is increasing, and the production of brick is expected to increase.

According to a research by a coal trading company, the coal for brick production is imported from Indonesia, India, and China. Indonesian coal is dominantly used now. Quality of these coals is classified into three: 5,000 kcal/kg, 6,500 kcal/kg, and 7,500 kcal/t.

Selling prices depend on the quality and seasonal demand, but they are currently BDT 7,000-9,500 (USD 90-122)/t for Indonesian coal, and BDT 10,000 (USD 125)/t for Indian coal. Considering the freight and conveying/shifting cost, they are appropriate, i.e., competitive against domestic coal. Annual import is 20,000-30,000 tonnes.

As primary transportation, the imported coal is transported by handy max vessels (DWT 30,000-50,000 tonnes) from the exporting port to Chittagong Port.

Brick factories, where most imported coal is consumed, concentrate on regions at the river mouth of any major river, and some regions have several tens of factories.

The secondary transportation from Chittagong Port to brick factories is by small vessels and barges. Each brick factory is expected to consume 700 tonnes of coal over a normal 6-month work period.

Estimating that there are 5,000 factories in Bangladesh, the coal demand for brick industry together with other consumers coincides with the annual import of 4 Mt as shown in the statistics.

Table 3.3.1 Amount of Imported Coal

use application	2010/2011		2011/2012	
	amount of import (t)	import figures (BDT)	amount of import (t)	import figures (BDT)
Coke and Semi-coke of Coal	59,778	4,768,131	56,636	4,116,081
Coal & Briquette	4,473,929	104,317,797	3,903,230	103,100,496

Source：Bangladesh Bureau of Statistics (BBS)

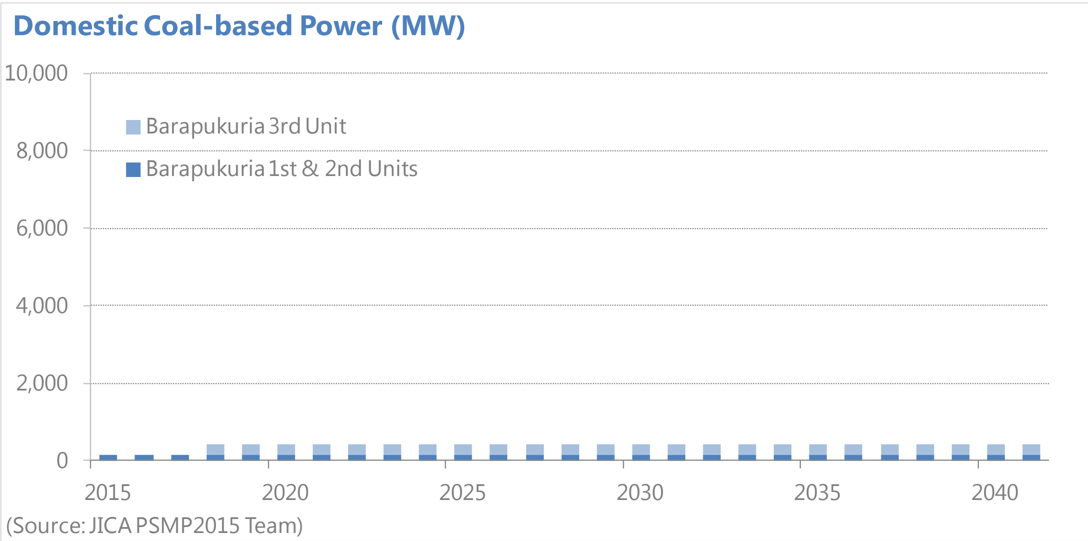
3.3.1. Estimates of Coal Demand in Bangladesh

(1) Existing Coal Development Plan

Barapukuria Coal Mine is the only existing domestic mine in Bangladesh and produces about 1 Mt/yr. The coal produced is supplied to Barapukuria Power Station and others including brick factories. In the future plan, the production will be limited up to 1.5 Mt/yr. On the other hand, the coal will be purchased by already fixed customers, and thus, there is little possibility that the mine can supply to other new power stations.

The Phulbari Coal Mine, which is a possible candidate for development, is known by its abundant reserve capacity, but the government refrains from developing the mine because the development would entail the relocation of many people and the local residents strongly oppose the development.

Since it is hardly expected that the domestic coal production will increase whilst the future demand for coal is expected to increase, the government plans to expand the use of imported coal. Figure 3.3.1 shows the existing coal-fired power development plan.



Source: Draft PSMP2015 (as of Jan 2016)

Figure 3.3.1 Existing Coal-fired Power Development Plan

(2) New Coal Development Plan

The draft PSMP 2015, which is being studied under JICA, estimates the total electric power demand in 2041 will to be 52,000 MW. 57,000MW including reserve margin. Whilst the draft PSMP2015 has not yet fixed the estimate of its breakdown, a scenario of the draft PSMP2015 estimates that the coal will account for about 40%.

Table 3.3.2 shows the coal demand forecast in Bangladesh, Figure 3.3.2 shows the estimate of coal demand whilst Figure 3.3.3 shows the demand and supply of coal.

In forecasting the coal demand, the JICA Study Team has some Limitations because the capacity and size of the planned power stations are yet to be decided and the procurement of coal, e.g., types of coal and caloric value. is also not yet decided. Therefore, the JICA Study Team assumed in the forecasting that the plants will adopt highly efficient technology like ultra-super critical (USC) or super critical type (average energy efficiency of 43%) and the plants will use either bituminous or sub-bituminous coal and the average calorie is 5,100 kcal/kg. This is the same assumption as in the draft PSMP2015. Annual coal consumption will be 2,900 t/MW.

The draft PSMP2015 estimates that the total demand for coal in 2041 will be 80.7 Mt, of which 97.5%, i.e., 79.5Mt, will be imported. It also estimates that 86.5% of coal will be used for the power sector.

Development of CFPPs using imported coal started in 2012 at 1,320 MW. This consumes 3.82 Mt of coal per year, and will reach 23,691 MW with 68.7 Mt of coal per year in 2041.

The first project is Rampal Power Station developed by the Joint Venture between BPDB and India's NTPC Limited, which plans to tranship coal from large vessel to barge (8,000-10,000 DWT) off Bengal Bay.

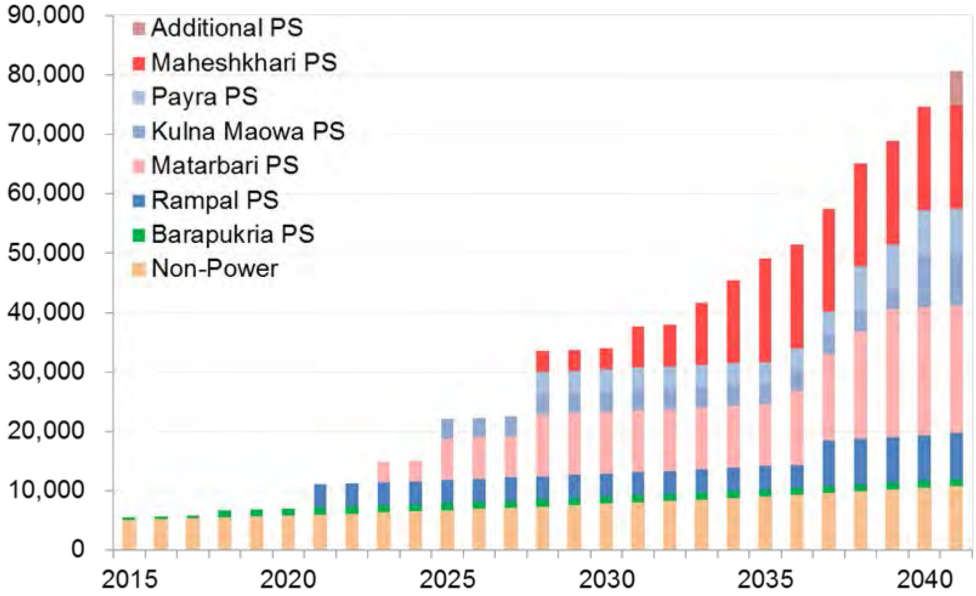
The plan of Matarbari Thermal Power Station, developed in Matarbari Region, Chittagong Prefecture in southern Bangladesh through Japanese ODA, is to construct two units of 600 MW USC with a very deep bay and port that will enable Panamax vessel (80,000 DWT) to call directly. The coal will be imported from Australia, Indonesia, or South Africa using large vessels, which is efficient in terms of transportation cost.

For reference, the values under the "Domestic, Amount (ktonne)" column in Table 3.2.2 indicate the estimated amount of coal (produced in Barapukuria Mine, which is the only domestic coal mine) that will be used for Barapukuria Mine-mouth Power Station.

Table 3.3.2 Coal Demand Forecast in Bangladesh

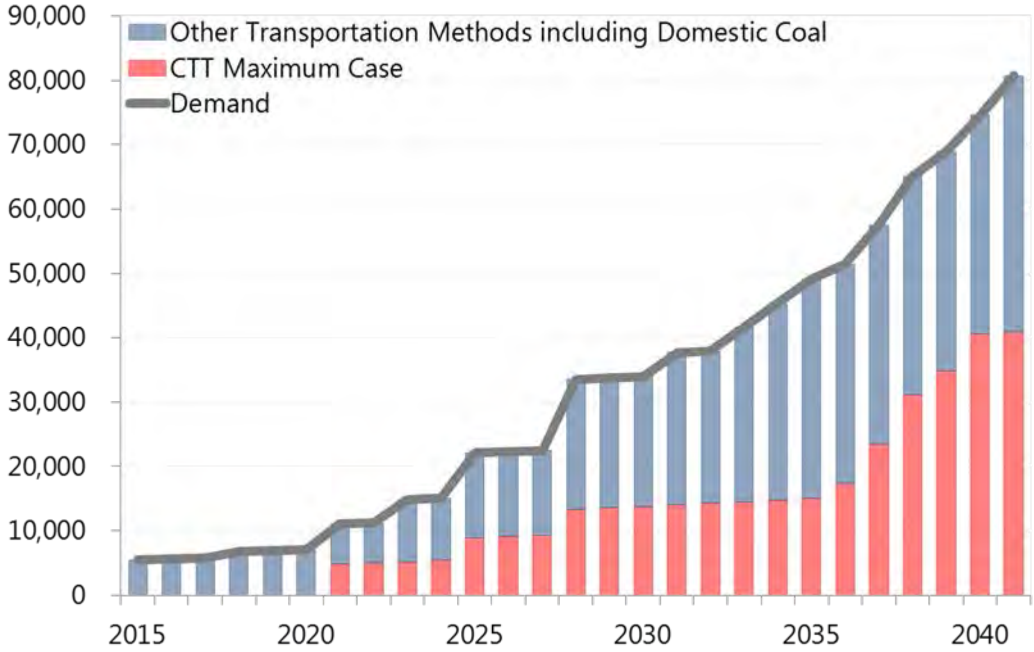
YEAR	Import Coal				Domestic				
	Power Sector		Non-Power	Total	Power Sector(Barapukuria)				Total
	Capacity	Amount			Capacity			Amount	
					# 1,#2	#3	Total		
	(MW)	(kton)	(kton)	(kton)	(MW)	(MW)	(MW)	(kton)	(kton)
2014	0	0	0	0	154		154	447	447
2015	0	0	5,000	5,000	154		154	447	5,447
2016	0	0	5,150	5,150	154		154	447	5,597
2017	0	0	5,305	5,305	154		154	447	5,752
2018	0	0	5,454	5,454	154	274	428	1,241	6,695
2019	0	0	5,628	5,628	154	274	428	1,241	6,869
2020	0	0	5,796	5,796	154	274	428	1,241	7,037
2021	1,320	3,828	5,970	9,798	154	274	428	1,241	11,039
2022	1,320	3,828	6,149	9,977	154	274	428	1,241	11,218
2023	2,520	7,308	6,334	13,642	154	274	428	1,241	14,883
2024	2,520	7,308	6,524	13,832	154	274	428	1,241	15,073
2025	4,872	14,129	6,720	20,849	154	274	428	1,241	22,090
2026	6,072	17,609	6,921	24,530	154	274	428	1,241	25,771
2027	6,072	17,609	7,129	24,738	154	274	428	1,241	25,979
2028	8,592	24,917	7,343	32,260	154	274	428	1,241	33,501
2029	8,592	24,917	7,563	32,480	154	274	428	1,241	33,721
2030	8,592	24,917	7,790	32,707	154	274	428	1,241	33,948
2031	9,792	28,397	8,024	36,421	154	274	428	1,241	37,662
2032	9,792	28,397	8,264	36,661	154	274	428	1,241	37,902
2033	10,992	31,877	8,512	40,389	154	274	428	1,241	41,630
2034	12,192	35,357	8,768	44,125	154	274	428	1,241	45,366
2035	13,392	38,837	9,031	47,868	154	274	428	1,241	49,109
2036	14,092	40,867	9,301	50,168	154	274	428	1,241	51,409
2037	16,112	46,725	9,581	56,306	154	274	428	1,241	57,547
2038	18,632	54,033	9,868	63,901	154	274	428	1,241	65,142
2039	19,832	57,513	10,164	67,677	154	274	428	1,241	68,918
2040	21,691	62,904	10,465	73,369	154	274	428	1,241	74,610
2041	23,691	68,704	10,783	79,487	154	274	428	1,241	80,728

Source: Draft PSMP2015 (as of Jan 2016)



Source: Draft PSMP2015 (as of Jan 2016)

Figure 3.3.2 Forecast of Coal Demand Increase (kt)



Source: Draft PSMP2015 (as of Jan 2016)

Figure 3.3.3 Coal Supply and Demand Balance (kt)

3.3.2. Coal Transshipment Terminal (CTT)

(1) Necessity of Coal Terminal

The draft PSMP2015 shows the long term development of CFPP using imported coal. According to the draft PSMP2015, most of the future CFPPs will be constructed in Matarbari area. However, the seashores are generally shallow and could not be reached by large vessels without modifications. Transportation method is not yet determined except that for Matarbari Units No.1 and No.2.

Therefore, in order to import coal for these power stations in Matarbari area, it is necessary to dredge vessel routes and harbors so that large vessels can pass and anchor and to construct a large-scale CTT to temporarily store coal for supply to the CFPPs. It is not economically advantageous to import coal to each power station by small vessels or to construct an off-shore coal storage facility and transport coal by barges.

When a very deep bay and port are completed in Matarbari Region and large vessels like Panamax (80,000 DWT) can have direct access to the port, the speed of developing new power stations will possibly increase. However, to reach the Moheshkhali CFPPs, it is necessary to extend the route from Matarbari. In this case, there are many problems including construction cost of route extension, treatment of soil and sand resulting from construction works, and other environmental concerns; therefore, it is uncertain when the route extension will be completed.

Regarding Maowa, Khulna, Rampal, and Payra project sites, the shores of Bengal Bay and the rivers for transportation are too shallow with sand from upstream for large vessels like Panamax to supply coal. In order to realise the long-term power development plan, on-shore (land) CTT should be considered from the viewpoints of transportation method and cost.

A concept flow of transportation using CTT is shown in Table 3.3.3.

Table 3.3.3 Concept flow of transportation using CTT

Producer Country ⇨	Primary Transportation ⇨	CTT ⇨	Secondary Transportation ⇨ Power Station
●Austlalia ●Indonesia ●Africa ●Others	【Type of Vessel】 ●Panamax 80,000DWT Class	【Proposed Site】 ●Chittagon Div. Matarbari Area	【Khulna、Chittagon】 ●Barge；5000t～10,000t 【Matarbari、Moheshkhali】 ●Belt Conveyor

Source: JICA Study Team

(2) Examination of Power Stations Using CTT

The maximum annual treatment amount of the CTT is determined by the development plan. The draft PSMP2015 assumes that the power development plan is based on the power demand forecast, that the off-shore coal transportation route will be extended to Moheshkali Region based on the previous preliminary research on South Chittagong Regional Development, and that coal transportation to Moheshkali Region will not use the CTT as large vessels will have direct access to the port adjacent to the power stations.

In general, in order to make the coal terminal plan, factors such as power station sites, commencement year, type of generation, generating capacity, and fuel type need to be determined. Secondly, based on these assumptions, power stations that the plan targets will be selected and design conditions will be determined. The CTT plan refers to the scenario shown in the draft PSMP2015 and also considers the requests of the Bangladeshi government.

The Bangladeshi government expects the early completion of the CTT as it will contribute to the development of infrastructure and the enhancement of investment into IPP projects. In this regard, the JICA Study Team will assume and evaluate the case of early completion and a more realistic case based on the power development plan proposed in the draft PSMP2015.

3.3.3. Planned Coal-Fired Power Stations Using Imported Coal

Regarding the planned coal-fired power stations using imported coal, the projects for which the Bangladeshi government signed a memorandum of understanding (MOU) are listed in Table 3.3.4. These MOUs have been signed by the Bangladeshi government and sponsors who eagerly consider investing in the project. However, the details including site selection, land acquisition, environmental and social impact assessment, detailed design, and contract procedure need to be discussed and determined before the commencement of construction.

Table 3.3.4 List of Power Projects with MOU with the Bangladeshi Government

Area	Power Plant	Cap(MW)		COD(FY)	Company/Sponsor
【Government project】					
Khulna Barisal	BIFPCL, Rampal, Coal Fired Power Plant #1	660		2018	NTPC+BPDB
	BIFPCL, Rampal, Coal Fired Power Plant #2	660		2019	NTPC+BPDB
	Payra,Patuakhali Coal Based Power Plant #1	660		2023	CMC(China)+NWPGCL
	Payra,Patuakhali Coal Based Power Plant #2	660	2640	2024	CMC(China)+NWPGCL
Ashuganj	Ashuganj Coal based power plant #1	660		2024	
	Ashuganj Coal based power plant #2	660	1320	2025	
Dhaka	Munshiganj	800	800	tbd	
Chittagong	Chittagong Anowara #1	660		tbd	Undesided
	Chittagong Anowara #2	660	1320	tbd	Undesided
Matabari	Matarbari USC Coal thermal #1	600		2023	Japan ODA,(COD;2023)
	Matarbari USC Coal thermal #2	600		2024	Japan ODA,(COD;2023)
	Matarbari 700 MW Coal Power Plant	700		tbd	Singapole(IN Enterprise)
	Matarbari USC Coal thermal#3	600		tbd	ODA or IPP
	Matarbari USC Coal thermal#4	600		tbd	ODA or IPP
	Matarbari USC Coal thermal#5	600		tbd	IPP
	Matarbari USC Coal thermal#6	600	4300	tbd	IPP
Moheshkhali	Moheskhali 1200 MW Coal Power Plant	600		tbd	JV with Huadian
	Moheskhali 1200 MW Coal Power Plant	600		tbd	JV with Huadian
	Moheshkhali 1320 MW Joint Venture #1	660		tbd	ECA Funding
	Moheshkhali 1320 MW Joint Venture #2	660		tbd	ECA Funding
	Moheshkhali Coal Based Power Plant #1	660		tbd	Malaysia
	Moheshkhali Coal Based Power Plant #2	660		tbd	Malaysia
	Moheskhali 1320 MW Coal Power Plant	660		tbd	ADB Funding
	Moheskhali 1320 MW Coal Power Plant	660		tbd	ADB Funding
	1320 MW Power Plant with South Korea #1	660		tbd	KEPCOSouth Korea
	1320 MW Power Plant with South Korea #2	660	6480	tbd	KEPCOSouth Korea
Government Project Total		16,860			
【Private Project】					
Khulna	Khulna 630 MW IPP	630		2015	Orion Khulna Power Ltd.
Maowa	Maoa Munshiganj 522 MW IPP	522		2016	Orion Dhaka Power Ltd.
Meghnaghat	Dhaka 635 MW	635		tbd	Orion Dhaka Power Ltd.
	Dhaka 282 MW	282		tbd	Orion Dhaka Power Ltd.
Chittagong	Chittagong Anowara 282 MW IPP	282		tbd	Orion Dhaka Power Ltd.
	Chittagong 612 MW	612		tbd	S Alam Group
	Chittagong 612 MW IPP8	612		tbd	S Alam Group
	Mirersorai Chittagong 150 MW Commercial Power Plant	150		tbd	Chittagong Power Co Ltd. (BSRM)
Bashkhali	Bashkhali 600 MW	600		tbd	Bangladesh Machine Tools Factory Ltd. (BMTFL)
Private Project Total		4,325			
Total		21,185			

Table 3.3.5 shows the power development plan based on Table 3.3.4 and the draft PSMP2015 based coal-fired power generation development plan as well as the plan of the CTT. Locations of the planned coal-fired power stations using imported coal are shown in Figure 3.3.4.

he Matarbari USC CFPP Units No. 1 and No. 2 (600 MW each), the construction of which will start soon, are planned to commence operation in 2023. This power station will provide direct access for Panamax size vessel due to the development of very deep bay and port; therefore, it will not be an object of this CTT study.

For other power stations, there is a possibility to use this CTT if cost and stability of coal procurement are judged satisfactory. However, this survey does not consider power stations that do not clearly express the possibility to use CTT in the future.

Rampal Power Station Units No. 1 and No. 2, located in Khulna Region, are planned to commence operation in 2018, and are the first target of the CTT. Since this plan precedes the completion of CTT, it examines a plan to tranship coal from large vessel to barge (8,000-10,000 DWT) off shore. However, if the completion of CTT precedes the start of the Rampal Project operation or the fee to use the CTT is lower than the offshore transshipment cost, the plan may consider using the CTT.

Table 3.3.5 Draft PSMP2015's Generation Plan and CTT-based Coal-Fired Power Plan

Government MOU Based Project				(Draft PSMP2015)				CTT				
Power Plant	(MW)	COD (FY)	Company/Sponsor	MW	COD (FY)	CTT	Coal (kton)	COD(FY) PSMP	MW	~2029 1st Phase	2030~ 2nd Phase	
Matarbari Island							19,720		**5,000**			
Matarbari#1	600	2023	Japan ODA,(COD;2023)	600	2023		1,740	2023	600			
Matarbari#2	600	2024	Japan ODA,(COD;2023)	600	2023		1,740		600			
Matarbari#3	600	tbd	ODA or IPP	600	2025		1,740	2025	600	○		1,740
Matarbari#4	600	tbd	ODA or IPP	600	2025		1,740	2025	600	○		1,740
Matarbari#5	600	tbd	IPP	600	2026		1,740	2026	600	○		1,740
Matarbari#5	600	tbd	IPP	600	2026		1,740	2026	600	○		1,740
Matarbari North #7	700	tbd	Singapole(IN Enterprise)	700	2036	○	2,030	2036	700		○	2,030
Matarbari North #8				700	2037	○	2,030	2037	700		○	2,030
Matarbari North #9				600	2038	○	1,740	2038	600		○	1,740
Matarbari North				600	2038	○	1,740	2038	600		○	1,740
Matarbari North				600	2039	○	1,740	2039				
Matarbari North				600	2039	○	1,740	2039				
Moheshkhali Island							15,660		**1,200**			
Moheshkhali#1	600	tbd	JV with Huadian	600	2028		1,740	2028	600	○		1,740
Moheshkhali#2	600	tbd	JV with Huadian	600	2028		1,740	2028	600			1,740
Moheshkhali#3	660	tbd	ECA Funding	600	2033		1,740	2033				
Moheshkhali#4	660	tbd	ECA Funding	600	2033		1,740	2033				
Moheshkhali#5	660	tbd	Malaysia	600	2034		1,740	2034				
Moheshkhali#6	660	tbd	Malaysia	600	2034		1,740	2034				
Moheshkhali#7	660	tbd	ADB Funding	600	2031		1,740	2031				
Moheshkhali#8	660	tbd	ADB Funding	600	2031		1,740	2031				
Moheshkhali#9	660	tbd	KEPCOSouth Korea	600	2035		1,740	2035				
Moheshkhali#10	660	tbd	KEPCOSouth Korea	600	2035		1,740	2035				
Khulna							5,742		**1,980**			
Rampal#1	660	2018	NTPC+BPDB	660	2021	○	1,914	2021	660		○	1,914
Rampal#2	660	2019	NTPC+BPDB	660	2021	○	1,914	2021	660		○	1,914
Rampal#3				660	2037	○	1,914	2037	660			
Rampal#4				660	2037	○	1,914	2037	660			
Patuakhali							5,742	0	**1,320**			
Payra#1	660	2023	CMC(China)+NWPGCL	660	2028	○	1,914	2028	660		○	1,914
Payra#2	660	2024	CMC(China)+NWPGCL	660	2028	○	1,914	2028	660		○	1,914
Payra#3				660	2038	○	1,914	2038				
Payra#4				660	2039	○	1,914					
Others							8,732		1,152			
Khulna	630	2015	Orion Khulna Power Ltd.	630	2025	○	1,827	2025	630			
Maowa	522	2016	Orion Dhaka Power Ltd.	522	2025	○	1,514	2025	522			
Dhaka	800	tbd		635	2040	○	1,842	2040				
Chittagong #1	660	tbd	Undesided	612	2040	○	1,775	2040				
Chittagong#2	660	tbd	Undesided	612	2040	○	1,775	2040				
Ashuganj#1	660	2024										
Ashuganj#2	660	2025										
Meghnaghat#1	635	tbd	Orion Dhaka Power Ltd.									
Meghnaghat#2	282	tbd	Orion Dhaka Power Ltd.									
Chittagong#1	282	tbd	Orion Dhaka Power Ltd.									
Chittagong#2	612	tbd	S Alam Group									
Chittagong#3	612	tbd	S Alam Group									
Chittagong#4	150	tbd	Chittagong Power Co (BSRM)									
Bashkhali	600	tbd	Bangladesh Machine Tools Factory Ltd. (BMTFL)									
Total Power							55,596		10,652			
Total for CTT+CTT							35,064					
Total Non-Power							5,783					
Total Coal Supply/Deamnd				21,691			**61,379**	1st Phase		3,600		10,440
								2nd Phase			5,240	**15,196**

Source: Draft PSMP2015 and JICA Study Team (as of Jan 2016)

Source: JICA Study Team

Figure 3.3.4 Location of Coal-fired Power Stations Using Imported Coal

Regarding the coal transportation for the planned power stations in Maowa and Khulna regions, it is considered to import coal by 5,000 DWT-class barge via Chittagong Port. However, the maximum depth at Chitaggong Port is shallow at merely 9.1 m and cannot accept Panamax vessels which need at least 15 m depth. Therefore, these power stations may switch to the utilisation of CTT.

The draft PSMP2015 assumes only the power stations in Matarbari North area as the targets of CTT, but the Coal Power Generation Company Bangladesh Limited (CPGCBL) plans to use CTT for all plants except Matarbari Units No.1 and No.2. Therefore, this feasibility study assumes that CTT will target all Matarbari Region's projects except Units No.1 and No.2 and will bring coal directly to their own coal storage facility.

The Moheshkhari area has several issues including construction cost for route extension, treatment of soil and sand due to the construction work and other environmental concerns. Since the timing of routs extension is uncertain, the JICA Study Team will examine the utilization of belt conveyor system for Moheshkhari Units No.1 and No.2, which is requested by CPGCBL. Regarding Units No.1 and No.2, the operation will start in 2018 and the concrete plan is yet to be made. However, CPGCBL expressed a likely option to transport coal from the CTT to power stations using a belt conveyor system. Furthermore, at the workshop with CPGCBL in Dhaka, Bangladesh expressed an interest to use CTT for all the planned units of Maheshkhali CFPPs. Bangladesh also indicated to be willing to consider using CTT for Rampal and Payra CFPPs if the use of CTT is beneficial, although those CFPPs planned to import fuel coal in their own way. (The 1st Phase of the project will target the original 3,600 GW of coal-fired generating units. However, the 2nd Phase of the project, which will start operation five year later of the 1st Phase, will be able to flexibly consider the amount of coal that CTT will treat. If the concrete projects and needs are indicated, it will be possible to examine the timing of the development of 2nd Phase.) For non-power sector utilization like brick factories, the coal will be supplied using 5,000DWT barge via Chittagong Port.

3.3.4. Examination of Coal Transshipment Terminal (CTT)

The MOUs signed between the Bangladeshi government and the sponsors regarding the commencement date of operation of the planned coal-fired power stations using imported coal are simply non-binding tentative agreements. Since most of the feasibility studies are executed after signing the MOUs, MOU-based commencement date of operation (COD) does not generally coincide with the COD based on actual construction procedure.

This study of CTT will consider the basis of the draft PSMP2015, the intention of the counterpart, and the estimated progress of infrastructure development. Table 3.2.6 lists the power stations in the draft PSMP2015 and the CTT plan that may use CTT.

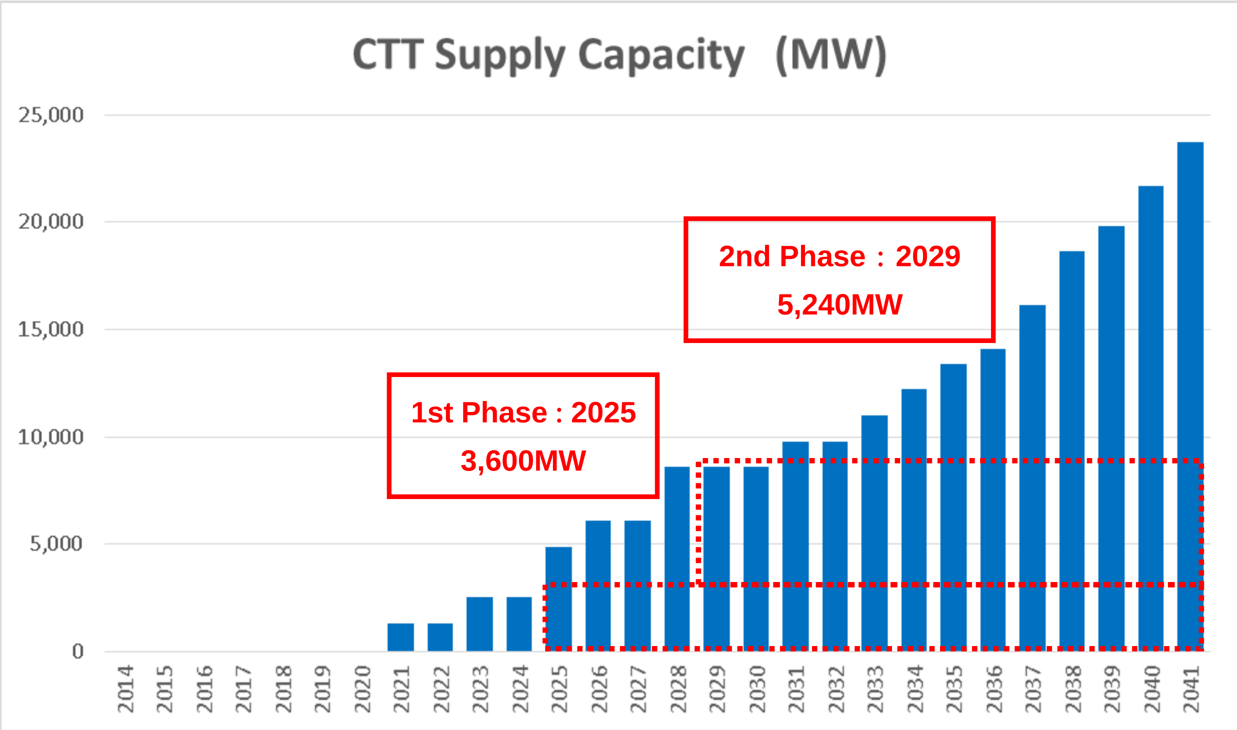
As explained above, the governmental plan does not coincide with the realistic date of operation commencement, and thus it is desirable to adopt a two-stage development plan so that the project can deal with the gradually increasing demand. In this Study, (as the first phase of the CTT will commence operation in 2025,) the object of 1st Phase will include the power stations that will commenced operation by 2029 and use CTT. The total generating capacity of these units will be 3,800 MW. The following 2nd Phase, which is planned to commence operation in 2030, targets plants with COD later than 2030, and the total generating capacity will be 5,240 MW.

Figure 3.3.5 shows the generating capacity (in MW) of power stations (units) that CTT will supply coal to, and Figure 3.3.6 shows the estimated amount of imported coal planned by the Bangladeshi government.

Table 3.3.6 List of Power Stations of the draft PSMP2015 and CTT Plan that May Use CTT

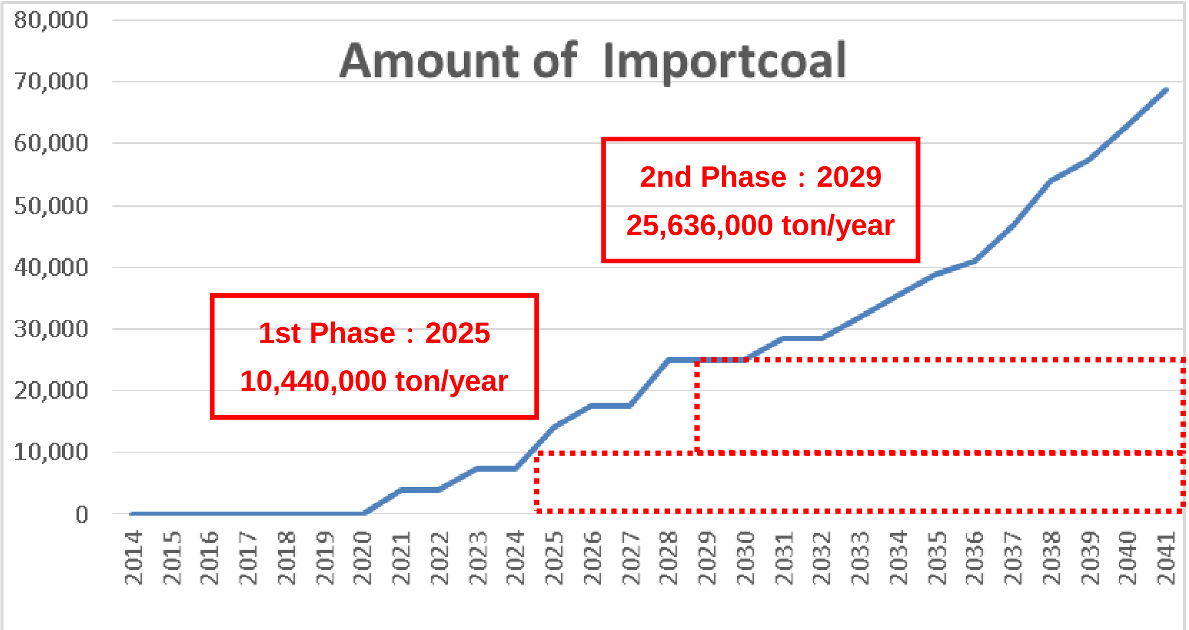
Name of Power Plant	Category	Capacity	COD	
Matarbari 1200 MW (Unit 3 & 4)	Public	1,200	2025	Phase-1
Matarbari 1200 MW (Unit 5 & 6)	Public	1,200	2026	Phase-1
Matarbari North 700 MW (Unit 7)	Public	700	2036	Phase-2
Matarbari North 700 MW (Unit 8)	Public	700	2037	Phase-2
Matarbari North 1200 MW (Unit 9& 10)	Public	1,200	2038	Phase-2
Moheskhali 1200 MW (Unit 1 & 2)	IPP	1,200	2028	Phase-1
Rampal 1320 MW (Unit 1 & 2)	Public	1,320	2021	Phase-2
Payra 1320MW (Unit 1 & 2)	Public	1,320	2028	Phase-2
Phase -1 total	MW	3,600		
Phase-2 total	MW	5,240		
Total	MW	8,840		

Source：JICA Study Team based on draft PSMP2015 (as of Jan 2016)



Source: JICA Study Team based on draft PSMP2015 (as of Jan 2016)

Figure 3.3.5 Generation Capacity of Power Generation Plan Using Imported Coal based on PSMP2015



Source: JICA Study Team based on draft PSMP2015 (as of Jan 2016)

Figure 3.3.6 Amount of Imported Coal Planned by Bangladeshi Government

The construction program for a new coal-fired power station using imported coal must satisfy important factors such as site acquisition, consent of local residents, various technical issues, procurement of construction cost, fuel procurement, and transportation. Thus, it is difficult to make a precise estimate of the commencement date of operation. Therefore, it is recommended to have enough flexibility, for example, to expand the CTT when the power generation program is developed and the realistic COD becomes certain.

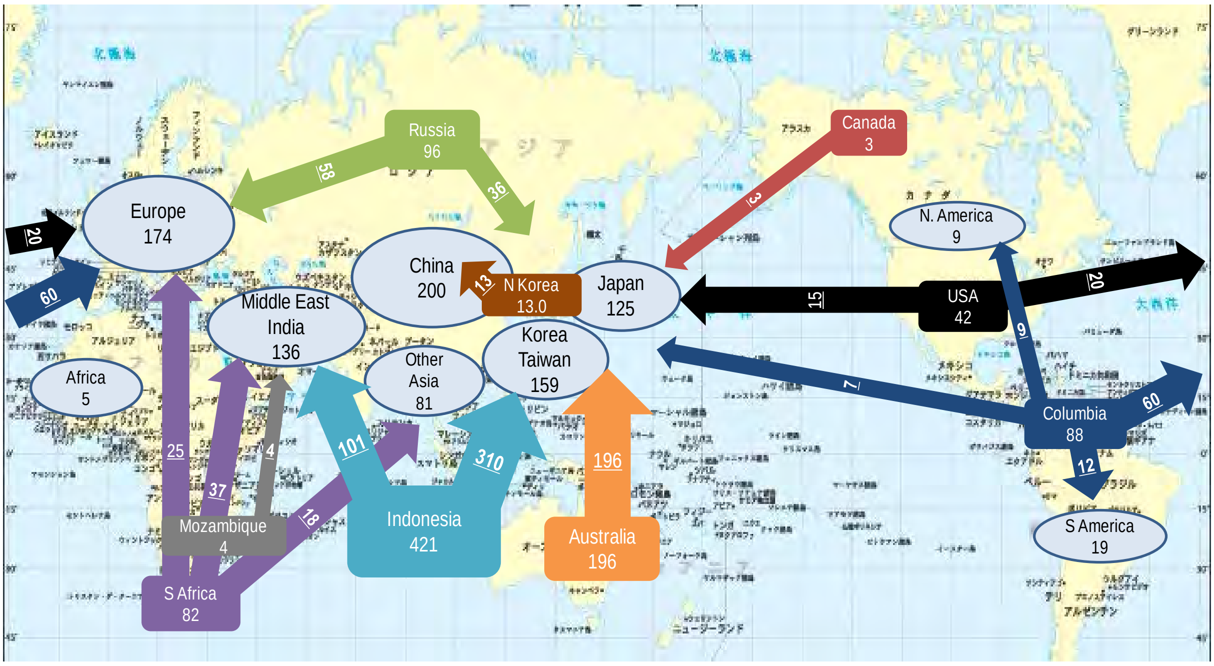
Chapter 4. Proposal of Optimum Planning of CTT

4.1. Coal Logistics Plan

4.1.1. Seaborne Market Supply and Demand as of 2014

As a starting point for the Coal Logistics Plan, the current and future production supply capacities of potential coal exporting countries are being studied.

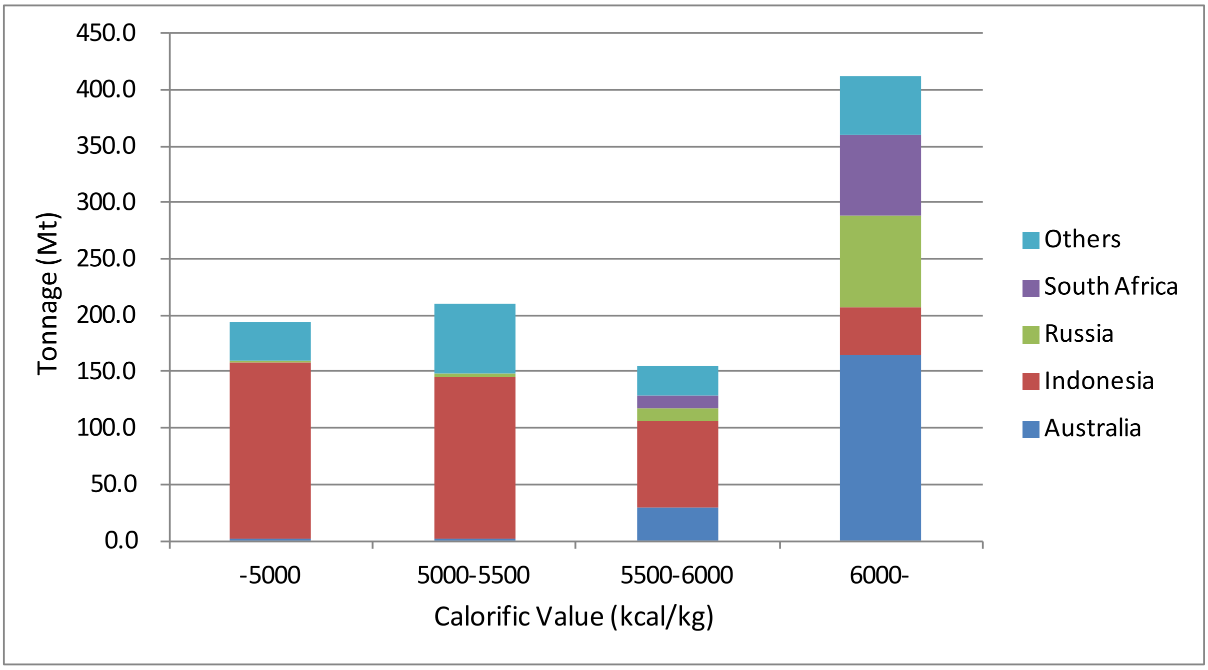
In 2014, the seaborne market of thermal coal is around 970 Mt. The largest exporter is Indonesia with export tonnage of 420 Mt, followed by Australia, Russia, Columbia, and South Africa. The cargo flow for 2014 is shown in Figure 4.1.1.



Source: JICA Study Team

Figure 4.1.1 Thermal Coal Seaborne Cargo Flow

The above tonnage is for the entire seaborne thermal coal and includes both bituminous and sub-bituminous coal. Main exporting countries and tonnages by calorific value range are shown in Figure 4.1.2. Coal that has a calorific value of 6,000kcal/kg or above has approximately 42% share of the entire seaborne market, however, for the largest exporter, i.e., Indonesia, only 10% of its tonnage has a calorific value of 6,000 kcal/kg or above, whereas more than 70% of its coal has a calorific value of less than 5,500 kcal/kg. This trend of decreasing production of higher calorific value coal should accelerate in the coming years.



Source: JICA Study Team

Figure 4.1.2 Thermal Coal Production in Calorific Values

4.1.2. Future Trend of Global Thermal Coal Supply and Demand

Until around 2020, Southeast Asian and South Asian countries such as India will face increase in demand, whilst this will be offset by decrease in Europe due to change of energy source from coal to renewable energy. This will lead to a slight increase in the total seaborne market volume, up to approximately 1 billion tones (bnt). Post 2020, the demand increase of approximately 50 Mt is expected year after year, bringing the seaborne market volume up to approximately 1.3 bnt in 2025, and 1.5bnt in 2030.

The breakdown of this 500 Mt increase towards 2030 is shown in Table 4.1.1.

Table 4.1.1 Coal Production Increase Towards 2030

Australia	210 Mt
Indonesia	120 Mt
United States	100 Mt
Columbia	50 Mt
Mozambique	10 Mt
South Africa	10 Mt
Canada	10 Mt
Russia	▲20Mt

Source: JICA Study Team

However, considering the location of Bangladesh, the United States, Canada and Colombia will be less competitive due to distance/freight, and the natural source will be Australia, Indonesia, Mozambique, and South Africa.

Australia has significant reserve and resource, and considering its quality, (although it may deteriorate from its current calorific value), it will be competent to produce coal in the range of 5,700 kcal/kg – 6,000kcal/kg. Subject to infrastructure construction such as rail and port, Australia will be capable of supplying the 210Mt mentioned above by opening up new coal basins such as Galilee Basin and Surat Basin.

On the other hand, as previously mentioned, the decrease of bituminous coal reserve is unavoidable. Although the production volume is expected to increase by approximately 120 Mt, the quality may further deteriorate. As a result, there is even a possibility that Indonesian coal will only be the imported sub-bituminous coal.

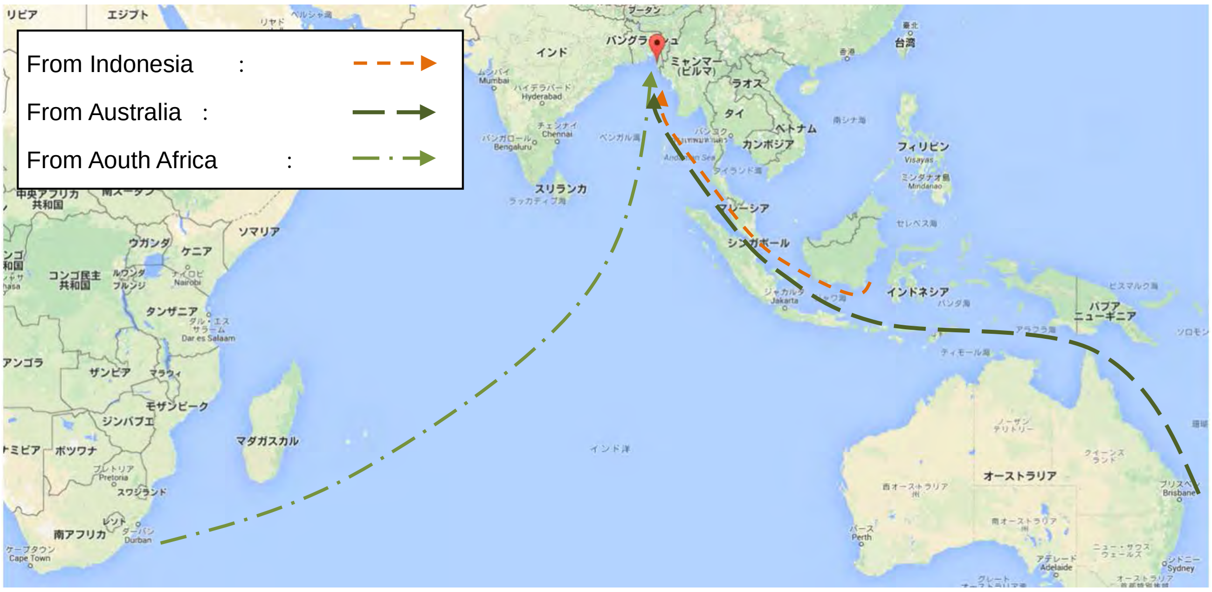
4.1.3. Coal Transportation Plan

(1) The coal supply sources, transportation from supply sources to CTT, type of vessels to be used and freight are studied.

1) Coal Loading Ports

Since the coal procurement policy of the Bangladesh government has not been fixed yet, the coal loading ports could not be specified. However, this study assumes that the coal will be imported from Australia, Indonesia, and South Africa (Mozambique is included in South Africa in terms of the transportation) as described above.

It will take about 19 days from the loading port of Australia, 8 days from Indonesia, and 17 days from South Africa up to CTT by ocean transportation.



Source：Google Map

Figure 4.1.3 Seaway from Australia, Indonesia, and South Africa

2) Vessel Type

Considering loading/unloading efficiency, it would be appropriate to have a certain amount of volume to be loaded. Therefore, this study is based on the assumption that vessels over 30,000DWT will be used for coal transportation. The type of vessel will be roughly as follows;

Cape Size	:	130,000-180,000 DWT
Panamax	:	63,000-80,000 DWT (Post Panamax: 100,000 DWT)
Handy	:	30,000-55,000 DWT (30,000 DWT vessel is smaller than the general Handy, however, the vessel from 30,000-55,000DWT is called Handy in this study because the freight would be the same level.)

Many coal loading ports are designed for larger vessels than Panamax and therefore, the port equipment is designed to accommodate Cape Size and Panamax which do not have vessel crane. Since vessel crane can be an obstacle in changing the holds during loading and unloading, it is normal that vessel with crane is not allowed to enter into the ports in Australia.

Currently, the gateway port of Bangladesh, Chittagong Port, is not handling coal. Even if Chittagong Port will handle coal, the vessel size should be limited to 20,000 DWT due to the shallow draft. In case of coal transportation to Bangladesh by 20,000 DWT vessels, 700 trips/yr to import 14 Mt of coal per year in the 1st Phase and 1,450 trips for 29 Mt of coal in the 2nd Phase would be necessary, making it impractical to import coal using 20,000 DWT vessels.

3) Ocean Freight Cost

The rough estimation of the ocean freight cost is shown in Table 4.1.2. Although Cape Size is not supposed to be used for CTT, this rough estimation of the ocean freight cost is for Cape Size and Panamax vessels.

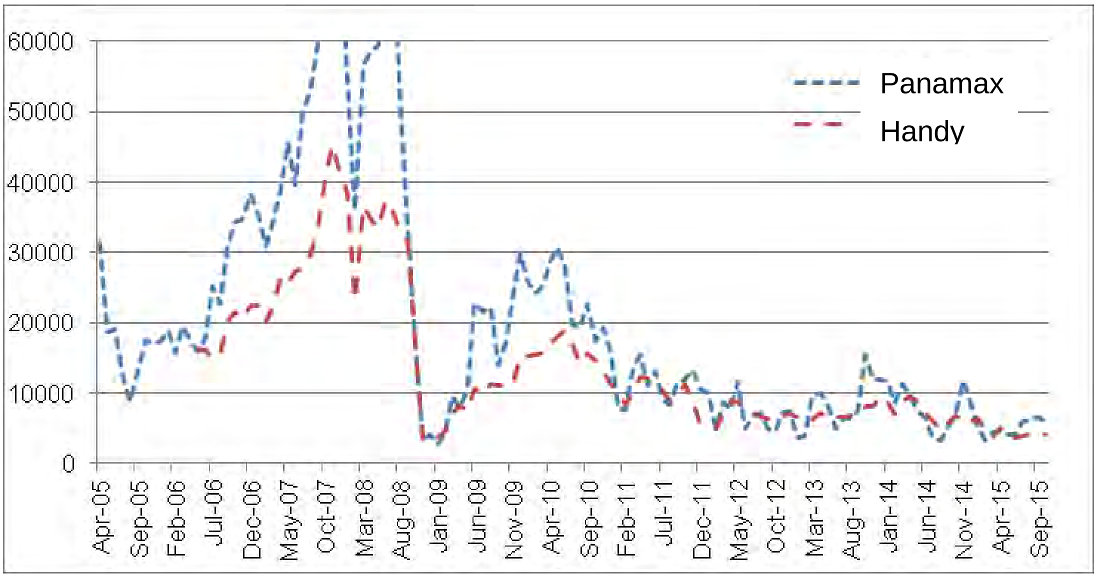
Table 4.1.2 Ocean Freight COST by Vessel Type

	Panamax	Handy
From Indonesia	USD 12 / MT	USD 17 / MT
From Australia	USD 21 / MT	USD 33 / MT
From South Africa	USD 19 / MT	USD 29 / MT

Source：JICA Study Team

The above figures are calculated based on the vessel operational costs and are higher compared with the figures based on the current maritime market. Although the actual freight cost should be subject to the maritime market, it would be practical to calculate based on the operational costs from the long-term perspective. The ocean freight cost is fluctuating according to oil price but the freight cost difference between the vessel types will not change. Therefore, the larger size vessel will basically lead to reduce the ocean freight cost per tonne. The estimated figures above do not include both the loading fees at the loading port and the unloading fees at CTT.

For the chartering cost, which is necessary to calculate the ocean freight cost, the market prices at the time of this report are around USD 4,000/day and USD 6,000/day for Handy and Panamax, respectively. The market trend for the past 10 years is shown in Figure 4.1.4 and seeing this, the current market price is at a rather low level. In this section, the ocean freight cost is calculated based on the assumption that the chartering costs are USD 15,000/day and USD 20,000/day for Handy and Panamax, respectively, considering the shipbuilding cost.



Source: JICA Study Team

Figure 4.1.4 Chartering Cost per Day

Table 4.1.3 shows the summary of the ocean freight cost per year based on the assumed yearly coal volume to be transported to CTT for the 1st Phase and 2nd Phase.

Table 4.1.3 Ocean Freight Cost/year (Comparison Between Vessel Type)

Yearly Ocean Freight (100% from Indonesia)

	Yearly Coal Volume	Panamax	Handy
1st Phase	10.4 Mt	USD 125 M/y	USD 177 M/y
2nd Phase	25.6 Mt	USD 307 M/y	USD 435 M/y

Yearly Ocean Freight (Indonesia:Australia=50%:50%)

	Yearly Coal Volume	Panamax	Handy
1st Phase	10.4 Mt	USD 172 M/y	USD 260 M/y
2nd Phase	25.6 Mt	USD 422 M/y	USD 640 M/y

Yearly Ocean Freight (100% from Australia)

	Yearly Coal Volume	Panamax	Handy
1st Phase	10.4 Mt	USD 218 M/y	USD 343 M/y
2nd Phase	25.6 Mt	USD 538 M/y	USD 845 M/y

Source：JICA Study Team

Although the ocean freight cost will possibly fluctuate based on the cargo movement, it can be said that the larger vessel can save ocean freight cost. Also, the longer the distance from the loading port to CTT, the higher the ocean freight cost; therefore, the cost reduction using larger vessel will be substantial.

As per the table above, in case 100% of the coal is transported from Australia, the cost merit in terms of ocean freight cost between Panamax and Handy would be about USD 350 million in the 2nd Phase.

The cost merit using larger vessel is studied here. In case of coal transportation by 20,000 DWT vessels from Indonesia and/or Australia to Bangladesh with volume of 14 Mt/yr in the 1st Phase and 29 Mt/yr in the 2nd Phase, it is anticipated that the arrangement of the total required number of 20,000 DWT vessels itself would be difficult.

Table 4.1.4 Number of Vessels and Capacity at the end of 2014

DWT	10,000 - 40,000		40,000 - 65,000		65,000 - 100,000		100,000 +	
	No. of vessel	000DWT	No. of vessel	000DWT	No. of vessel	000DWT	No. of vessel	000DWT
Total	**2,415**	**69,476**	**2,793**	**149,069**	**2,240**	**177,639**	**1,545**	**288,805**

Source：JICA Study Team

Amongst the abovementioned 10,000-40,000 DWT vessels, about 200 units of 20,000 DWT-30,000 DWT vessels are supposed to be operating in Southwest Asia. On the other hand, if 29 Mt/yr of coal will be imported to Bangladesh, it is necessary to dedicate 120 numbers of 20,000 DWT vessels with the assumption of 12 round trips per year (21 days per one round trip). Even if such numbers of vessels can be arranged, the dedication of these vessels to this CTT project is quite significant, which may affect the maritime market. Also, considering the necessity to expand the number of berths at CTT and the demurrage occurring due to congestion, 20,000 DWT vessels would be an impractical option.

Taking into consideration of the analysis above, the practical way of coal delivery would be the transshipment at CTT, which is the deploy of Panamax or Handy size vessels from coal loading ports to CTT and then delivery by small vessels and/or belt conveyor from CTT to each CFPP. The chartering contract will be concluded to secure the Panamax or Handy size vessels for the certain term and numbers. Since there’s enough supply in the market, no problem is expected to secure the vessels if the necessary preparation is made with the appropriate timing.

4.1.4. Secondary Transportation Plan

(1) Secondary Transportation

The imported coal will be stored at the CTT for a certain period of time and then will be transported to power plants near CTT by belt conveyor during the 1st Phase and to power plants far from the CTT by small vessels and/or barges with tug boat during the 2nd Phase. The coal transportation to the far power plants from CTT during the 2nd Phase by vessels and/or barges is called as secondary transportation and is studied in this section. However, since the secondary transportation is assumed to be under each coal-fired power plant’s (CFPP) scope, this study should be for reference purpose only.

Amongst the CFPPs which need secondary transportation, Rampal CFPP and Payra CFPP in Khulna are selected to be studied as described in Chapter 3. The study for Maowa CFPP and Mushunganj CFPP along the Megha River and Chittagong CFPP should be for reference purpose only.

It would be efficient if secondary transportation can be done by large vessels; however, as a result of the hearing from the local shipping companies, river transportation in Bangladesh is through small vessels which are mainly 1,000 DWT and the available maximum capacity is 3,200 DWT. Therefore, it is difficult to find similar example in Bangladesh as a reference for the CTT project’s secondary transportation. The desirable vessel for practical and efficient secondary transportation would have the following points:

i) Large vessel as much as possible
ii) Stability which can allow outer sea navigation (Bengal Bay)
iii) Shallow draft which can allow river navigation

In order for the stable navigation, the draft of the vessel should be deep to some extent, on the other hand, the deep-draft vessel has a difficulty in the river navigation.

Also, for the efficient operation and cost minimization of the secondary transportation, the vessels should be as large as possible. In this sense, the suitable vessel for the secondary transportation should be selected considering the climate condition of Bengal Bay, draft of the river, and the limitation of the navigation due to river width.

In addition to the next section (2), as a result of the survey of the limiting factors for river navigation, the suitable vessel type is considered as per Table 4.1.5 below. It is assumed that self-propelled vessels are deployed for the safe navigation on the Bengal Bay. The vessel types under this section are considered to be suitable just from the viewpoint of the limiting factors for navigation and the design of CTT is made under the assumption that 5,000 DWT vessels will be deployed.

Table 4.1.5 Suitable Vessel Type for each CFPP

	Rampal	Payra	Maowa / Mushunganj	Chittagong
DWT	6,100	8,500	2,000	20,000
Draft	5m	7.5m	3.6m	8.5m
LOA	128m	90m	82m	140m
Width	No limitation	No limitation	13m	No limitation

Source: JICA Study Team

(2) Hydrographic Conditions in Bangladesh

The Mongla Port and Chittagong Port, which are the main ports of Bangladesh, were closed for 31-40 days per year (about 10%) from 2007 to 2011 according to the data from the Bangladesh Inland Water Transport Authority (BWTA), which means that about 90% of 365 days would have loading and unloading operations at the port.

Bangladesh is located in an area affected by frequent tropical cyclones. Although it varies year by year, according to the Regional Specialised Meteorological Centre (RSMC) of India Meteorological Department (IMD), cyclones occur for 3-10 days/yr from 2005 to 2014 and 0-3 cyclones/yr might affect the river navigation. It is impossible to measure and predict the disturbance of the navigation because the scale, wind directions, and period will vary from time to time. But assuming that cyclone disturbance would be for about 5 days and three cyclones occur per year, it seems that the disturbance due to cyclone will be about 15 days/yr.

Table 4.1.6 Number of Closed Days of Mongla Port (2007-2011)

SI No	Month	Number of Closed Days				
		2007	2008	2009	2010	2011
1	January - March	0	0	0	0	0
2	April	4	3	2	4	1
3	May	6	5	3	5	5
4	June	8	6	5	7	5
5	July	5	5	7	8	6
6	August	3	6	5	3	4
7	September	6	4	4	6	6
8	October	4	3	4	5	4
9	November	…	1	2	…	…
10	December	…	…	…	…	…
Total days in a year		36	33	32	38	31
Percent (%) of a year		9.9	9.0	8.8	10.4	8.5

Source：JICA Study Team

Table 4.1.7 Number of Closed Days of Chittagong Port（2007 - 2011）

SI No	Month	Number of Closed Days				
		2007	2008	2009	2010	2011
1	January - March	0	0	0	0	0
2	April	4	3	3	4	1
3	May	6	5	5	5	5
4	June	8	6	7	7	5
5	July	5	5	7	8	6
6	August	3	6	6	3	4
7	September	6	4	5	6	6
8	October	4	3	5	5	4
9	November	…	1	2	…	…
10	December	…	…	…	…	…
Total days in a year		36	33	40	38	31
Percent (%) of a year		9.9	9.0	10.7	10.4	8.5

Source：JICA Study Team

Table 4.1.8 Number of Cyclones that Occurred in Bengal Bay

	LAND	D	DD	CS	SCS	VSCS	SuCS	Total	Number of Cyclonic Disturbance Which Might Affect Bangladesh River Operation
2005	1	2	3	4	0	0	0	10	0
2006	1	5	2	1	0	1	0	10	2
2007	0	3	4	1	0	1	0	9	3
2008	1	1	2	3	0	1	0	8	3
2009	0	0	2	2	1	0	0	5	3
2010	0	2	1	0	2	1	0	6	2
2011	1	2	2	0	0	1	0	6	2
2012	0	0	2	1	0	0	0	3	1
2013	1	3	0	1	1	3	0	9	3
2014	2	2	1	0	0	1	0	6	N/A
Total	7	20	19	13	4	9	0	72	

LAND: Any tropical depression formed on the land.

D: Depression with wind speed between 17 and 27 kt (31 and 51 km/h)

DD: Deep Depression with wind speed between 28 and 33 kt (52 and 61 km/h)

CS: Cyclonic storm with wind speed between 34 and 47 kt (62 and 88 km/h)

SCS: Severe cyclonic storm with wind speed between 48 and 63 kt (89 and 118 km/h)

VSCS: Very severe cyclonic storm with wind speed between 64 and 119 kt (119 and 221 km/h)

SuCS: Super cyclonic storm with wind speed 120 kt (222 km/h) and above

Source：JICA Study Team

(2) Trial Calculation of the Secondary Transportation

Since there are neither shipping lines nor vessels which can transport large volume of coal in Bangladesh, this study is under the assumption that the vessels are newly built to be dedicated vessels for the secondary transportation.

The following are the assumptions and factors used to study the cost of the secondary transportation;

i) The speed of 17,000Mt/day for loading and unloading is secured including the allowance.

ii) Although the locations of CFPPs are not fixed, the distance from CTT to each CFPP is supposed to be as follows (NM: Nautical Mile):

- Rampal : 250 NM
- Payra : 120 NM
- Maowa and Mushunganj : 160 NM
- Chittagong : 45 NM

iii) The required number of vessels is calculated based on the assumption that 15,000 Mt/day of coal will be delivered to each CFPP. Although the case of less than 15,000 Mt/day can be considered, there is negligible impact on the unit price.

For river navigation to Rampal, Parya, and Maowa, the vessels should wait for high tide to cross the shallow area at the river mouth. Table 4.1.9 shows the calculated numbers of vessels considering that the navigation is restricted by high tide twice a day. For example, in the case of Rampal, four batches are necessary, i.e., one batch for loading at CTT, one batch from CTT to CFPP, one batch to unload at CFPP, and one batch from CFPP to CTT.

Table 4.1.9 Required Numbers of Vessels

	Rampal	Payra	Maowa / Mushunganj	Chittagong
DWT	6,100	8,500	2,000	20,000
Amount per Batch (Number of Vessel)	18,200 (3)	17,000 (2)	16,000 (8)	20,000 (1)
Number of Batch	4	4	5	2
Number of Vessel	12	8	40	2

Source: JICA Study Team

iv) Shipbuilding costs are estimated at USD 17 million for 20,000 DWT, USD 5 million for 8,500 DWT, USD 4 million for 6,100 DWT, and USD 1.9 million for 2,000 DWT class vessels, which can be built in Bangladesh. It is confirmed that the shipyards in Bangladesh have the experience in building 20,000 DWT class vessels. But if all the vessels are to be built in Bangladesh, the difficulty might be the limited supply and delivery time.

v) Fuel consumption is set at USD 0.9/L based on the procurement of high speed diesel in Bangladesh.

vi) Interest is assumed to be 6% which is the same as for the CTT. Depreciation and repayment period is set to be 20 years.

vii) Manpower cost (captain, engineer, crew) is set at USD 9,000/vessel/month based on the current level of USD 6,000/vessel/month in Bangladesh with 50% allowance and standby persons.

Based on the above assumptions, the cost is estimated as USD 5.8-6.3/Mt for Rampal and USD 2.7-2.9/Mt for Parya, although it may fluctuate subject to the actual conditions. Also, just for reference purpose, the estimated cost would be USD 5.4-5.9/Mt for Maowa and USD 1.7-1.9/Mt for Chittagong,

The cost estimation for the secondary transportation in this section should be treated as a reference only due to the following:

- ✓ The secondary transportation in the 2nd Phase is planned to commence after ten years or so and therefore, it is impossible to estimate such future costs for fuel, shipbuilding, and manpower.
- ✓ The location of CFPPs, berthing conditions at CFPPs, and unloading capacity at CFPPs are not fixed. Also, dredging and shore protection in front of the CFPPs might be necessary.

4.2. Preliminary Site Selection of the CTT

4.2.1. Basic Policy for the Basic Layout Plan of Major Port Facilities

(1) Consistency with the Land Use Plan of the Surrounding Area

The layout plan should match the development plan of the CFPPs in the surrounding area, residential areas, environmental reserve areas, inundation areas during floods, and soil condition. Above all, the effect to the existing habitat should be minimized.

(2) Availability of Future Expansion

There is a future development plan of the commercial port. Accordingly, the layout plan of the port facilities of the CTT should not constrain future expansion. The south area of the main channel is to be left for future expansion and the additional quay walls are mainly to be located at the north side of the main channel. In case additional quay walls have to be located on the south side of the main channel, they are to be aligned so as to maintain the possibility of future development.

(3) Economic Efficiency

Since a large amount of excavation or dredging is required for construction of a port of this type, the layout plan of the port facilities should be designed so as to minimize the water area in the port. The main channel of the CFPP would be commonly used for the CTT in order to avoid additional maintenance dredging or anti-sedimentation measures.

(4) Efficiency of Operation

For the improvement of port operational efficiency, the movement of vessels in the port should be minimized. To enhance efficiency and safety, the maneuvering area for large vessels and the one for small vessels should be separated as much as possible. The distance between the berths and stock area should also be minimized for efficient land side operation.

4.2.2. Site Selection of the CTT

(1) Scope of CTT Facilities

The CTT facilities are as follows:

- Coal unloading berth
- Coal loading berth
- Expansion of inner harbour for Matarbari CFPP
- Coal stockyard
- Belt conveyor from unloading berth to coal stock yard

Although secondary transportation facilities to surrounding CFPPs are not within the scope of CTT but of the CFPPs, they are studied conceptually in this study to consider more efficient operation of the CTT project.

(2) Layout of the CTT Facilities

1st Phase

The layout plan for the 1st Phase is especially considered to minimize the effect to the surrounding society and environment, since early start of operation is required in Bangladesh. Each facility is explained below.

1) Coal Unloading Berth

It is possible to allocate the coal unloading berth at the northern side and southern side of the inner harbour for Matarbari CFPP. However, the southern side of the harbour area is limited since there are many habitats, and expansion of the existing harbour area is required to develop new unloading berth. In order to avoid resettlement of inhabitants in the southern side of the harbour, it is recommended to allocate new coal unloading berth at the northern side of the inner harbour.

In order to install the unloading berth, it is required to expand the inner harbour for the Matarbari CFPP for maintaining enough space in the inner harbour.

2) Coal Loading Berth

The coal loading berth for large barge is not installed in the 1st Phase because coal is only supplied to nearby CFPPs such as Matarbari area or Moheshkali area. Although secondary transport methods to CFPPs should be studied for each CFPP, it is recommended to use belt conveyor or small barge which can navigate behind the river.

The expected secondary transportation methods are shown in Figure 4.2.1 and Figure 4.2.2. In case small barges will be used, construction of small facilities for coal loading and dredging works for broadening and deepening the Kohelia River are required. In case of using conveyor belt, more than 5-6 km long conveyor belt will be necessary to connect the CTT with the CFPPs.

Figure 4.2.1 Expected Loading Facilities and Small Barges

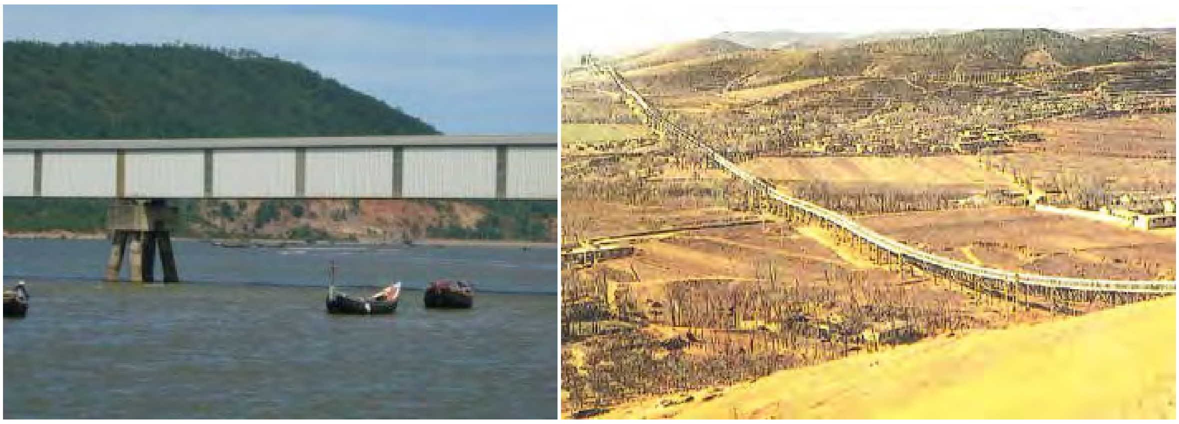


Figure 4.2.2 Examples of Conveyor Belt

3) Coal Stockyard

As mentioned in Chapter 4.4, coal stockyard of about 45 ha is required for the 1st Phase. Three locations of coal stockyard for the 1st Phase are selected as candidates

1. Northern Side of Inner Harbour for Matarbari CFPP

There are many habitats around the site. It is required to conduct reclamation of the sea area in order to avoid resettlement of the habitats. However, sea reclamation is not employed because of environmental problem.

2. Seaside at the Southern Side of Inner Harbour for Matarbari CFPP

   There are also many habitats around the southern side of the turning basin for Matarbari CFPP, but it is possible to ensure enough area at the seaside without resettlement of the habitats. However, according to the environmental impact assessment (EIA) of the Matarbari CFPP, a habitat of sea turtle, which is listed as endangered species, exists in the area. Therefore, large environmental impact is expected.

3. Riverside at the Southern Side of Inner Harbour for Matarbari CFPP

   Although there are also many habitats around the southern side of the turning basin for Matarbari CFPP, it is possible to ensure enough area at the riverside without resettlement of the habitat. Large-scale involuntary resettlement is not estimated since applicable countermeasures such as layout or dust protection wall will be employed.

As a result, No. 3 site is selected. According to the preparatory social survey shown in Chapter 11.2, it was confirmed that there are four villages with 467 households and 2,576 people in the south side of Matarbari CFPP. The layout and coordinates of the coal stockyard without large-scale involuntary resettlement are considered as shown in Table 4.2.1 below. Therefore, involuntary resettlement are not occurred. The details of the environmental and social consideration study are mentioned in Chapter 11.

Table 4.2.1 Coordinates of Coal Stockyard Location for 1st Phase

Point	Latitude	Longitude
1－A1	21°41'16.54"N	91°52'19.51"E
1－A2	21°41'16.54"N	91°52'23.44"E
1－A3	21°41'22.66"N	91°52'23.44"E
1－B1	21°41'00.72"N	91°52'19.51"E
1－B2	21°41'00.72"N	91°52'24.66"E
1－B3	21°40'55.68"N	91°52'24.66"E
1－C	21°40'55.68"N	91°52'36.94"E
1－D	21°41'22.66"N	91°52'36.94"E

Source: JICA Study Team based on Google Earth Pro

Figure 4.2.3 Layout of Coal Stockyard for the 1st Phase

4) Belt Conveyor from Unloading Berth to Coal Stockyard

In order to transport imported coal from the unloading berth allocated at the northern side to the stockyard at the southern side, belt conveyor is installed in front of Matarbari CFPP. The belt conveyor is located so as not to disturb the operation of the CFPP. Type of belt conveyor is closed type to avoid dust.

5) Layout of CTT Facilities

The following Figure 4.2.4 shows the layout plan of the CTT in the 1st Phase. Required facilities for the CTT are shown below.

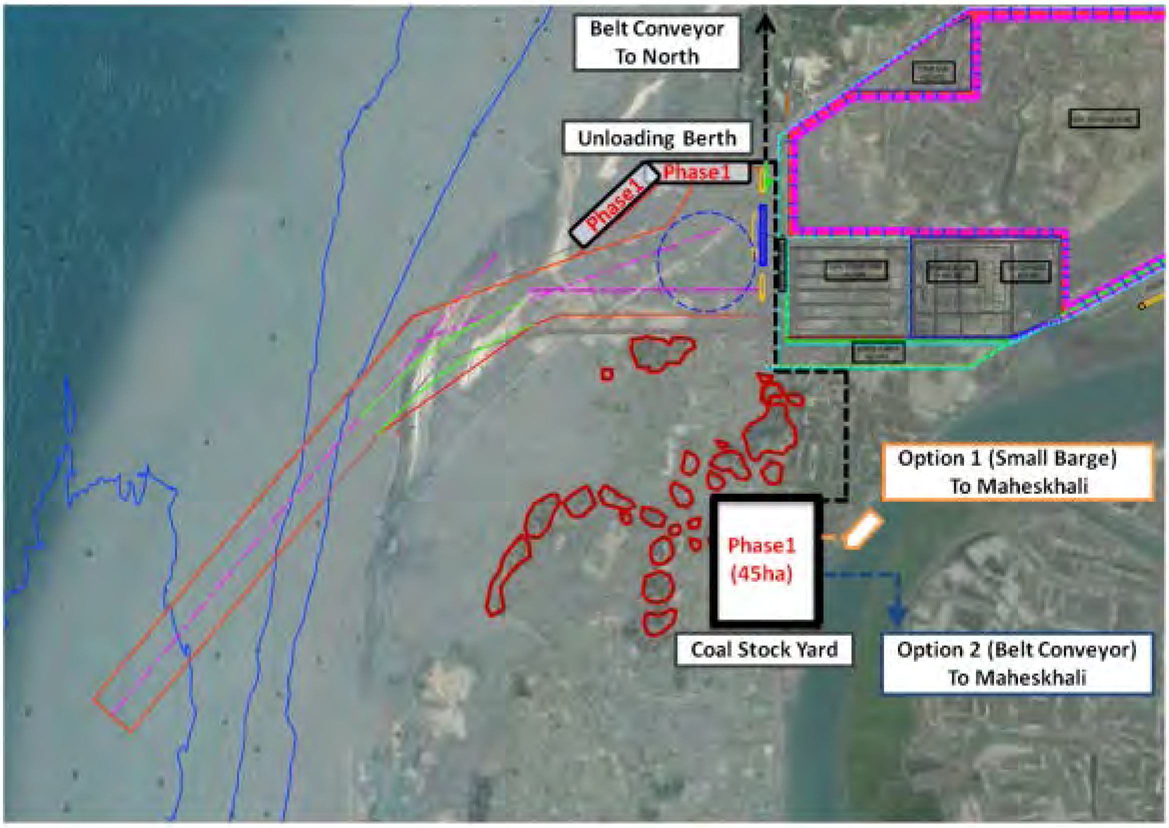


Figure 4.2.4 Layout Plan in the 1st Phase

2nd Phase

The required facilities are additional facilities to those of the 1st Phase and coal loading berth to transport to faraway CFPPs in Bangladesh.

There are several options for the determination of the layout plan for the 2nd Phase depending on the requirement or non-requirement of resettlement before the implementation of the 2nd Phase. In this study, the case where resettlement has not been conducted until the start of the 2nd Phase study is employed as the “Base Case”. If resettlement has been conducted based on other applicable studies, alternative plan is also considered.

(A) Base Case: “Resettlement has not been conducted until the start of the 2nd Phase study.”

1) Coal Unloading Berth

Unloading berth is allocated at the northern side of the inner harbour for Matarbari CFPP to avoid adverse environmental impact on residents at the southern side of the turning basin for Matarbari CFPP.

2) Coal loading berth

As mentioned in Chapter 4.3, four loading berths are required for the transportation to faraway CFPPs. The loading berth is allocated at the southern side of the channel for Matarbari CFPP.

3) Coal stock yard

As mentioned in Chapter 4.4, the required area of the coal stockyard in the 2nd Phase is 50 ha. The concept of the layout is the same as for the 1st Phase which is considered to avoid negative impact on the surrounding environment. Therefore, the coal stockyard in the 2nd Phase is allocated at the southern side of the 1st Phase yard. The coordinates and layout are respectively shown in Table 4.2.2 and Figure 4.2.5 below.

Table 4.2.2 Coordinates of Coal Stockyard Location in 2nd Phase

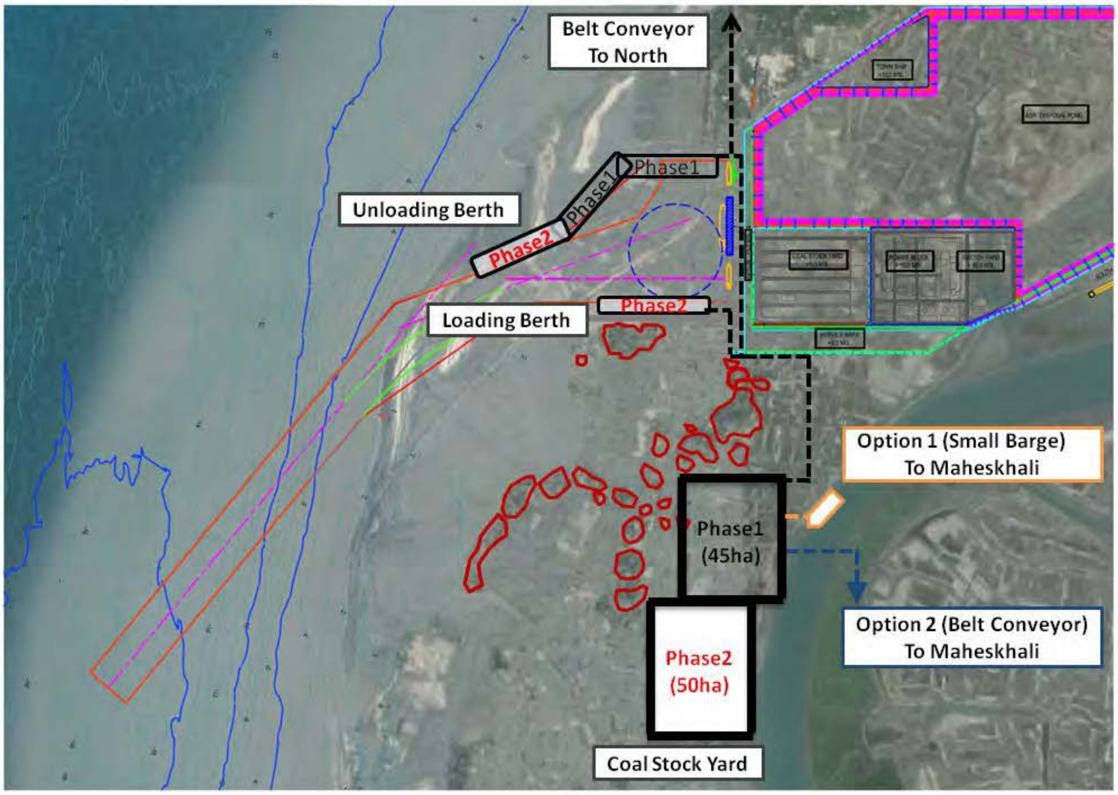
Point	Latitude	Longitude
2－A	21°40'55.68"N	91°52'17.91"E
2－B	21°40'23.00"N	91°52'17.91"E
2－C	21°40'23.00"N	91°52'35.10"E
2－D	21°40'55.68"N	91°52'35.10"E
2－E1	21°40'42.76"N	91°52'17.91"E
2－E2	21°40'42.76"N	91°52'19.75"E
2－E3	21°40'38.63"N	91°52'19.63"E
2－E4	21°40'38.63"N	91°52'17.91"E

Source: JICA Study Team

Source: JICA Study Team Based on Google Earth Pro

Figure 4.2.5 Layout of Coal Stockyard in the 2nd Phase

The following Figure 4.2.6 shows the CTT layout plan in the 2nd Phase.



Source: JICA Study Team based on Google Earth Pro

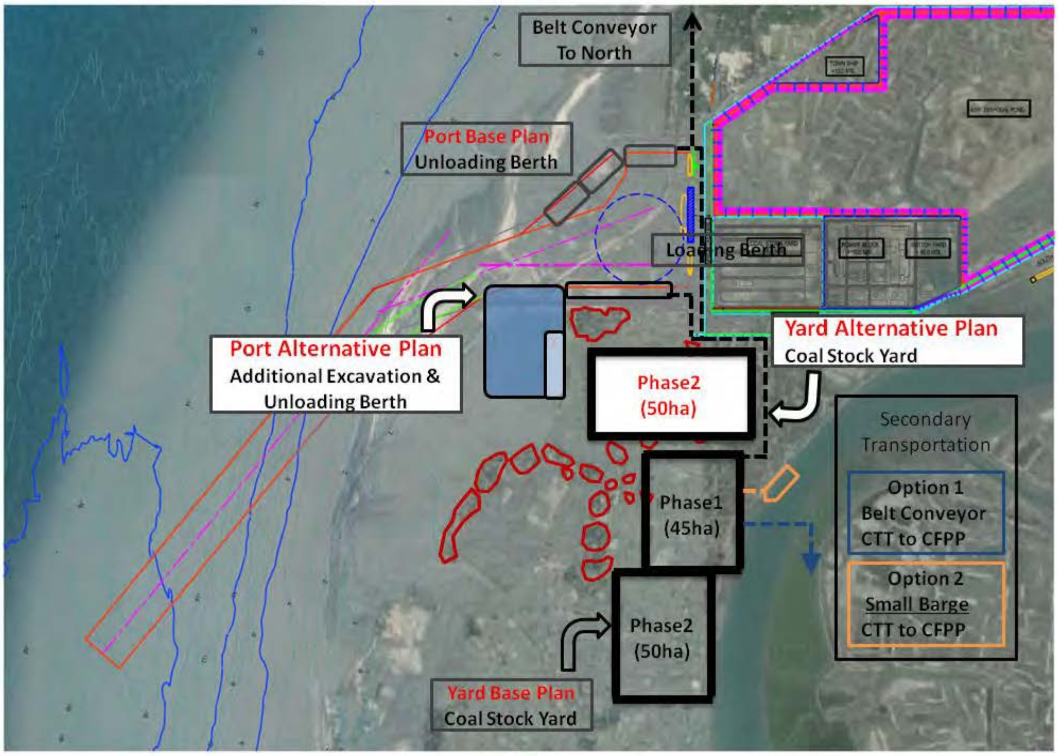
Figure 4.2.6 Layout of CTT in the 2nd Phase

<u>(B) Alternative Plan: “Resettlement has been conducted before the start of the 2nd Phase.”</u>

In case that resettlement has been conducted before the start of the 2nd Phase, large ship berths can be located along the south side of the main channel. The new berth should be developed by expanding the main channel southward as shown in Figure 4.2.7. Future expansion is possible by excavating further southward. The distance between the new berth and the coal stockyard would be longer than in the other layout plan. However, additional cost of dredging works is expected.

In the study and verification survey on the comprehensive development of southern Chittagong Region in Bangladesh, the proposed site is planned to develop as energy basis. If the plan will progress, it will require large-scale resettlement in the Matarbari area. Therefore, the alternative plan is adopted depending on the progress of these projects.

As mentioned in chapter 6, the construction in the 2nd Phase is estimated to start from 2025. Therefore, it is necessary to judge the adoption of this alternative plan before 2021. As mentioned in the preparatory social survey shown in Chapter 11.2, there are four villages with 467 households and 2,576 people in the south side of Matarbari CFPP. Therefore, the project proponent should formulate the land acquisition and resettlement action plan (LARAP) after having thoroughly surveyed in light of Bangladesh legal requirement as well as JICA Guidelines for Environmental and Social Considerations. The required action in detail is shown in Chapter 11.5.



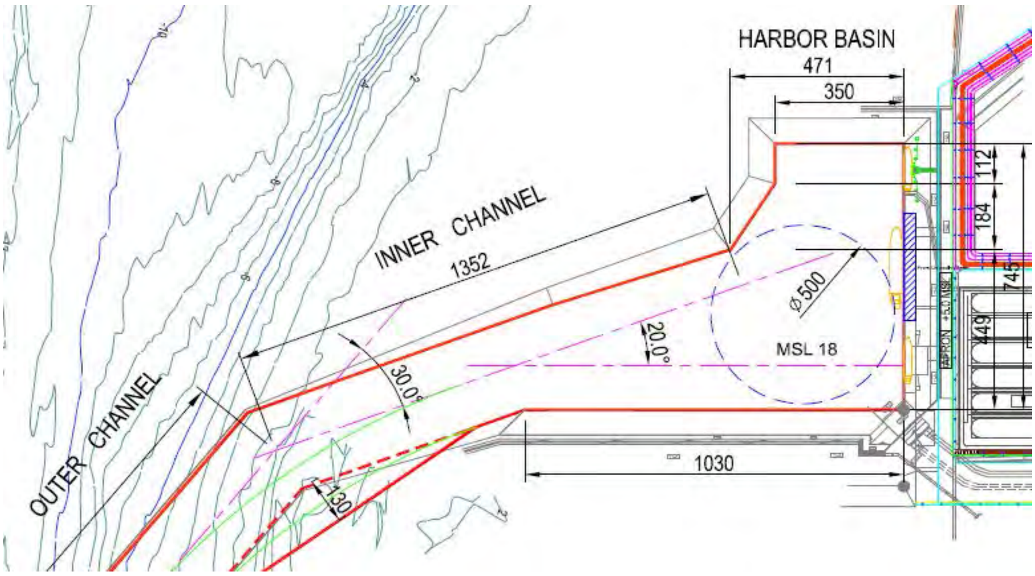
Source: JICA Study Team

Figure 4.2.7 Alternative Layout of CTT in the 2nd Phase

4.3. Determination of Port and Terminal Layout Plan

4.3.1. Port Development Plan of the Matarbari CFPP Project

The port facilities of the CTT are to be developed by fully utilizing the basic facilities such as the main channel, and basin, which are being developed in the Matarbari CFPP Project.



Source: Report of Basic Design for Matarbari Coal Fired Power Plant

Figure 4.3.1 Layout Plan of Deep Sea Port for Matarbari CFPP

In the feasibility study of the CFPP, the target vessel type for deciding the size of the port facilities is proposed as follows:

Class (DWT)	80,000
Length L (m)	230
Breadth B (m)	37.0
Draft D (m)	14.5

The following basic port facilities are included in the CFPP Project:

Main Channel:	Breadth	250 m (1L)
	Length	Excavation of land area 1,350 m (5L)
		Dredging water area 2,500 m
	Depth	-18.0m MSL
Basin:	Turning basin with a diameter of 500 m (2L) is located in front of the coal berth.	
	Depth -18.0 m MSL	
Coal Unloading Berth:		
	Length	300 m
	Depth	-18.0 m MSL
Oil Berth:	Length	150 m
	Depth	-7.5 m
Unloader:	Capacity	800 t/h 2 unit

There is only one coal unloading berth for large vessels in the port. When a large coal carrier is berthing at the port, no other large coal carrier is allowed to enter the access channel. It is estimated to take four days for a large vessel from the time it enters the access channel to the time it exits the entrance channel. In this way, a large vessel does not encounter another large vessel in the channel.

In the previous Japanese Standard, the width of a single-way waterway should be more than 0.5 L (L: the overall length of the ship =250 m). The proposed plan complies with this standard. There are many other standards related to the width of the waterway based on B (breadth of ships). The majority of these standards stipulate that the necessary width of single-way waterway should be 4~6 B (=150 m ~ 224 m). The proposed plan also satisfies such standards. The proposed width of 250 m (1 L) is expected to be sufficient as a single-way waterway.

In the previous Japanese Standard, the area of the basin for turning the bow of a ship should exceed the area of a circle with a radius of 1.0 times the overall length of the ship in case of using an anchor or tugboats. The turning basin could be placed just in front of the coal berth since no other vessel is berthing when a vessel turns in the basin.

Regarding the calmness of the basin, the critical wave height in front of the berthing facilities is designed as 1.0 m with a calmness factor of 96%. This is in line with the previous Japanese Standard which states that the critical wave height for cargo handling by a large vessel should be 0.7~1.5 m, and that cargo handling should be possible 95~97.5% or more of the year. The critical wave height of the entrance of the channel is evaluated as 1.5 m with a calmness factor of 96%.

There is no description for the target vessel type for the oil berth or the number of vessels expected to be accommodated.

In the feasibility study of the CFPP, the annual volume of imported coal is estimated as 373,000 t. The average capacity of the coal carriers calling at the port is estimated as 76,000 t/yr. Consequently, the average number of vessel calls is calculated at 49/yr. If the average dwell time for a coal carrier in the port is four days, the berth occupancy rate will be 55% (4.0 x 49/356 = 0.55), which is rather high compared with the United Nations Conference on Trade and Development (UNCTAD) standard (40%). The average waiting time for entering the port is estimated as 2.5~5.0 days which would be unacceptable for merchant vessels such as container ships. In the case of coal carriers, however, it may be within an acceptable range considering that it takes more than 50 days for one navigation cycle for importing coal from Australia.

	λ (=49/356)	μ (=1/4.0)	ρ	wQ
M/M/1	0.138	0.25	0.55	4.93
M/D/1	0.138	0.25	0.55	2.46

Since the number of operators of coal carriers calling at the port is limited, the average waiting time could be lowered by arranging the optimum calling schedule. In addition, the average berthing time could be curtailed by introducing an additional unloader or by replacing the current unloader with one with a greater handling capacity. This would also contribute to decreasing the average waiting time. More efficient utilisation of the port facilities by combining operations of the CTT with the CFPP would also lead to shorter average waiting times.

Although there is no description in the feasibility study of the CFPP, it is necessary to secure the water area outside the port for anchorage of vessels waiting to enter the access channel of the port. According to the previous Japanese Standard, a basin used for anchorage or mooring should have a water area exceeding the area of a circle with a radius of L+6D+30 m (=250+6x16+30=376 m) for one vessel. Judging from the nautical chart, it seems possible to secure the required anchorage area.

4.3.2. Condition for Port Layout Planning

(1) Handling Volume of Coal in Target Years

Forecast volumes of coal imports described in Chapter 3.3.3 are used in planning of port facilities for the CTT. Transshipment coal volume of 8Mt is for planned CFPPs at Rampal and Payra as are shown in Chapter 3.3.3 which have four units of 600MW. Matabari CFPP No.1 and No.2 have their own coal import facilities and thus, coal from the CTT is not required; however, the other CFPPs planned in the vicinity of the CTT are supposed to be supplied from the CTT through belt conveyors. Table 4.3.1 shows the import and transshipment volumes of coal to plan the port facilities.

Table 4.3.1 Import and Transshipment Volumes of Coal (Unit: Mt)

Year	Import Volume	Supply by Land Transportation	Transshipment Volume
2025	10.40	10.40	0.00
2029	25.60	17.60	8.00

Source: JICA Study Team

The CTT project will be developed based on a phased plan. According to the increment of coal volume, the target year of the 1st Phase is 2025 and that of the 2nd phase is 2029.

(2) Design Vessel

1) Vessel for Coal Importation

The CTT is expected to utilize basic port facilities such as the channel and basin constructed for the CFPP project. Accordingly, the design vessel for the CTT is assumed to be the same level with that of the CFPP. The design vessel adopted for the Matabari CTT project is the 80,000 DWT class Panamax-type with the following specifications.

DWT	80,000
LOA (m)	230.0
Beam (m)	37.0
Draft (m)	14.5

2) Vessel for Transshipment

A vessel of 5,000 DWT is planned to be introduced for the transshipment to the CFPPs in the other areas from CTT, considering the size of the domestic shipping fleet, efficiency of transshipment, and navigability of the access channel to the CFPPs. Therefore, design vessel for the loading berth is set as follows:

Specifications of the design vessel

DWT	5,000
LOA (m)	109.0
Draft (m)	6.4
Beam (m)	17.0

Specifications of the coal loading berth

Length (m)	130.0
Depth of Water (m)	7.5

(3) Conditions on Coal Handling

1) Capacity of Unloader and Loader

The capacity of the unloader and loader installed at the quayside is generally determined by the handling volume of coal, scale of the stockyard, and economic efficiency. Generally, unloaders with a capacity of 1,000~2,500 t/h are deployed. In the feasibility study of the CFPP, two unloaders with the capacity of 800 t/h are equipped for one berth. More than one unloader will be necessary for each berth considering regular maintenance and repair in case of trouble. Given the projected cargo volume of 3.75 Mt/yr, this plan is appropriate.

In case the volume of coal increases further, there are two choices: one is to increase the capacity of the unloaders, whilst the other is to increase the number of berths. As the coal volume being handled at the berths increases, the capacity of the belt conveyor and stacker/reclaimers should also be increased. Life cycle cost including operation and maintenance cost should be considered when upgrading the facilities

It will be necessary to construct new berths if there is no other existing berth which could be utilised for coal handling. This is a far costlier option than increasing the capacity of unloaders. According to a preliminary estimation, in case two unloaders with a capacity of 800 t/h are deployed for each berth, three berths in total will be necessary in 2025, and six berths in 2029. On the other hand, in case of deploying unloaders with a capacity of 2,500 t/h, only two berths would be necessary in 2025, and three berths in 2029. Investment cost for berth construction could be greatly reduced.

In this study, considering the result of the design vessel, the unloader should meet the following conditions:

Capacity: 2,500 t/h for unloading
Unloading Efficiency: 70% (Based on the result of the feasibility study of the CFPP)
Number: Two unloaders per berth

Considering the result of the feasibility study of the CFPP and the size of the design vessel, the loader for transshipment should meet the following conditions:

Capacity: 1,500 t/h for loading
Loading Efficiency: 90%
Number: One loader per berth

Table 4.3.2 Specification of Coal Handling Equipment

	Unloader		Loader
	Matabari CFPP	CTT	CTT
Capacity (t/h)	800	2,500	1,500
Number / Berth	2	2	1
Efficiency (%)	70	70	90

Source: JICA Study Team

2) Operational Days per Year and Working Hours per Day

A coal loading/unloading port is usually operated through the year on a round-the-clock basis. Although the operation of the CTT should be examined in consideration of the rules and regulations of Bangladesh, the following conditions are set in this study:

i) Operation days per year

Operation days per year are usually determined in consideration of days of rough weather, days for maintenance, and special holidays in the case of other bulk terminals. In this study, operation days per year are set at 350 days. However, operation days per year of the coal loading facilities are set at 300 days in consideration of the annual operation rate of the barges for coal transshipment.

ii) Working hours per day

Based on a three-shift working system, working hours per day are usually determined in consideration of time for meal breaks, resting, takeover, and maintenance and so on in the case of other bulk terminals. In this study, working hours per day are set at 18 hours.

(4) Calmness of the port

Considering the operating rate of coal handling and stability of mooring, 97.5% calmness is determined. The planning area is excavated into the land area and enclosed by land. Accordingly, a calmness factor of 97.5 % or more is secured in the water area.

4.3.3. Port Facilities Planning

(1) Method of Determining the Required Number of Berths

The number of berths to cope with the handling volume is calculated using the following formula.

Number of berths = Berthing days per year / (Operation days per year x Berth occupancy ratio)

Hereto;

Berthing days per year = Number of calling vessels per year x Average berthing days per vessel
Number of calling vessels per year = Handling volume per year / Average carrying volume per vessel
Average berthing days per vessel = (Average carrying volume per vessel /Average handling capacity per day) + Idling days

(Note: as this method uses the average value, the peak ratio is sometimes not adequately taken into account.)

Regarding berth occupancy ratio, "Port Development – A handbook for planner in developing countries" issued by UNCTAD indicates the advisable berth occupancy ratios as shown in Table 4.3.3 in the case of break bulk cargo berth. These ratios should not be exceeded.

Table 4.3.3 Berth Occupancy Ratio

Number of Berth	Berth Occupancy Ratio
1	40 %
2	50 %
3	55 %
4	60 %
5	65 %
6 - 10	70 %

Source: "Port Development − A handbook for planner in developing countries -) by UNCTAD

In this study, the required number of berths is to be determined from a comprehensive point of view taking into account the above figures, average waiting time of vessels computed by a queuing theory and other factors.

(2) Required Number of Coal Unloading Berths

1) 1st Phase: Handling volume of coal is 10,400,000 t/yr.

Average carrying volume of a Panamax vessel is set as 76,000 t with an estimated loading efficiency of 0.95. These figures are the same as in the feasibility study of the CFPP.

Required hours for unloading 76,000 t of coal are calculated as follows. The preparation time between the shifts is set at 2 hours and other idling time is set at 6 hours, which includes procedures for entering and departing the port, vessel maneuvering in the port, and mooring and unmooring.

Number of shifts: 4 (76,000 / (2,500 x 2 x 0.7 x 6) = 3.6)
Average berthing hours: 35.7 hours (1.49 days) (76,000 / (2,500 x 2 x 0.7) + 2 x 4 + 6 = 35.7)

4h	2h	6h	2h	6h	2h	6h	2h	3.7h	2h

Total number of calling vessels is calculated as follows:

Number of calling vessels per year: 137 (10,400,000 / 76,000 = 136.8)

In case there is only one berth, the berth occupancy rate is calculated as follows:

137x 1.49 / 350 = 0.583

This far exceeds the advisable berth occupancy ratio by UNCTAD (40%). Average waiting time of vessels is estimated to fall within the range of 0.96 to 1.91 days. This is too long considering the average service time for vessels (1.49days) and thus not acceptable

Two berths are necessary to meet the UNCTAD standard. The berth occupancy rate is 29.2% (0.583/2=0.292) and the average waiting time drops between 0.06～0.13days.

	λ (=137/350)	μ (=1/1.49)	ρ	wQ
M/M/1	0.391	0.671	0.583	1.911
M/D/1	0.391	0.671	0.583	0.956
M/M/2	0.391	0.671	0.583	0.128
M/D/2	0.391	0.671	0.583	0.064

2) 2nd Phase: Handling volume of coal is 25,600,000 t.

Design vessel and the method to determine the number of berths are the same as in the 1st Phase.

Average berthing days: 1.49 days
Number of calling vessels per year: 337 (25,600,000/76,000 = 336.8)
Number of berths: 3 ((337 x 1.49 / 350 = 1.43) / 3 = 0.478)

Therefore, the required number of coal unloading berths in the 2nd Phase is set as three and berth occupancy ratio becomes 47.8 % which satisfies the criteria of UNCTAD. The average waiting time of vessels is calculated to fall within a range of 0.10～0.20 days.

	λ (=337/350)	μ (=1/1.49)	ρ	wQ
M/M/2	0.963	0.671	0.717	1.562
M/D/2	0.963	0.671	0.717	0.781
M/M/3	0.963	0.671	0.478	0.202
M/D/3	0.963	0.671	0.478	0.101

(3) Required Number of Coal Loading Berths

The method to examine the required number of coal loading berths is the same as that used for unloading berths. However, due to the incremental weather condition in the monsoon season, operational days for the transshipment by barges or small vessels would be limited to 300 days.

1) 1st Phase: Transshipment volume of coal is zero tonne per year.

All imported coal is expected to be transported to the nearby CFPPs with belt conveyors. No loading berth is required.

2) 2nd Phase: Transshipment volume of coal is 8,000,000 t/yr.

Idling time for a 5,000 DWT transshipment vessel is much less compared with unloading vessels because such vessels are used for domestic shipping only. Therefore, idling time is set at around 2 hours. The number of berths is calculated as follows:

Average berthing time: 0.32 days ((5,000 / (1,500 x 0.90) + 2 = 5.7 hr) / 18 = 0.317)

1.5h	3.7h	1.5h

Number of calling vessels per year: 1,600 (8,000,000/5,000 = 1,600)
Number of berths: 4 ((1,600 x 0.317 / 300 = 1.691) / 4 = 0.423)

The number of berths is four and berth occupancy ratio becomes 42.3%, which is far lower than the criteria of UNCTAD. Average waiting time of vessels is estimated to fall within the range of 0.02 to 0.04 days, which is a relatively short period of time compared with the average berthing time of 0.32 days. In case that the number of berths is two, berth occupancy ratio becomes 55.9%, which exceeds the criteria of UNCTAD and average waiting time of vessels is estimated to range from 0.06 to 0.13 days. This means that the figures exceed the average berthing time so it may not be possible to cope with the demand. Therefore, the required number of coal loading berths in the 2nd phase is four.

	λ (=1,600/300)	μ (=1/0.317)	ρ	wQ
M/M/3	5.33	3.15	0.564	0.075
M/D/3	5.33	3.15	0.564	0.038
M/M/4	5.33	3.15	0.423	0.015
M/D/4	5.33	3.15	0.423	0.007

Remarks: Average waiting time of vessels in this report is calculated using the computational function in the website (http://queueingtoolpal.org/). Under the assumption that distribution of the arrival ratio follows Poisson distribution and that of the berthing time follows exponential distribution or constant, computational calculation is conducted. Although no data on port activities are obtained because facilities are still in the planning stage, actual waiting time of vessels seems to fall within the range of the two figures.

(4) Capacity of Approach Channel

The capacity of the approach channel shall be examined as follows;

In the channel, two large ships are allowed to pass each other. Vessels entering the port transit the channel and turn in the turning basin and come alongside the berth. During this transit time, the next vessel should not enter the channel. In case of departing the port, vessels leave berths, turn in the turning basin and progress out the channel. During this transit time, no other vessel shall leave the berth. The average waiting time for a large vessel to enter the access channel could be estimated by queueing theory under the assumption that distribution of the arrival ratio follows Poisson distribution and that the berthing time is constant.

Necessary time for a vessel from the entrance of the access channel to come alongside the berth (transit time) could be estimated as 1.0 hr for both large and small vessels.

In the 2nd Phase plan, the annual number of vessels entering the port is 337 large vessels, 1,600 small vessels, and 1,937 in total. If large vessel calls as well as small vessel calls are concentrated within 300 days in the year, the channel occupancy rate is estimated as 35.9%.

The average waiting time for entry to the access channel is estimated as 23 min by M/D/1, and 46 min by M/M/1 model.

	λ (=1,937/300)	μ (=18/1.0)	ρ	wQ
M/M/1	6.46	18.0	0.359	0.031
M/D/1	6.46	18.0	0.359	0.016

In case two large ships are not allowed to pass each other, the channel occupancy rate will further increase. To estimate this effect, one large ship is assumed to be equivalent to two small ships. The converted number of the ships comes to (337 x 2 + 1,600) = 2,274 and the channel occupancy rate becomes 2,274 / (18 x 300) = 0.421 whilst the average waiting time is estimated as 32 min (0.022 x 24 x 60) by M/G/1 model and 62 min (0.040 x 24 x 60) by M/M/1.

	λ (=2,350/300)	μ (=18/1.0)	ρ	wQ
M/M/1	7.83	18.0	0.435	0.043
M/D/1	7.83	18.0	0.435	0.022

The average transit time consists of channel transit time and turning time as estimated below;

Channel outside the port: 2.5 km / (5 kt = 9 km/h) = 0.28 h
Channel inside the port: 1.4 km/ (2 kt = 3.6 km/h)= 0.38 h
Turning and mooring: 0.3 h

Actual transit time is expected to be less than 1 hr.

In the estimation above, calls of large ships are concentrated within 300 days; however, they are actually distributed within 350 days. This alleviates congestion to some extent.

In addition, the estimated time above treats the transit time of small vessels the same as that of large vessels; however, small vessels could turn and moor before the turning basin if berths for small vessels are located close to the entrance of the port. Accordingly, the transit time could be considerably shortened for small vessels.

Accordingly, the capacity of the access channel is sufficient even in the long-term stage.

(5) Impact on Existing Plan of Matarbari CFPP

It is required to expand the inner harbour in the existing plan of Matarbari CFPP since CTT is necessary to be installed at the expansion area of the inner harbour. Although it is expected to remove the constructed revetment for Matarbari CFPP in case the construction of CFPP started earlier than CTT, it is possible to proceed without the removal of the revetment by discussing the construction plan with Matarbari CFPP.

Construction of CTT is estimated not to impact on the operation of Matarbari CFPP, because the COD of Matarbari CFPP is in September 2013 and the construction of the unloading berth for CTT is almost completed.

4.3.4. Staged Development Planning

The staged plan for port and terminal planning is proposed as follows. The plan is divided into two phases based on increasing coal demand.

(1) 1st Phase Development Plan

The 1st Phase development plan for the target year of 2025 is shown in Table 4.3.4.

Table 4.3.4 1st Phase Development Plan (Excluding the CFPP)

<table>
<tr><td colspan="2">Coal Demand</td><td colspan="2">10.40 Mt</td></tr>
<tr><td colspan="2">Port Facility</td><td>Unloading Berth</td><td>Loading Berth</td></tr>
<tr><td rowspan="5"></td><td>Design Vessel</td><td>Over Panamax (80,000 DWT)</td><td>-</td></tr>
<tr><td>Berth (Number, Length Depth)</td><td>(2,300 m,16 m)</td><td>(-,-,-)</td></tr>
<tr><td>Approach Channel (Breadth, Depth)</td><td>(250 m,16 m)</td><td>—</td></tr>
<tr><td>Turning Basin (Depth)</td><td>16.0 m</td><td>-</td></tr>
<tr><td>Handling Equipment</td><td>Unloader 4
Capacity 2,500 t/h</td><td></td></tr>
<tr><td colspan="2">Layout of Port and Terminal</td><td colspan="2">Figure 4.3.2</td></tr>
</table>

Source: JICA Study Team

The coal unloading berths (300 m x 2) can be located at the north side of the turning basin as shown in Figure 4.3.2. Since all the large ship berths will face the turning basin, effective berthing/leaving is possible. The distance between the berths and coal stockyard could be minimised. Since more than one large vessel will stay in the port, it is necessary to secure a turning basin that is 50 m apart from the quay wall in order to let a large vessel turn whilst another vessel is at berth. Expansion of the water area of 8.5 ha including 1.7 Mt of dredging is necessary.

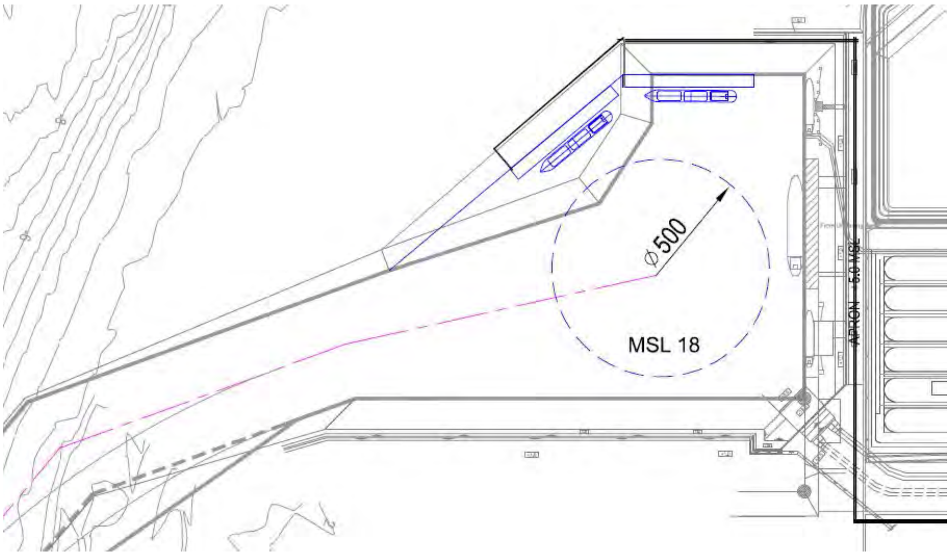


Figure 4.3.2 Layout Plan of Coal Unloading Berth in the 1st Phase

(2) 2nd Phase Development Plan

The 2nd Phase Development Plan for the target year of 2029 is shown in Table 4.3.5.

Table 4.3.5 2nd Phase Development Plan (Excluding the CFPP)

Coal Demand		25.56 Mt	
Port Facility		Unloading Berth	Loading Berth
	Design Vessel	Over Panamax (80,000 DWT)	5000 DWT
	Berth (Number, Length Depth)	(3,300 m,16 m)	(4,130 m, 7.5 m)
	Approach Channel (Breadth, Depth)	(250 m,16 m)	—
	Turning Basin (Depth)	(16.0 m)	(7.5 m)
	Handling Equipment	Unloader 6 Capacity 2,500 t/h	Loader 4 Capacity 1,500 t/h
Layout of Port and Terminal		Figure 4.3.3, Figure 4.3.4 and Figure 4.3.5	

1) Layout Plans of the Coal Unloading Berths

In the 2nd Phase Development Plan, one more coal unloading berth is required in addition to the one constructed under the 1st Phase Development Plan. It is possible to secure the necessary length of the water front line and water area of the mooring basin for the new berth as shown in Figure 4.3.3.

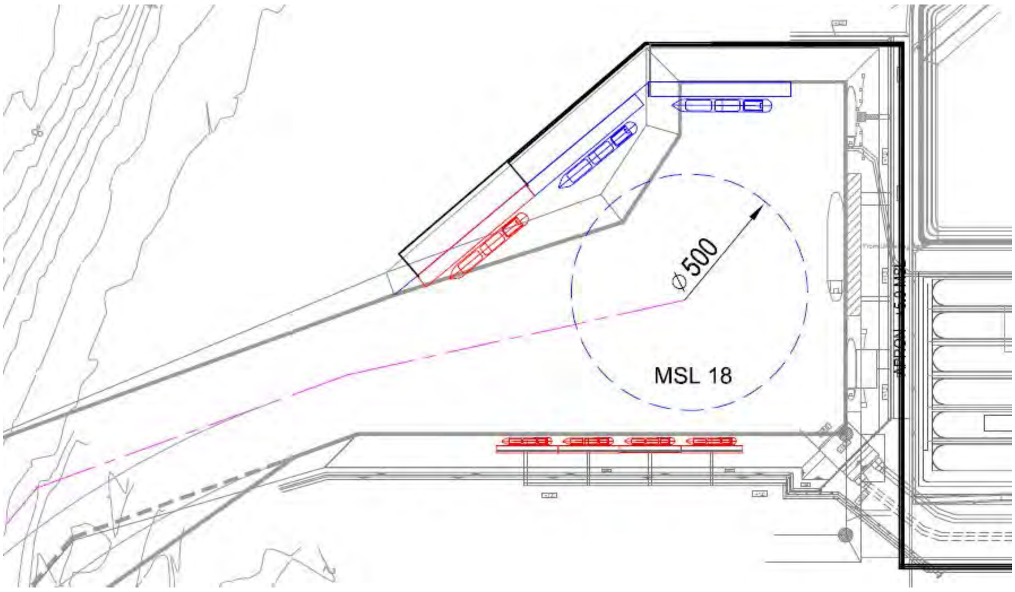


Figure 4.3.3 Layout Plan of Coal Unloading Berth in the 2nd Phase

In case that resettlement has been conducted before the start of the 2nd Phase, large ship berths can be located along the south side of the main channel. The new berth should be developed by expanding the main channel southward as shown in Figure 4.3.4. Future expansion is possible by excavating further southward. The distance between the new berth and the coal stockyard would be longer than in the other layout plan.

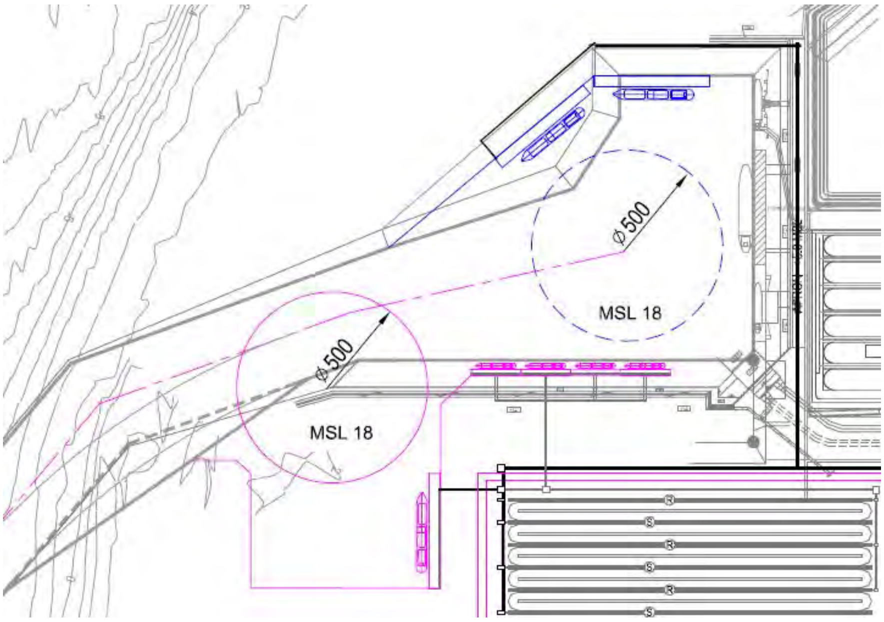


Figure 4.3.4 Alternative Layout Plan of Coal Unloading Berth in the 2nd Phase

2) Layout Plans of the Coal Loading Berths

Four coal loading berths are required in the 2nd Phase Development Plan. The coal loading berths could be located at the inner basin. It is relatively easy to secure the necessary space. However, further expansion of the unloading berths southward which could hinder future expansion should be considered.

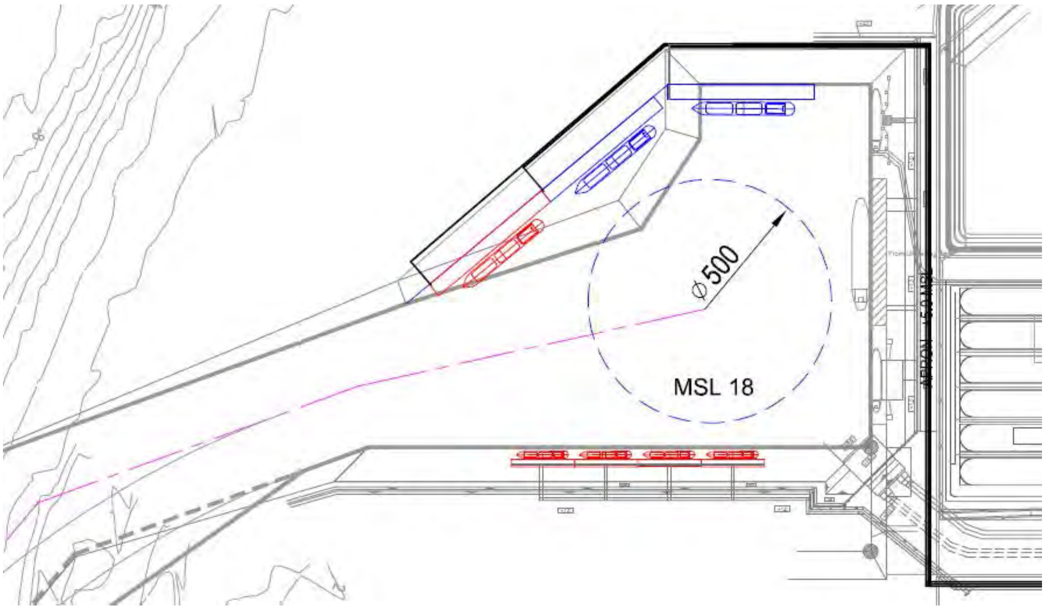


Figure 4.3.5 Layout Plan of Coal Loading Berth in the 2nd Phase

4.4. Determination of Terminal Layout Plan (Including Coal Handling and Conveying Equipment)

4.4.1. Coal Storage Facility

The coal storage facilities are roughly classified into two types, namely, outdoor coal storage and indoor coal storage. The outdoor coal storage is the appropriate type of stockyard for the project especially from the perspective of safety control against spontaneous combustion in handling sub-bituminous coal. (If bituminous coal such as Australian coal is the main coal source, the risk of spontaneous combustion is reduced. Therefore, the indoor coal storage type could be a candidate, although it is inferior from the viewpoint of cost competitiveness and required land space.)

(1) Type of Coal Storage

1) Indoor Coal Storage

For indoor storage facility, there are silo coal storage and roofed longitudinal coal yard as shown in Figure 4.4.1 below. Silo coal storage is adopted by plants with limited space and/or those with concern on the neighborhood environment. Roofed longitudinal coal yard is mainly adopted by plants with concern on the neighborhood environment.

However, the disadvantage of the silo coal storage type is greater construction and operation cost compared with outdoor coal storage type. The cost of the roofed longitudinal coal yard is smaller than that of the silo yard; however, the required land space is bigger than outdoor coal yard. The most important disadvantage of these indoor coal storage facilities is that they may cause a serious damage due to fire accident unless appropriate measures against spontaneous combustion are provided.

Silo Coal Atorage

Source：J-Power HP

Roofed Longitudinal Coal Yard

Source：Sakata Kyodo Power (Japan)

Figure 4.4.1 Indoor Coal Storage Facilities

2) Outdoor Coal Storage

Outdoor coal storage, such as that involving a stockpile, stackers, and reclaimers, is used for piling and delivering coal because of its advantage in terms of cost and convenience of handling operation, including its measure against spontaneous combustion. Therefore, this type of storage is used in many cases by steelworks and thermal power generation plants on large sites.

Disadvantage of the outdoor coal storage is that it requires appropriate coal dust control by equipping dust-control fence and by sprinkling with water. Besides, it requires bigger land space for coal storage than silo storage. (Required land space of outdoor storage is smaller than that of roofed longitudinal coal yard.)

Table 4.4.1 Comparison of Advantages and Disadvantages of Coal Storage Types

	Outdoor (Open Yard)	Indoor (Roofed Longitudinal)
Cost increase in relation to open yards of the same size	○：100%	△：220%
Land space increase in relation to open yards	△：100%	×：130%
Dust control	△：Appropriate measures are required	○：Very low
Safety control	○：Easy to control	△：Difficulty in handling of sub-bituminous coal (spontaneous combustion)

Source : JICA Study Team

(2) Spontaneous Combustion

When storing coal for an extended period of time, attention must be paid to the possibility of spontaneous combustion. The temperature inside a pile immediately after the piling is approximately 30 ℃ to 40 ℃, but it rises gradually due to the heat generated by the low-temperature oxidation of the coal. The temperature of a pile is determined by the balance of the heat of coal oxidation, the latent heat of water evaporation, and the heat dissipated from the pile by air flow. It is considered that the temperature continues to rise at a spot where heat generation dominates, which eventually leads to spontaneous combustion.

There are internal and external factors based on the characteristics of stored coal such as the size distribution, the amount of sprinkled water, and ambient temperature. It has been known that coal with strong oxidising properties, such as a high O/C ratio (the ratio of oxygen to carbon contained in coal), and large specific surface area is more prone to spontaneous combustion.

Coal with high O/C ratio such as brown coal and sub-bituminous coal is more prone to spontaneous combustion, and coal with low O/C ratio such as anthracite coal does not cause spontaneous combustion. Therefore, strict control against spontaneous combustion is required in this CTT since sub-bituminous coal is supposed to be mainly used.

(3) Spontaneous Combustion Management

As a spontaneous combustion management, appropriate prevention, monitoring and corrective actions are required. Unlike handling low O/C ratio coal such as typical Australian bituminous coal or Vietnamese anthracite coal, some preventive actions are required for typical Indonesian sub-bituminous coal; i.e. moist control by sprinkling water while loading coal, press compaction with dozer to reduce inflow of oxygen. However, these preventive actions are insufficient especially for Indonesian sub-bituminous coal, thus monitoring and corrective cooling actions are also required. As a cooling action, some measures are taken in a gradual manner based on temperature of coal stockpile; i.e. sprinkling water, injecting water to stockpile, removal of hot coal by shovel, removal and re-storage of whole coal stockpile.

As mentioned above, flexible stock management and strict safety control are required since serious damage may result in case spontaneous combustion occurs. Therefore, it is common to choose outdoor coal storage for handling sub-bituminous coal. Main coal type for indoor coal storage is generally limited to bituminous coal or anthracite coal. Therefore, usage of sub-bituminous coal is very restrictive with segregated management from bituminous coal in indoor storage.

Source: IEA Clean Coal Center Homepage

Source: Blair Athol Coal Mine

Figure 4.4.2 Spontaneous Combustion Accident

(4) Dust Control and Environmental Measures

For environmental preservation efforts for outdoor coal storage, it is required to reduce coal dust pollution by using dust proofing fences, net sheets, and automatic sprinkler system in addition to maintaining a wastewater treatment facility.

One coal center in Japan, i.e., Chubu Coal Center, established an environmental management system which complies with ISO 14001 in 2003 and has been operating according to that system to be a more socially responsible corporation.

Chubu Coal Center (Japan)

Dust Proofing Fence

Automatic Sprinkler System

Vacuum Dumper

Wastewater Treatment System

“Environmental Management System (EMS)” Registration Certificate

Source：Chubu Coal Centre

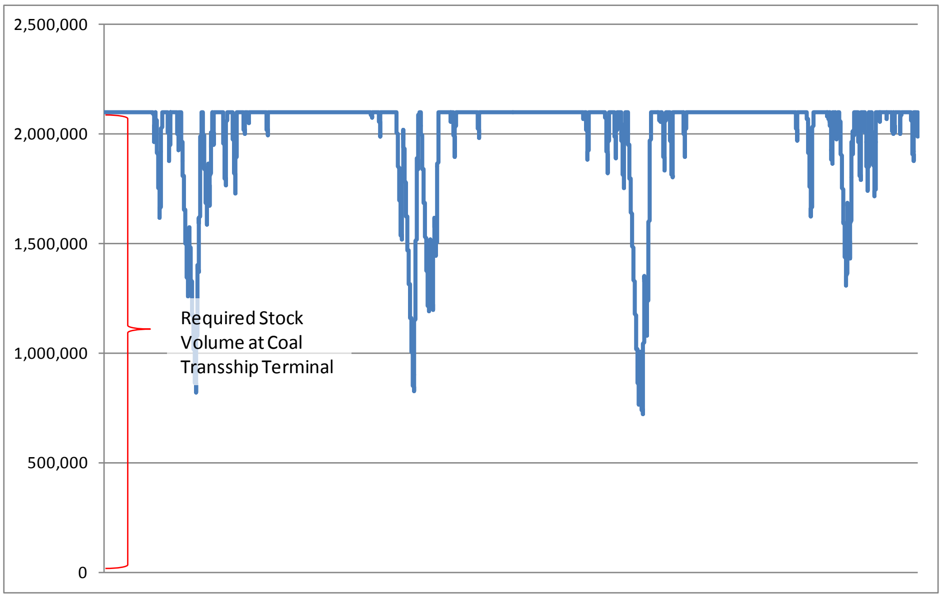
Figure 4.4.3 Environmental Measures in Chubu Coal Centre

4.4.2. Required Coal Stock Volume at Terminal

The following conditions for terminal planning are used.

- Coal handling volume at the terminal (stock): 10.40 Mt/yr for the 1st Phase, 23.60 Mt/yr for the 2nd Phase
- Specific gravity: 0.9
- Coal stock volume at terminal: 30 days
- Yard operation efficiency: 0.75
- Unloader: continuous type 2,500 t/h
- Ship loader: 1,500 t/h
- Stacker / reclaimer: 5,500t/h, 3,000 t/h
- Belt conveyor (unloading): 6,000 t/h
- Belt conveyor (discharging): 3,600 t/h

Figure 4.4.4 shows the examination results of required coal stock volume considering four-year offshore wave data from 2006 to 2010. It says 30-day coal stock can be sufficient for stable coal supply under the given wave condition. The threshold wave height for ship operation is determined to be 2.0 m based on the interview with a Japanese shipping company. Coal stock volume for the 2nd Phase is computed to be 2.10 Mt/month, which is 25.6 Mt/yr divided by 12 months, based on a 30-day coal stock.



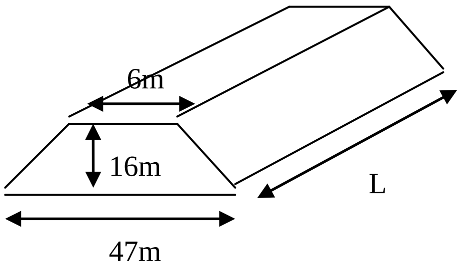
Source: JICA Study Team

Figure 4.4.4 Examination of Required Coal Stock Volume for the 2nd Phase Based on Wave Condition

4.4.3. Staged Development Planning

(1) Terminal Layout for the 1st Phase

The dimensions of the stockpile are determined as illustrated below.



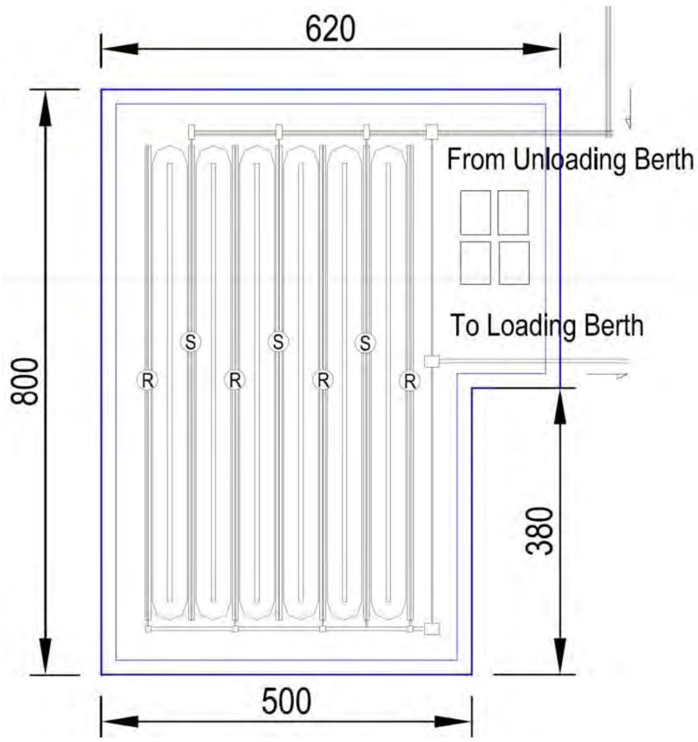
The sectional area is calculated as follows: A = (6 + 47) x 16 ÷ 2 = 424 m^2.

The coal stock volume, length, and number of stock piles, and required terminal areas for the 1st Phase plan are summarised in Table 4.4.2 below. It is assumed that coal will be transported through belt conveyor from the unloading berth to the CFPP, which a Singaporean enterprise has a plan to invest in and develop. Terminal layout is shown in Figure 4.4.5.

Table 4.4.2 Required Area of Coal Stockyard (1st Phase)

Coal Stock Volume (mil ton)	Yard Operation Efficiency	Length of Stockpile (m)	Number of Stockpile	Required Area of Coal Stockyard (ha)
0.90	0.75	600	6	45

Source: JICA Study Team



Source: JICA Study Team

Figure 4.4.5 Terminal Layout (1st Phase)

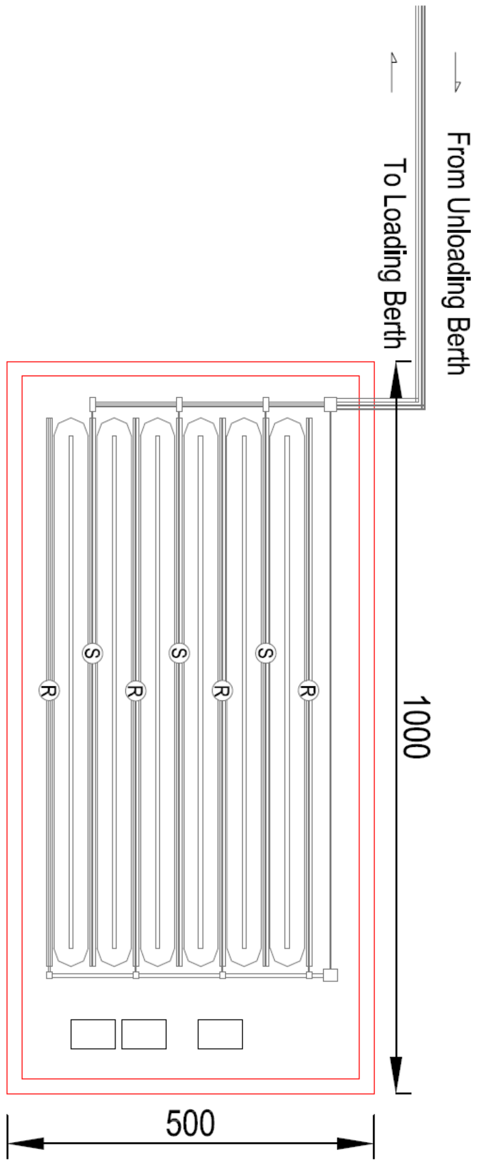
(2) Terminal Layout for the 2nd Phase

The coal stock volume, length, and number of stock piles, and required terminal areas for the 2nd Phase plan are summarised in Table 4.4.3 below. Terminal layout is shown in Figure 4.4.6.

Table 4.4.3 Required Area of Coal Stock Yard (2nd Phase)

Coal Stock Volume (mil ton)	Yard Operation Efficiency	Length of Stockpile (m)	Number of Stockpile	Required Area of Coal Stockyard (ha)
1.13	0.75	700	6	50

Source: JICA Study Team



Source: JICA Study Team

Figure 4.4.6 Terminal Layout (2nd Phase)

(3) Coal Handling and Conveying Equipment

The number and capacity of coal handling and conveying equipment in each phase are summarised in Table 4.4.4 below.

Table 4.4.4 Summary of Coal Handling and Conveying Equipment

		1st Phase	2nd Phase (to be newly installed)
Annual handling volume		10.4 Mt	13.2 Mt
Unloader	Continuous type 2,500t/h	4 nos	2 nos
Shiploader	1,500t/h	—	3 nos
Stacker	5,500t/h	4 nos	4 nos
Reclaimer	3,000t/h	3 nos	3 nos
Belt conveyor (unloading)	6,000t/h	3.9 km	8.4 km
Belt conveyor (discharging)	3,600t/h	8.9 km	6.5 km

Source: JICA Study Team

Maximum of three lines of belt conveyor are installed in this study. Each berth has one line belt conveyor for back up. The length of the belt conveyor is shown in Table 4.4.5 below.

Table 4.4.5 Belt Conveyor for 1st Phase

Belt Conveyor (m)		Length	nos	total
Unloading	Berth	350	1	350
		650	1	650
	Berth to Stock Yard	2,500	2	5,000
	Stock Yard	400	2	800
		700	3	2,100
Loadeing	Stock Yard	700	4	2,800
		400	1	400
		700	1	700
			Total	**12,800**

Source: JICA Study Team

Table 4.4.6 Belt Conveyor for 2nd Phase

Belt Conveyor (m)		Length	nos	total
Unloading	Berth	1,050	1	1,050
	Berth to Stock Yard	2,500	1	2,500
		800	1	800
	Stock Yard	400	2	800
		800	3	2,400
Loadeing	Stock Yard	800	4	3,200
		400	1	400
		800	2	1,600
	Stock Yard to Berth	2,100	1	2,100
			Total	**14,850**

Source: JICA Study Team

Chapter 5. Conceptual Design of Port and Terminal Facilities

Conceptual design is conducted to assess project costs of the main port and terminal facilities based on collecting data, or design planning from this study and "Matarbari Coal Fired Power Plant Study Report (hereinafter called Matarbari CFPP Study). At the stage of basic design or detailed design, it is necessary to survey in more detail and to revise design conditions or project planning based on the detailed survey results.

The studied main facilities for CTT are coal unloading berth, coal loading berth, reclamation and soil improvement for coal stock yard, foundation for coal handling equipment, dust protection fence, and pavement for yard and road. It is out of scope to design security fence, drainage facilities, drainage treatment facilities, water supply facilities, and buildings. Although these facilities are considered in cost estimation, the design of these facilities should be studied in the basic and detailed design stage after determining the detailed plan.

The design is based on Japanese design standard for port structure and British Standard (BS), rock manual or related standard in Bangladesh are used as reference.

5.1. Design Conditions

Design conditions include commonly applicable conditions at the site and specifically applied conditions for each specific structure. Commonly applicable natural conditions and design conditions at the site are shown in this section.

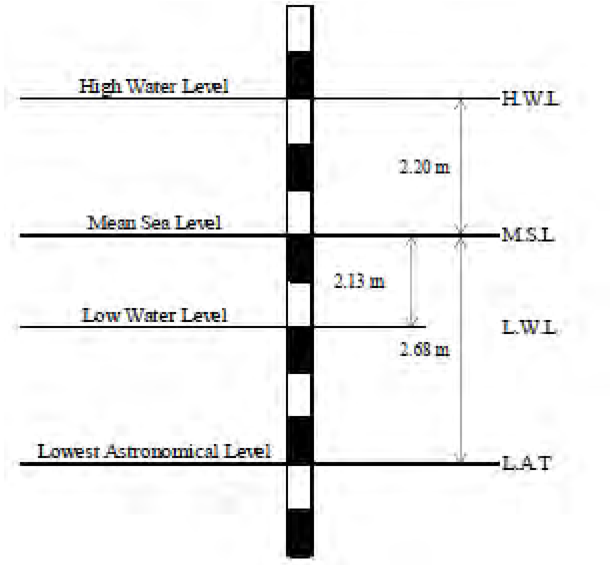
The natural conditions in this study set up the survey results of Matarbari CFPP Study.

5.1.1. Natural Conditions

1) Tidal level

According to the study for the Matarbari CFPP Study, the tidal levels based on the tidal observation from 9th September to 17th April, are shown in Figure 5.1.1 below. The relation between chart datum level (CDL) and national datum level in Bangladesh (PWD=EL=MSL) are also shown in Figure 5.1.1.

		CDL	EL(MSL)
HWL	:	+4.33m	+2.20m
MWL	:	+2.13m	0.00m
LWL	:	-0.00m	-2.13m
LLWL	:	-0.55m	-2.68m



Source: Matarbari CFPP Study

Figure 5.1.1 Relation between Chart Datum Level (CDL) and National Datum Level

2) Tidal current

The port type of Matarbari CFPP is the artificially excavated port. The location of coal wharf in this port was about 1.5 km landward from the harbour entrance. Therefore, the tidal current is not significant that current affects for the structure is not taken into account in the conceptual design.

3) Waves

The simulation results of the **calmness** in Matarbari CFPP Study show the wave height ratio at the north and south side in Table 5.1.1. From the result, offshore wave of 50 years return period is shown in Table 5.1.2. The maximum wave height based on 50 years return period of inner harbour is estimated as $H_{1/3}$ = approximately 2.6 m. Port facilities for CTT are planned to employ pile typed pier. It is estimated that waves are not significantly affected to piles. Therefore, it is not considered to affect the waves in this conceptual design for CTT.

Table 5.1.1 Wave Height Ratio at the Port

Area	Incident wave	$T_{1/3}$=6s	$T_{1/3}$=9s	$T_{1/3}$=12s
North Side	SW	0.37	0.48	0.47
	W	0.32	0.32	0.26
	WSW	0.40	0.42	0.45
South Side	SW	0.11	0.10	0.09
	W	0.08	0.12	0.06
	WSW	0.09	0.09	0.09

Source: JICA Study Team

Table 5.1.2 Significant Wave with Return Period of 50 Years

Wave direction	Significant wave height	Significant wave period
SW	5.45m	9.4s
SSW	6.69m	10.2s
S	6.03m	9.8s

Source: Matarbari CFPP Study

4) High Tide

According to the Matarbari CFPP Study, Matarbari area, southern Bangladesh, is a region that storm surge caused by infestation of cyclone occurs. The recorded storm surges by cyclones and the Bangladesh National Building Code (BNBC), and the height of the storm surge by statistical analysis are shown in Table 5.1.3 .

Table 5.1.3 Design Storm Surge Height

Range	25-year Return Period	50-year Return Period	Actual Result in period of near50 years	Remarks
Maximum	8.0 m	9.0 m	-	Statistical analysis results (Conservative Condition)
↕	-		7.6 m	Previous highest Record* (April 1991,Chittagong Patenga)
	-	7.1m	-	Standard of Bangladesh national code
Minimum	6.2m	7.0 m	-	Statistical analysis results (Critical Condition)

* the worst cyclone in 50 years observed November 1970 in Chittagong, Sarankhola-Bhola Noakhali is not adopted, since it is geographically so far from Matarbari site that it didn't strike.

Although storm surges cause inundation of port facilities such as quay, the effect of the pile structures such as piers is not considered as the schematic design of pier because the flow is assumed to be not so large.

5) Tsunami

According to the Matarbari CFPP Feasibility Study (F/S) Report, the maximum tsunami wave height is expected to be from 1~3 m in the simulation of the tsunami caused by an earthquake that occurred in the fault of the Bay of Bengal.

Fault of the Bay of Bengal is shown in Figure 5.1.2 below.

Source : Matarbari CFPP F/S Study

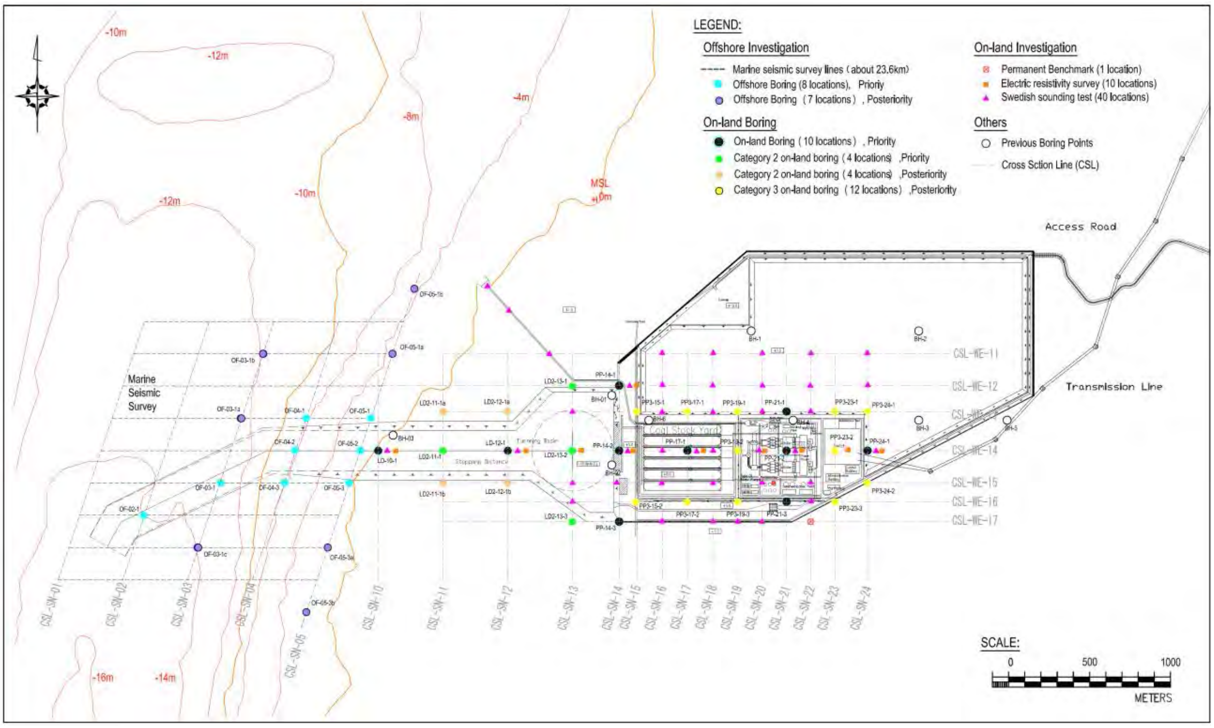
Figure 5.1.2 Fault of the Bay of Bengal

The impact of the pier pile of such structures by wave force of the tsunami will not be considered in this conceptual design because it is assumed that the wave force is not so large compared with other external forces.

6) Soil Conditions

According to the Matarbari CFPP F/S Report, the JICA Study Team has done geological survey by 45 points in the planning area.

The location of boring surveys and their results are shown in Figure 5.1.3 below.



Source: Matarbari CFPP F/S Study

Figure 5.1.3 Location of Boring Surveys

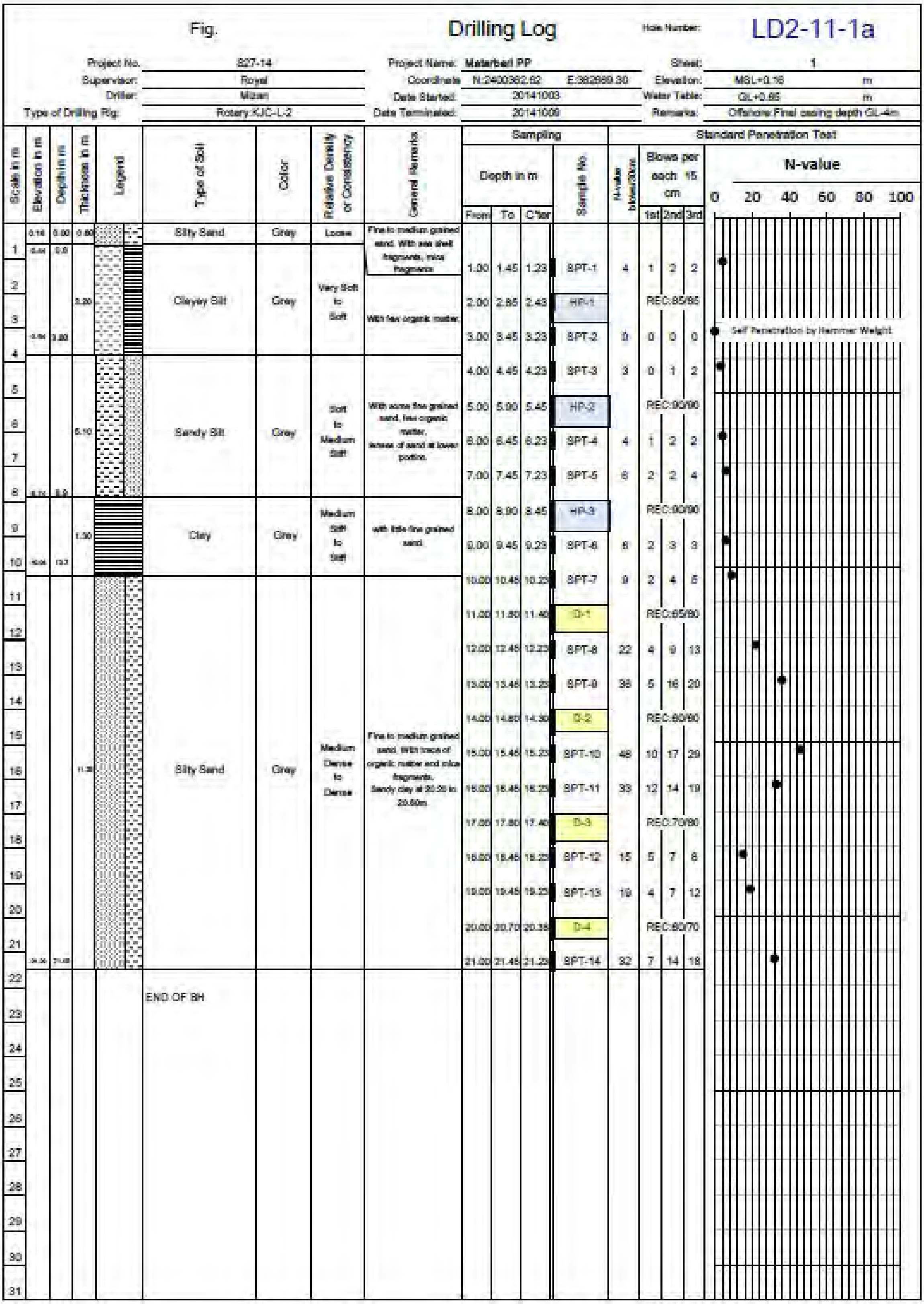
There are five borehole logs in the north area and four borehole logs in the south area, which correspond to the planning area of coal terminal in Matabari CFPP F/S. Applicable boring survey point is as follows.

North area

LD2-11-1a, LD2-12-1a, LD2-13-1, LD2-11-1, LD-12-1,

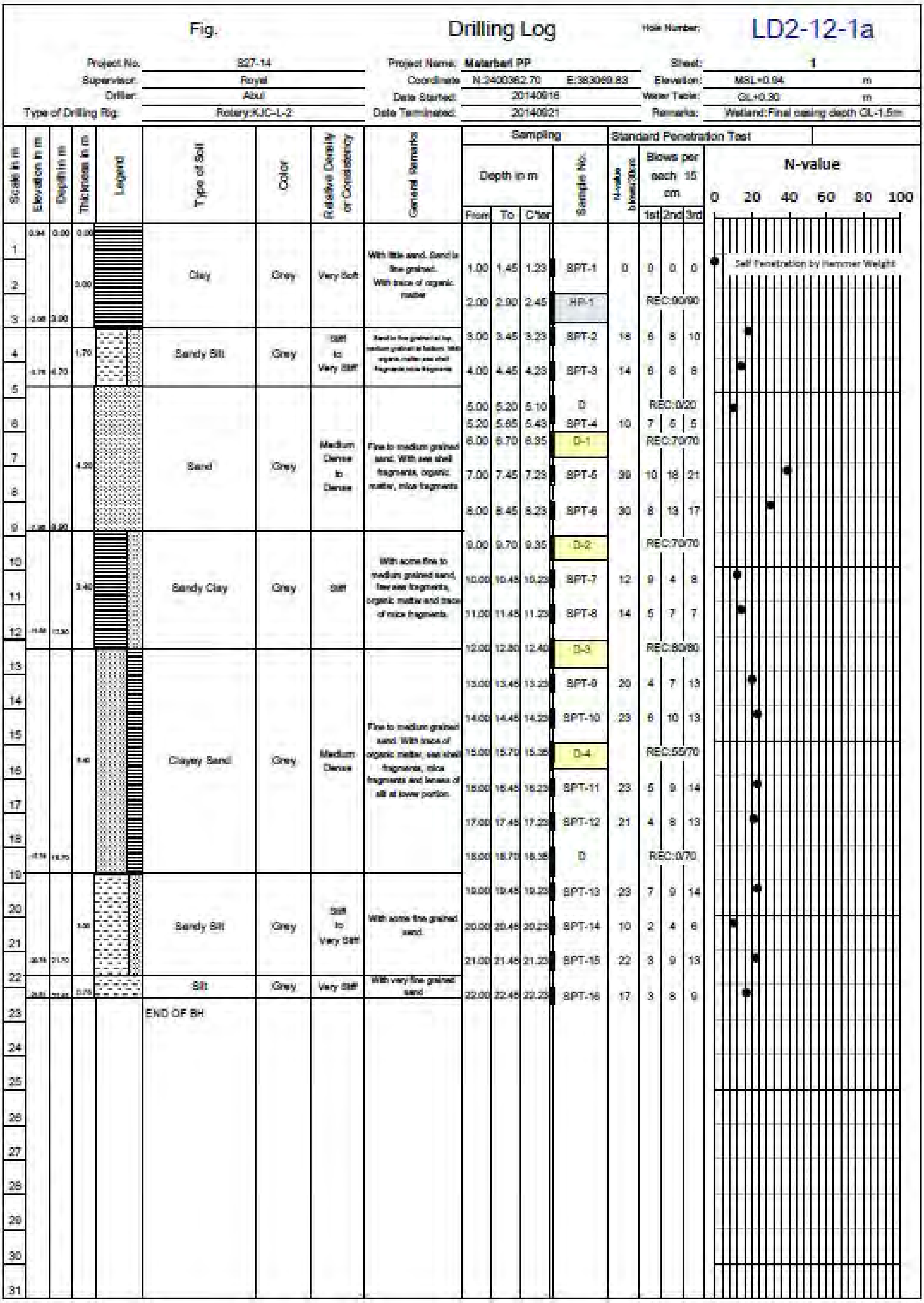
South area

LD2-11-1b, LD2-12-1b, LD2-13-3, LD2-14-3,



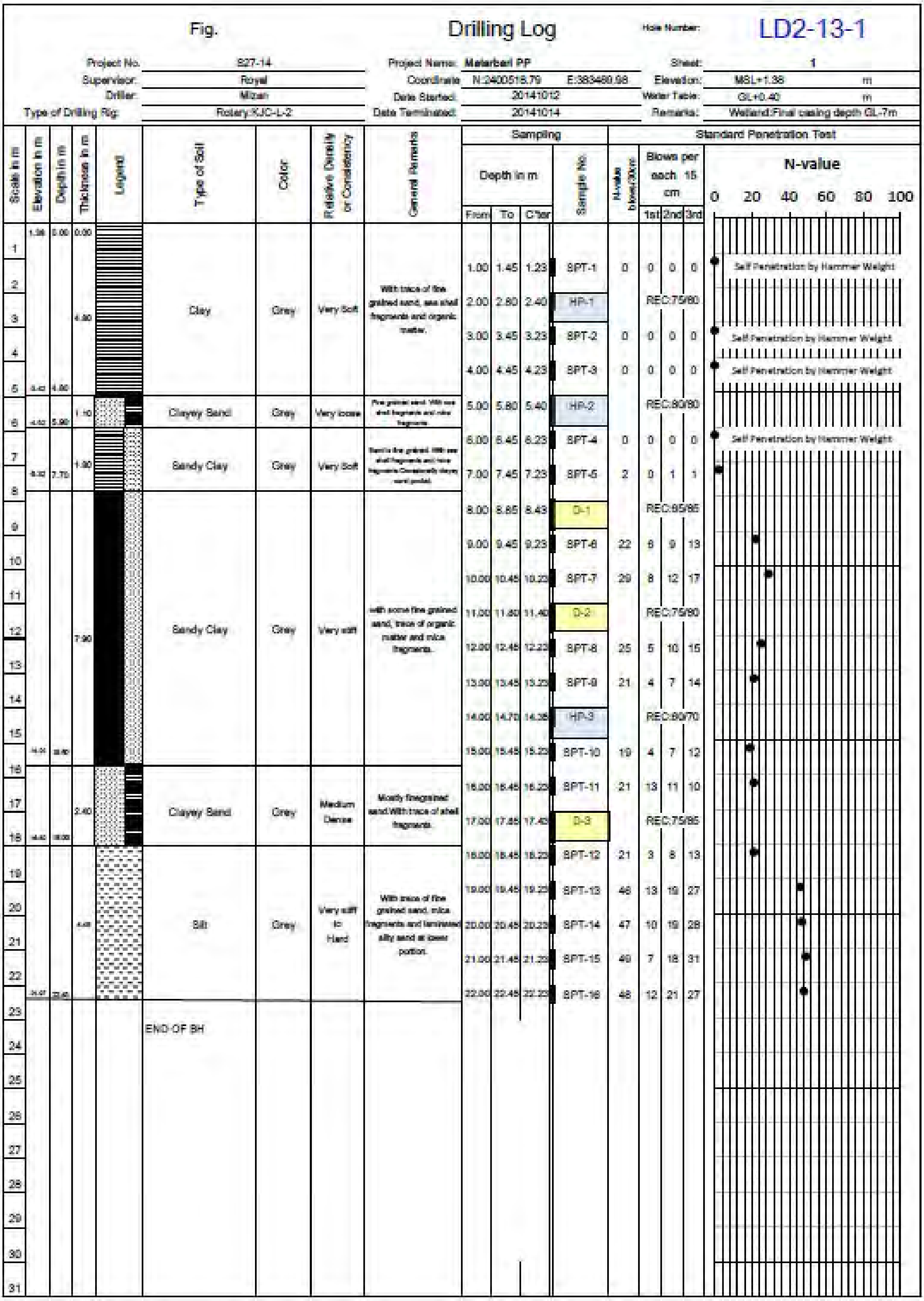
Source:Matarbari CFPP F/S

Figure 5.1.4 Boring Holes at Survey Point BH1



Source:Matarbari CFPP F/S

Figure 5.1.5 Boring Holes at Survey Point BH2



Source:Matarbari CFPP F/S

Figure 5.1.6 Boring Holes at Survey Point BH2

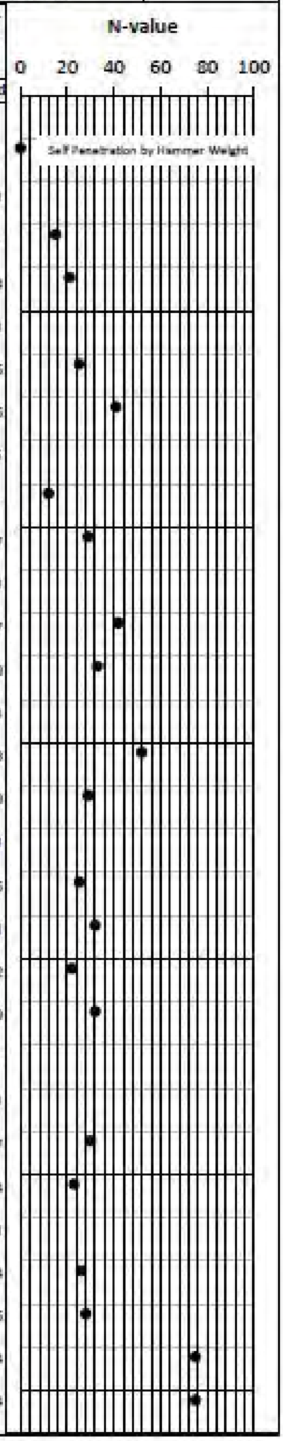
Fig. Drilling Log

Hole Number: **LD-12-1**

Project No.	827-14	Project Name:	Matarbari PP
Supervisor:	Royal	Coordinate:	N:2400120.42 E:383068.87
Driller:	Abul	Date Started:	20140922
Type of Drilling Rig:	Rotary:KJC-L-2	Date Terminated:	20140927
Sheet:	1	Elevation:	MSL+1.43 m
Water Table:	GL+0.25 m	Remarks:	Wetland:Final casing depth GL-1.5m

Elevation in m	Depth in m	Thickness in m	Type of Soil	Color	Relative Density or Consistency	General Remarks
1.43 / -0.92	0.00 / 2.35	2.35	Clay	Grey	Very Soft	With trace of fine grained sand, sea shell fragments and organic matter
-2.27	3.70	1.35	Sandy Silt	Grey	Stiff	Sand is fine grained
-9.27	10.70	7.00	Clayey Sand	Grey	Medium Dense to Dense	Fine to medium grained sand. With organic matter and decomposed wood. Occasinally Clayey Sand. Occasionally brownish grey
-18.27	19.70	9.00	Sand	Grey	Medium Dense to Very Dense	Fine to medium grained sand.With trace of organic matter and mica fragment and occasionally lenses of clayey soil. Silty sand at 14.00 to 14.30m.
-22.27	23.70	4.00	Sandy Clay	Grey	Very Stiff to Hard	Sand is fine to medium grained with mica fragments
-27.27	28.70	5.00	Silt	Grey	Very Stiff to Hard	With fine grained sand
		5.00	Silty Sand	Grey to yellowish brown	Very Dense	Fine to medium grained sand. With thinly lenses of silt

From	To	C'ter	Sample No.	N-value	1st	2nd	3rd
1.00	1.45	1.23	SPT-1	0	0	0	0
2.00	2.90	2.45	HP-1		REC:90/90		
3.00	3.45	3.23	SPT-2	15	4	6	9
4.00	4.45	4.23	SPT-3	21	4	7	14
5.00	5.80	5.40	D-1		REC:80/80		
6.00	6.45	6.23	SPT-4	25	5	10	15
7.00	7.45	7.23	SPT-5	41	10	16	25
8.00	8.85	8.43	D-2		REC:80/85		
9.00	9.45	9.23	SPT-6	12	2	4	8
10.00	10.45	10.23	SPT-7	29	4	12	17
11.00	11.50	11.25	D-3		REC:40/50		
12.00	12.45	12.23	SPT-8	42	5	15	27
13.00	13.45	13.23	SPT-9	33	14	14	19
14.00	14.80	14.40	D-4		REC:50/80		
15.00	15.45	15.23	SPT-10	52	11	24	28
16.00	16.45	16.23	SPT-11	29	5	10	19
17.00	17.60	17.30	D-5		REC:60/60		
18.00	18.45	18.23	SPT-12	25	5	10	15
19.00	19.45	19.23	SPT-13	32	6	11	21
20.00	20.45	20.23	SPT-14	22	6	10	12
21.00	21.45	21.23	SPT-15	32	9	13	19
22.00	22.70	22.35	HP		REC:0/70		
23.00	23.60	23.30	D-6		REC:60/60		
24.00	24.45	24.23	SPT-16	30	7	13	17
25.00	25.45	25.23	SPT-17	23	6	9	14
26.00	26.45	26.23	SPT-18	35	6	14	21
27.00	27.45	27.23	SPT-19	26	7	12	14
28.00	28.45	28.23	SPT-20	28	6	13	15
29.00	29.45	29.23	SPT-21	75	19	31	44
30.00	30.45	30.23	SPT-22	75	20	31	44



Source:Matarbari CFPP F/S

Figure 5.1.7 Boring Holes at Survey Point BH2

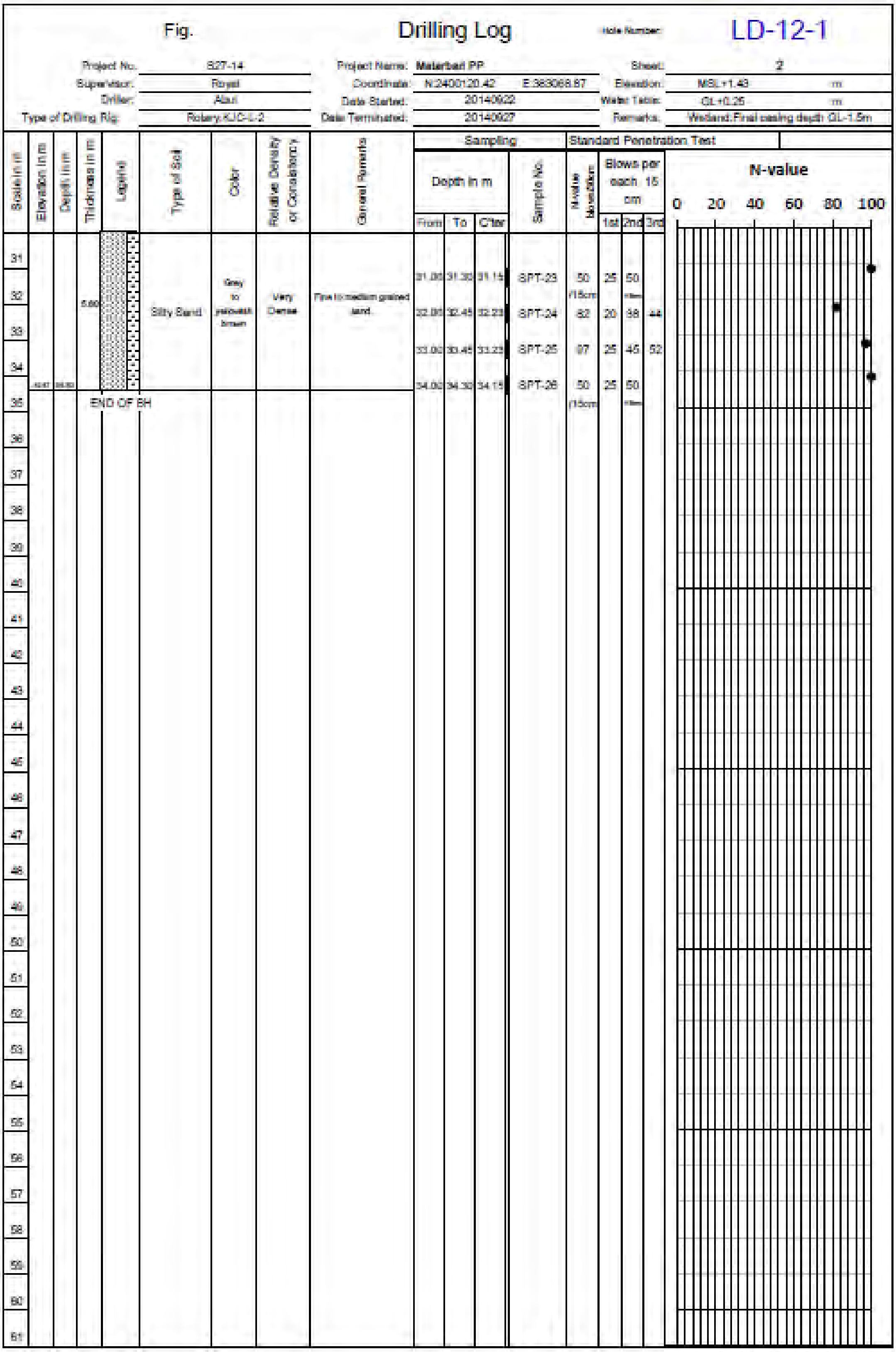


Fig. Drilling Log Hole Number: LD-12-1

Project No.: 827-14	Project Name: Matarbari PP		Sheet: 2
Supervisor: Royel	Coordinate: N:2400120.42	E:383068.87	Elevation: MSL+1.43 m
Driller: Alauddin	Date Started: 20140922		Water Table: GL+0.25 m
Type of Drilling Rig: Rotary KJC-L-2	Date Terminated: 20140927		Remarks: Wetland:Final casing depth GL-1.5m

Scale in m	Elevation in m	Depth in m	Thickness in m	Legend	Type of Soil	Color	Relative Density or Consistency	General Remarks	Sampling Depth in m From	To	C'ter	Sample No.	N-value blows/30cm	Blows per each 15 cm 1st	2nd	3rd
31–34	-33.47	34.90	5.60		Silty Sand	Grey to yellowish brown	Very Dense	Fine to medium grained sand.	31.00	31.30	31.15	SPT-23	50 /15cm	25	50	
									32.00	32.45	32.23	SPT-24	82	20	38	44
									33.00	33.45	33.23	SPT-25	97	25	45	52
									34.00	34.30	34.15	SPT-26	50 /15cm	25	50	
35			END OF BH													

Source:Matarbari CFPP F/S Study

Figure 5.1.8 Boring holes at survey point BH2

Fig.

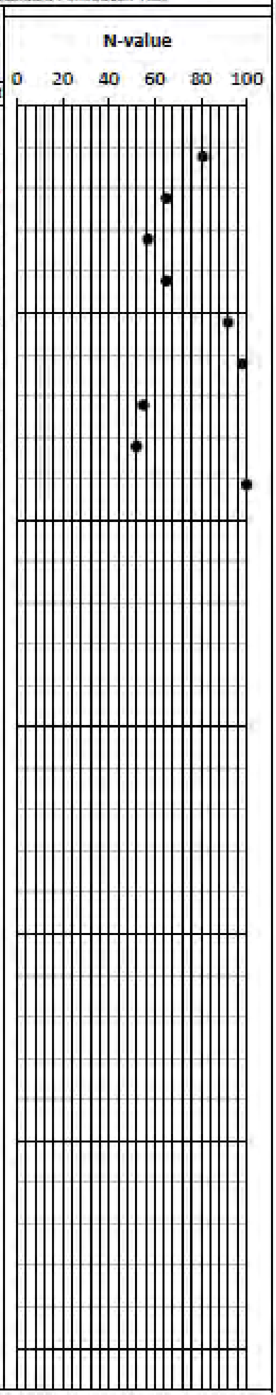
Drilling Log

Hole Number: **LD2-11-1**

Project No.	327-14	Project Name:	Matarbari PP
Supervisor:	Royal	CordinateCoordinate	N:2400120.34 E:382669.58
Driller:	Matab	Date Started:	20140911
Type of Drilling Rig:	Rotary KJC-S-1	Date Terminated:	20140919
Sheet:	2	Elevation:	MSL+1.50 m
Water Table:	GL+0.30 m	Remarks:	Offshore Final casing depth GL-6m

Scale in m	Type of Soil	Color	Relative Density or Consistency	General Remarks	Sampling Depth in m From	To	C'ter	Sample No.	N-value blows/cm	Blows per each 15 cm 1st	2nd	3rd
31–35	Silty Sand	Yellowish brown	Very Dense	Fine to medium grained sand	31.00	31.45	31.23	SPT-24	81	22	36	45
					32.00	32.45	32.23	SPT-25	65	18	28	37
					33.00	33.45	33.23	SPT-26	57	18	22	35
					34.00	34.45	34.23	SPT-27	65	22	50	15
35–39	Silty Sand	Grey	Very Dense	Fine to medium grained sand With trace of organic matter	35.00	35.45	35.23	SPT-28	92	15	34	58
					36.00	36.45	36.23	SPT-29	98	14	35	63
					37.00	37.45	37.23	SPT-30	55	13	21	34
					38.00	38.45	38.23	SPT-31	52	17	24	28
					39.00	39.30	39.15	SPT-32	50 /15cm	27	50	

Standard Penetration Test



Source:Matarbari CFPP F/S

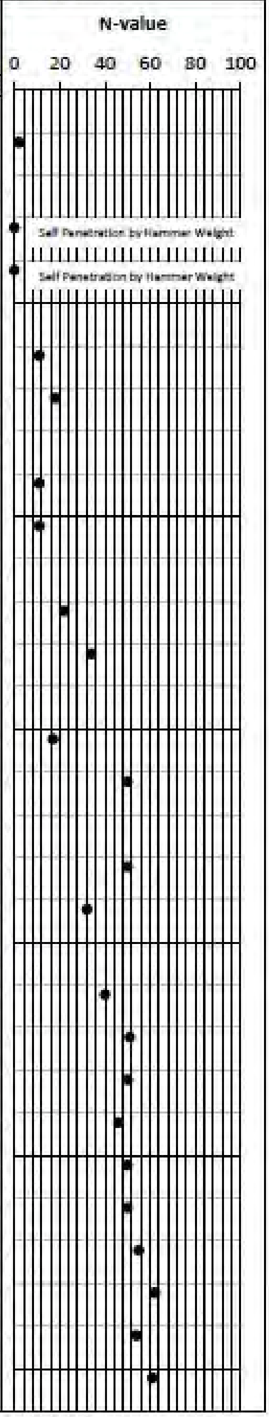
Figure 5.1.9 Boring Holes at Survey Point BH2

Fig. **Drilling Log** Hole Number: **LD2-11-1**

Project No.	827-14	Project Name:	Matarbari PP	Sheet:	1
Supervisor:	Royal	CordinateCoordinate	N:2400120.34 E:382680.58	Elevation:	MSL+1.50 m
Driller:	Matab	Date Started:	20140911	Water Table:	GL+0.30 m
Type of Drilling Rig:	Rotary:KJC-S-1	Date Terminated:	20140919	Remarks:	Offshore.Final casing depth GL-6m

Elevation in m	Depth in m	Thickness in m	Type of Soil	Color	Relative Density or Consistency	General Remarks
1.50 / -3.30	0.00 / 4.80	4.80	Clay	Greenish Grey	Very Soft	With trace of fine grained sand, sea shell fragments, organic matter and decomposed wood
-10.50	12.00	7.20	Sandy Silt	Grey	Stiff to Very Stiff	Sand is fine to medium grained. With trace of mica fragments. Clay at 8.00 to 8.90m. Silty sand at 9.00 to 9.45m
-19.40	20.90	8.90	Silty Sand	Grey	Medium Dense to Dense	Fine to medium grained sand. With trace of mica fragments. Sandy silt at 17.00 to 17.80m
-22.30	23.80	2.90	Sandy Silt	Grey	Hard	Sand is fine to medium grained. With trace of mica fragments
-24.30	25.80	2.00	Silty Sand	Grey, Yellowish Brown	Dense to Very Dense	Mostly fine grained sand. With trace of mica fragments.
-26.20	27.70	1.90	Sandy Silt	Grey	Hard	Sand is fine to medium grained. With trace of mica fragments
		7.30	Silty Sand	Yellowish brown	Very Dense	Fine to medium grained sand

Depth From (m)	To	C'ter	Sample No.	N-value blows/30cm	Blows 1st	2nd	3rd
1.00	1.45	1.23	SPT-1	2	1	1	1
2.00	2.80	2.40	HP-1		REC:80/80		
3.00	3.45	3.23	SPT-2	0	0	0	0
4.00	4.45	4.23	SPT-3	0	0	0	0
5.00	5.90	5.45	HP-2		REC:90/90		
6.00	6.45	6.23	SPT-4	11	3	4	7
7.00	7.45	7.23	SPT-5	18	7	8	10
8.00	8.90	8.45	HP-3		REC:90/90		
9.00	9.45	9.23	SPT-6	11	2	3	8
10.00	10.45	10.23	SPT-7	11	3	5	6
11.00	11.80	11.40	HP-4		REC:79/80		
12.00	12.45	12.23	SPT-8	22	5	10	12
13.00	13.45	13.23	SPT-9	34	7	14	20
14.00	14.80	14.40	D-1		REC:50/80		
15.00	15.45	15.23	SPT-10	17	1	6	11
16.00	16.45	16.23	SPT-11	50	17	23	27
17.00	17.80	17.40	D-2		REC:75/80		
18.00	18.45	18.23	SPT-12	50	10	21	29
19.00	19.45	19.23	SPT-13	32	4	12	20
20.00	20.80	20.40	D-3		REC:70/80		
21.00	21.45	21.23	SPT-14	40	15	19	21
22.00	22.45	22.23	SPT-15	51	16	22	29
23.00	23.45	23.23	SPT-16	50	14	23	27
24.00	24.45	24.23	SPT-17	46	12	20	26
25.00	25.45	25.23	SPT-18	50	15	25	25
26.00	26.45	26.23	SPT-19	50	16	22	28
27.00	27.45	27.23	SPT-20	55	10	24	31
28.00	28.45	28.23	SPT-21	62	19	24	38
29.00	29.45	29.23	SPT-22	54	18	25	29
30.00	30.45	30.23	SPT-23	61	16	28	33



Source:Matarbari CFPP F/S

Figure 5.1.10 Boring Holes at Survey Point BH2

Fig.

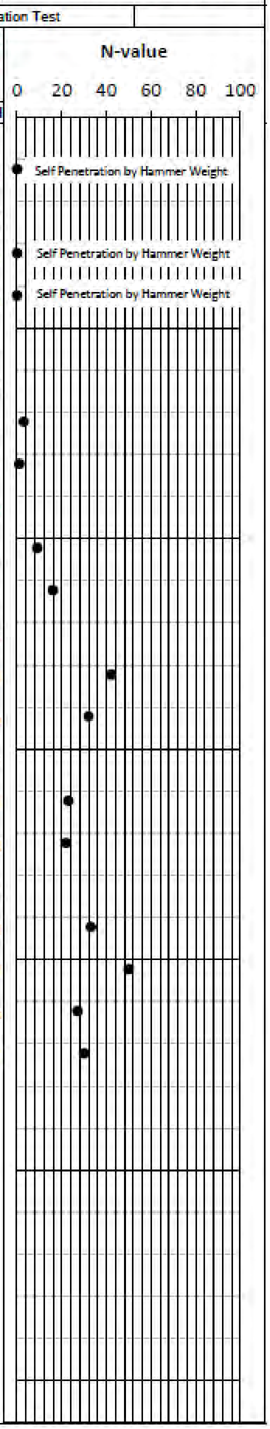
Drilling Log

Hole Number: **LD2-11-1b**

Project No.	S27-14	Project Name:	Matarbari PP
Supervisor:	Royal	Coordinate	N:2399921.61 E:382669.21
Driller:	Mizan	Date Started:	20140929
Type of Drilling Rig:	Rotary:KJC-L-2	Date Terminated:	20141001
Sheet:	1	Elevation:	MSL+1.64 m
Water Table:	GL+0.20m m	Remarks:	Wetland:Final casing depth GL-7m

Elevation in m	Depth in m	Thickness in m	Type of Soil	Color	Relative Density or Consistency	General Remarks
1.64 / -2.86	0.00 / 4.50	0.00 / 4.50	Clay	Grey	Very Soft	With trace of fine grained sand, organic matter. At top mottled with yellowish brown
-7.06	8.70	4.20	Sandy Silt	Grey	Very Soft to Soft	With lots of fine grained sand
-13.46	15.10	6.70	Clayey Sand	Grey	Medium Dense to Dense	Fine to medium grained sand. With trace of sea shell fragments
-14.26	15.90	0.80	Sandy Clay	Grey	Very Stiff	Sand is fine grained .
-19.06	20.70	4.80	Silty Sand	Grey	Medium Dense to Dense	Fine to medium grained sand. With trace of sea shell fragments. Color is Brownish Grey at 20.00 to 20.45m.
-20.81	22.45	1.75	Sandy Silt	Grey	Very Stiff	With trace of fine grained sand
			END OF BH			

Sampling Depth From (m)	To	C'ter	Sample No.	N-value blows/30cm	1st	2nd	3rd
1.00	1.45	1.23	SPT-1	0	0	0	0
2.00	2.90	2.45	HP-1		REC:90/90		
3.00	3.45	3.23	SPT-2	0	0	0	0
4.00	4.45	4.23	SPT-3	0	0	0	0
5.00	5.85	5.43	HP		REC:0/85		
6.00	6.90	6.45	HP-2		REC:90/90		
7.00	7.45	7.23	SPT-4	3	0	1	2
8.00	8.45	8.23	SPT-5	1	0	0	1
9.00	9.50	9.25	HP-3		REC:50/50		
10.00	10.45	10.23	SPT-6	9	2	4	5
11.00	11.45	11.23	SPT-7	16	3	8	8
12.00	12.86	12.43	D-1		REC:65/85		
13.00	13.45	13.23	SPT-8	42	13	18	24
14.00	14.45	14.23	SPT-9	32	7	14	18
16.00	16.86	16.43	D-2		REC:60/85		
16.00	16.45	16.23	SPT-10	23	13	12	11
17.00	17.45	17.23	SPT-11	22	6	9	13
18.00	18.60	18.30	D-3		REC:60/60		
19.00	19.45	19.23	SPT-12	33	6	13	20
20.00	20.45	20.23	SPT-13	50	20	23	27
21.00	21.45	21.23	SPT-14	27	7	12	15
22.00	22.45	22.23	SPT-15	30	8	13	17



Source:Matarbari CFPP F/S

Figure 5.1.11 Boring Holes at Survey Point BH2

Fig.

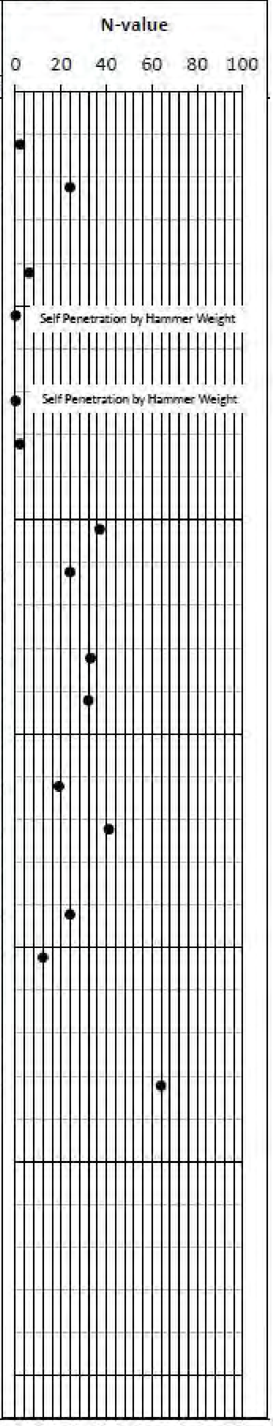
Drilling Log

Hole Number: **LD2-12-1b**

Project No.	S27-14	Project Name:	Matarbari PP
Supervisor:	Royal	Coordinate	N:2399921.47 E:383069.02
Driller:	Matab	Date Started:	20141030
Type of Drilling Rig:	Rotary:KJC-L-1	Date Terminated:	20141031
Sheet:	1		
Elevation:	MSL+1.33 m		
Water Table:	GL+0.40 m		
Remarks:	Wetland:Final casing depth GL-8m		

Elevation in m	Depth in m	Thickness in m	Type of Soil	Color	Relative Density or Consistency	General Remarks
1.33 / 0.53	0.00 / 0.80	0.00 / 0.80	Clay	Grey	Very Soft	With trace of fine grained sand, sea shell fragments, organic matter
-2.27	3.60	2.80	Clayey Sand	Grey	Dence	Fine grained sand. With sea shell fragments, organic matter, mica fragments
-3.37	4.70	1.10	Sandy Silt	Grey	Medium Stiff	Sand is fine grained. With organic matter, sea shell fragments, mica fragments
-4.47	5.80	1.10	Silty Sand	Grey	Very Loose	Fine to medium grained sand. With sea shell fragments, organic matter, mica fragments
-7.47	8.80	3.00	Clay	Grey	Very Soft	with trace of fine grained sand, sea shell fragments, organic matter
-8.67	10.00	1.20	Clayey Silt	Grey	Very Soft	with little fine grained sand, trace of organic matter.
-11.47	12.80	2.80	Silty Sand	Brown	Dense	Fine to medium grained sand. With trace of sea shell fragments
-17.07	18.40	5.60	Clayey Sand	Grey	Medium Dense to Dense	Fine grained sand. With sea shell fragments, organic matter, mica fragments
-21.57	22.90	4.50	Sandy Silt	Grey	Stiff to Very Stiff	Sand is fine grained. With sea shell fragments, organic matter. Occasionally clay with sand .x Clay with sand at 22.00 to 22.60m.
-22.12	23.45	0.55	Silty Sand	Yellowish brown	Very Dense	Fine to medium grained sand. With mica fragments
			END OF BH			

Sampling Depth in m From	To	C'ter	Sample No.	N-value blows/30cm	Blows per each 15 cm 1st	2nd	3rd
1.00	1.45	1.23	SPT-1	2	0	1	1
2.00	2.45	2.23	SPT-2	24	7	9	15
3.00	3.90	3.45	D-1		REC:90/90		
4.00	4.45	4.23	SPT-3	6	2	3	3
5.00	5.45	5.23	SPT-4	0	0	0	0
6.00	6.80	6.40	HP-1		REC:80/80		
7.00	7.45	7.23	SPT-5	0	0	0	0
8.00	8.45	8.23	SPT-6	2	1	1	1
9.00	9.65	9.33	D-2		REC:65/65		
10.00	10.45	10.23	SPT-7	37	6	16	21
11.00	11.45	11.23	SPT-8	24	3	9	15
12.00	12.65	12.33	D-3		REC:65/65		
13.00	13.45	13.23	SPT-9	33	5	15	18
14.00	14.45	14.23	SPT-10	32	8	15	17
15.00	15.90	15.45	D-4		REC:75/90		
16.00	16.45	16.23	SPT-11	19	7	9	10
17.00	17.45	17.23	SPT-12	41	13	21	20
18.00	18.90	18.45	D-5		REC:75/90		
19.00	19.45	19.23	SPT-13	24	6	8	16
20.00	20.45	20.23	SPT-14	12	3	2	10
21.00	21.90	21.45	D		REC:0/90		
22.00	22.90	22.45	D-6		REC:70/90		
23.00	23.45	23.23	SPT-15	64	15	26	38



Source:Matarbari CFPP F/S

Figure 5.1.12 Boring Holes at Survey Point BH2

Fig. **Drilling Log**

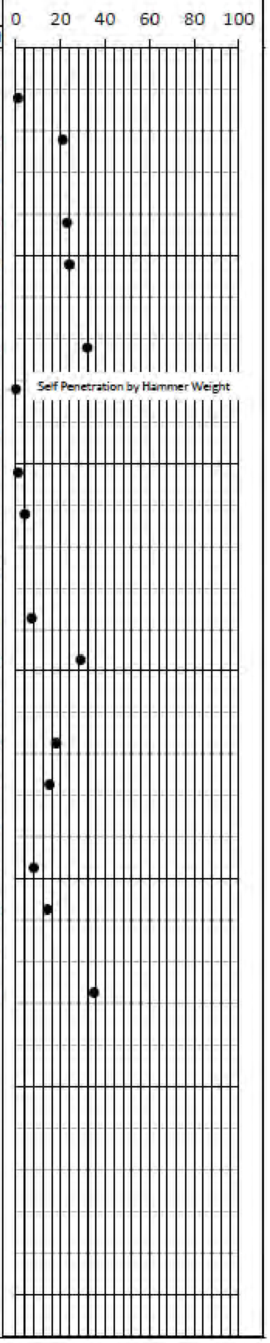
Hole Number: **LD2-13-3**

Project No.	S27-14	Project Name:	Matarbari PP
Supervisor:	Royal	Coordinate:	N:2399680.09 E:383469.28
Driller:	Matab	Date Started:	20141031
Type of Drilling Rig:	Rotary:KJC-L-1	Date Terminated:	20141101
Sheet:	1		
Elevation:	MSL+1.06 m		
Water Table:	GL+0.45 m		
Remarks:	Wetland:Final casing depth GL-2m		

Elevation in m	Depth in m	Thickness in m	Type of Soil	Color	Relative Density or Consistency	General Remarks
1.06 / -0.64	0.00 / 1.70	0.00 / 1.70	Clayey Sand	Grey	Very Loose	Fine to medium grained sand. With sea shell fragments, organic matter, mica fragments
-6.64	7.70	6.00	Clayey Sand	Grey	Medium Dense to Dense	Fine to medium grained sand. With sea shell fragments, organic matter, mica fragments
-10.74	11.80	4.10	Clay	Grey	Very Soft to Soft	With trace of fine grained sand, sea shell fragments, organic matter
-14.94	16.00	4.20	Clayey Sand	Grey	Loose to Medium Dense	Fine grained sand. With organic matter, sea shell fragments. Silty sand at 15.50 to 16.00m
-18.24	19.30	3.30	Sandy Silt	Grey	Stiff to Very Stiff	Sand is fine grained. With trace of organic matter, sea shell fragments.Occasionally silt with sand. Silt with sand at 18.50 to19.20m.
-20.44	21.50	2.20	Silty Sand	Grey	Loose to Medium Dense	Fine to medium grained sand. With sea shell fragments, organic matter
-21.89	22.95	1.45	Clay	Grey	Hard	With few sand .Sand is fine grained sand. With trace of sea shell fragments, organic matter
			END OF BH			

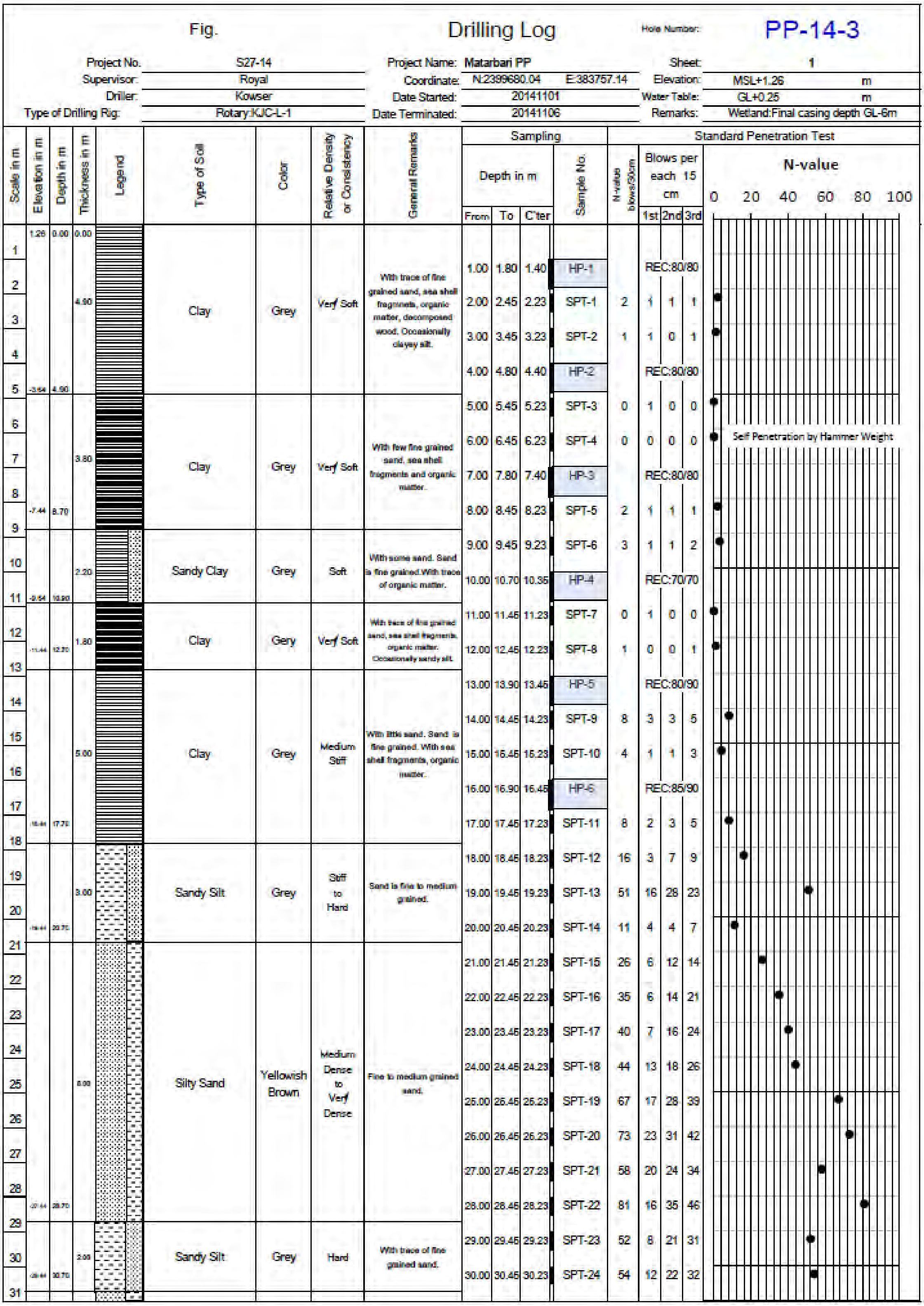
Depth From	Depth To	C'ter	Sample No.	N-value blows/30cm	1st	2nd	3rd
1.00	1.45	1.23	SPT-1	1	1	0	1
2.00	2.45	2.23	SPT-2	21	5	9	12
3.00	3.80	3.40	D-1		REC:80/80		
4.00	4.45	4.23	SPT-3	23	5	10	13
5.00	5.45	5.23	SPT-4	24	6	10	14
6.00	6.80	6.40	D-2		REC:80/80		
7.00	7.45	7.23	SPT-5	32	8	13	19
8.00	8.45	8.23	SPT-6	0	0	0	0
9.00	9.80	9.40	HP-1		REC:80/80		
10.00	10.45	10.23	SPT-7	1	1	0	1
11.00	11.45	11.23	SPT-8	4	1	2	2
12.00	12.45	12.23	D-3		REC:45/45		
12.50	13.40	12.95	D-4		REC:79/90		
13.50	13.95	13.73	SPT-9	7	2	3	4
14.50	14.95	14.73	SPT-10	29	2	11	18
15.50	16.40	15.95	D-5		REC:80/90		
16.50	16.95	16.73	SPT-11	18	3	6	12
17.50	17.95	17.73	SPT-12	15	2	6	9
18.50	19.40	18.95	D-6		REC:80/90		
19.50	19.95	19.73	SPT-13	8	2	2	6
20.50	20.95	20.73	SPT-14	14	2	4	10
21.50	22.40	21.95	D-7		REC:80/90		
22.50	22.95	22.73	SPT-15	35	9	14	21

Standard Penetration Test — N-value



Source:Matarbari CFPP F/S

Figure 5.1.13 Boring Holes at Survey Point BH2



Source:Matarbari CFPP F/S

Figure 5.1.14 Boring Holes at Survey Point BH2

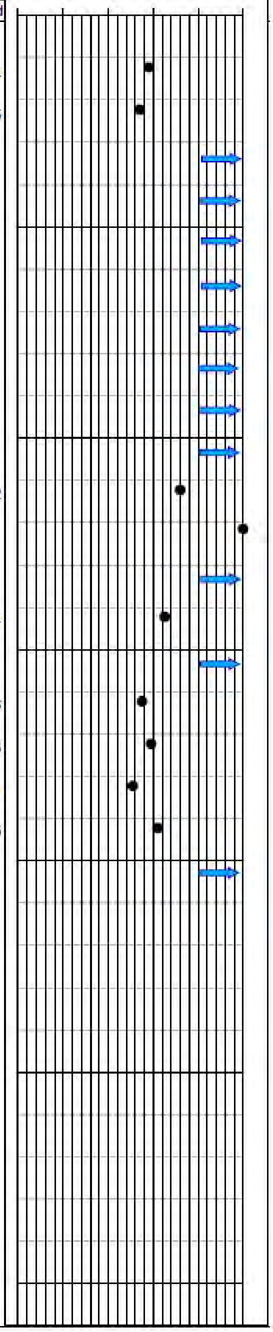
Fig. **Drilling Log** Hole Number: **PP-14-3**

Project No.	S27-14	Project Name:	Matarbari PP
Supervisor:	Royal	Coordinate:	N:2399680.04 E:383757.14
Driller:	Kowser	Date Started:	20141101
Type of Drilling Rig:	Rotary:KJC-L-1	Date Terminated:	20141106
Sheet:	2	Elevation:	MSL+1.26 m
Water Table:	GL+0.25 m	Remarks:	Wetland:Final casing depth GL-6m

Elevation in m	Depth in m	Thickness in m	Type of Soil	Color	Relative Density or Consistency	General Remarks
-29.44	30.70	2.00	Sandy Silt	Grey	Hard	With trace of fine grained sand
-31.44	32.70	2.00	Silty Sand	Light Greenish Grey	Very Dense	Fine grained sand
-33.44	34.70	2.00	Silty Sand	Brown	Very Dense	Fine to medium grained sand
-42.44	43.70	9.00	Silty Sand	Grey to yellowish Brown	Very Dense	Fine to medium grained sand
-49.02	50.28	6.58	Silt	Grey	Hard	With trace of fine grained sand
			END OF BH			

Sampling Depth in m From	To	C'ter	Sample No.	N-value blows/30cm	Blows per each 15 cm 1st	2nd	3rd
31.00	31.46	31.23	SPT-25	58	16	24	34
32.00	32.45	32.23	SPT-26	54	12	19	35
33.00	33.28	33.14	SPT-27	50 /13cm	36	50	
34.00	34.26	34.13	SPT-28	50 /11cm	44	50	
35.00	35.28	35.14	SPT-29	50 /13cm	26	50	
36.00	36.26	36.13	SPT-30	50 /11cm	24	50	
37.00	37.26	37.13	SPT-31	50 /11cm	31	50	
38.00	38.27	38.14	SPT-32	50 /12cm	28	50	
39.00	39.27	39.14	SPT-33	50 /12cm	27	50	
40.00	40.25	40.13	SPT-34	50 /10cm	25	50	
41.00	41.46	41.23	SPT-35	72	13	30	42
42.00	42.30	42.15	SPT-36	50 /15cm	20	50	
43.00	43.28	43.14	SPT-37	50 /13cm	26	50	
44.00	44.45	44.23	SPT-38	65	12	21	44
45.00	45.29	45.15	SPT-39	50 /14cm	23	50	
46.00	46.45	46.23	SPT-40	55	13	19	36
47.00	47.45	47.23	SPT-41	59	17	26	33
48.00	48.45	48.23	SPT-42	51	11	20	31
49.00	49.45	49.23	SPT-43	62	17	27	35
50.00	50.28	50.14	SPT-44	50 /13cm	21	50	

Standard Penetration Test: N-value



Source:Matarbari CFPP F/S

Figure 5.1.15 Boring Holes at Survey Point BH2

Table 5.1.4 shows the geological test results conducted in Matarbari CFPP F/S.

Table 5.1.4 Laboratory Test Results

Table 5.13 Summary Table of Soil Property

Layer	Distribution of Area	Thickness of Layer (m)	Color	Relative Density or Consistency	Material	N value	Wn (%)	Wet Density (g/cm3)	Gs	Grained Size: Sand (%)	Grained Size: Silt (%)	Grained Size: Clay and Colloid (%)	LL	PL	PI	qu/2 (kPa)	cu (kPa)	C (kPa)	φ (deg)	e	Pc (kPa)	Cc
Bs	Land Off-shore	0.6 to 2.6	Brown, Grey	Loose to Medium dense	Sandy Soil	4 to 24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ac-1	Land Power Plant	0.8 to 12.7	Grey, Greenish grey, Brownish grey	Very soft to Soft	Clayey Soil	0 to 4	29 to 78	1.52 to 1.93	2.68 to 2.78	1 to 41	31 to 57	25 to 67	28 to 80	19 to 37	6 to 44	8.6 to 9.8	10 to 35	0	38 to 40	0.82 to 1.93	35 to 190	0.22
Ac-2	Land Power Plant Off-shore	0.9 to 8.7	Grey	Medium stiff to Stiff	Clayey Soil	4 to 15	25 to 38	1.75 to 2.02	2.71 to 2.74	2 to 47	24 to 50	23 to 43	25 to 40	15 to 24	6 to 17	-	44 to 71	0 to 4	37	0.69 to 1.05	260 to 450	0.16 to 0.22
Ac-3	Land Power Plant Off-shore	1.1 To 9.0	Grey	Stiff to Hard	Clayey Soil	15 to 30	22 to 42	1.77 to 2.04	2.69 to 2.74	8 to 49	25 to 57	21 to 49	23 to 40	15 to 22	7 to 20	29.2	-	-	-	0.63 to 1.17	190	0.19
As-1	Land Power Plant Off-shore	1.1 to 6.0	Grey	Very loose to loose	Sandy Soil	0 to 10	19 to 31	1.71 to 2.05	2.66 to 2.72	53 to 97	2 to 22	10 to 28	-	-	-	-	-	-	-	0.73 to 1.06	-	-
As-2	Land Power Plant Off-shore	0.7 to 21.9	Light grey, Brownish grey, Yellowish grey,	Medium dense to Dense	Sandy Soil	10 to 50	13 to 34	1.79 to 2.12	2.67 to 2.72	50 to 96	4 to 30	11 to 28	-	-	-	-	-	-	-	0.61 to 0.88	-	-
Dc	Land Power Plant	1.4 to 17.3	Grey	Hard	Clayey Soil	≥ 30	23 to 31	1.83 to 2.12	2.71 to 2.73	13 to 48	24 to 59	23 to 34	25 to 43	14 to 22	11 to 21	227	-	-	-	0.72 to 0.94	-	-
Ds	Land Power Plant	0.5 to 13.2	Light grey, Grey, Yellowish grey	Very dense	Sandy Soil	≥ 50	12 to 13	1.97	2.69	94	6	0	-	-	-	-	-	-	-	-	-	-

Source: JICA "Matarbari CFPP F/S

Table 5.1.5 Soil Parameter for Design

Item				Layer									
				Embankment (Sand)	Ac-1 (Clay)	Ac-2 (Clay)	Ac-3 (Clay)	Ac-4 (Clay)	As-1 (Sand)	As-2 (Sand)	As-3 (Sand)	Dc (Clay)	Ds (Sand)
N-value				-	1	6	13	22	7	22	37	68	85
Specific Gravity		Gs		-	2.73	2.73	2.72	2.71	2.70	2.69	2.69	2.72	2.68
Wet Density		γt	(kN/m^3)	18.0	17.9	18.7	19.1	19.1	19.4	19.4	19.4	19.1	20.0
Saturated Density		γsat	(kN/m^3)	20.0	17.9	18.9	19.2	19.2	19.8	19.7	20.0	19.2	20.2
Void Ratio		eo		-	1.18	0.95	0.87	0.86	0.74	0.74	0.69	0.86	0.65
Liquid Limit		W_L	(%)	-	46.2	33.6	30.8	29.8	-	-	-	36.5	-
Plasticity Index		I_P		-	21.9	13.8	12.0	10.4	-	-	-	16.5	-
Undrained Shear Strength	Cohesion	Su	(kN/m^2)	-	15	40	60	100	-	-	-	200	-
	Internal Friction Angle	φu	(degree)	-	0	0	0	0	-	-	-	0	-
Drained Shear Strength	Cohesion	Cd	(kN/m^2)	0	-	-	-	-	0	0	0	-	0
	Internal Friction Angle	φd	(degree)	25	-	-	-	-	24	31	36	-	45
Rate of Strength Increase		m		-	0.19	0.16	0.15	0.15	-	-	-	0.17	-
Consolidation Parameters	Coefficient of Volume	mv	(m^2/kN)	-	$0.0565P^{-0.906}$	$0.00818P^{-0.7005}$	-	-	-	-	-	-	-
	Coefficient of Consolidation	Cv	(cm^2/day)	-	200	500	-	-	-	-	-	-	-

Note (1): The value of γsat is calculated using Gs and eo with the saturation of 100%

Note (2): The value of φd of sand layer is calculated using Dunham's equation of "φd = 15 + SQRT(12N)"

Note (3): The value of rate of strength increase (m) is calculated using Skempton's equation of "$m = 0.11 + 0.0037I_P$"

Source: JICA "Matarbari CFPP F/S

The geological conditions for the coal terminal have been set as follows.

EL(MWL)	Soil Name	N-value
+1.0m		
	Ac1	1
-3.7m		
	As-1	7
-4.7m		
	Ac1	1
-6.7m		
	Ac4	22
-14.7m		
	As2	22
-17.0m		
	Dc	68

Source: JICA Study Team

Figure 5.1.16 Coal Unloading Pier Ground Configuration.

EL(MWL)	Soil Name	N-value
+1.0m		
		1
+0.0m		
	As-2	22
-2.0m		
	Ac1	1
-3.0m		
	As1	7
-4.5m		
	Ac1	1
-7.5m		
	As-2	22
-8.8m		
	As3	37
-17.0m		
	Ac4	22
-21.5m		
	Ds	85

Source: JICA Study Team

Figure 5.1.17 Coal Shipment Pier and Stockyards Ground Configuration

7) Meteorological conditions

There are two weather stations around the planning area, Kutubdia which is located 10 km north and Cox's Bazar is 30 km south.

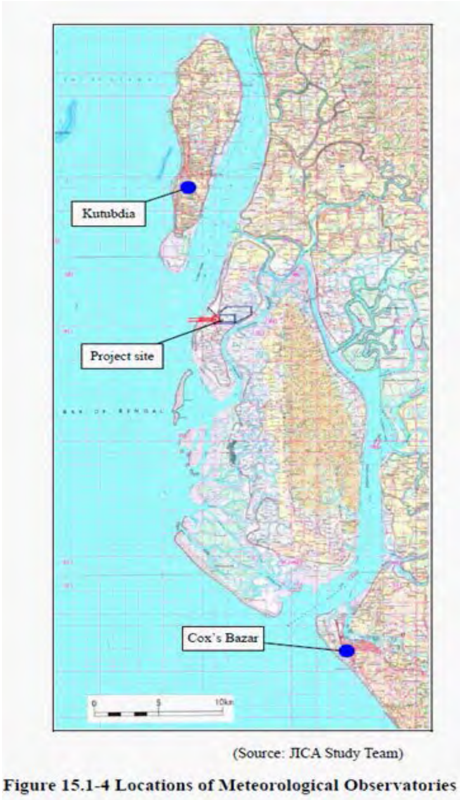


Figure 5.1.18 Weather Stations Around the Planning Area, Kutubdia 10 km North and Cox's Bazar 30 km South

Weather conditions in the surrounding area of Matabari CTT are set based on the observations in these weather stations.

i) Wind

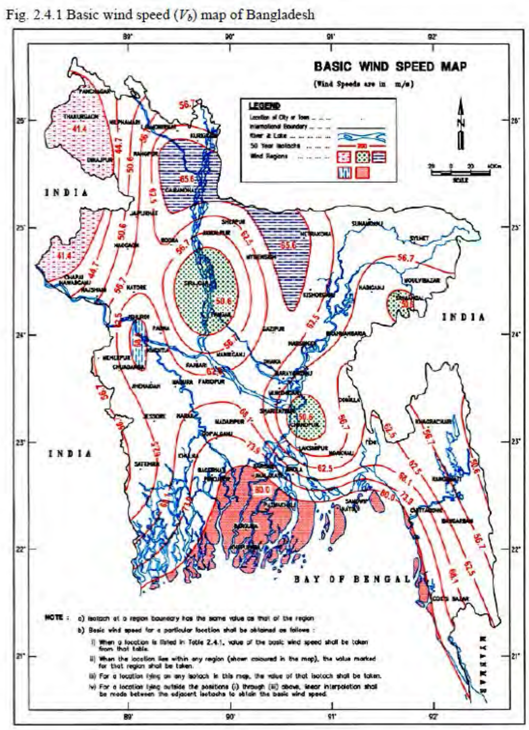
Table 5.1.6 Wind Data Observed Nearby the Project Site (1999 - 2008)

Wind speed (m/s)	1 - 2	2 - 4	4 - 7	7 - 9	9 - 12	12 - 16	> 16
Frequency (%)	99.3	96.3	82.4	48.1	23.4	3.3	0.04

Source: JICA Study Team

According to the observations, the wind from west-southwest and east-northeast caused by monsoon are affected, and wind from other direction is not affected. The frequency of wind speed over 16 m/s is very low. Therefore, it is expected that the effect on the facilities is not significant.

According to the wind speed distribution diagram of the BNBC, the maximum moment wind speed is about 80 m/s around this area. The design maximum wind speed applied for handling equipment is 55 m/s based on Japanese equipment design, since the probability maximum wind speed has not been analysed.

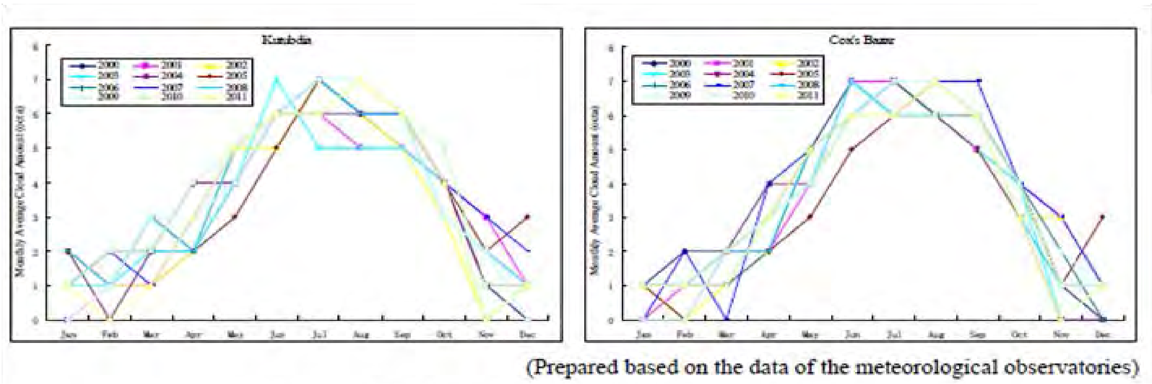


Source: BNBC 2012

Figure 5.1.19 : Basic Wind Speed (Velocity) Map of Bangladesh

ii) Rainfall

Annual rainfall in Kutubdia is 4,321 ~ 5,905mm, and in Cox's Bazar is 5,286 ~ 6,707mm.

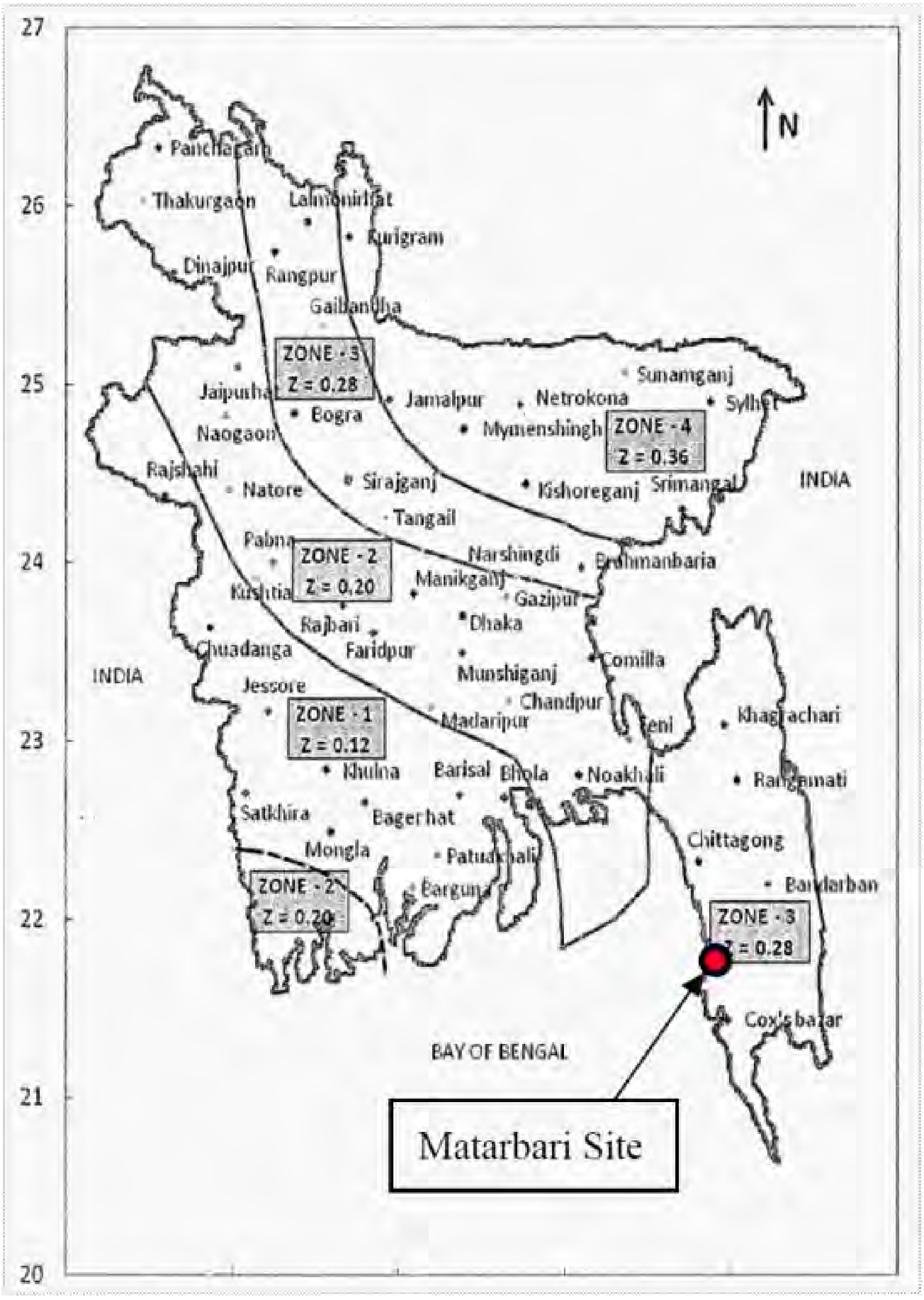


Source: JICA Matarbari CFPP F/S

Figure 5.1.20 Rainfall in Kutubdia and Cox's Bazar

8) Earthquake

Seismic coefficient in Bangladesh was defined by the BNBC 2012 as shown in Figure 5.1.21. According to this figure, the seismic coefficient at the site is 0.28. Earthquake coefficients for the design are considered based on technical criteria in the BNBC 2012.



Source: BNBC 2012

Figure 5.1.21 Seismic Coefficient in Bangladesh

Seismic coefficient formula is shown by BNBC 2012 as follows:

$$S_a = \frac{2}{3}\frac{ZI}{R}C_s \qquad (2.5.4)$$

where,

S_a = Design spectral acceleration (in units of g), which shall not be less than 2/3*ZI*β.

β = coefficient used to calculate lower bound for S_a. Recommended value for β is 0.2.

Z = Seismic zone coefficient, as defined in Section 2.5.6.2

I = Structure importance factor, as defined in Section 2.5.7.1

R = Response reduction factor which depends on the type of structural system given in Table 2.5.7. The ratio I/R cannot be greater than one.

C_s = Normalized acceleration response spectrum, which is a function of structure (building) period and soil type (site class) as defined by Equations 2.5.5a-d

$$C_s = S\left(1 + \frac{T}{T_B}(2.5\eta - 1)\right) \quad \text{for} \quad 0 \le T \le T_B \qquad (2.5.5a)$$

$$\boxed{C_s = 2.5S\eta \quad \text{for} \quad T_B \le T \le T_C \qquad (2.5.5b)}$$

$$C_s = 2.5S\eta\left(\frac{T_C}{T}\right) \quad \text{for} \quad T_C \le T \le T_D \qquad (2.5.5c)$$

$$C_s = 2.5S\eta\left(\frac{T_C T_D}{T^2}\right) \quad \text{for} \quad T_D \le T \le 4\,\text{sec} \qquad (2.5.5d)$$

C_s depends on S and values of T_B, T_C and T_D, (Fig. 2.5.2) which are all functions of the site class. Constant C_s value between periods T_B and T_C represents constant spectral acceleration.

S = Soil factor which depends on site class and is given in Table 2.5.4

T = Structure (building) period as defined in Section 2.5.9.2

T_B = Lower limit of the period of the constant spectral acceleration branch given in Table 2.5.4 as a function of site class.

T_C = Upper limit of the period of the constant spectral acceleration branch given in Table 2.5.4 as a function of site class

T_D = Lower limit of the period of the constant spectral displacement branch given in Table 2.5.4 as a function of site class

η = Damping correction factor as a function of damping with a reference value of η=1 for 5% viscous damping. It is given by the following expression:

$$\eta = \sqrt{10/(5+\xi)} \ge 0.55 \qquad (2.5.6)$$

where, ξ is the viscous damping ratio of the structure, expressed as a percentage of critical damping. The value of η cannot be smaller than 0.55.

Type of soil at the site is SD by following the table below.

Table 2.5.1: Site classification based on soil properties

Site Class	Description of soil profile up to 30 meters depth	Average Soil Properties in top 30 meters		
		Shear wave velocity $\bar{V}_s$ (m/s)	Standard Penetration Value, $\bar{N}$ (blows/30cm)	Undrained shear strength, $\bar{S}_u$ (kPa)
SA	Rock or other rock-like geological formation, including at most 5 m of weaker material at the surface.	> 800	--	--
SB	Deposits of very dense sand, gravel, or very stiff clay, at least several tens of metres in thickness, characterised by a gradual increase of mechanical properties with depth.	360 – 800	> 50	> 250
SC	Deep deposits of dense or medium dense sand, gravel or stiff clay with thickness from several tens to many hundreds of metres.	180 – 360	15 - 50	70 - 250
SD	Deposits of loose-to-medium cohesionless soil (with or without some soft cohesive layers), or of predominantly soft-to-firm cohesive soil.	< 180	< 15	< 70
SE	A soil profile consisting of a surface alluvium layer with V_s values of type C or D and thickness varying between about 5 m and 20 m, underlain by stiffer material with V_s > 800 m/s.	--	--	--
S_1	Deposits consisting, or containing a layer at least 10 m thick, of soft clays/silts with a high plasticity index (PI > 40) and high water content	< 100 (indicative)	--	10 - 20
S_2	Deposits of liquefiable soils, of sensitive clays, or any other soil profile not included in types SA to SE or S_1	--	--	--

Therefore, S, TB (s), Tc, are shown in the table below.

Table 2.5.4 : Site dependent soil factor and other parameters defining elastic response spectrum

Soil type	S	T_B(s)	T_C (s)	T_D (s)
SA	1.0	0.15	0.40	2.0
SB	1.2	0.15	0.50	2.0
SC	1.15	0.20	0.60	2.0
SD	1.35	0.20	0.80	2.0
SE	1.4	0.15	0.50	2.0

CTT facilities correspond to Category Ⅱ from the table below.

Table 1.2.1 Occupancy Category of Buildings and Other Structures for Flood, Surge, Wind and Earthquake Loads

Nature of Occupancy	Occupancy Category
Buildings and other structures that represent a low hazard to human life in the event of failure, including, but not limited to: • Agricultural facilities • Certain temporary facilities • Minor storage facilities	I
All buildings and other structures except those listed in Occupancy Categories I, III, and IV	II
Buildings and other structures that represent a substantial hazard to human life in the event of failure, including, but not limited to: • Buildings and other structures where more than 300 people congregate in one area • Buildings and other structures with daycare facilities with a capacity greater than 150 • Buildings and other structures with elementary school or secondary school facilities with a capacity greater than 250 • Buildings and other structures with a capacity greater than 500 for colleges or adult education facilities • Health care facilities with a capacity of 50 or more resident patients, but not having surgery or emergency treatment facilities • Jails and detention facilities Buildings and other structures, not included in Occupancy Category IV, with potential to cause a substantial economic impact and/or mass disruption of day-to-day civilian life in the event of failure, including, but not limited to: • Power generating stations[a] • Water treatment facilities • Sewage treatment facilities • Telecommunication centers Buildings and other structures not included in Occupancy Category IV (including, but not limited to, facilities that manufacture, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, hazardous waste, or explosives) containing sufficient quantities of toxic or explosive substances to be dangerous to the public if released.	III
Buildings and other structures designated as essential facilities, including, but not limited to: • Hospitals and other health care facilities having surgery or emergency treatment facilities • Fire, rescue, ambulance, and police stations and emergency vehicle garages • Designated earthquake, hurricane, or other emergency shelters • Designated emergency preparedness, communication, and operation centers and other facilities required for emergency response • Power generating stations and other public utility facilities required in an emergency • Ancillary structures (including, but not limited to, communication towers, fuel storage tanks, cooling towers, electrical substation structures, fire water storage tanks or other structures housing or supporting water, or other fire-suppression material or equipment) required for operation of Occupancy Category IV structures during an emergency • Aviation control towers, air traffic control centers, and emergency aircraft hangars • Water storage facilities and pump structures required to maintain water pressure for fire suppression • Buildings and other structures having critical national defense functions Buildings and other structures (including, but not limited to, facilities that manufacture, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, or hazardous waste) containing highly toxic substances where the quantity of the material exceeds a threshold quantity established by the authority having jurisdiction.	IV

[a] Cogeneration power plants that do not supply power on the national grid shall be designated Occupancy Category II.

Importance factor of Category II is 1.0 according to the following table.

Table 2.5.5 Importance Factors for Buildings and Structures for Earthquake design

Occupancy Category	Importance factor I
I or II	1.0
III	1.25
IV	1.5

Source: National Building Code 2012

b) The building period T (in secs) may be approximated by the following formula:

$$T = C_t (h_n)^m \tag{2.5.8}$$

where,

h_n = Height of building in metres from foundation or from top of rigid basement. This excludes the basement storeys, where basement walls are connected with the ground floor deck or fitted between the building columns. But it includes the basement storeys, when they are not so connected.

C_t and m are obtained from Table 2.5.8

Table 2.5.8 Values for coefficients to estimate approximate period

Structure type	C_t	m
Concrete moment-resisting frames	0.0466	0.9
Steel moment-resisting frames	0.0724	0.8
Eccentrically braced steel frame	0.0731	0.75
All other structural systems	0.0488	0.75

NOTE:
Consider moment resisting frames as frames which resist 100% of seismic force and are not enclosed or adjoined by components that are more rigid and will prevent the frames from deflecting under seismic forces.

Source：Bangladesh National Building Code

The seismic coefficient is calculated from these formulae:

hn= 23m (CD-16.0m～MSL+5.0m,MSL=DL+2.02m)

T=0.0488 x 23 x 0.75 = 0.513

η = 1.0

Cs = 2.5 x 1.35 x 1.0 = 3.375

Z = 0.28

I = 1.0

R =3

Sa = 2/3(0.28 x 1.0 x 3.375)/ 3 = 0.21

Horizontal seismic coefficient、 Kh = 0.21

Vertical seismic coefficient、 Kv = 0.00 （JDSOPF）

5.1.2. Conditions for use

1) Design vessels

i) Coal import vessels and its dimensions

Design vessels for coal import vessels are shown in Table 5.1.6. For the 1st phase and 2nd phase design target is 80,000DWT.

Table 5.1.7 Coal import Vessels and its Dimensions

Phase	Vessels (DWT)	L_{oa} (m)	Draft (m)	Beam (m)
1・2	80,000	230	14.5	37.0

Source: JICA Study Team

ii) Secondary transport vessels of coal

Design vessels for secondary transport vessels of coal are shown in Table 5.1.7. For the 2nd phase, design target is 5,000DWT.

Table 5.1.8 Secondary Transport Vessels of Coal and its Dimensions

Vessels (DWT)	L_{oa} (m)	Draft (m)	Beam (m)
5,000	110	6.5	17.0

Source: JICA Study Team

2) Coal handling equipments

The design conditions of the coal handling equipments are determined based on the specifications reported by the maker. In this study, 20% more of the load of coal handling equipment is applied in consideration with the difference of the maker.

i) Unloader

Handling capacity	2,700 t/h
Total weight	1,775t
Rail gauge	25.0 m
Wheel base	22 m
Number of wheel	front : 12 wheels/coner rear : 8 wheels/coner
Wheel span	900 mm
Unit wheel load	Table 5.1.8.

Table 5.1.9 Unit Wheel Load of Unloader

		Unit Front Wheel Load (kN/wheel)	Unit Rear Wheel Load (kN/wheel)
Vertical load	Under operation (wind velocity 16m/s)	510	550
	Storm condition	650	700
	Seismic condition (Kh=0.21)	670	720
Horizontal load	Under operation (wind velocity 16m/s)	51	55
	Storm condition	65	70
	Seismic condition (Kh=0.21)	67	72

Source: JICA Study Team

ii) Ship loader

Handling capacity	2,500 t/h
Total weight	540t
Rail gauge	14.0 m
Wheel base	8 m
Number of wheel	6 wheels/corner x 2 arms
Wheel span	680 mm
Unit wheel load	Table 5.1.9.

Table 5.1.10 Unit Wheel Load of Ship Loader

		Maximum Unit Wheel Load (kN/wheel)
Vertical load	Under operation (wind velocity 16m/s)	260
	Storm condition	280
	Seismic condition (Kh=0.21)	270
Horizontal load	Under operation (wind velocity 16m/s)	260
	Storm condition	280
	Seismic condition (Kh=0.21)	290

Source: JICA Study Team

iii) Belt conveyor

Table 5.1.11 Dimensions of Belt Conveyor Considered in this Design Section

	Unloading Line (Offshore Side)	Loading Line (Land Side)
Handling capacity	5,500 t/h (2 line)	3,300 t/h (2line)
Width of belt	2,200mm	1,600mm
Speed of belt	240m/min	240m/min
Weight of conveyor	21kN/m	21kN/m

Source: JICA Study Team

iv) Stacker and Reclaimer

Handling capacity 6,500/2,500 t/h
Coal stock pile height 16m
Coal stock pile width 47m
Rail span 8m
Wheel base 10.0m
Wheel formation 8 wheel / corner
Unit wheel load 250kN/wheel (working condition)
280kN/wheel (seismic condition)
Total weight 10,000 kN (Main body 7,500kN + Tripper 2,500kN)

3) Load conditions

i) Dead load

Unit weight of super structure concrete is assumed as follows.

Reinforced concrete: 24k N/m3
Unreinforced concrete: 23k N/m3

ii) Vertical Load conditions

Apron

On the berth：vertical load of 2 t/m^2
(Unloading/loading of equipment is considered separately)

Trestle

Management aisle：”A live load” in Specification of highway bridge.

iii) Other load conditions

Specific weight of coal

Coal mass : 7.8kN/m3

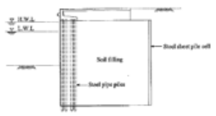
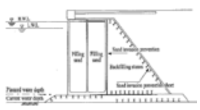
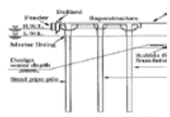
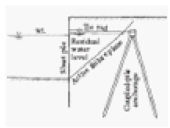
Coal powder : 9.8kN/m3

5.2. Coal Unloading Berth

(1) Selection of the structure type

The candidates of berth structure type are cell type, caisson type, jetty type and sheet pile type considering the deep water depth of -16m at berth front for larger size vessels. Comparing the soil conditions at the site, easiness of construction and cost efficiency, jetty type is considered as most appropriate candidate. Table 5.2.1 shows the comparison of four candidate type of structure for berth structure.

Table 5.2.1 Comparison of Four Candidate Type of Berth Structures

	Cell Type	Caisson Type	Jetty Type	Dolphin Type
Schematic structural figure				
For the case of soft soil conditoin	No necessity of soil improvement work A	Appropriate soil improvement work is necessary C	No necessity of soil improvement work A	No necessity of soil improvement work A
Installation of unloading equipment	Possible on the superstructure A	Possible on the superstructure A	Possible on the superstructure A	Another base structure is necessary. B
Easiness of construction	Large scale temporally working site and equipments are necessary C	Large scale temporally working site and equipments are necessary C	No necessity of large scale working site A	No necessity of large scale working site A
Cost efficiency	Steel type cell structure and comparatively expensive C	Conventional concrete and rock material work and not so expensive B	Steel pipe pile and concrete works and comparatively cost efficient A	Steel sheet pile and steel pipe pile works and most cost efficient B
Judge	Not applicable D	Not applicable C	Applicable A	Applicable B

Source: JICA Study Team

(2) Design conditions

Design conditions of coal unloading berth are shown as below.

1) Natural conditions

Natural conditions are shown in "5.1.1 Design Conditions". The design soil conditions near the shore location are shown in Table 5.1.16 and were considered for unloading berth.

2) Conditions for use

Conditions for use are shown in "5.1.1 Design Conditions". Major issues are shown below.

i) Design vessels

- For the 1st and 2nd Phase：80,000DWT

ii) Load conditions of coal handling equipment

Two unloaders are installed in each unloading berth.

iii) Vertical load conditions

Uniform vertical load of 20kN/m2 is considered for the entire area of berth.

(3) Dimensions of structure

1) Berth top surface level

Surface level of berth top is determined by considering the local tide condition and size of design vessel. According to Table 5.2.2 by the Japanese design standard for port structure, which shows the relation between HWL and top surface level of berth, 0.5 m to 1.5 m are considered appropriate.

+2.2 m+0.5 m~+2.2 m+1.5 m=+2.7 m~+3.7 m

Considering the standard and effect of storm surge, top surface level of MSL+5.0 m is employed. However, it is required to confirm the top surface level depending on the frequency of storm surge and coal handling equipment on unloading berth in the basic and detailed design stage.

Table 5.2.2 Threshold of Berth Top Surface Level by Considering the Local Tide Condition and Size of Design Vessel

	Tidal range 3.0m or more	Tidal range less than 3.0m
Wharf for large vessels (water depth of 4.5m or more)	+0.5–1.5m	+1.0–2.0m
Wharf for small vessels (water depth of less than 4.5m)	+0.3–1.0m	+0.5–1.5m

Source: Japanese Design Standard for Port Structure

2) Berth length

Berth length is determined as follows in Section 5.2.2

1st and 2nd Phase 80,000DWT：1 berth=300m

3) Berth allocation

Berths are allocated on one side of jetty based on the unloader type in port planning.

4) Width of berth

Total width of 29.5m is employed by considering the unloader’s rail span of 25m, interval between sea side rail and front side end of berth of 2.5m and interval between landside rail and back side of berth of 2.0m.

Access road on the berth and installation space of belt conveyor is allocated within the rail span of unloader.

5) Water depth in front of the berth

Water depth in front of the berth is planned as follows.

For 1st and 2nd Phase: 80,000DWT, 16.0m water depth

(4) Design force

1) Wave, tide and tsunami forces

These forces are not considered at this stage of work, because the wave, tide and tsunami forces are comparatively small with other dominant forces such as berthing of design vessels or earthquake forces.

2) Earthquake force

Seismic force was applied to the parallel and the perpendicular direction of the berth.
Horizontal design seismic intensity was Kh = 0.21

3) Berthing forces

i) Berthing velocity

Figure 5.2.1 shows the relation between the berthing velocity and DWT of the vessels. Berthing velocity of 5 cm/s which is the maximum value for largest ship in the Figure 5.2.1 is selected as the design berthing velocity for 80,000DWT vessel. Fender interval of 10m is assumed.

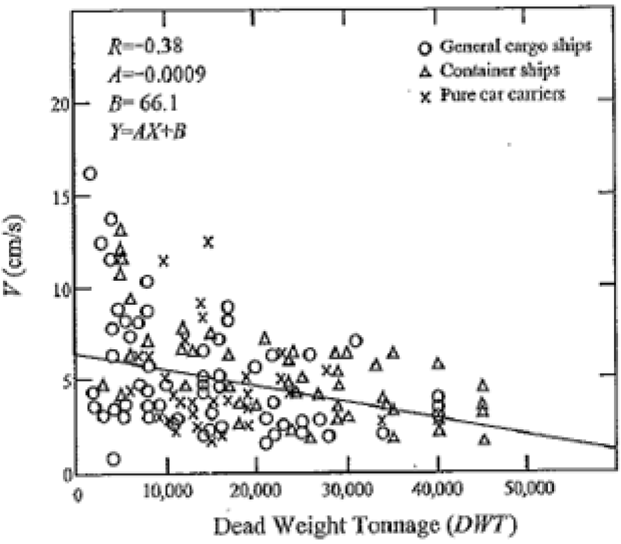


Fig. 2.2.5 Relationship between Dead Weight Tonnage and Berthing Velocity [5)]

ii) Berthing forces

Berthing forces are determined based on the Japanese design standard for port structure. The results are shown below.

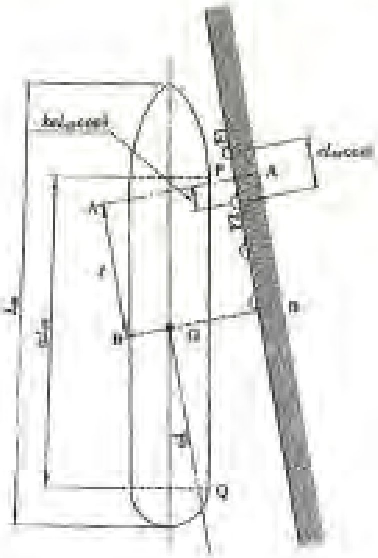
For the 1st and 2nd Phase: 1560kN/location (design vessel=80,000 DWT, berthing velocity=5cm/s)

Table 5.2.3 Calculation of Berthing Energy for 80,000DWT Vessels

Calculation of Berthing Energy

Key-in Data

Type of Vessel		[illegible] Vessel		
Deadweight Ton	DWT	[illegible]	ton	
Length (over all)	Loa	[illegible]	m	
Length (between perpendiculars)	Lpp	[illegible]	m	(Assumed)
Breadth	B	37.0	m	
Depth	D	28.0	m	
Draft (full)	d	[illegible]	m	
Displacement	Ws	[illegible]	ton	(Assumed)
Berthing Angle	TH	[illegible]	degree	(Assumed)
Hydrodynamic coefficient	Cm	1.892		Cm=1+(pai/2Cb)(d/B)
Block coefficient	Cb	0.767		Cb=Ws/(LppXBXdX1.03)
Eccentricity coefficient	Ce	0.676		Ce=1/(1+(l/r)^2)
Radius of gyration	r	37.55	m	r=(0.19Cb+0.11)Lpp
Distance alongside the water line from the center of gravity of vessel to the berthing point	l	39.83 min(l1,l2)	m	l1=(0.5a+e(1-k))LppXcos(TH) l2=(0.5a-ek)LppXcos(TH)
Fender Spacing	Lf	[illegible]	m	(Assumed)
Coefficient of parallel side	a	0.40		
Coefficient of Fender interval	e	0.045		e=Lf/(LppXcosTH)
Coefficient of berthing point	k	0.50		
Block coefficient	Cb	0.767		Cb=Ws/(LppXBXdX1.03)
Softness coefficient	Cs	[illegible]		
Berth configuration coefficient	Cc	[illegible]		
Berthing Velocity	V	[illegible]	m/sec	(Assumed)
Berthing Energy	E	145.3	kN-m	E=0.5XWsXV^2XCmXCeXCsXCc
Safety factor	Sf	1.10		(Assumed)
Abnormal Berthing Energy	Ea	159.9	kN-m	Ea = E × Sf



Source: JICA Study Team

4) Mooring forces

Mooring forces are obtained from Table 5.2.3. Bollard force of 1,000kN for 80,000DWT (about 45,000GT) is selected from Table 5.2.4.

Table 5.2.4 Relationship Between Gross Tonnage of Ship and Mooring Force

Gross tonnage of ship (t)	Tractive force acting on mooring post (kN)	Tractive force acting on bollard (kN)
Over 200 and not more than 500	150	150
Over 500 and not more than 1,000	250	250
Over 1,000 and not more than 2,000	350	250
Over 2,000 and not more than 3,000	350	350
Over 3,000 and not more than 5,000	500	350
Over 5,000 and not more than 10,000	700	500
Over 10,000 and not more than 20,000	1,000	700
Over 20,000 and not more than 50,000	1,500	1,000
Over 50,000 and not more than 100,000	2,000	1,000

Source: JICA Study Team

(5) Design structures

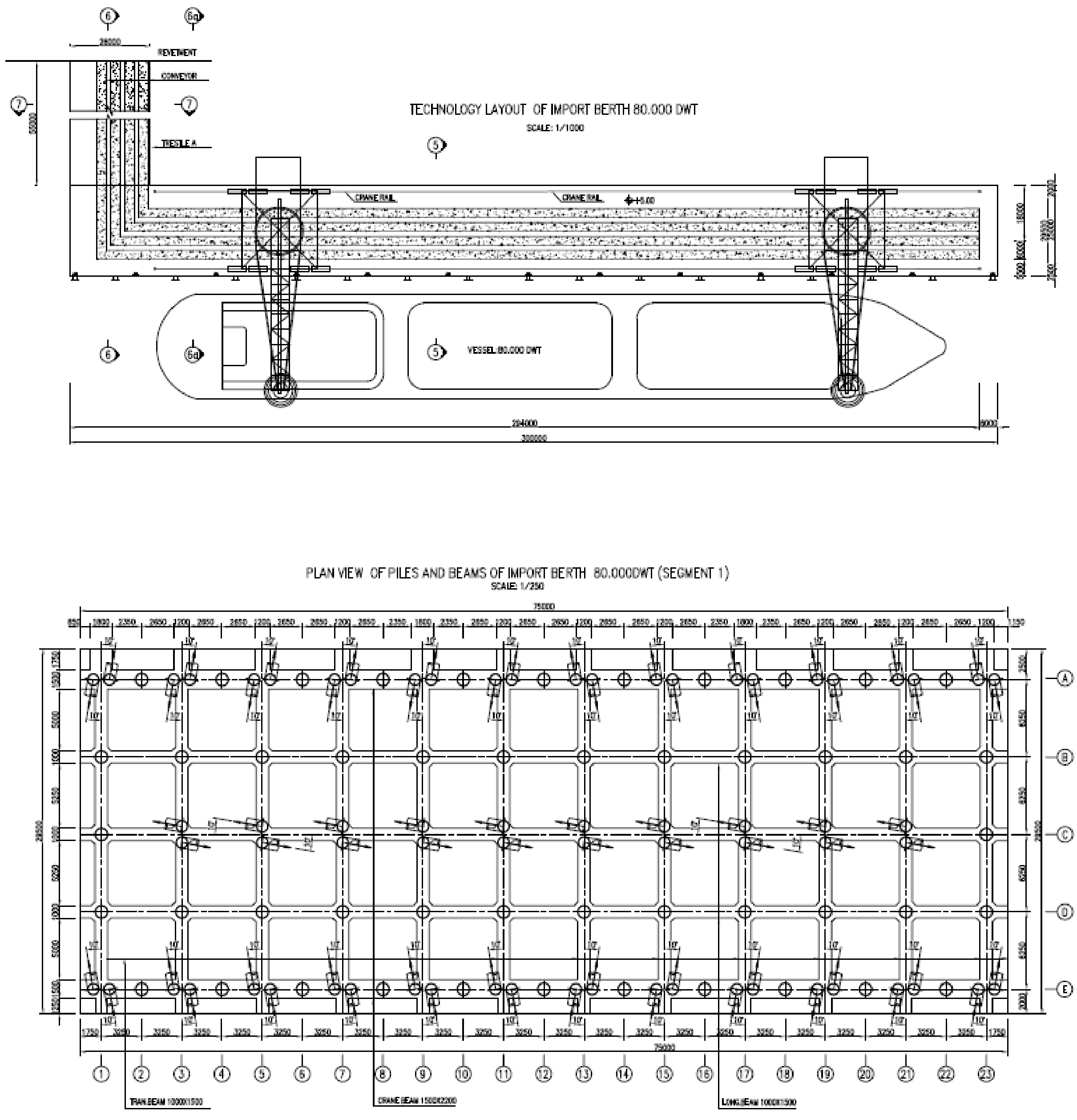
Location of pile: Two sets of pile casting are allocated to resist the strong horizontal berthing forces. Pile interval of 6.25 m to 6.5 m is determined by considering the use of reinforced concrete (RC) beam. Supporting piles just underneath the rail for unloader are allocated because of heavy vertical load. The interval of the piles is 3.25 m. The piles are allocated at the intermediate RC beam under rail for unloader.

Type of pile: Steel pipe pile is selected by considering the necessity of long pile due to subsurface soft soil conditions. Corrosion protection is considered.

Superstructure: RC type structure is considered.

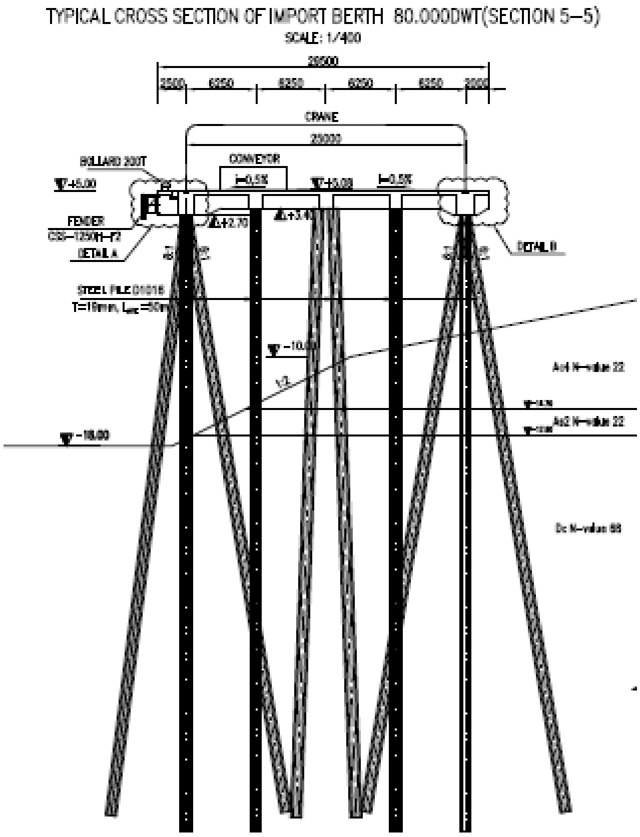
(6) Design drawings

For 80,000DWT berth



Source: JICA Study Team

Figure 5.2.2 Front View and Side View of the Berth for 80,000 DWT



Source: JICA Study Team

Figure 5.2.3 Typical Cross Section of the Berth for 80,000 DWT

5.3. Coal Loading Berth

(1) Selection of the type of structure

Jetty type structure for the coal loading berth same as the coal unloading berth is selected.

(2) Design conditions

1) Design condition for the facility

i) Natural conditions

Natural conditions are shown in “5.1.1 Design Conditions”. The design soil conditions at near shore location shown in Table 5.1.17 was considered for loading berth.

ii) Conditions for use

Conditions for use and major items are shown below.

Uniform vertical load of 20 kN/m^2 is considered for the entire area of berth.

A 5,000 DWT barge is considered to be used in the planning. However, the specifications of the barges are not clear because there are plans that barges will be newly built. Therefore, the specifications of 5,000 DWT vessels are considered for this design. In the stage of basic design and detailed design, it is necessary to determine the specification of the barges.

(3) Dimensions of structure

i) Berth top surface level

Berth top surface level of MSL+5.0m, same value of unloading berth, is selected by considering the tide conditions and design vessel size.

ii) Berth length

Berths are allocated at one side of jetty based on the port planning. A ship loader is also allocated at each berth.

iii) Berth allocation

Berths are allocated one side of jetty based on the port planning. A Ship loader is also allocated at the each berth.

iv) Width of berth

Total width of 18.0 m is determined by considering the loader's rail span of 14.0 m, berth front side of 2.5 m, and rear side of 1.5 m. Access road on the berth and installation of conveyor belt are allocated within the rail span of loader.

v) Water depth in front of the berth

Water depth in front of the berth is MSL-7.5m

(4) Design forces

1) Wave, tide and tsunami forces

These forces are not considered at this stage of work, because the wave, tide and tsunami forces are comparatively small with other dominant forces such as berthing of design vessels, and earthquake forces.

2) Earthquake force

Seismic force was applied to the parallel and the perpendicular direction of the berth.
Horizontal design seismic intensity was Kh = 0.21

3) Berthing forces

i) Berthing velocity

According to Figure 5.2.1, the berthing velocity of targeted ship of 5,000 DWT is 10.0 cm/s, which was selected considering the variation of data. Fender allocation interval of 10 m is also assumed.

ii) Berthing force

Berthing force is determined based on the Japanese design standard for port structure. The 53 kN/location is obtained for the design ship of 5,000 DWT.

4) Mooring force

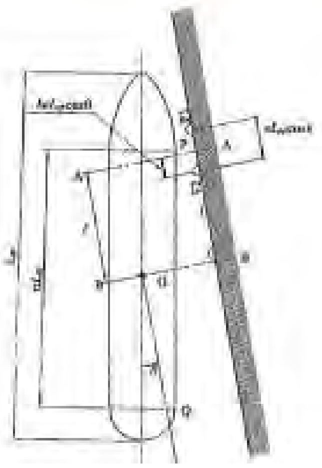
Mooring force is obtained from Table 5.3.1. Bollard force of 350 kN/location is considered. Bollard interval of 10 m is selected.

Table 5.3.1 Calculation of Berthing Energy for 5,000DWT Vessels

Calculation of Berthing Energy

Key-in Data

Type of Vessel		Bulk Carrier Vessel		
Deadweight Ton	DWT	5,000	ton	
Length (overall)	Loa	110.0	m	
Length (between perpendiculars)	Lpp	101.0	m	(Assumed)
Breadth	B	17.0	m	
Depth	D	8.7	m	
Draft (full)	d	6.5	m	
Displacement	Ws	6950	ton	(Assumed)
Berthing Angle	TH	5	degree	(Assumed)
Hydrodynamic coefficient	Cm	1.993		Cm=1+(pai/2Cb)(d/B)
Block coefficient	Cb	0.605		Cb=Ws/(LppXBXdX1.03)
Eccentricity coefficient	Ce	0.693		Ce =1/(1+(l/r)^2)
Radius of gyration	r	22.71	m	r=(0.19Cb+0.11)Lpp
Distance alongside the water line from the center of gravity of vessel to the berthing point	l	15.12 min(l1,l2)	m	l1=(0.5a+e(1-k))LppXcos(TH) l2=(0.5a-ek)LppXcos(TH)
Fender Spacing	Lf	10.00	m	(Assumed)
Coefficient of parallel side	a	0.40		
Coefficient of Fender interval	e	0.099		e=Lf/(LppXcosTH)
Coefficient of berthing point	k	0.50		
Block coefficient	Cb	0.605		Cb=Ws/(LppXBXdX1.03)
Softness coefficient	Cs	1.0		
Berth configuration coefficient	Cc	1.00		
Berthing Velocity	V	0.10	m/sec	(Assumed)
Berthing Energy	E	48.0	kN-m	E=0.5XWsXV^2XCmXCeXCsXCc
Safety factor	Sf	1.10		(Assumed)
Abnormal Berthing Energy	Ea	52.8	kN-m	Ea = E × Sf



Source: JICA Study Team

(5) Design structure

Layout: Coal loading berth is planned to be installed in the harbour.

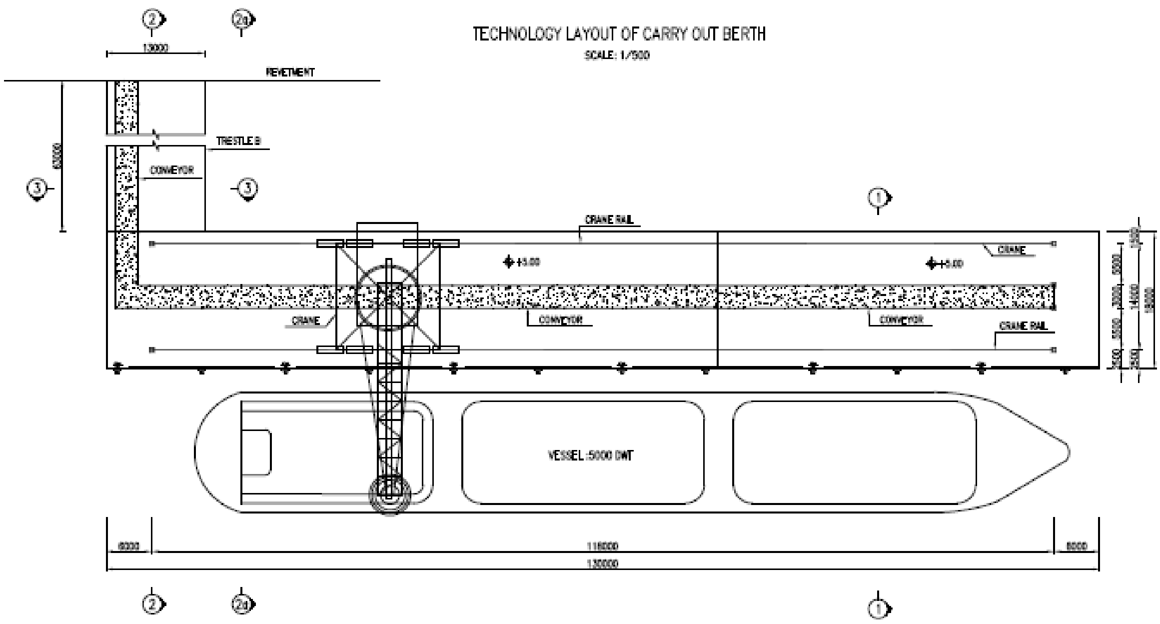
Location of pile: Two set of pile casting are allocated at the centre to resist the horizontal berthing forces. Supporting piles just underneath the rail for loader are allocated. Pile interval of 7m is selected by considering the dimensions of rail span.

Type of pile: Steel pipe pile is employed by considering the necessity of long pile due to subsurface soft soil conditions. Corrosion protection is considered.

Superstructure: RC type structure is selected.

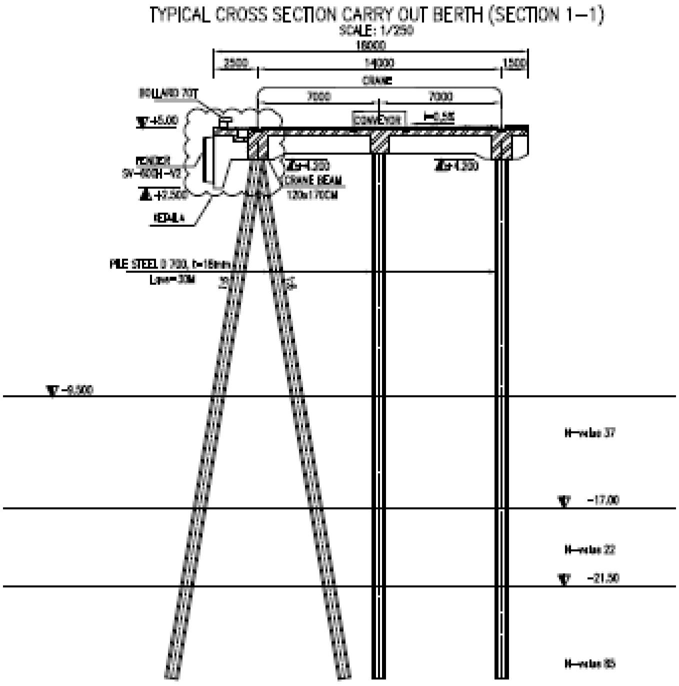
(6) Design drawings

For 5,000DWT berth



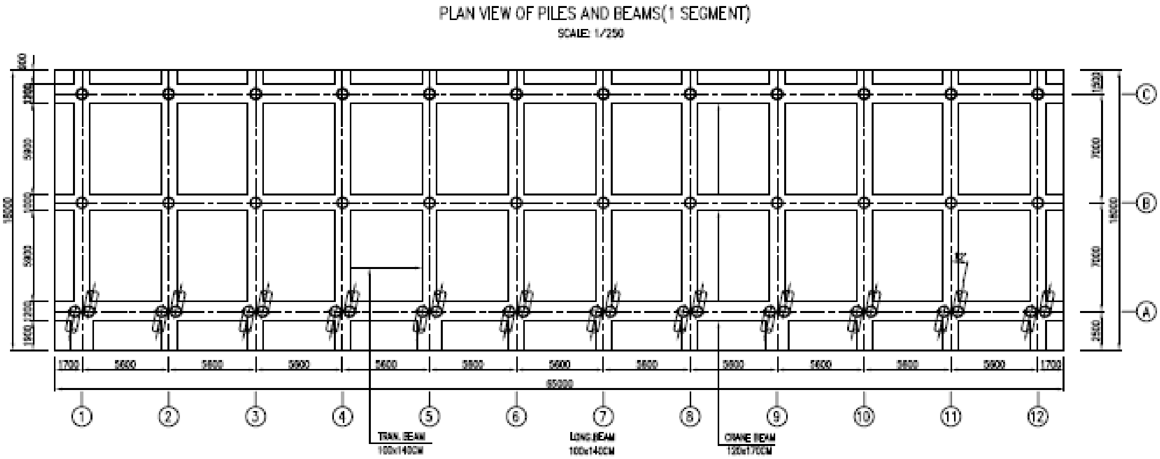
Source: JICA Study Team

Figure 5.3.1 Layout of Berth for 5,000DWT



Source: JICA Study Team

Figure 5.3.2 Typical Cross Section of the Berth for 5,000 DWT



Source: JICA Study Team

Figure 5.3.3 Pile Plan of the Berth for 5,000 DWT

5.4. Trestle

Trestle consists of Trestle A for unloading and Trestle B for loading. Both cross sections are considered for parallel access road.

1) Design conditions

i) Natural conditions

Natural conditions are shown in “5.1.1 Design Conditions”.

ii) Conditions for use

Trestle A

Belt conveyor: Unloading berth belt conveyors with four lanes in the 1st Phase and six lanes in the 2nd Phase are considered for transfer of import coal to coal stock yard. The width of belt conveyor is 2,200 mm.

Trestle B

Belt conveyor: Loading berth belt conveyors with one lanes of one berth in the 2nd Phase, is considered for transfer of coal from coal stock yard to loading berth. The width of belt conveyor is 1,600 mm.

Access road

Two-lane access road for management purpose are considered. Width of the access road is 8.0 m. Live load of large sized vehicle of 20 kN/m^2 is applied.

2) Selection of the type of structure

Bridge type is selected by considering the length, water depth, waves, and impact on the sea environment.

PC hollow slab girder is selected for the access road and steel truss bridge is employed for belt conveyor. The truss structure of belt conveyor will be studied in more detail at the determination of conveyor structure. Steel pile for bridge pier is selected because the load of bridge pier is not so large and long pile is expected. Covers for belt conveyor are considered to protect the environment.

3) Dimensions

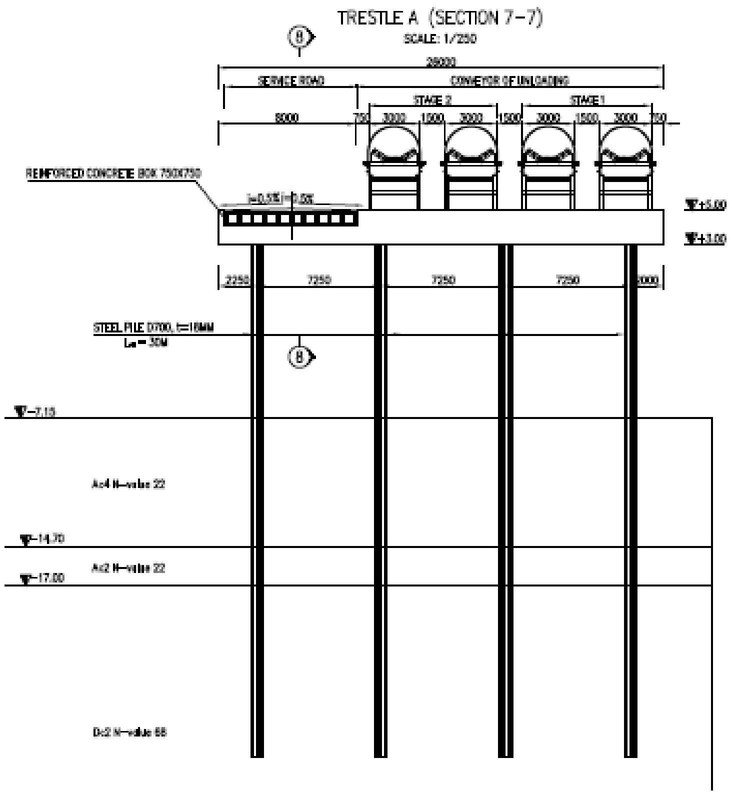
Width: The width of 26.0m for Trestle A and 13.0m for Trestle B are determined by considering the access road for management and four lanes belt conveyor.

Span of the bridge: The span of 20 m is determined by considering its balance with the dead load of superstructure.

Top surface elevation: The elevation of MSL+5.0m is determined by considering the extreme wave conditions at the time of HWL.

4) Design Drawings

Trestle A



Source：JICA Study Team

Figure 5.4.1 Typical Cross Section of Trestle A

Trestle B

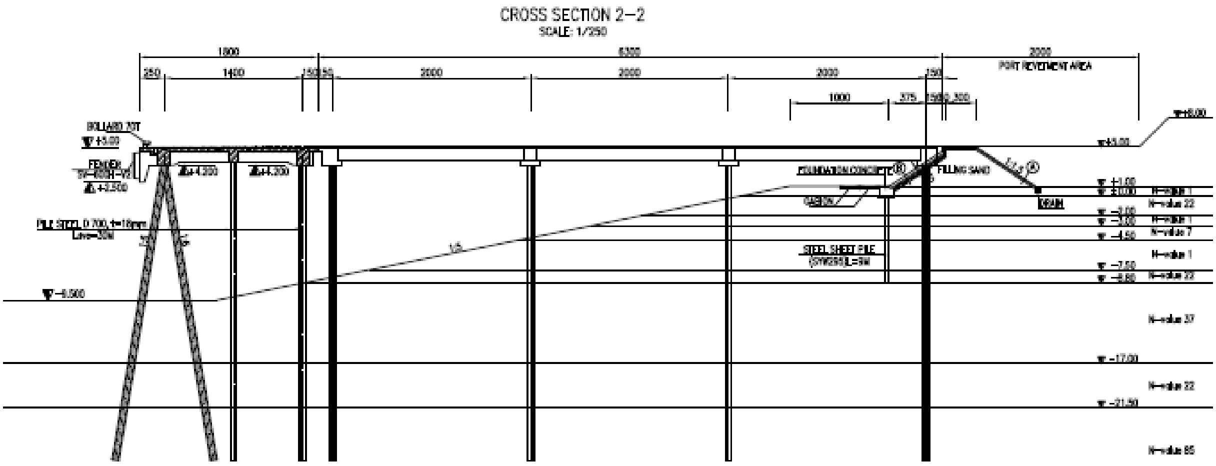


Figure 5.4.2 Side Cross Section of Trestle B

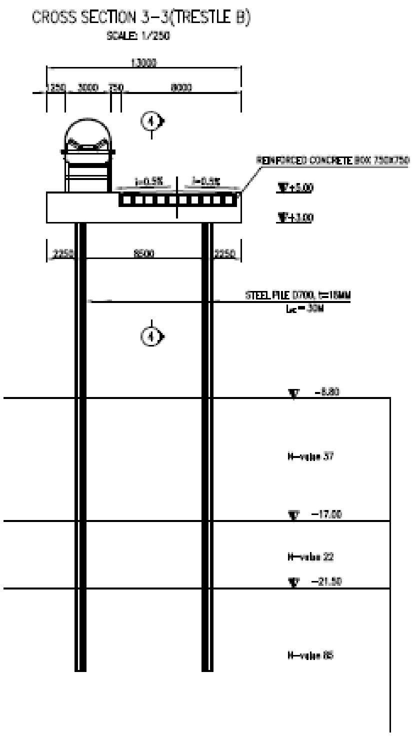


Figure 5.4.3 Typical Cross Section of Trestle B

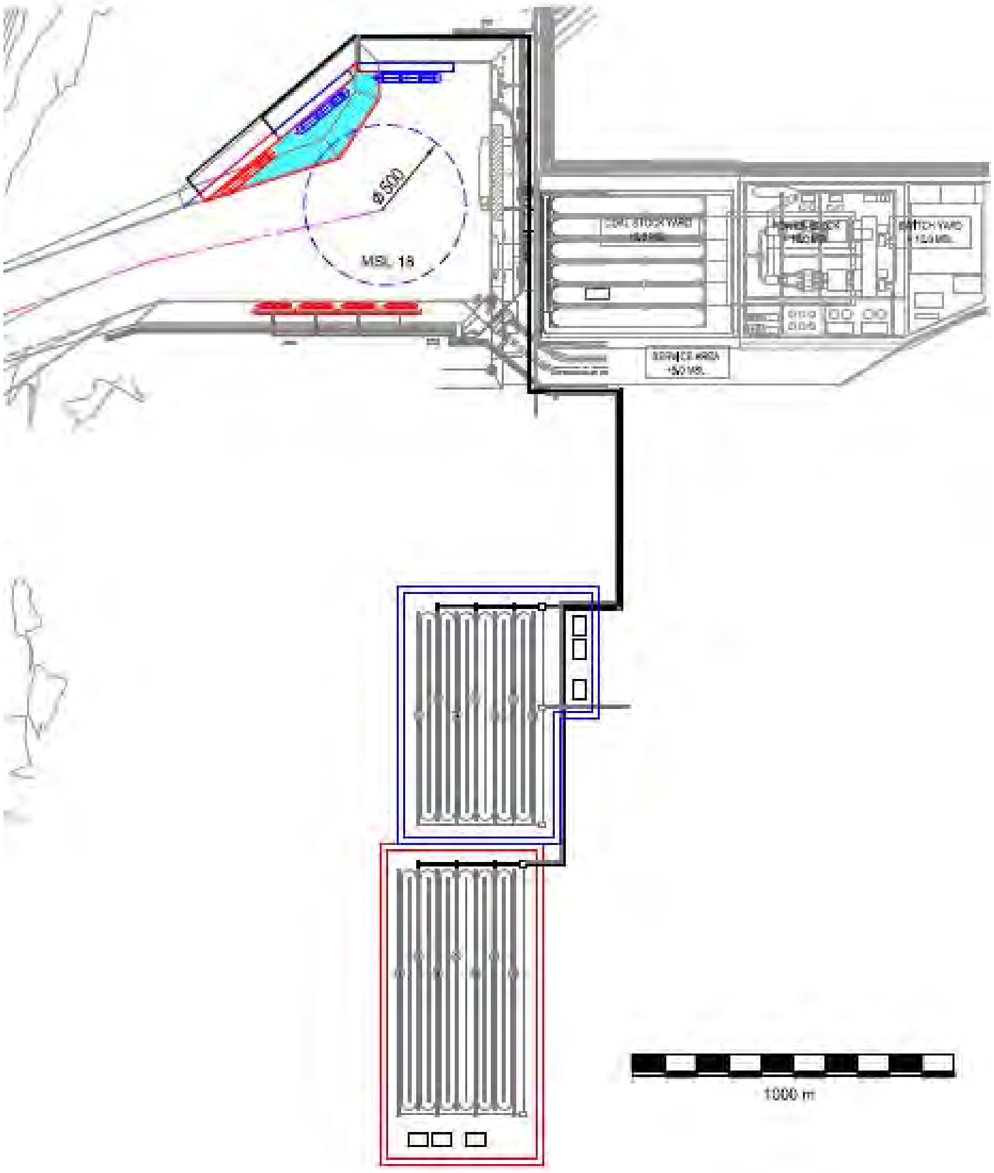
5.5. Coal Stockyard

(1) Selection of the structure type

Development plan from the 1st Phase to 2nd Phase is considered. Required areas of stockyard are as follows:

1st Phase: 45ha
2nd Phase: 50ha

The layout of stockyard is shown in Figure 5.5.1 below.



Source：JICA Study Team

Figure 5.5.1 Layout of Planned Coal Stockyard

Designed structures and facilities are shown as below.

i) Reclamation
ii) Base of stacker reclaimer
iii) Soil improvement
iv) Pavement
v) Dust protection fence

As mentioned before, other facilities such as utility of drainage or water treatment are studied in cost estimation.

(2) Design conditions

1) Natural conditions

Land elevation: Land reclamation is conducted from MSL+1.0 m current average elevation to MSL+8.0 m considering the prevention of storm surge damage. In the case that a risk of severe storm surge caused by low frequent cyclone is acceptable, elevation of land reclamation is determined at MSL+5.0 m. Therefore, MSL+8.0 m and MSL+5.0 m of reclamation elevation are designed in this study.

Reclamation material: The material to be used for land reclamation is soil, which will be dredged in the construction work of Matarbari CFPP. The height of land reclamation is necessary to be reconsidered based on the quality and quantity of material and cyclone risk. The height should be studied in more detail in the detailed design stage.

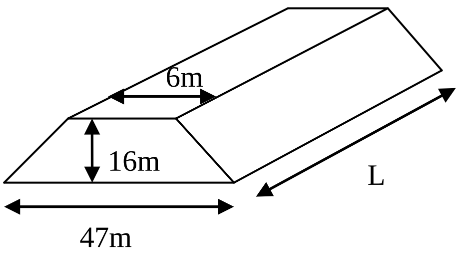
Soil conditions: The design conditions shown in Table 5.1.17 are applied.

2) Conditions for use

Current average elevation at the site is about MSL+1.0 m. The elevation after land reclamation will be at MSL+8.0 m and MSL+5.0 m considering the prevention of storm surge and drainage water from the facilities.

The typical cross section of coal stock pile is determined by considering the past examples and capacity of stacker reclaimer as follows.

Cross section of coal stock pile: trapezoid
Slope gradient: 40°
Height of coal stock pile: 16.0m
Width of top surface: 6.0m
Width of bottom: 47.0m



Source：JICA Study Team

Figure 5.5.2 Dimensions of Coal Stockpile

3) Structure results

i) Reclamation

The stockyard elevation of MSL+8.0 m and MSL +5.0 m, which are higher than the current elevation, is determined by considering the wave or drainage. An average of 7.0 m and 4.0 m height of the reclamation is considered. The dredged soil placed temporally at the ash pond is used for reclamation.

ii) Basement of rail for stacker reclaimer

The beams under the ground supported by steel pile are considered as basement of rail for stacker reclaimer. The grid span of 10m connecting with both sides of beams was considered to ensure the rail span. The height of basement is 1.2m higher than coal stock yard to protect rail from sedimentation by coal.

iii) Soil improvement

Weight from the height of coal stock pile of 16.0 m and reclamation of 7.0 m and 4.0 m are expected. Maximum of about 1.0 m consolidation settlement of clay soil layer is expected because there is a soft clay layer with about 7.0 m depth in current soil. Therefore, soil improvement for control of settlement is required at the whole of reclamation area.

Soil improvement aims less than 30 cm of residual settlement and 80% of final settlement during six months of surcharge period. Pre-loading method with PVD is expected as the most cost efficient. Square configuration of PVD with 1.3 m interval is determined. The surcharge height of 3.0 m is considered and over 90% of final volume of consolidation settlement is expected for eight months.

Ground settlement and stability of slope should be considered. To prevent from circular slip of slope, 1:3 slope gradients are employed for reclamation. Small embankment with 1.0 m height and 10 m width are also considered at the end of slope. A 20 m of offset distance from top of slope of land reclamation are ensured because large weight from stock coal affects the yard.

iv) Pavement

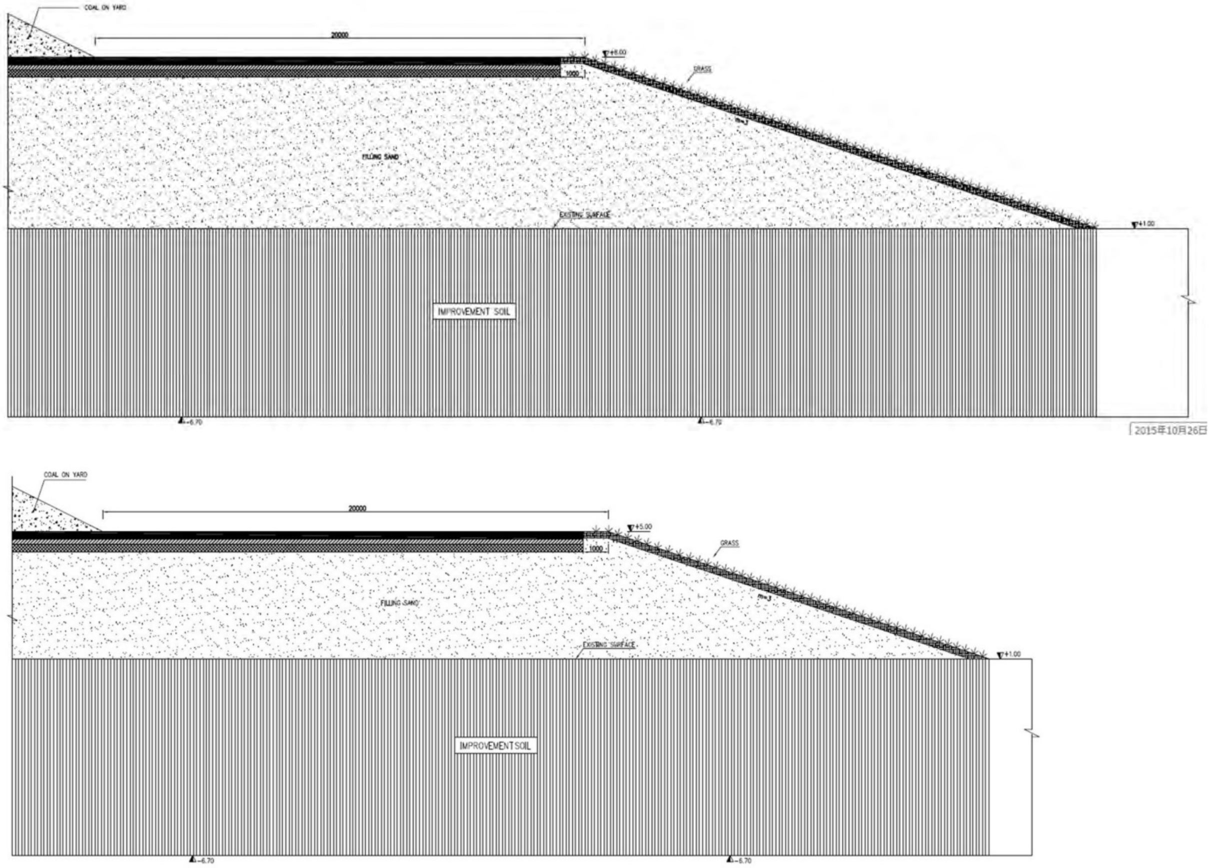
Wheel loader, reclaimer or bulldozer for transfer of coal stock pile is considered for the design of pavement. Concrete slab with thickness of 30cm, upper road bed with thickness of 20cm and lower road bed with thickness of 30cm for capacity of wheel loader of 2.0 m3 are considered. About 2% gradient is selected to drain water from sprinkler for dust or fire protection.

v) Dust protection fence

The dimensions of dust protection fence are expected that the height of fence is 16m and the height of base is 2.0m, which are same as Chubu Coal Center in Japan. PC piles, L=20m, ∅=400m and t=65mm, are considered as the base of the fence. The dust protection fence is planned to be installed at the border of coal stock yard on land side until the 2nd Phase.

4) Design drawings

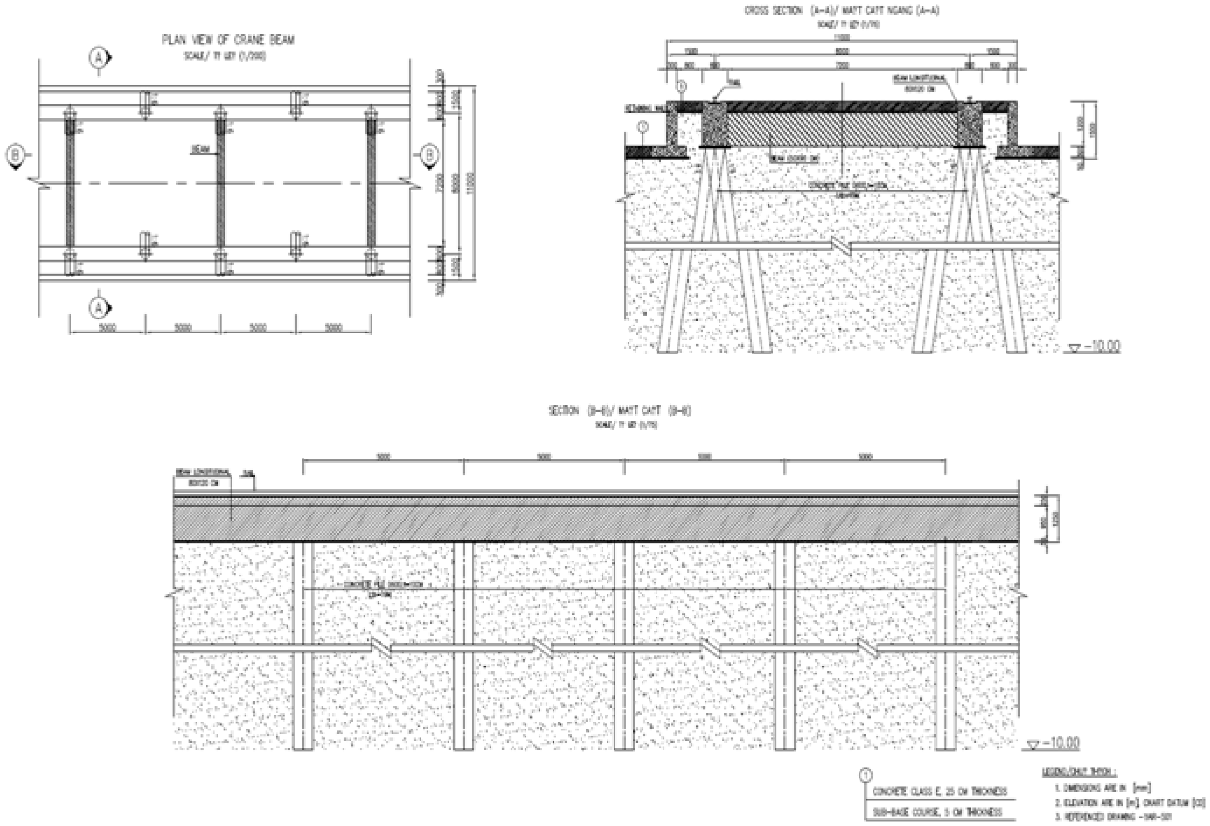
i) Reclamation slope on the land side



Source: JICA Study Team

Figure 5.5.3 Typical Cross Section of Reclamation Slope on the Land Side

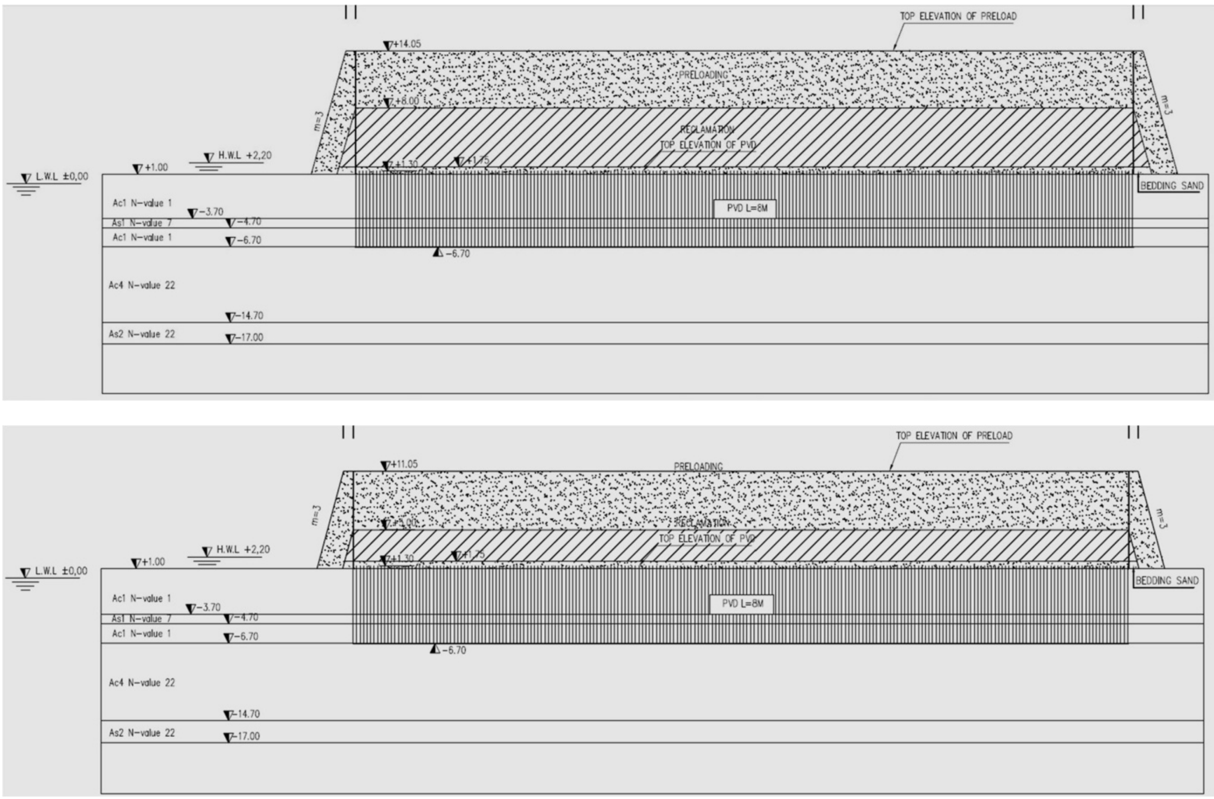
ii) Basement for stacker reclaimer



Source: JICA Study Team

Figure 5.5.4 Drawings of Basement for Stacker Reclaimer

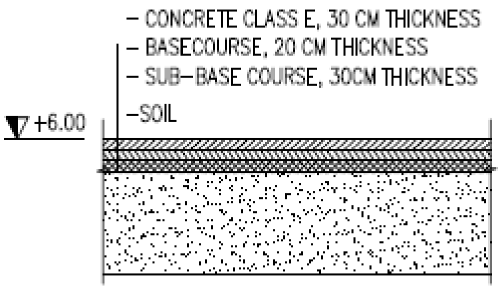
iii) Soil improvement of the coal stock yard



Source: JICA Study Team

Figure 5.5.5 Cross Section of Soil Improvement

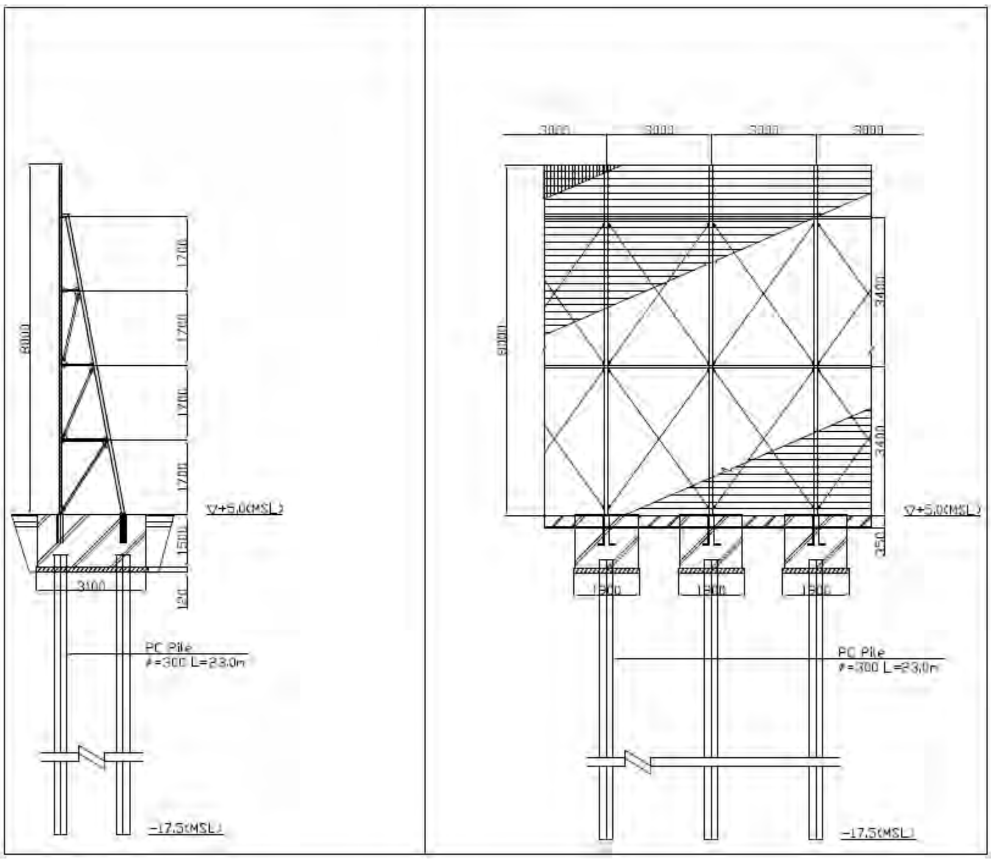
iv) Pavement



Source: JICA Study Team

Figure 5.5.6 Cross Section of Pavement

v) Dust protection fence



Source: JICA Study Team

Figure 5.5.7 General Layout of Dust Protection Fence

5.6. Basement of Facilities on Land Side

(1) Structure

Belt conveyor is designed with steel truss type and MSL+10.0 m height in order to consider crossover to other facilities. PC concrete piles are expected as basement of facilities on land side such as belt conveyors or buildings.

Chapter 6. CTT Project Plan and Cost Estimation

6.1. Execution Plan and schedule for Construction Work

6.1.1. Outline of the Work Items

This construction project is recommended to be divided into two stages such as the public portion and the private portion and be divided into two stages in accordance with coal demand as mentioned in the above section.

Facility name, quantity, and outline of the work items, the coal handling equipment to be installed and buildings to be constructed in the CTT to be executed in accordance with each stage and each phase are summarised in Table 6.1.1 and Table 6.1.2.

Table 6.1.1 Facilities to be constructed in the Public portion

No.	Facility's Name	Unit	Quantity	
			1st Phase	2nd Phase
1	Construction of the Coal Unloading Berth	berth	2	1
2	Construction of the Coal Loading Berth for 5,000DWT	berth	0	4
3	Reclamation and Earth Works	ha	45	50

Source: JICA Study Team

Table 6.1.2 Facilities to be Constructed in the Private Portion

No.	Facility's Name	Unit	Quantity	
			1st Phase	2nd Phase
	Building and Civil Works			
1	Pavement	ha	36	40
2	Drainage and Utilities	L.S	1.0	1.0
3	Administration Building	L.S	1.0	1.0
4	Maintenance Shop	L.S	1.0	1.0
5	Sub-Station	L.S	1.0	1.0
6	Dust Protection Wall	km	3.0	3.4
7	Security Fence and Gate	km	2.9	3.2
	Coal Handling Equipments			
1	Coal unloading machine	Set	4	2
2	Coal loading machine	Set	0	4
3	Stacker Reclaimer	Set	6	7
4	Belt Conveyor	km	12.8	14.9

Source: JICA Study Team

Notes: Belt conveyor from CTT to CFPPs. is not included in the item of "Belt Conveyor". It was confirmed at the stakeholder meeting that those belt conveyor will be constructed under the responsibility of each CFPPs.

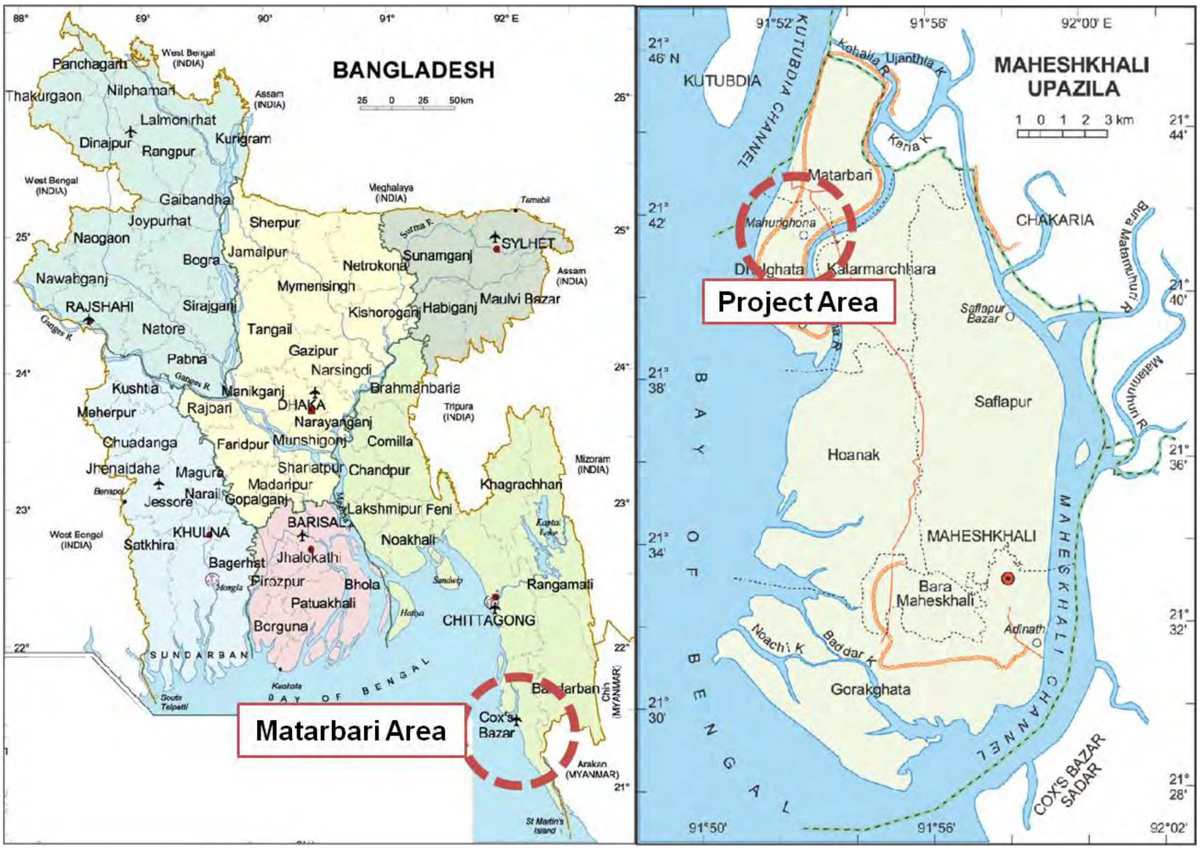
6.1.2. General Condition of the Site

Location, access, natural condition, and social condition are studied in this section. These conditions will be used for the consideration of the work execution method.

(1) Project site location and accessibility to the site

The project site is located near the Matarbari CFPP in the Matarbari area. The CTT faces the vessel turning basin and the sea channel which will be constructed for the Matarbari CFPP.

Land transportation and water transportation are possible to be used as access to the site. However, water depth near the project site is too shallow to be used as water transportation until construction of the channel and turning basin is completed. Project site is shown in Figure 6.1.1.



Source：http://www.in2bangla.com/upazilaMap.php?id=293

Figure 6.1.1 Project Site Location

(2) Natural conditions

The project site is located on the shoreline of the Matarbari area. Main characteristics of the natural condition of the site are summarised below.

Table 6.1.3 Natural Conditions

No.	Item	Condition
1	Climate	Monsoon climate
2	Rainfall	Annual rainfall is 2,106mm
3	Wind	Annual average wind velocity is 6.79m/s
4	Wave	Significant wave height higher than 1.5m is 2.5%
5	Existing ground	Subsurface ground is soft silt layer with thickness of 12m

Source: JICA Study Team

(3) Cooperation with the Matabari CFPP Project

This project has a close relationship with the Matabari CFPP Project. Therefore, the following basic conditions will be applied.

- Turning basin of the power plant will be used for operating vessels.
- Sea channel and channel navigation system of the power plant will be used.
- A part or whole of the reclamation soil will be delivered from the soil stockpile area of the CFPP project. The selected dredged sand will be used for reclamation.
- Construction of the common infrastructure such as power supply, water supply, access road and public drainage line around the project site are assumed to be completed at the construction stage of the CFPP project.
- Marine construction of the 1st Phase such as berth construction shall commence after completion of the dredging work of the CFPP project due to limitation of the working area.
- Reclamation work of the 1st Phase shall commence after completion of the reclamation work of the CFPP project because surplus selected dredged sand of the CFPP project is expected to be used.

6.1.3. Availability of Material and Equipment

Availability of materials and equipment is important for the consideration of execution plan and construction schedule. It will have an effect on the construction cost too. In this study, the available materials and equipment from local sources will be applied as much as possible and imported materials and equipment will be applied only when they are difficult to be obtained from local sources with suitable quantity and quality.

(1) Availability of materials

Considering the preliminary design of the structures, main used materials and its expected source are studied and listed in Table 6.1.4 below.

Table 6.1.4 Availability of Materials

No.	Material	Facility	Source
1	Concrete	Berth, yard, and buildings	Local
2	Stone	Berth and revetment	Local
3	Reclamation soil	Yard	Selected dredged sand of the CFPP project
4	Rebar	Berth, yard, and buildings	Local
5	PVD	Yard (soil improvement)	Imported
6	Steel Pipe Pile	Berth and trestle	Imported

Source: JICA Study Team

(2) Availability of reclamation soil

Basically, stockpiled selected dredged sand of the CFPP project will be used for the reclamation work due to the following reasons:

- Unit price of purchased reclamation sand in this area is relatively expensive.
- Capacity of purchased reclamation sand is not enough compared with its demand.
- It is difficult to obtain reclamation material from the surrounding area due to geographical reasons.

Approximately, over 5.2 million m^3 of the stockpile good soil is estimated in the CFPP project. Adding to that, dredged material in the berth construction work, maintenance dredged material of the sea channel, dredged material of other projects and a part of disposed soft soil in the CFPP project will be possible to be selected and applied to the reclamation work not only of the 1st Phase but also the 2nd Phase.

When quantity of above material is not enough for the reclamation works, reclamation sand shall be purchased in the northern part of the country.

In accordance with the soil profile data and seabed material survey result, it is expected that 37.5% of the dredged material of CFPP project are sandy material. Adding to that, in this study, it is tentatively assumed that over 20% of the disposed material will be available to use as reclamation material after five years from the completion of dredging works of the CFPP project.

The following Table 6.1.5 shows the expected balance of stocked soil and reclamation volume

Table 6.1.5 Soil Balance

No	Soil Origins	1st Phase (million m3)	2nd Phase (million m3)	Total (million m3)
1	Necessary volume for reclamation	3.78	4.20	7.98
2	Available quantity of CFPP stockpile	5.23	1.45	5.23
3	Disposed material	19.64	0.00	19.64
4	Available quantity of disposed material	0.00	3.93	3.93
5	Necessary volume to be purchased	0.00	0.00	0.00
6	Surplus volume (2+4-1)	1.45	0.27	0.27

Source: JICA Study Team

(3) Availability of equipment

Considering the preliminary design of the structures, main used equipment and its expected source are studied and listed in Table 6.1.1 below.

Table 6.1.6 Availability of Equipment

No.	Equipment	Work item	Source
1	Piling barge	Piling	Foreign
2	Crane barge (50 t class)	Berth superstructure	Foreign
3	Material barge (1,000 t)	Berth superstructure	Foreign
5	Excavator (0.7 m^3 class)	Earth works	Local
6	PVD machine (20 m)	Soil improvement	Foreign
7	Dump truck (15 t)	Earth works	Local
8	Mobile crane (50 t)	Building works	Local
9	Dredger (5,000 m^3/day)	Dredging work	Foreign

Source: JICA Study Team

6.1.4. Preliminary Execution Plan

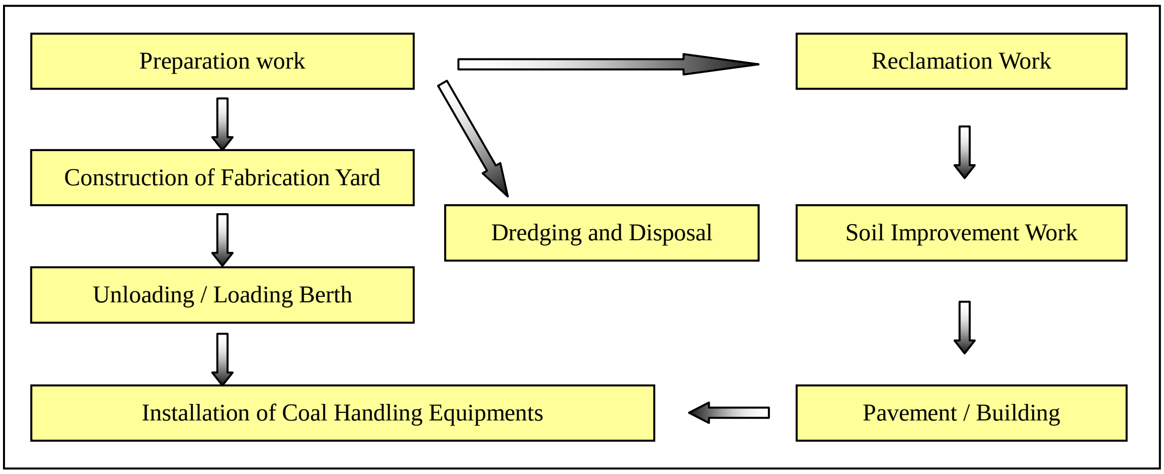
Preliminary construction method is studied in the following tentative conditions. The purposes of studying the preliminary execution plan are to calculate a reasonable and possible construction schedule and to estimate the reasonable construction cost.

<Applied conditions>

- The international experienced contractor will implement works.
- Popular and reasonable work method and materials in South-East Asia will be applied.
- Popular and reasonable work progress and activity ratio will be expected.

(1) Overall execution flow

Tentative overall execution flow of the construction is shown in Figure 6.1.2.



Source: JICA Study Team

Figure 6.1.2 Overall execution flow

(2) Execution plan of the preparation works and temporary works

Prior to the commencement of construction works, the necessary preparation works such as general survey work, installation of fence and gate, construction of the contractor's office, obtaining permissions and preparation of the method statement, and preparation of drawings shall be carried out.

Fabrication yard for the pre-cast concrete structures and splicing piles shall be constructed prior to commencement of the marine construction work.

Belt conveyer and/or temporary access road for dump truck to transport reclamation soil from the soil stockpile yard of CFPP project shall be prepared prior to the commencement of reclamation works too. Above preparation works should be completed in the preparation period for smooth commencement of the implementation of permanent works.

(3) Execution plan of the construction of the coal unloading/loading berth

The coal unloading berth and loading berth will be constructed in the harbour of the Matabari Power Plant. Piling of foundation piles will be installed by piling barge with hammer. Pile materials will be transported by material barges after splicing at the temporary yard.

After completion of the piling work, concrete superstructure will be constructed. Supporting works, formworks, and rebar works will be carried out by manpower supported by crane barge and concrete will be placed by concrete pump truck located on the existing revetment. Ready mixed concrete will be produced at the batching plant located at the temporary yard and transported by agitator trucks.

Pre-cast concrete beam and slab may be applied to shorten the construction period. They will be fabricated in the fabrication yard and be installed by crane barge.

Slope under the berth will be protected by stone layer to prevent damage by current and water flow caused by vessel's screw.

Anchor bolt and anchor plate for the coal handling equipment/belt conveyer shall be installed into the concrete structure in this stage.

(4) Execution plan of the dredging and disposal

Main sea channel and turning basin will be dredged by the CFPP project. However, dredging for port extension area and river channel for the secondary transportation may be required.

Port area and berth pocket will be dredged up to the required depth and width. A grab dredger (GD) or cutter suction dredger (CSD) may be used.

Location of the loading/unloading berth and trestle shall be dredged prior to the commencement of construction of these structures.

Dredged materials will be transported by barge or pipeline and disposed to the provided disposal area. When barge is used for transporting disposal soil, secondary transportation using pump barge will be necessary. In this study, onshore dumping area as same facility as used for the CFPP project is tentatively applied considering the relatively small volume of the dredged material. Disposed soil may be selected and used for the reclamation works.

This works may be carried out in the scope of the CFPP project to shorten the construction period of the project. Therefore, it is strongly recommended to discuss this demarcation between both projects.

(5) Execution plan of the reclamation works

Existing ground elevation is too low for the CTT in consideration of the storm surge. Therefore, reclamation will be necessary up to the required elevation. Prior to the filling sand, surface soil including organic materials and garbage will be removed by backhoe and dump truck. Temporary road and/or work stage may be required for backhoe and dump truck in some parts of the working area due to the soft ground condition.

Reclamation sand will be transported from the soil stockpile area of the CFPP project by dump truck or belt conveyor and installed to the reclamation area. Installed soil will be leveled and compacted by bulldozer. Edge of the reclamation area may be protected by stone, concrete blocks, or vegetation. Reclamation materials shall be used for the surcharge material of the soil improvement works.

(6) Execution plan of the soil improvement work

PVD method will be applied to the soil improvement for the yard area. Because this method has enough actual results in Asia and known as relatively low cost and easy construction. Adding to that, this method is suitable for huge area compared with other method in view of cost/schedule points. Necessary work items for the soil improvement by PVD method are the following:

(a) Installation of the pump well, monitoring well, and monitoring plate for settlement.

(b) Installation and leveling of the sand mat (horizontal drain) by bulldozer and dump truck.
(c) Installation of PVD by PVD machine.
(d) Installation of surcharge soil (reclamation material).
(e) Monitoring and measuring during the surcharge period.
(f) Removal of the surplus surcharge soil.

Stocked soil at the CFPP project will be used for the surcharge soil but it may not be used for the sand mat due to lack of permeability. Therefore, the purchased sand with appropriate hydraulic permeability will be used as the sand mat material.

Sand mat shall be installed as layer of the reclamation material and reclamation material shall be applied to surcharge material. Therefore, parts or whole of the surcharge material may not be required to be removed.

When shortening the schedule is seriously required, cement mixing method such as DMM method shall be applied to parts or whole area of the soil improvement.

(7) Execution plan of the pavement/building works

After completion of the soil improvement works, foundation of the coal handling equipment, buildings, utilities, and pavement will be constructed at the filled and improved yard. Mobile crane will be used for the main equipment of the building works, and earth equipment such as backhoe will be used for other works. Ready mixed concrete will be produced at the temporary yard and transported by agitator truck and installed by concrete pump truck or concrete hopper.

Foundation pile of the coal handling equipment and buildings will be installed by diesel hammer.

Utilities such as power supply line, water supply line, and drainage system should be constructed prior to the construction of the pavement.

In this study, concrete pavement is applied to the pavement type of the terminal. This type of pavement has merit on its strength and durability compared with other types. Adding to this, this type is more suitable for the climate in this location.

Sub-grade, sub-base, and base course will be installed and leveled by a bulldozer and compacted by a roller. Surface concrete will be placed by concrete hopper or concrete pump. Reinforcing bar and joints will be installed to avoid cracks and to increase its durability.

(8) Execution plan of installation of the coal handling equipment

Parts of unloader and loader will be transported by vessels and assembled on the berth. Vessel’s crane will be used for unloading and mobile crane will be used for assembling.

Parts of stacker reclaimer will be transported by vessels, unloaded to MOF of CFPP, transported to the coal storage yard by trucks and assembled by mobile crane.

Parts of the belt conveyer will be transported by vessels too. They will be assembled by crane barge and mobile crane.

6.1.5. Temporary Works

Temporary works are important items in order to estimate the construction period and the construction cost.

(1) Necessary temporary works

Necessary temporary works for this project are the following:

(a) Installation of the temporary security gate and fence
(b) Construction of the fabrication yard
(c) Temporary jetty and access road to deliver materials and equipments
(d) Temporary project office and camp

Above works should be conducted prior to the commencement of related permanent works. Therefore, careful schedule control of the temporary works will be required for the smooth implementation of the construction project.

(2) Fabrication yard

Following works will be conducted at the fabrication yard.

(a) Stockpiling and splicing of the foundation piles;
(b) Producing the ready mixed concrete;
(c) Fabrication and stockpiling of PC beam and PC slab;
(d) Stockpiling, cutting, and bending of rebar; and
(e) Stockpiling of the materials and equipment.

Ground of the fabrication yard will be filled by sand and covered by gravel. Filling sand and gravel will be compacted well by roller for vehicles to move smoothly.

Fabrication yard will be enclosed by security fence to avoid third party’s accident.

(3) Location and area of the fabrication yard

Location of the fabrication yard shall be selected considering the following factors:

- Method and required time of material transportation to the fabrication yard;

- Method and required time of material transportation from the fabrication yard to the working area;
- Required area and used period; and
- Security and safety.

Considering the above factors, behind area of the unloading berth is recommended for the fabrication yard.

Required area of the fabrication yard is tentatively estimated as follows:

- Stockpiling and splicing yard for SPP : 50m x 200m (1.0 ha)
- Concrete batching plant : 50m x 100m (0.5 ha)
- PC beam fabrication and stockpile : 50m x 200m (1.0 ha)
- Rebar storage and bending area : 50m x 50m (0.25 ha)
- Stockpile for other materials : 50m x 200m (1.0 ha)

In accordance with above estimation, approximately 4.0 ha of the fabrication yard shall be prepared.

6.1.6. Schedule of Construction Work

In this section, tentative construction schedule of each stage is estimated based on the preliminary design and preliminary execution plan. Tentative construction period will be calculated based on the work quantity, workability ratio and daily progress. Lead activity, critical path and construction period will be taken cared to determine the tentative construction schedule.

(1) Commencement date of construction

Commencement date of the work of the 1st Phase has the following conditions due to the relation with the CFPP project.

- Reclamation works of the 1st Phase shall commence after completion of reclamation works of the CFPP project, which is expected in the beginning of 2021. It is because produced and stocked soil by the CFPP project will be used for the reclamation works of the CFPP projects and surplus soil will be used for the project.
- Marine works such as dredging and berth construction shall commence after completion of dredging works by CFPP project, which is expected in the middle of 2021. It is because channel dredged by the CFPP project will be used for access and material transportation of the works. Adding to that, berth and trestle will be constructed in the area, which is dredged by the CFPP project.

Commencement date of the 1st Phase shall be determined based on its required period of preparation works and above condition.

Commencement date of the 2nd Phase is determined by estimated construction period and the target date of opening operation.

(2) Work quantity of each facility

Work quantity is calculated based on the preliminary design. Estimated work quantities are shown in the tentative construction schedule.

(3) Work activity ratio

The following work activity ratios will be applied in consideration of the site condition such as climate, wind, wave, and social condition.

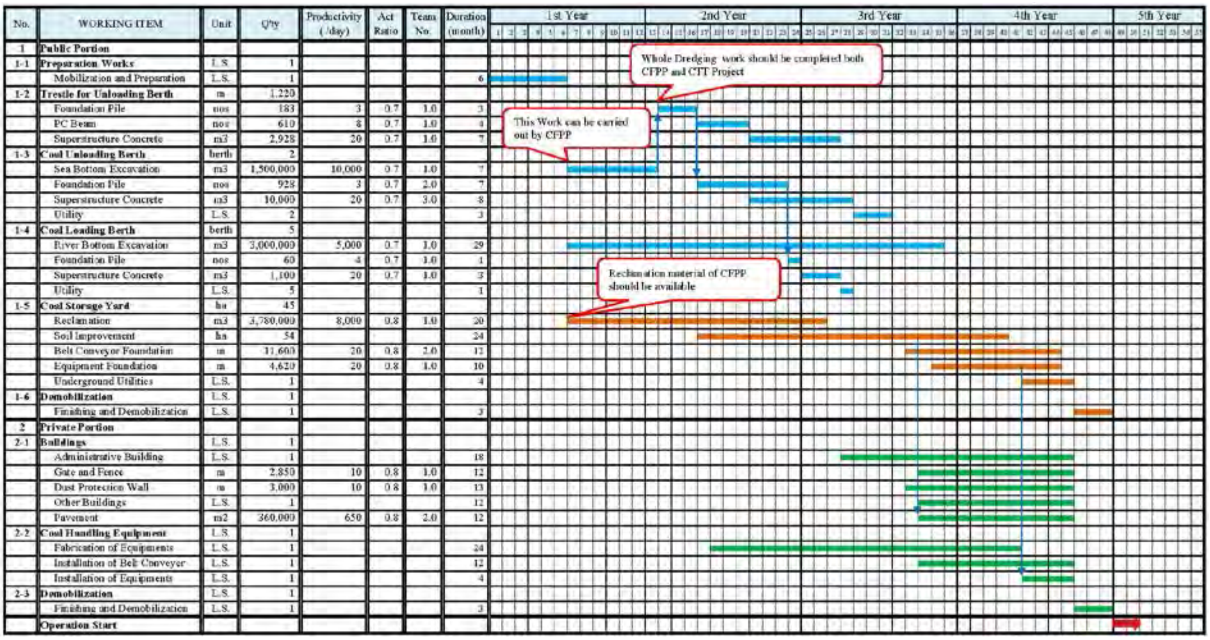
Table 6.1.7 Applied Activity Ratio

No.	Work Item	Applied Activity Ratio
1	Offshore works	0.7
2	Onshore works	0.8
3	Fabrication works	0.9
4	Other works	0.8

Source: JICA Study Team

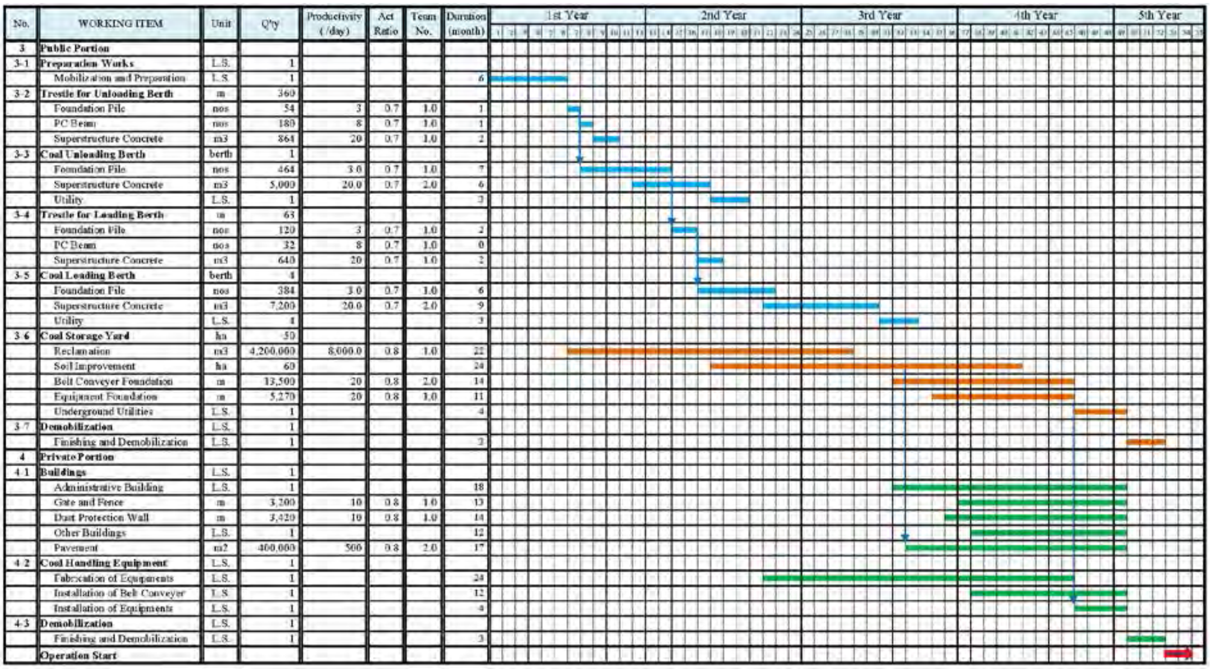
(4) Tentative construction schedule

Tentative construction schedule (1st Phase and 2nd Phase) calculated by the work quantity, activity ratio and assumed daily progress is shown in Figure 6.1.3 and Figure 6.1.4.



Source: JICA Study Team

Figure 6.1.3 Tentative Construction Schedule of the 1st Phase



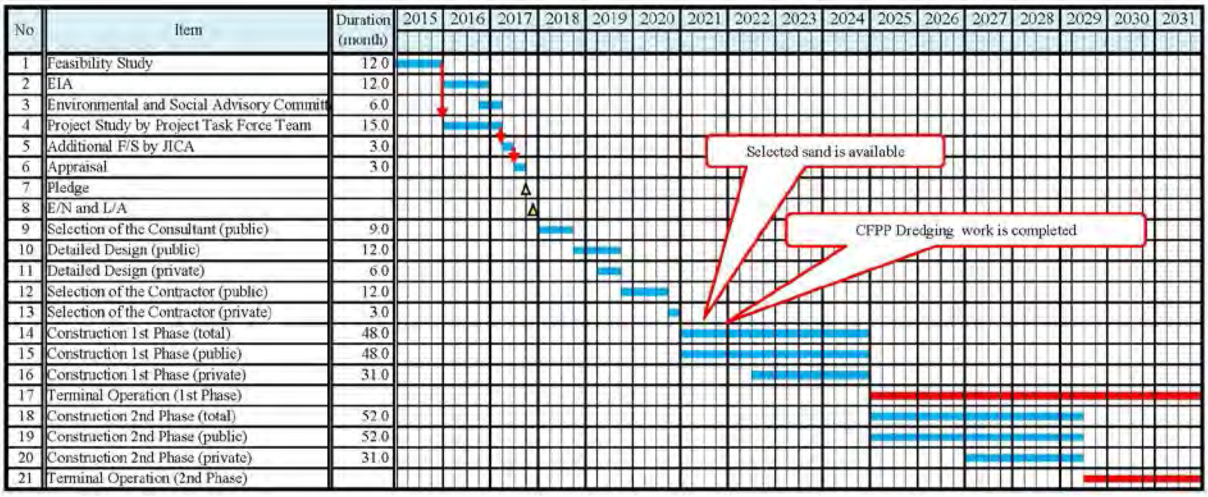
No.	WORKING ITEM	Unit	Q'ty	Productivity (/day)	Act Ratio	Team No.	Duration (month)
3	**Public Portion**						
3-1	**Preparation Works**	L.S.	1				
	Mobilization and Preparation	L.S.	1				6
3-2	**Trestle for Unloading Berth**	m	360				
	Foundation Pile	nos	54	3	0.7	1.0	1
	PC Beam	nos	180	8	0.7	1.0	1
	Superstructure Concrete	m3	864	20	0.7	1.0	2
3-3	**Coal Unloading Berth**	berth	1				
	Foundation Pile	nos	464	3.0	0.7	1.0	7
	Superstructure Concrete	m3	5,000	20.0	0.7	2.0	6
	Utility	L.S.	1				3
3-4	**Trestle for Loading Berth**	m	63				
	Foundation Pile	nos	120	3	0.7	1.0	2
	PC Beam	nos	32	8	0.7	1.0	0
	Superstructure Concrete	m3	640	20	0.7	1.0	2
3-5	**Coal Loading Berth**	berth	4				
	Foundation Pile	nos	384	3.0	0.7	1.0	6
	Superstructure Concrete	m3	7,200	20.0	0.7	2.0	9
	Utility	L.S.	4				3
3-6	**Coal Storage Yard**	ha	50				
	Reclamation	m3	4,200,000	8,000.0	0.8	1.0	22
	Soil Improvement	ha	60				24
	Belt Conveyer Foundation	m	13,500	20	0.8	2.0	14
	Equipment Foundation	m	5,270	20	0.8	1.0	11
	Underground Utilities	L.S.	1				4
3-7	**Demobilization**	L.S.	1				
	Finishing and Demobilization	L.S.	1				3
4	**Private Portion**						
4-1	**Buildings**	L.S.	1				
	Administrative Building	L.S.	1				18
	Gate and Fence	m	3,200	10	0.8	1.0	13
	Dust Protection Wall	m	3,420	10	0.8	1.0	14
	Other Buildings	L.S.	1				12
	Pavement	m2	400,000	500	0.8	2.0	17
4-2	**Coal Handling Equipment**	L.S.	1				
	Fabrication of Equipments	L.S.	1				24
	Installation of Belt Conveyer	L.S.	1				12
	Installation of Equipments	L.S.	1				4
4-3	**Demobilization**	L.S.	1				
	Finishing and Demobilization	L.S.	1				3
	Operation Start						

Source: JICA Study Team

Figure 6.1.4 Tentative Construction Schedule of the 2nd Phase

(5) Tentative project schedule

Considering the implementation plan of the CTT and the construction schedule of each phase, tentative project schedule is estimated as shown in Figure 6.1.5.



No	Item	Duration (month)
1	Feasibility Study	12.0
2	EIA	12.0
3	Environmental and Social Advisory Committ	6.0
4	Project Study by Project Task Force Team	15.0
5	Additional F/S by JICA	3.0
6	Appraisal	3.0
7	Pledge	
8	E/N and L/A	
9	Selection of the Consultant (public)	9.0
10	Detailed Design (public)	12.0
11	Detailed Design (private)	6.0
12	Selection of the Contractor (public)	12.0
13	Selection of the Contractor (private)	3.0
14	Construction 1st Phase (total)	48.0
15	Construction 1st Phase (public)	48.0
16	Construction 1st Phase (private)	31.0
17	Terminal Operation (1st Phase)	
18	Construction 2nd Phase (total)	52.0
19	Construction 2nd Phase (public)	52.0
20	Construction 2nd Phase (private)	31.0
21	Terminal Operation (2nd Phase)	

Source: JICA Study Team

Figure 6.1.5 Tentative Project Schedule

6.1.7. Construction Safety

Safety in any Project is the most important and serious matter for all of the concerned organizations and individuals involved. Important matters for the Safety Control are “To evaluate Safety Risk” and “To take counter measurements against the Safety Risk”. In this Study, “Safety Risk Assessment” is recommended to evaluate the Safety Risk.

Important actions to conduct the Safety Risk Assessment and recommended actions for safety control are mentioned in this section.

(1) Important actions to conduct the Safety Risk Assessment

- Possible safety risks shall be listed up.
- Safety risk shall be evaluated based on the multiple value of possibility of accident by scale of damage by the accident.
- Safety risk with high score will be determined as the important safety risk to be monitored and necessary countermeasures shall be taken.
- Detailed factors, which make the risk realise and necessary countermeasures to avoid these factors shall be analysed.
- Safety Risk Assessment shall be reviewed and revised as necessary.

(2) Recommended safety measures at the site

- Safety officer will be assigned (Safety organisation).
- Safety fence, safety path, safety stage will be installed (Safety facilities).
- Helmet, safety boots, safety glove will be used (PPG).
- Safety information should be shared by every related person (Safety meeting).
- Third party should check safety management at the site (Safety patrol).
- Near-miss study and case-study should be carried out (Safety training).
- Efficient measures in case accident happens (Emergency network and emergency plan).

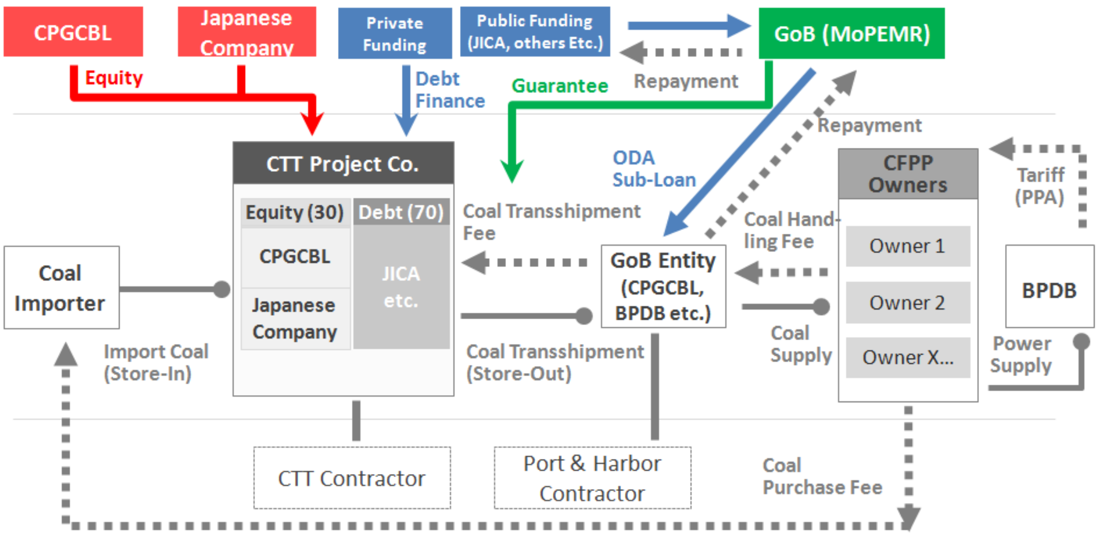
6.2. Terminal Management Organisation

In order to make the project successful, it is important to clearly obtain project risk assignment between the government and the private sector. For this reason, it is expected that the lower part of infrastructure for unloading berth, loading berth, coal stock yard will be applied with Japanese official development assistance (ODA) as managed by the Bangladesh government, and that for the CTT project including the upper part of infrastructure will be invested and operated by the private sector. It is also expected that the private sector can obtain enough profit for promoting the project.

It is necessary for the CTT project, that a company manages the whole coal terminal operation of ship entry into port, coal unloading, conveyance to stock yard, coal storage control, loading coal to conveyer for delivery, and loading coal to barge for secondary transportation, in order to satisfy the users' demand in timely manner.

For the CTT project, it is desirable that a company participating in management of coal terminal, a company with experience in coal sale and transportation in Bangladesh, and a company related to power generation in Bangladesh, etc., take part as equity participants, concentrate on know-how of each company, and be in charge of corporate management. The Special Purpose Company (SPC), in which a Japanese company and Bangladesh firms invest in, will perform the construction management, and operation and maintenance (O/M) of the coal terminal.

About the performance of each work, it is expected that capable companies will be selected for each work and the work will be performed under subcontract arrangement. For the organisation of SPC, the scheme shown in Figure 6.2.1 is reviewed. Manpower planning for SPC and the expected staff required for each work is described below.



Source: JICA Study Team

Figure 6.2.1 Relation of SPC and Other Related Organisations and Firms

(1) It is assumed to place three sections, namely, General-affairs Accounting Department, Business Department, and Facilities Department, under the president/chief executive officer (CEO) and a vice president/chief financial officer (CFO), as the management organisation of SPC. In order to accumulate and share know-how of the whole management of CTT, a close liaison mechanism amongst the business departments and O/M management persons in charge is important. It is assumed that subcontractors will be used for the operation of unloading, coal stockyard and loading. It is expected that the staff of SPC will understand the whole project, lead the management of operation, and improve such if needed. For this reason, acquisition of know-how on the existing CTT becomes indispensable in this business promotion in Bangladesh. It is very important to train specialists on CTT operation in Bangladesh by the consultant with know-how

on handling of imported coal and extensive experience in operation of a Japanese CTT, or to dispatch Bangladesh staff to a CTT in Japan for training.

1) General-affairs Accounting Department

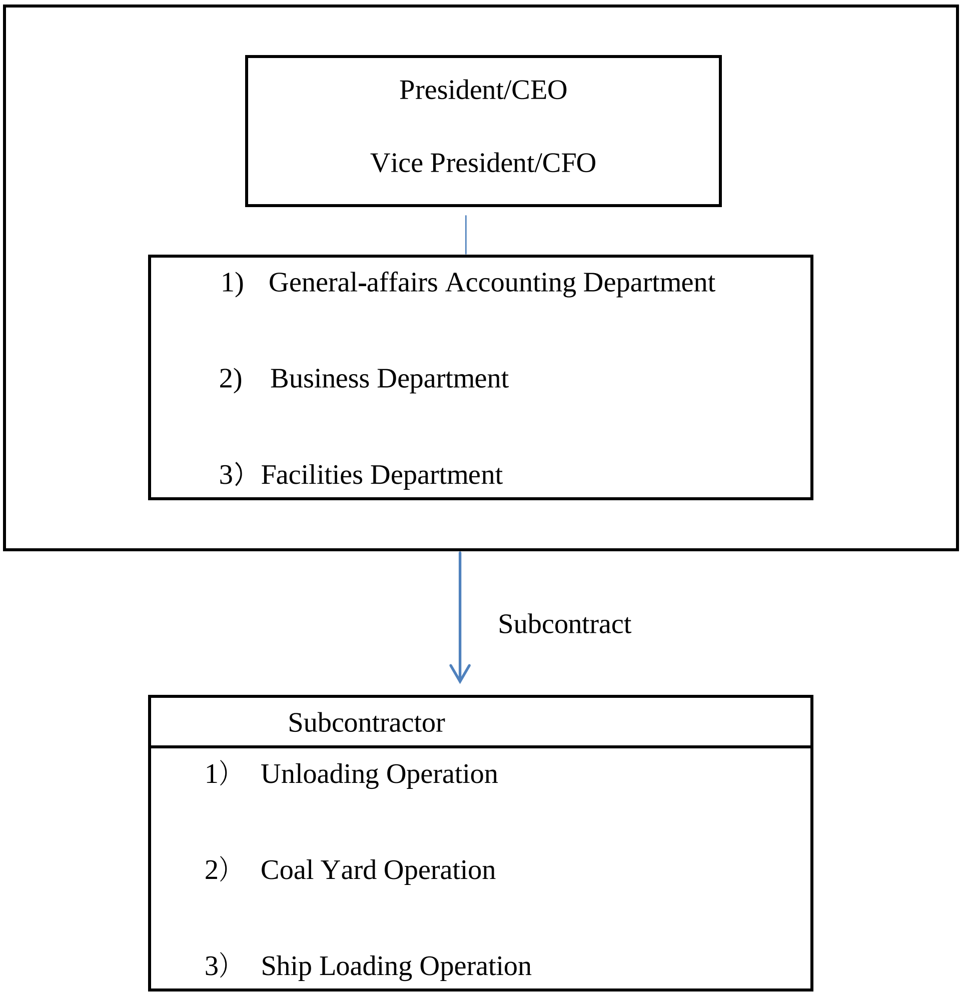
Responsible for general affairs relation, personnel relation, and accounting.

2) Business Department

Responsible for storage and delivery, shipping schedule management, inventory control, subcontractor management, and business development

3) Facilities Department

Responsible for construction, O&M of facilities, and IT-related works.



Source: JICA Study Team

Chart 6.1.2 SPC Organisation and Subcontractor

(2) The General-affairs Accounting Department performs general-affairs financial operation, and contract management of subcontracted companies.

(3) The Business Department performs storage and delivery, and inventory control for each customer, shipping schedule management of primary and secondary transport, management of subcontractors who perform the operation of unloading, yard and ship loading, fulfillment of contracts for customers, and business development. In order to grasp and share each customer's stock status and storage and delivery schedule timely, it is important to establish a suitable operation system.

1) Receipt and Delivery

For receipt and delivery operation, it is important to manage the shipping schedule, select the suitable facilities taking into account the efficiency of actual operation, operate them properly, and provide enough trainings for operators as mentioned later.

2) Yard Operation

For storage, operation taking account operational efficiency, safety, and attention to environmental aspects are important. As there will be several customers for this project and one customer will be using some kind of coal, it is necessary to make an inventory schedule of effective receipt and delivery without having to wrongly mix coal. As the imported sub-bituminous coal for this project is different from anthracite coal which has been used in Bangladesh and has the nature of spontaneous combustion during long periods of storage, it is very important to avoid the occurrence of spontaneous combustion for storage management with sufficient knowledge. In order to avoid generation of heat, temperature control, spraying of water at appropriate areas, and taking weather conditions and coal specifications into consideration must be done. In addition to those, in case when temperature is high, applying of press on coal, stock location change, spraying of water and pouring water must be done. It achieves a higher efficiency of operation and safety by maintaining a suitable shape of coal that can avoid disruption of coal pail by wind and rain. The effective use of limited storage space is also required. It is also necessary to consider environmental aspects by installing dust fences to suppress particulate scattering of coal, and recovery and recycle treatment facility of rain in the yard.

(4) For the construction stage, the Facilities Department will select, order, and install equipment that can satisfy the expected orders and demand of customers. After commencement of operation, the department will prepare the schedule and manage operation and manage O/M.

1) For the construction stage, enough training of staff operating the equipment or workers will be provided before the start of CTT operation. It will be also investigated to carry out the training through cooperation with an existing coal terminal in Japan.

2) Operation of facilities is based on three shifts and for 24 hours. The managers are allocated with main equipment in order to perform proper work management. The work will be conducted after making the work plan in advance, considering the vessel, schedule for receiving and delivering coal.

3) For CTT equipment, unloading equipment of coal, belt conveyor from berth to coal stock yard, belt conveyor in stock yard, and stacker (for stacking coal), reclaimer (for loading coal to conveyor) and feeding conveyor to a berth and a ship loader (for loading coal to barge) are needed. Taking into account the users' demand, the space of the coal stock yard and the number of equipment will be selected, and the equipment will be installed.

   In order to establish a highly-efficient management organisation, it is important to hear the opinions of users and the personnel of concerned companies, and to reflect the results of hearing at the planning stage of equipment installation.

4) It is required that these facilities are stabilised in order to perform stable operation of unloading, coal stock, and loading, for users. In order to satisfy this function, it is necessary to always maintain equipment operation in a good state. As equipment has the risk of breaking down, it is important to choose a suitable number of equipment so that operation can be complemented by other sound equipment at the time of failure. Maintenance will be done after planning both annual and middle-term maintenance. The necessary replacement parts will be purchased at the required time, and maintenance will be performed so that the service to customers may not be affected. IT apparatus-related installation, O/M will be conducted appropriately. Information control of customers, CTT, and equipment data is performed properly.

   i) Repair will be done suitably, looking at the operation condition of the equipment before commencement of daily works and also under operation. It is very important to also carry out preventive maintenance and a periodic check in order to secure the function of equipment.
   Check and repair are planned to be carried out so that the actual operation of coal handling may not be affected.
   ii) Parts with the possibility of failure should be equipped with replacement parts, and can be exchanged promptly at the time of failure. Since there are some which require a long time for delivery, advance purchase and storage of replacement parts are carried out appropriately.
   Looking for cooperation with the maker side, it is necessary to prepare the system which can perform failure correspondence on a 24-hour basis. Furthermore, it is also important to select a maker who can respond and accepts such users' request.
   iii) Efficient maintenance is carried out and it would be better to take into consideration excessive repair works and avoid it to save on maintenance costs. For example, it would be possible to simplify the maintenance method by reducing the frequency of check and maintenance of equipment that has lower influence on terminal operation and on failure of other facilities. It is

also important to set up the period of the first stage, the middle, and the second half based on the lapsed time from installation, and to adopt a maintenance management method suitable for each period.

iv) For failed parts, the cause of failure will be analysed, and check up to discover failure at an early stage and preventive maintenance will be applied. It is also important to propagate this approach to similar equipment to lower the rate of failure.

5) In case failure of equipment occurs and coal delivery is delayed, it is desirable to stock in a power station the minimum amount of coal to cover the user demand until such time that the failed equipment is repaired. Usually, in case there are replacement parts, the failure would be fixed and operation could restart in about one week or longer. A suitable amount of stock should be prepared taking into account the situation in Bangladesh.

6) It is required to carry out terminal management after mastering special knowledge and skill on such. For this reason, close and positive liaison mechanism is built between makers and terminal operator, and it is also important at failure time of equipment to combine the method of agreement for the reservation of replacement parts and on-call contract for failure correspondence which receives the dispatch of a specialist on a 24-hour basis.

7) In failure developmental time, a terminal operator should understand the facts quickly and correctly and make judgment to minimise influence on terminal operation. When a phenomenon of failure is derived, it is required to take into consideration the influence on users’ demand, give a role to operators of facilities and maker staff, and judge what function is suspended and substituted with what, and by when, and how the failed equipment will restart. The complement organisation for assumed failure and trouble will be trained before the start-up of terminal, and the possibility of problem will be also actualised. From this training, the effect for minimising the influence of a trouble under actual terminal operation could be expected.

(5) The education of workers is important for all jobs for project operation. Regarding such education, there is a method for understanding the equipment well through O&M management training by the maker, on-site inspection during construction, and O&M management manuals. Moreover, operation survey or training for coal handling at another coal centre or power generation plant may be utilised. It is considered to use the support of a consultant with abundant management experience in a coal centre, from the test run of facilities to the beginning of actual terminal operation for smooth start-up.

It is also important to utilise IT systems in managing information including information on operation, maintenance plan, history, and analyse such information rationally and utilise them in order to perform more efficient O&M management.

6.3. Running Cost of CTT Operation

(1) Personnel Expenses

1) Number of Employees

The required number of employees is calculated based on coal demand as referred to in Section 4 and 5. It is divided into direct labor cost and indirect labor cost.

The number of direct labour is calculated based on the hearing information from existing CTTs in Japan, and the required number of equipment to be installed in each phase.

The number of indirect labour is calculated based on hearing information from existing CTTs in Japan and taking the volume of handling coal into consideration.

2) Unit Cost of Personnel Expenses

Unit cost of personnel expenses are calculated referring to the minimum wage in Bangladesh, which is stipulated in the Bangladesh Labor Law 2006 and information from the Japan External Trade Organization (JETRO), and hearing information through a local study.

(2) Utilities Expenses

1) Usage of Electricity

The usage of electricity is calculated by the required amount of electricity consumption of equipment to be installed in each phase.

2) Electricity Cost

Electricity costs, as shown in Table 6.3.1 below, are calculated based on the tariff stipulated by the Bangladesh Energy Regulatory Commission (BERC).

Table 6.3.1 Estimated Electricity Costs

Type	Price (BDT/kWh)
Commercial & Office	9.58
Medium Voltage User (11kV)	7.32
High Voltage User (33kV)	7.20
Very High Voltage User (132kV)	6.96

Source：Bangladesh Energy Regulatory Commission (BERC)

(3) Water Charge

The water charges are stipulated by the Dhaka Water Supply and Sewerage Authority (WASA).

Table 6.3.2 Water Charges

Type	Price (BDT/m3)
Industrial / Commercial	24.44
Retail / General Public	7.33

Source：Dhaka Water Supply and Sewerage Authority (WASA)

(4) Depreciation Cost

Useful life is based on discussion with the local accounting firm as shown in the table below.

Table 6.3.3 Depreciation Period

Main Equipments:	**Item**	**Depreciation period**
Unloader	B-22	20 years
Belt Conveyor	B-18	12 years
Stacker-Reclaimer	B-18	12 years
Ship-Loader	B-22	20 years
Handling Machinery:		
Wheel Loader	D-7	10 years
Buldozer	D-7	10 years
Truck	D-7	10 years
Power Supply & Control System		
Electricity Supply System for unloader	A-3	15 years
Central Control System for unloader	A-3	15 years
Environmental Facilities:		
Dustproof Fence	I	25 years
Drain Water Treatment Facility:	B-18	12 years

Source: JICA Study Team

(5) Maintenance Cost for Coal Handling Equipment

It is assumed that 3% of purchased cost is the maintenance cost for coal handling equipment per year according to hearing information from equipment suppliers.

(6) Insurance Cost

The cost of property damage, business interruption and third party liability insurance for the terminal assets for the upper infrastructure amount is as below, which is according to hearing information from existing CTTs in Japan and insurance company. This insurance compensates the damage of equipment and damage caused by equipment trouble.

1) Property Damage / Business Interruption Insurance: 0.5%-1.0% on Insured Amount* per annum

   *Insured Amount is based on, project costs + expected annual income

2) Third Party Liability Insurance: US$250,000 per annum, based on max payment liability of US$100 mil

3) Property Damage to Coal Stock: 0.2% on Insured Amount* per annum

*Insured Amount is based on 30 days coal stock

(7) Land Usage Fee

1) The lower infrastructure should be prepared by the Bangladesh government. Otherwise this project will not be feasible for private investors. Therefore, lower infrastructure is prepared and owned by the Bangladesh government, and not by SPC.

2) The lower infrastructure is an asset of the Bangladesh government, and will have economic value after the project term. Therefore, necessary funding for the lower infrastructure, which is assumed to come from a JICA ODA loan, should basically be prepared and borne by the Bangladesh government. However, it is assumed in this study that SPC will pay a "Land Usage Fee" for the usage of the lower infrastructure to the Bangladesh government. Based on hearings from the Bangladesh government personnel's and from past power IPP projects, the "Land Usage Fee" is assumed to be BDT 250,000/ha. However, this issue should be further discussed with the Bangladesh government.

   Land acquisition and resettlement costs are not included. Such costs must be borne by the Bangladesh government.

3) Assumed Terms and Conditions of JICA ODA Loans

   i) Terms and conditions: For least developed countries (LDC) / Low-income countries
   ii) Interest rate: 0.01%
   iii) Repayment period: 40 years (Grace period is 10 years.)
   iv) ODA loan amount:
   v) ODA loan amount:

Initial Debt	(2021):	USD 341 million
Additional Debt	(2026):	USD 226 million
Total	:	USD 567 million

(8) Maintenance Cost for the Lower Infrastructure

The lower infrastructure is supposed to be owned by the Bangladeshi government; however, the JICA Study Team assumed that 100% of the maintenance cost during the project term is borne by SPC, instead of the Bangladeshi government.

(9) Other Expenses

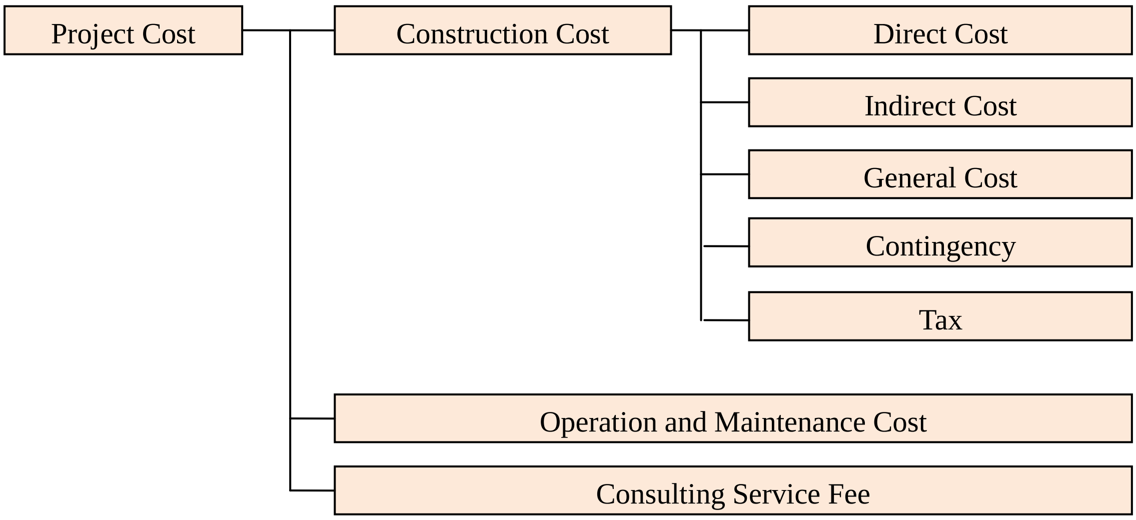
The JICA Study Team estimated other costs such as incorporation fee, training fee, waste liquid treatment cost, security cost, consumable goods expenses, and cost for consulting services from the existing CTT, based on the hearing information.

6.4. Project Cost Estimation

6.4.1. General Description

Construction cost and maintenance/operation cost will be studied and estimated in this section.

Generally, project cost consists of construction cost, operation/maintenance cost and consulting service fee as shown in Figure 6.4.1. The construction cost consists of direct cost, indirect cost and general cost. Direct cost consists of material cost, equipment cost and manpower cost. Normally, indirect cost and general cost are shown as percentage of the direct cost.



Source: JICA Study Team

Figure 6.4.1 Proportion of the Project Cost

6.4.2. General Conditions

The following are the general conditions that will be applied to the estimated project cost.

- Normal market price at the project site will be applied to unit price.
- Price fluctuation will not be considered in this section.
- Interest of the rent money will not be considered in this section.
- Unit prices of the procurement of the coal handling equipment will include indirect cost and general cost.
- The consultant’s service consists of the design work, tender assistance and the construction supervision.
- Consulting service and construction works will be carried out by the experienced parties which have appropriate technical skill and experience.
- Normal and reasonable execution method and construction schedule as mentioned in Section 6.1 of this report will be applied.
- Applied exchange rate : JPY 120 = USD 1 = BDT 78 (as of October 2015)

6.4.3. Construction Cost

Construction cost will be estimated based on the work quantity and unit price. In this section, construction cost of each stage will be estimated.

1) Quantity of facilities

Facility name, quantity and outline of the work items including buildings to be constructed in the CTT and the coal handling equipment to be procured in the project are summarised in Table 6.4.1 and Table 6.4.2.

Table 6.4.1 Outline of the Facilities to be constructed in the Public Portion

No.	Facility's Name	Unit	Quantity	
			1st Phase	2nd Phase
1	Construction of the Coal Unloading Berth	berth	2	1
2	Construction of the Coal Loading Berth	berth	0	4
3	Reclamation and Earth Works	ha	45	50

Source: JICA Study Team

Table 6.4.2 Outline of the Facilities to be Constructed by Private Portion

No.	Facility's Name	Unit	Quantity	
			1st Phase	2nd Phase
	Building and Civil Works			
1	Pavement	ha	36	40
2	Drainage and Utilities	L.S	1.0	1.0
3	Administration Building	L.S	1.0	1.0
4	Maintenance Shop	L.S	1.0	1.0
5	Sub-station	L.S	1.0	1.0
6	Dust Protection Wall	km	3.0	3.4
7	Security Fence and Gate	km	2.9	3.2
	Coal Handling Equipments			
1	Coal Unloaded Machine	Set	4	2
2	Coal Loading Machine	Set	5	4
3	Stacker Reclaimer	Set	6	7
4	Belt Conveyor	km	12.8	14.9

Source: JICA Study Team

2) Work quantities of each facility

Required work quantities of each facility will be calculated based on the preliminary design as mentioned in Section 5 of this report. Applied work quantities are shown in the cost calculation sheet.

3) Unit price of the work

The JICA Study Team studied normal market price of the main materials, equipment, manpower, and coal handling equipment at the site. These unit prices shown below are reference only and will be used in estimating the unit price of the works. Applied unit prices of the works are determined considering the social condition such as balance of the supply and demand.

i) Unit price of main material

Studied unit price of main materials are shown in Table 6.4.3. These unit prices include transportation fee to the site and other related necessary cost.

Table 6.4.3 Unit Price of Main Materials

No.	Material	Description	Unit	Unit Price（USD）
1	Reclamation Sand	Reclamation sand	m3	15
2	Ready mixed concrete	30N/mm2	m3	130
3	Reinforcing bar	D13	ton	800
4	Stone	Rubble	m3	75

Source: JICA Study Team

ii) Unit price of main equipment

Studied unit prices of main used equipment are shown in Table 6.4.4. These unit prices include the fuel fee, operator’s cost, mobilisation and demobilisation cost, maintenance cost, and other related necessary cost.

Table 6.4.4 Unit Price of Main Equipment

No.	Equipment	Description	Unit	Unit Price（USD）
1	Backhoe	0.7m3 class	day	153
2	Crawler Crane	50 t	day	443
3	Dump Truck	15 t	day	130

Source: JICA Study Team

(1) Unit Price of Manpower

The studied unit prices of manpower are shown in Table 6.4.5. These unit prices include social insurance, allowances and management cost of the contractor, and other related necessary cost.

Table 6.4.5 Unit Price of Manpower

No.	Manpower	Unit	Unit price（USD）
1	General Worker	month	150
2	Skilled Worker	month	300
3	Site Supervisor	month	300

Source: JICA Study Team

4) Coal handling equipment

Coal handling equipment will be purchased from international supplier considering their quality and price. In this study, tentative cost will be applied to the estimated project cost.

Applied unit prices of coal handling equipment are shown in Table 6.4.6. These unit prices include transportation fee, installation fee, indirect cost, general cost, and design fee.

Table 6.4.6 Unit Price of Coal Handling Equipment

No.	Equipment	Description	Unit	Unit price（USD）
1	Coal Unloader	2,500 t/h	set	15,440,000
2	Ship Loader	1,500 t/h	set	800,000
3	Stacker Reclaimer	3,000 t/h	set	6,440,000

Source: JICA Study Team

5) Construction cost

Construction cost is estimated based on the above work quantities and assumed unit prices. Estimated construction cost of each phase and each portion is shown below.

i) Direct Cost of the 1st Phase

Table 6.4.7 Estimated Direct Cost of the 1st Phase (Public Portion)

Facility Name	Work Item	Unit	Quantity	Unit Price	Price
				USD	USD
1st Phase	**Public Portion**				
Trestle for Unloading Berth					
	Length	m	1,220		
	Foundation Pile SPP D800 (L30, W9.3t)	nos	183	22,600	4,135,800
	PC Beam W16.2ton	nos	610	5,040	3,074,400
	Superstructure Concrete	m3	2,928	400	1,171,200
	Utility	L.S.	1	244,000	244,000
Coal Unloading Berth					
	Berth No.	berth	2		
	Foundation Pile SPP D1000 (L42, W19.3t)	nos	752	42,600	32,035,200
	Foundation Pile SPP D1200 (L42, W23.2t)	nos	176	50,400	8,870,400
	Superstructure Concrete	m3	10,000	400	4,000,000
	Utility	L.S.	2	675,000	1,350,000
Coal Loading Berth					
for initial stage	Berth No.	berth	5		
	Foundation Pile SPP D600 (L22, W3.8t)	nos	60	10,600	636,000
	Superstructure Concrete	m3	1,100	400	440,000
	Utility	L.S.	5	40,000	200,000
Terminal Yard					
	Area	ha	45		
	Reclamation	m3	3,780,000	15	56,700,000
	Soil Improvement	ha	54	600,000	32,400,000
	Underground Utilities	L.S.	1	3,000,000	3,000,000
Dredging and Disposal					
	Sea bottom excavation	m3	1,500,000	15	22,500,000
	Riverbed excavation	m3	3,000,000	15	45,000,000
Sub total of 1st Phase Public Portion					**215,757,000**

Source: JICA Study Team

Table 6.4.8 Estimated Direct Cost of the 1st Phase (Private Portion)

Facility Name	Work Item	Unit	Quantity	Unit Price	Price
				USD	USD
1st Phase	**Private Portion**				
Civil Works					
	Pavement	m2	360,000	120	43,200,000
	Security fence and gate	m	2,850	200	570,000
	Dust protection wall (h=16m)	m	3,000	2,500	7,500,000
	Drainage system	L.S.	1	1,500,000	1,500,000
	Water Supply system	L.S.	1	800,000	800,000
	Power Supply system	L.S.	1	4,000,000	4,000,000
	Civil Works Sub-Total				57,570,000
Building Works					
	Office Building	L.S.	1	5,000,000	5,000,000
	Maintenance house	L.S.	1	2,000,000	2,000,000
	Warehouse	L.S.	1	1,000,000	1,000,000
	Sub-station	L.S.	1	15,000,000	15,000,000
	Security house	L.S.	3	100,000	300,000
	Rest house	L.S.	3	500,000	1,500,000
	Other utilities	L.S.	1	1,800,000	1,800,000
	Building Works Sub-Total				26,600,000
Coal Handling Equipment					
	Belt Conveyor Foundation	m	11,600	570	6,612,000
	Equipment Foundation	m	4,620	785	3,626,700
	Unloader	set	4	15,440,000	61,760,000
	Ship Loader	set	5	800,000	4,000,000
	Stacker Reclaimer	set	6	6,440,000	38,640,000
	Belt conveyer for unloading line	m	7,800	7,800	60,840,000
	Belt conveyer for loading line	m	3,800	4,800	18,240,000
	Belt conveyer for Trestle (unloading)	m	1,200	12,000	14,400,000
	Belt conveyer for Trestle (loading)	m	0	7,000	0
	Other equipments	L.S.	1	2,000,000	2,000,000
	Equipments Sub-Total				210,118,700
Sub total of 1st Phase Private Portion					**294,288,700**

Source: JICA Study Team

ii) Direct Cost of the 2nd Stage

Table 6.4.9 Estimated Direct Cost of the 2nd Phase (Public Portion)

Facility Name	Work Item	Unit	Quantity	Unit Price	Price
				USD	USD
2nd Phase	**Public Portion**				
Trestle for Unloading Berth					
	Length	m	360		
	Foundation Pile SPP D800 (L30, W9.3t)	nos	54	22,600	1,220,400
	PC Beam W16.2ton	nos	180	5,040	907,200
	Superstructure Concrete	m3	864	400	345,600
	Utility	L.S.	1	72,000	72,000
Coal Unloading Berth					
	Berth No.	berth	1		
	Foundation Pile SPP D1000 (L42, W19.3t)	nos	376	42,600	16,017,600
	Foundation Pile SPP D1200 (L42, W23.2t)	nos	88	50,400	4,435,200
	Superstructure Concrete	m3	5,000	400	2,000,000
	Utility	L.S.	1	675,000	675,000
Trestle for Loading Berth					
	Length	m	63		
	Foundation Pile SPP D800 (L30, W9.3t)	nos	120	22,600	2,712,000
	PC Beam W16.2ton	nos	32	5,040	161,280
	Superstructure Concrete	m3	640	400	256,000
	Utility	L.S.	1	6,300	6,300
Coal Loading Berth					
for 2nd stage	Berth No.	berth	4		
	Foundation Pile SPP D800 (L30, W9.3t)	nos	384	22,600	8,678,400
	Superstructure Concrete	m3	7,200	400	2,880,000
	Utility	L.S.	4	216,000	864,000
Terminal Yard					
	Area	ha	50		
	Reclamation	m3	4,200,000	15	63,000,000
	Soil Improvement	ha	60	600,000	36,000,000
	Underground Utilities	L.S.	1	3,000,000	3,000,000
Sub total of 2nd Phase Public Portion					**143,230,980**

Source: JICA Study Team

Table 6.4.10 Estimated Direct Cost of the 2nd Phase (Private Portion)

Facility Name	Work Item	Unit	Quantity	Unit Price	Price
				USD	USD
2nd Phase	**Private Portion**				
Civil Works					
	Pavement	m2	400,000	120	48,000,000
	Security fence and gate	m	3,200	200	640,000
	Dust protection wall (h=16m)	m	3,420	2,500	8,550,000
	Drainage system	L.S.	1	1,800,000	1,800,000
	Water Supply system	L.S.	1	1,000,000	1,000,000
	Power Supply system	L.S.	1	5,000,000	5,000,000
	Civil Works Sub-Total				64,990,000
Building Works					
	Office Building	L.S.	1	5,000,000	5,000,000
	Maintenance house	L.S.	1	2,000,000	2,000,000
	Warehouse	L.S.	1	1,000,000	1,000,000
	Sub-station	L.S.	1	15,000,000	15,000,000
	Security house	L.S.	3	100,000	300,000
	Rest house	L.S.	3	500,000	1,500,000
	Other utilities	L.S.	1	1,800,000	1,800,000
	Building Works Sub-Total				26,600,000
Coal Handling Equipment					
	Belt Conveyor Foundation	m	13,500	570	7,695,000
	Equipment Foundation	m	5,270	785	4,136,950
	Unloader	set	2	15,440,000	30,880,000
	Ship Loader	set	4	4,400,000	17,600,000
	Stacker Reclaimer	set	7	6,440,000	45,080,000
	Belt conveyer for unloading line	m	6,500	7,800	50,700,000
	Belt conveyer for loading line	m	7,000	4,800	33,600,000
	Belt conveyer for Trestle (unloading)	m	1,100	12,000	13,200,000
	Belt conveyer for Trestle (loading)	m	252	7,000	1,764,000
	Other equipments	L.S.	1	2,000,000	2,000,000
	Equipments Sub-Total				206,655,950
Sub total of 2nd Phase Private Portion					**298,245,950**

Source: JICA Study Team

iii) Indirect Cost

Indirect cost consists of common temporary cost and site management cost. The common temporary cost shows costs of temporary works, fence and gate, access road, common equipment. The site management cost shows the cost of management staff, office operation, accommodation, and transportation.

According to the experience of the JICA Study Team in South-East Asia, 6.0% of direct cost will be applied to the common temporary cost and 14.0% of direct cost will be applied to the site management cost in this study.

iv) General Cost

General cost shows necessary cost of headquarter and/or branch of the contractor.

According to the instruction of JICA, 5.0% of direct cost will be applied to the general cost in this study.

v) Contingency

Considering the risks that stocked soil of the CFPP project is not enough relocation of residence and diversion of surrounding roads, 10% of the total of the direct cost, indirect cost and general cost are applied tentatively.

vi) Tax

Fifteen percent of the total of the direct cost, indirect cost, general cost, and contingency are applied to the necessary tax.

vii) Estimated Construction Cost

Estimated construction cost of each stage including direct cost, indirect, general cost, contingency, and tax is shown in Table 6.4.11 below.

Table 6.4.11 Estimated Construction Cost

Work Item		Price (USD)				
		1st Phase (Public)	1st Phase (Private)	2nd Phase (Public)	2nd Phase (Private)	Total
1	Civil Works	215.757.000	57,570,000	143,230,980	64,990,000	481.547.980
2	Building Works	0	26,600,000	0	26,600,000	53,200,000
3	Coal Handling Equipments	0	210,118,700	0	206,655,950	416,774,650
4	**Sub total (Direct Cost 1+2+3)**	**215,757,000**	**294,288,700**	**143,230,980**	**298,245,950**	**951,522,630**
5	Indirect Cost (20% of 1+2)	43,151,400	16,834,000	28,646,196	18,318,000	106,949,596
6	General Cost (5% of 1+2)	10.787,850	4,208,500	7,161,549	4,579,500	26,737,399
7	**Sub total (4+5+6)**	**269,696,250**	**315,331,200**	**179,038,725**	**321,143,450**	**1,085,209,625**
8	Contingency (10% of 7)	26,969,625	31,533,120	17,903,873	32,114,345	108,520,963
	Total Construction Cost without Tax	**296,665,875**	**346,864,320**	**196,942,598**	**353,257,795**	**1,193,730,588**
9	Tax (15% of 7+8)	44.499,881	52,029,648	29,541,390	52,988,669	179,059,588
TOTAL CONSTRUCTION COST (7+8+9)		**341,165,756**	**398,893,968**	**226,483,987**	**406,246,464**	**1,372,790,176**

Source: JICA Study Team

6.4.4. O/M Cost

O/M cost, which occurred after the commencement of operation will be estimated in this section. This cost will be shown as an annual cost of each phase of the project. Contingency will not be considered for the O/M cost in this study.

1) Work item and quantity of the O/M cost

Explanation, quantity, unit price and annual cost of each O/M cost will be estimated below.

i) Maintenance of the constructed facilities and coal handling equipment

According to the hearing results to existing terminal operators in Asia and experience of the JICA Study Team, expected annual maintenance cost of the civil constructed facilities is calculated as 0.5% of direct construction cost except dredging works. And 1.0% of the direct construction cost for the building works, 1.5% of the purchase/installation cost for the coal handling equipment will be applied to the expected annual maintenance cost. Calculated maintenance cost of the construction facilities are shown in Table 6.4.12 below.

Table 6.4.12 Maintenance Cost of the constructed facilities

Base Case
Maintenance Cost for Structure (2025-2029)

Cost Factor	Construction Cost	Ratio	Maintenance Cost (USD/year)	
	(USD)	(%)	exclude Tax	include Tax
Civil Works	205,827,000	0.5	1,029,135	1,183,505
Building Works	26,600,000	1.0	266,000	305,900
Coal Handling Equipment	210,118,700	1.5	3,151,781	3,624,548
Total			4,446,916	5,113,953

Maintenance Cost for Structure (2029-)

Cost Factor	Construction Cost	Ratio	Maintenance Cost (USD/year)	
	(USD)	(%)	exclude Tax	include Tax
Civil Works	414,047,980	0.5	2,070,240	2,380,776
Building Works	53,200,000	1.0	532,000	611,800
Coal Handling Equipment	416,774,650	1.5	6,251,620	7,189,363
Total			8,853,860	10,181,939

Source: JICA Study Team

ii) Operation Cost

Operation cost includes manpower cost, power and water supply cost, fuel cost, and communication cost. Expected annual operation cost is shown in Chapter 6.2.

6.4.5. Consulting Service Fee

Consultant service consists of design work and construction supervision work. According to the current records of similar construction projects in South-East Asia, the following consulting service fees which include necessary tax will be considered for this project.

Table 6.4.13 Summary of the Expected Consulting Service Fees (Unit: million USD)

No.	Public Portion	Private Portion	Total
1st Phase			
Feasibility Study (F/S)	1.0	0.5	1.5
Detailed Study (D/D)	10.0	1.5	11.5
Construction Supervision (C/S)	10.0	5.0	15.0
2nd Phase			
Feasibility Study (F/S)	1.0	0.5	1.5
Detailed Study (D/D)	10.0	1.5	11.5
Construction Supervision (C/S)	10.0	5.0	15.0
TOTAL	**42.0**	**14.0**	**56.0**

Source: JICA Study Team

6.4.6. Disbursement Schedule

Tentative disbursement schedule estimated in this section is shown in Table 6.4.14

Table 6.4.14 Disbursement Schedule

Year	Public Portion	Private Portion
2015	Consulting fee (100% of F/S)	Consulting fee (100% of F/S)
2016	EIA study fee	
2018	Consulting fee (20% of D/D)	
2019	Consulting fee (80% of D/D) Consulting fee (20% of Tender Assistance)	Consulting fee (100% of D/D)
2020	Consulting fee (80% of Tender Assistance)	Consulting fee (100% of Tender Assistance)
2021	Construction cost (25% of 1st Phase) Consulting fee (25% of C/S 1st Phase)	
2022	Construction cost (25% of 1st Phase) Consulting fee (25% of C/S 1st Phase)	Construction cost (20% of 1st Phase) Consulting fee (20% of C/S 1st Phase)
2023	Construction cost (25% of 1st Phase) Consulting fee (25% of C/S 1st Phase)	Construction cost (40% of 1st Phase) Consulting fee (40% of C/S 1st Phase)
2024	Construction cost (25% of 1st Phase) Consulting fee (25% of C/S 1st Phase)	Construction cost (40% of 1st Phase) Consulting fee (40% of C/S 2nd stage)
2025	Construction cost (20% of 2nd Phase) Consulting fee (20% of C/S 2nd Phase)	O/M cost of 1st Phase
2026	Construction cost (20% of 2nd Phase) Consulting fee (20% of C/S 2nd Phase)	O/M cost of 1st Phase
2027	Construction cost (20% of 2nd Phase) Consulting fee (20% of C/S 2nd Phase)	Construction cost (40% of 2nd Phase) Consulting fee (40% of C/S 2nd Phase) O/M cost of 1st Phase
2028	Construction cost (20% of 2nd Phase) Consulting fee (20% of C/S 2nd Phase)	Construction cost (40% of 2nd Phase) Consulting fee (40% of C/S 2nd Phase) O/M cost of 1st Phase
2029	Construction cost (20% of 2nd Phase) Consulting fee (20% of C/S 2nd Phase)	Construction cost (20% of 2nd Phase) Consulting fee (20% of C/S 2nd Phase) O/M cost of 1st Phase and 2nd Phase
2030-		O/M cost of 1st Phase and 2nd Phase

Source: JICA Study Team

6.5. Countermeasures for earlier Opening

At the stakeholder meeting at Dhaka in Dec, 2015, the GoB requested JICA Study Team to shorten the Project Schedule as much as possible and start operation by 2021. The JICA Study Team examined the possibility of earlier opening of CTT according to the request of the CPGCBL. The study results are shown below.

Recommended countermeasures are mentioned which consists of construction stage and preparation stage. Purpose of the following study in this section is earlier opening of CTT, so countermeasures for the 2nd Phase is not considered in this study.

Construction schedules and project schedule as results of the study shown in this section are earliest schedules and actual required time of opening CTT is not considered. Reasonable time of opening and actual possibility of recommended countermeasures shall be studied in the next stage. In this report, the project plan, in which all the proposed countermeasures are applied, is named Option Plan.

6.5.1. Proposed Measure at the Construction Stage

The JICA Study Team recommends the following countermeasures at the construction stage for earlier opening of CTT.

Table 6.5.1 Proposed measure at the construction stage

No.	Bottleneck of the Original Plan	Recommended Countermeasure
1	Only the selected dredged sand of the CFPP project shall be used for the reclamation works. Therefore, reclamation works of the CTT project cannot be commenced prior to completion of reclamation of the CFPP project.	Purchased sand shall be used for reclamation and soil improvement work together with the selected dredged sand of the CFPP project. It is not necessary to wait the completion of reclamation works of the CFPP. Also, necessary reclamation material shall be supplied by the CFPP project to the CTT project even when reclamation works of the CFPP project is ongoing. So daily progress of reclamation works will increase.
2	Marine works such as construction of coal unloading berth cannot be commenced prior to completion of dredging works of the CFPP project because disposing pipe and dredgers of the CFPP project will disturb the working area of the CTT project.	Dredging work of the CTT marine construction area shall be completed prior to commencement of the CTT marine construction works and discharging pipe of the CFPP project shall be laid out not to disturb the CTT marine construction works. So commencement of the CTT marine construction works will be able to commence earlier.
3	Reclamation works take long time because of its huge work quantities.	Elevation of the CTT shall be changed from +8.0 m to +5.0 m to reduce reclamation volume. So construction period of reclamation works will reduce.
4	Soil improvement works take long time because of its huge work quantities.	Construction of the 1st Phase shall separate the Initial Stage-1 and Initial Stage-2 so as the commencement and completion of the following works become earlier.

Source：JICA Study Team

When all the above countermeasures are possible and applied, a half area of the CTT will be possible to open after 36 months from the commencement of construction, which is 12 months shorter than that of the original plan. And construction of the CTT project will be possible to be commenced three months earlier than that of the original plan due to the arrangement of the supplying reclamation soil and limitation of working area of the marine works. It shows shortening the schedule for 15 months is possible.

6.5.2. Proposed Measure at the Preparation Stage

The JICA Study Team recommends the following countermeasures at the preparation stage for earlier opening of CTT.

Table 6.5.2 Proposed measure at the preparation stage

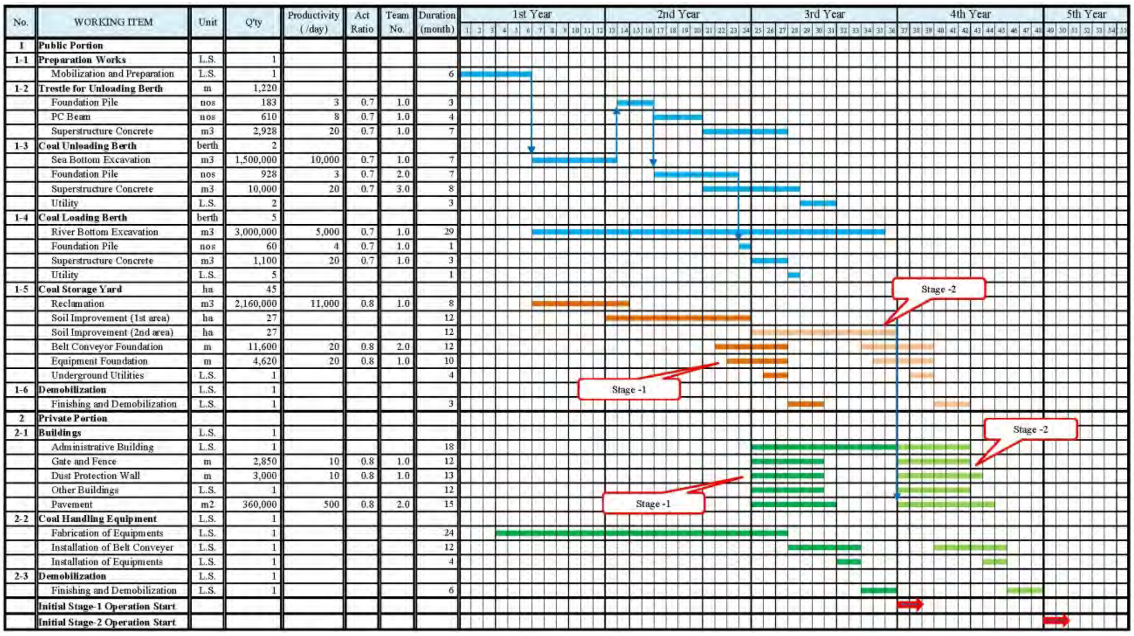
No.	Bottle neck of the original plan	Recommended counter measurement
1	Selection of the contractor takes one year.	The selection period of the Contractor may be shorten nine months if CPGCBL could prepare tender documents during detailed design work in paralell.

Source: JICA Study Team

When all the above countermeasure is possible and applied, the construction of the CTT project will be possible to be commenced three months earlier. However, the countermeasure at the preparation stage will not be effective when the countermeasures at the construction stage are not applied because construction of the CTT project should wait completion of dredging works and reclamation works of the CFPP project.

6.5.3. Construction Schedule of the Option Plan

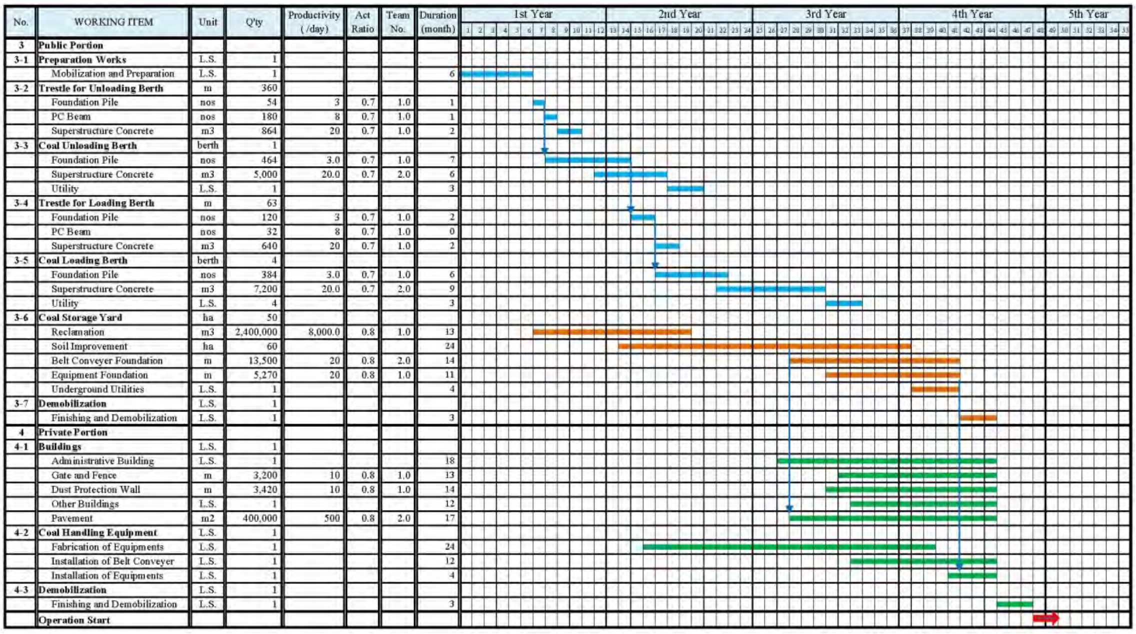
Revised construction schedule in which all the above countermeasures are applied is shown below. Total construction period of the 1st Phase is 48 months, which is same as the original plan but the construction of a half area will be completed 12 months earlier due to dividing 1st Phase to Stage-1 and Stage-2. Construction period of the 2nd Phase become 47 months, which is five months shorter against the original plan because reclamation volume become smaller due to change of its elevation from MSL+8 m to MSL+5 m.



No.	WORKING ITEM	Unit	Q'ty	Productivity (/day)	Act Ratio	Team No.	Duration (month)
1	**Public Portion**						
1-1	**Preparation Works**	L.S.	1				
	Mobilization and Preparation	L.S.	1				6
1-2	**Trestle for Unloading Berth**	m	1,220				
	Foundation Pile	nos	183	3	0.7	1.0	3
	PC Beam	nos	610	8	0.7	1.0	4
	Superstructure Concrete	m3	2,928	20	0.7	1.0	7
1-3	**Coal Unloading Berth**	berth	2				
	Sea Bottom Excavation	m3	1,500,000	10,000	0.7	1.0	7
	Foundation Pile	nos	928	3	0.7	2.0	7
	Superstructure Concrete	m3	10,000	20	0.7	3.0	8
	Utility	L.S.	2				3
1-4	**Coal Loading Berth**	berth	5				
	River Bottom Excavation	m3	3,000,000	5,000	0.7	1.0	29
	Foundation Pile	nos	60	4	0.7	1.0	1
	Superstructure Concrete	m3	1,100	20	0.7	1.0	3
	Utility	L.S.	5				1
1-5	**Coal Storage Yard**	ha	45				
	Reclamation	m3	2,160,000	11,000	0.8	1.0	8
	Soil Improvement (1st area)	ha	27				12
	Soil Improvement (2nd area)	ha	27				12
	Belt Conveyor Foundation	m	11,600	20	0.8	2.0	12
	Equipment Foundation	m	4,620	20	0.8	1.0	10
	Underground Utilities	L.S.	1				4
1-6	**Demobilization**	L.S.	1				
	Finishing and Demobilization	L.S.	1				3
2	**Private Portion**						
2-1	**Buildings**	L.S.	1				
	Administrative Building	L.S.	1				18
	Gate and Fence	m	2,850	10	0.8	1.0	12
	Dust Protection Wall	m	3,000	10	0.8	1.0	13
	Other Buildings	L.S.	1				12
	Pavement	m2	360,000	500	0.8	2.0	15
2-2	**Coal Handling Equipment**	L.S.	1				
	Fabrication of Equipments	L.S.	1				24
	Installation of Belt Conveyer	L.S.	1				12
	Installation of Equipments	L.S.	1				4
2-3	**Demobilization**	L.S.	1				
	Finishing and Demobilization	L.S.	1				6
	Initial Stage-1 Operation Start						
	Initial Stage-2 Operation Start						

Source: JICA Study Team

Figure 6.5.1 Tentative Construction Schedule of the 1st Phase (Option Plan)



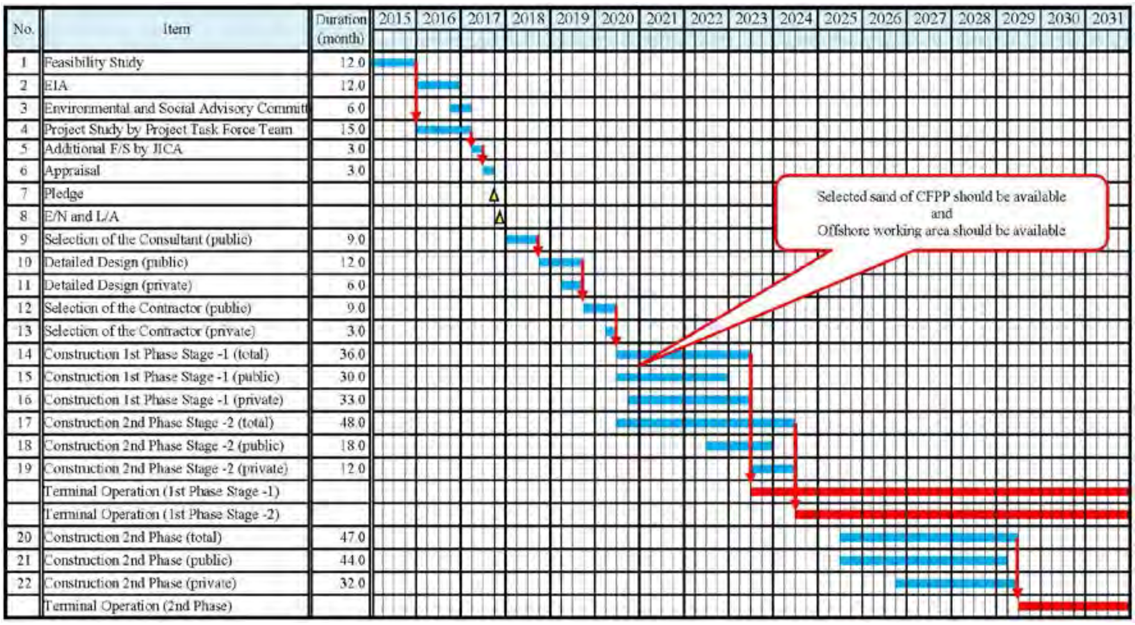
No.	WORKING ITEM	Unit	Q'ty	Productivity (/day)	Act Ratio	Team No.	Duration (month)
3	**Public Portion**						
3-1	**Preparation Works**	L.S.	1				
	Mobilization and Preparation	L.S.	1				6
3-2	**Trestle for Unloading Berth**	m	360				
	Foundation Pile	nos	54	3	0.7	1.0	1
	PC Beam	nos	180	8	0.7	1.0	1
	Superstructure Concrete	m3	864	20	0.7	1.0	2
3-3	**Coal Unloading Berth**	berth	1				
	Foundation Pile	nos	464	3.0	0.7	1.0	7
	Superstructure Concrete	m3	5,000	20.0	0.7	2.0	6
	Utility	L.S.	1				3
3-4	**Trestle for Loading Berth**	m	63				
	Foundation Pile	nos	120	3	0.7	1.0	2
	PC Beam	nos	32	8	0.7	1.0	0
	Superstructure Concrete	m3	640	20	0.7	1.0	2
3-5	**Coal Loading Berth**	berth	4				
	Foundation Pile	nos	384	3.0	0.7	1.0	6
	Superstructure Concrete	m3	7,200	20.0	0.7	2.0	9
	Utility	L.S.	4				3
3-6	**Coal Storage Yard**	ha	50				
	Reclamation	m3	2,400,000	8,000.0	0.8	1.0	13
	Soil Improvement	ha	60				24
	Belt Conveyer Foundation	m	13,500	20	0.8	2.0	14
	Equipment Foundation	m	5,270	20	0.8	1.0	11
	Underground Utilities	L.S.	1				4
3-7	**Demobilization**	L.S.	1				
	Finishing and Demobilization	L.S.	1				3
4	**Private Portion**						
4-1	**Buildings**	L.S.	1				
	Administrative Building	L.S.	1				18
	Gate and Fence	m	3,200	10	0.8	1.0	13
	Dust Protection Wall	m	3,420	10	0.8	1.0	14
	Other Buildings	L.S.	1				12
	Pavement	m2	400,000	500	0.8	2.0	17
4-2	**Coal Handling Equipment**	L.S.	1				
	Fabrication of Equipments	L.S.	1				24
	Installation of Belt Conveyer	L.S.	1				12
	Installation of Equipments	L.S.	1				4
4-3	**Demobilization**	L.S.	1				
	Finishing and Demobilization	L.S.	1				3
	Operation Start						

Source: JICA Study Team

Figure 6.5.2 Tentative Construction Schedule of the 2nd Phase (Option Plan)

6.5.4. Project Schedule of the Option Plan

Revised project schedule in which all the above countermeasures are applied is shown in Figure 6.5.3 below. Opening date of the 2nd Phase is not revised from the original plan.



Source: JICA Study Team

Figure 6.5.3 Tentative Project Schedule (Option Plan)

6.5.5. Soil Balance of the Option Plan

Revised soil balance in which all the above countermeasures are applied is shown in Table 6.5.3 below.

In this plan, only surplus selected dredged sand of the CFPP project will be used for reclamation works and disposed material of CFPP project is not required to be used.

Table 6.5.3 Soil Balance for Option Plan

No	Soil origins	1st Phase (million m3)	2nd Phase (million m3)	Total (million m3)
1	Necessary volume for reclamation	2.16	2.40	4.56
2	Available quantity of CFPP stockpile	5.23	3.07	5.23
3	Necessary volume to be purchased	0.00	0.00	0.00
4	Surplus volume (2-1)	3.07	0.67	0.67

Source: JICA Study Team

6.5.6. Construction Cost and Project Cost of the Option Plan

Estimated construction cost and maintenance cost in which all the above counter measurements are applied is shown below. In this plan, construction cost of public portion will be reduced due to the change of reclamation volume and construction cost of private portion will not be changed.

Table 6.5.4 Estimated Direct Cost of the 1st Phase (Option Plan Public Portion)

Facility Name	Work Item	Unit	Quantity	Unit Price	Price
				USD	USD
1st Phase	**Public Portion**				
Trestle for Unloading Berth					
	Length	m	1,220		
	Foundation Pile SPP D800 (L30, W9.3t)	nos	183	22,600	4,135,800
	PC Beam W16.2ton	nos	610	5,040	3,074,400
	Superstructure Concrete	m3	2,928	400	1,171,200
	Utility	L.S.	1	244,000	244,000
Coal Unloading Berth					
	Berth No.	berth	2		
	Foundation Pile SPP D1000 (L42, W19.3t)	nos	752	42,600	32,035,200
	Foundation Pile SPP D1200 (L42, W23.2t)	nos	176	50,400	8,870,400
	Superstructure Concrete	m3	10,000	400	4,000,000
	Utility	L.S.	2	675,000	1,350,000
Coal Loading Berth					
for initial stage	Berth No.	berth	5		
	Foundation Pile SPP D600 (L22, W3.8t)	nos	60	10,600	636,000
	Superstructure Concrete	m3	1,100	400	440,000
	Utility	L.S.	5	40,000	200,000
Terminal Yard					
	Area	ha	45		
	Reclamation +5.0m	m3	*2,160,000*	*20*	43,200,000
	Soil Improvement	ha	54	600,000	32,400,000
	Underground Utilities	L.S.	1	3,000,000	3,000,000
Dredging and Disposal					
	Sea bottom excavation	m3	1,500,000	15	22,500,000
	Riverbed excavation	m3	3,000,000	15	45,000,000
Sub total of 1st Phase Public Portion					**202,257,000**

Source: JICA Study Team

Table 6.5.5 Estimated Direct Cost of the 1st Phase (Option Plan Private Portion)

Facility Name	Work Item	Unit	Quantity	Unit Price	Price
				USD	USD
1st Phase	**Private Portion**				
Civil Works					
	Pavement	m2	360,000	120	43,200,000
	Security fence and gate	m	2,850	200	570,000
	Dust protection wall (h=16m)	m	*3,000*	*2,500*	7,500,000
	Drainage system	L.S.	1	1,500,000	1,500,000
	Water Supply system	L.S.	1	800,000	800,000
	Power Supply system	L.S.	1	4,000,000	4,000,000
	Civil Works Sub-Total				57,570,000
Building Works					
	Office Building	L.S.	1	5,000,000	5,000,000
	Maintenance house	L.S.	1	2,000,000	2,000,000
	Warehouse	L.S.	1	1,000,000	1,000,000
	Sub-station	L.S.	1	15,000,000	15,000,000
	Security house	L.S.	3	100,000	300,000
	Rest house	L.S.	3	500,000	1,500,000
	Other utilities	L.S.	1	1,800,000	1,800,000
	Building Works Sub-Total				26,600,000
Coal Handling Equipment					
	Belt Conveyor Foundation	m	11,600	570	6,612,000
	Equipment Foundation	m	4,620	785	3,626,700
	Unloader	set	4	15,440,000	61,760,000
	Ship Loader	set	5	800,000	4,000,000
	Stacker Reclaimer	set	6	6,440,000	38,640,000
	Belt conveyer for unloading line	m	7,800	7,800	60,840,000
	Belt conveyer for loading line	m	3,800	4,800	18,240,000
	Belt conveyer for Trestle (unloading)	m	1,200	12,000	14,400,000
	Belt conveyer for Trestle (loading)	m	0	7,000	0
	Other equipments	L.S.	1	2,000,000	2,000,000
	Equipments Sub-Total				210,118,700
Sub total of 1st Phase Private Portion					**294,288,700**

Source: JICA Study Team

Table 6.5.6 Estimated Direct Cost of the 2nd Phase (Option Plan Public Portion)

Facility Name	Work Item	Unit	Quantity	Unit Price	Price
				USD	USD
2nd Phase	**Public Portion**				
Trestle for Unloading Berth					
	Length	m	360		
	Foundation Pile SPP D800 (L30, W9.3t)	nos	54	22,600	1,220,400
	PC Beam W16.2ton	nos	180	5,040	907,200
	Superstructure Concrete	m3	864	400	345,600
	Utility	L.S.	1	72,000	72,000
Coal Unloading Berth					
	Berth No.	berth	1		
	Foundation Pile SPP D1000 (L42, W19.3t)	nos	376	42,600	16,017,600
	Foundation Pile SPP D1200 (L42, W23.2t)	nos	88	50,400	4,435,200
	Superstructure Concrete	m3	5,000	400	2,000,000
	Utility	L.S.	1	675,000	675,000
Trestle for Loading Berth					
	Length	m	63		
	Foundation Pile SPP D800 (L30, W9.3t)	nos	120	22,600	2,712,000
	PC Beam W16.2ton	nos	32	5,040	161,280
	Superstructure Concrete	m3	640	400	256,000
	Utility	L.S.	1	6,300	6,300
Coal Loading Berth					
for 2nd stage	Berth No.	berth	4		
	Foundation Pile SPP D800 (L30, W9.3t)	nos	384	22,600	8,678,400
	Superstructure Concrete	m3	7,200	400	2,880,000
	Utility	L.S.	4	216,000	864,000
Terminal Yard					
	Area	ha	50		
	Reclamation	m3	*2,400,000*	*20*	48,000,000
	Soil Improvement	ha	60	600,000	36,000,000
	Underground Utilities	L.S.	1	3,000,000	3,000,000
Sub total of 2nd Phase Public Portion					**128,230,980**

Source: JICA Study Team

Table 6.5.7 Estimated Direct Cost of the 2nd Phase (Option Plan Private Portion)

Facility Name	Work Item	Unit	Quantity	Unit Price	Price
				USD	USD
2nd Phase	**Private Portion**				
Civil Works					
	Pavement	m2	400,000	120	48,000,000
	Security fence and gate	m	3,200	200	640,000
	Dust protection wall (h=16m)	m	*3,420*	*2,500*	8,550,000
	Drainage system	L.S.	1	1,800,000	1,800,000
	Water Supply system	L.S.	1	1,000,000	1,000,000
	Power Supply system	L.S.	1	5,000,000	5,000,000
	Civil Works Sub-Total				64,990,000
Building Works					
	Office Building	L.S.	1	5,000,000	5,000,000
	Maintenance house	L.S.	1	2,000,000	2,000,000
	Warehouse	L.S.	1	1,000,000	1,000,000
	Sub-station	L.S.	1	15,000,000	15,000,000
	Security house	L.S.	3	100,000	300,000
	Rest house	L.S.	3	500,000	1,500,000
	Other utilities	L.S.	1	1,800,000	1,800,000
	Building Works Sub-Total				26,600,000
Coal Handling Equipment					
	Belt Conveyor Foundation	m	13,500	570	7,695,000
	Equipment Foundation	m	5,270	785	4,136,950
	Unloader	set	2	15,440,000	30,880,000
	Ship Loader	set	4	4,400,000	17,600,000
	Stacker Reclaimer	set	7	6,440,000	45,080,000
	Belt conveyer for unloading line	m	6,500	7,800	50,700,000
	Belt conveyer for loading line	m	7,000	4,800	33,600,000
	Belt conveyer for Trestle (unloading)	m	1,100	12,000	13,200,000
	Belt conveyer for Trestle (loading)	m	252	7,000	1,764,000
	Other equipments	L.S.	1	2,000,000	2,000,000
	Equipments Sub-Total				206,655,950
Sub total of 2nd Phase Private Portion					**298,245,950**

Source: JICA Study Team

Table 6.5.8 Estimated Construction Cost (Option Plan)

Work Item		Price (USD)				
		1st Phase (Public)	1st Phase (Private)	2nd Phase (Public)	2nd Phase (Private)	Total
1	Civil Works	202,257,000	57,570,000	128,230,980	64,990,000	453,047,980
2	Building Works	0	26,600,000	0	26,600,000	53,200,000
3	Coal Handling Equipments	0	210,118,700	0	206,655,950	416,774,650
4	Sub total (Direct Cost 1+2+3)	**202,257,000**	**294,288,700**	**128,230,980**	**298,245,950**	**923,022,630**
5	Indirect Cost (20% of 1+2)	40,451,400	16,834,000	25,646,196	18,318,000	101,249,596
6	General Cost (5% of 1+2)	10,112,850	4,208,500	6,411,549	4,579,500	25,312,399
7	Sub total (4+5+6)	**252,821,250**	**315,331,200**	**160,288,725**	**321,143,450**	**1,049,584,625**
8	Contingency (10% of 7)	25,282,125	31,533,120	16,028,873	32,114,345	104,958,463
	Total Construction Cost without Tax	**278,103,375**	**346,864,320**	**176,317,598**	**353,257,795**	**1,154,543,088**
9	Tax (15% of 7+8)	41,715,506	52,029,648	26,447,640	52,988,669	173,181,463
TOTAL CONSTRUCTION COST (7+8+9)		**319,818,881**	**398,893,968**	**202,765,237**	**406,246,464**	**1,327,724,551**

Source: JICA Study Team

Table 6.5.9 Estimated Maintenance Cost (Option Plan)

Saving Schedule

Maintenance Cost for Structure (2023-2029)

Cost Factor	Construction Cost (USD)	Ratio (%)	Maintenance Cost (USD/year)	
			exclude Tax	include Tax
Civil Works	192,327,000	0.5	961,635	1,105,880
Building Works	26,600,000	1.0	266,000	305,900
Coal Handling Equipment	210,118,700	1.5	3,151,781	3,624,548
Total			4,379,416	5,036,328

Maintenance Cost for Structure (2029-)

Cost Factor	Construction Cost (USD)	Ratio (%)	Maintenance Cost (USD/year)	
			exclude Tax	include Tax
Civil Works	385,547,980	0.5	1,927,740	2,216,901
Building Works	53,200,000	1.0	532,000	611,800
Coal Handling Equipment	416,774,650	1.5	6,251,620	7,189,363
Total			8,711,360	10,018,064

Source: JICA Study Team

6.5.7. Disbursement Schedule of Alternative Plan

Tentative disbursement schedule in which Option Plan is applied is shown in Table 6.5.10 below.

Table 6.5.10 Disbursement Schedule of Option Plan

Year	Public Portion	Private Portion
2015	Consulting fee (100% of F/S)	Consulting fee (100% of F/S)
2016	EIA study fee	
2018	Consulting fee (25% of D/D)	
2019	Consulting fee (75% of D/D) Consulting fee (30% of Tender Assistance)	Consulting fee (100% of D/D)
2020	Consulting fee (70% of Tender Assistance) Construction cost (10% of 1st Phase) Consulting fee (10% of C/S 1st Phase)	Consulting fee (100% of Tender Assistance) Construction cost (5% of 1st Phase) Consulting fee (5% of C/S 1st Phase)
2021	Construction cost (30% of 1st Phase) Consulting fee (30% of C/S 1st Phase)	Construction cost (25% of 1st Phase) Consulting fee (25% of C/S 1st Phase)
2022	Construction cost (30% of 1st Phase1st Phase) Consulting fee (30% of C/S 1st Phase)	Construction cost (25% of 1st Phase) Consulting fee (25% of C/S 1st Phase)
2023	Construction cost (30% of 1st Phase) Consulting fee (30% of C/S e1st Phase)	Construction cost (25% of 1st Phase) Consulting fee (25% of C/S 1st Phase) O/M cost of 1st Phase
2024	(Maintenance Dredging)	Construction cost (20% of 1st Phase) Consulting fee (20% of C/S 1st Phase) O/M cost of 1st Phase
2025	Construction cost (10% of 2nd Phase) Consulting fee (10% of C/S 2nd Phase) (Maintenance Dredging)	O/M cost of 1st Phase
2026	Construction cost (25% of 2nd Phase) Consulting fee (25% of C/S 2nd Phase) (Maintenance Dredging)	Construction cost (10% of 2nd Phase) Consulting fee (10% of C/S 2nd Phase) O/M cost of 1st Phase
2027	Construction cost (25% of 2nd Phase) Consulting fee (25% of C/S 2nd Phase) (Maintenance Dredging)	Construction cost (40% of 2nd Phase) Consulting fee (40% of C/S 2nd Phase) O/M cost of 1st Phase
2028	Construction cost (25% of 2nd Phase) Consulting fee (25% of C/S 2nd Phase) (Maintenance Dredging)	Construction cost (40% of 2nd Phase) Consulting fee (40% of C/S 2nd Phase) O/M cost of 1st Phase
2029	Construction cost (15% of 2nd Phase) Consulting fee (15% of C/S 2nd Phase) (Maintenance Dredging)	Construction cost (10% of 2nd Phase) Consulting fee (10% of C/S 2nd Phase) O/M cost of 1st Phase and 2nd Phase
2030-	(Maintenance Dredging)	O/M cost of 1st Phase and 2nd Phase

Source: JICA Study Team

Chapter 7. Economic and Financial Analysis

7.1. Economic Analysis

7.1.1. Objective and Method of the Economic Analysis

(1) Objective

The purpose of this section is to evaluate the project from the viewpoint of the national economy. The economic analysis is carried out to study economic benefits as well as economic costs arising from the project, and to evaluate whether the benefits of the project exceed those that could be obtained from other investment opportunities in Bangladesh.

(2) Method

Economic analysis will be carried out by comparing the “with the project” to the “without the project” case. All the benefits and cost differences between the “with” case and “without” case will be calculated, and the economic internal rate of return (EIRR) will be used to evaluate and appraise the economic feasibility of the project. The EIRR is a discount rate which makes the costs and the benefits of the project during the project life equal.

7.1.2. Assumptions of Economic Analysis

(1) Base year

The “Base Year” here means the standard year in the estimation of costs and benefits. In this study, 2015 is set as the “Base Year”.

(2) Component of the development plan in the analysis

Main objective of this economic analysis is to evaluate the project, namely “Construction and Operation of Imported Coal Transshipment Terminal (CTT) Project in Matarbari Area.” The planned terminal will handle approximately 10.40 million tons (Mt) and 25.60 Mt imported coal during the 1st Phase (2025～2028) and 2nd Phase (2029~2054), respectively.

The scope of CTT’s business is unloading imported coal from the vessel, inventory control, and loading for a secondary transshipment to the CFPP.

The project includes dredging of the channel and basin up to -16 m, construction of a coal unloading berth, coal storage yard, and coal loading berth for a secondary transshipment to the CFPP, and installation of a coal unloader, ship loader, and belt conveyor as well as other related terminal facilities and systems (Project contents are detailed in Chapter 4 and Chapter 5). As to the secondary transshipment to CFPP, assumptions for each phase are as follows:

1st Phase : Belt conveyor system will be used for the CFPP planned to be developed within 10 km from the CTT.

2nd Phase : Small barges will be used for CFPP planned to be developed in a distant place from CTT. Barges used for secondary transshipment are assumed to be 5,000 DWT due to the limited water depth of the routes (Water depth of the routes are detailed in 4.1 of Chapter 4).

(3) Project life

The period of calculation (project life) in the economic analysis is assumed to be 25 years from the year 2029 when operation of the CTT in the 2nd Phase of the project is expected to commence.

(4) Foreign exchange rate

The exchange rates adopted for this analysis are the same as those adopted for the project cost estimation (refer to Chapter 6).

7.1.3. Project Case

(1) “With the Project” Case

In the “with the project” case, facilities such as the imported coal unloading berth capable of accommodating large vessels, coal loading berth for secondary transshipment and the coal storage yard will be constructed and coal handling equipment such as unloader/ship loader will also be installed for operation of the CTT.

(2) “Without the Project” Case

In the “without the project” case, the above mentioned facilities and equipment will not be installed; therefore, each CFPP shall be responsible for unloading coal from larger size vessels to small size vessels at offshore and receiving coal at CFPP. Crane barge is considered to be used for unloading at offshore and a breakwater also is considered necessary to ensure unloading works can be conducted during the monsoon season.

Unloading works at offshore are described in Rampal CFPP F/S Report as follows.

> There is a deep sea area alongside of the Outer Bar, which is called the Akram Point where Panamax vessels are passable. Imported coal shall be unloaded from Panamax vessels to barges (5,000 DWT ~ 10,000 DWT) and transported to each CFPP.
>
> Akram Point is situated offshore although it is located at the landside of the Outer Bar, therefore the decline in efficiency of coal unloading works is expected during monsoon and the capacity of coal

stockyard is designed for 90 days operation (additional space for coal stockyard sufficient for 180 days operation is secured)

In Bangladesh, prevailing wind direction is southerly to southwesterly from the months of May to September and the wave condition is severe. Therefore, without wave control facility such as a breakwater, working efficiency of coal unloading works inevitably declines during this season. Breakwater shall be constructed in order to make the water area calm to secure sufficient working efficiency during this season.

According to the F/S report of Rampal CFPP, large scale coal stockyard for long term operation is planned to be constructed within the CFPP compound, however, there is a possibility of spontaneous combustion in case of long term storage. Therefore, appropriate breakwater is introduced to secure working efficiency for unloading works. From October to April, sufficient working efficiency of unloading is secured even if no breakwater is provided.

The estimated main facilities and the estimated construction cost for "Without" case are shown in below.

Table 7.1.1 Estimated direct cost for main facilities of "without the project"

	Quantity	Million USD	Million USD
Breakwater (Depth -18m)	2.9 km	170	493
Floating Equipment (800t/h)	18 unit	15	270
Unloading Facilities at CFPPs (*including berth, unloader, trestle, administration building, etc)	6 unit	17	102
Handing Equipment at CFPPs	18 unit	6.4	116
Coal Stock Yard at CFPPs	90 ha	2.2	202

Source: JICA Study Team

7.1.4. Benefits of the Projects

(1) Estimation of Benefits

Cost reduction of secondary coal transport is a major component of the benefits in this project. The benefits are quantified by calculating the difference in transport cost as described in sections 7.1.2 and 7.1.3. Transport cost will be calculated in each phase as follows:

Phase	"With the project" case	"Without the project" case
1st Phase :	(1) transport cost by large size vessel to CTT + (2) secondary transshipment cost to CFPP via belt conveyor	(1) transport cost by large size vessel to unloading point at offshore + (2)secondary transshipment cost to CFPP + (3) Construction cost of breakwater and other facilities

2nd Phase :	(1) transport cost by large size vessel + (2) secondary transshipment cost to CFPP via belt conveyor + (3) secondary transshipment cost to CFPP via small size barge	(1) transport cost by large size vessel to unloading point at offshore + (2) secondary transshipment cost to CFPP + (3) Construction cost of breakwater and other facilities

7.1.5. Cost of the Projects

Construction costs consist of (1) civil structure, (2) coal handling equipment, (3) maintenance, (4) operation and (5) consultant service fee. Specific items are shown as follows:

(1) Civil structure

Initial dredging, port facilities (coal unloading berth, coal loading berth for secondary transshipment), coal storage yard, and other facilities

(2) Coal handling equipment

Port facilities (coal unloader, coal ship loader), belt conveyor, stacker, and other equipment

(3) Maintenance

Maintenance dredging, maintenance of constructed facilities, maintenance of coal handling equipment and other equipment

(4) Operation

Manpower (direct, indirect), electricity, insurance, and other running costs

(5) Consulting service fee

Design work, and construction supervision work

7.1.6. Sensitivity Analysis

(1) Calculation of EIRR

The economic internal rate of return (EIRR) based on a cost-benefit analysis is used to appraise the economic feasibility of the project. EIRR is a discount rate which makes the costs and benefits of a project equal.

It is calculated by using the following formula.

$$\sum_{i=1}^{n} \frac{Bi - Ci}{(1+r)^{i-1}} = 0$$

Where, n; Period of economic calculation (project life= 36years)

Bi; Benefits in i-th year

Ci, Costs in i-th year

r; Discount rate

(2) Sensitivity Analysis

In order to see whether the project is still feasible when some conditions change, a sensitivity analysis is made with the following assumptions.

Assumption :Both the costs increase by 10% and the benefits decrease by 10%, and
:Both the costs increase by 20% and the benefits decrease by 20%

(3) Evaluation

EIRR of the project is estimated as follows:

Table 7.1.2 Project EIRR

	EIRR (%)		
	Base Case	Sensitivity Analysis (±10%)	Sensitivity Analysis (±20%)
Base Plan	89.55	50.97	12.14
Option Plan	158.17	94.24	16.62

Source: JICA Study Team

Project feasibility is generally evaluated by whether the EIRR of the project exceeds the social discount rate (SDR) or the opportunity cost in the target country or not. The JICA Study Team applied 12% for the evaluation, which is generally adopted in the case of Bangladesh by donor agencies such as JICA.

Therefore it is considered that the planned project is economically feasible. However, the following points shall be taken into consideration.

Point (1) Currently, no coal handling facilities are in operation nor coal transportation is carried out in Bangladesh, therefore, the analysis in this chapter shall be understood as a cost/benefit analysis rather than the economic analysis

Point (2) The so called “Without Case” in the economic analysis could lead to utilisation of ports in neighboring counties and land transportation. In such a case, EIRR will definitely yield a huge value and the project will be economically feasible with no doubt.

Point (3) From the result of the analysis in this chapter, CTT project (Alternative 1) is more economically favourable than offshore unloading (Alternative 2). On the other hand, it shall be noted that the project feasibility is sensitive to changes in conditions.

Table 7.1.3 EIRR of Base Plan (Base Case)

Unit million USD	With Case									Without Case					Net Project Benefit
	CTT Construction Cost	CTT Equipment Cost	CTT Maintenance Cost	CTT Operation Cost	CFPP Transportation Facility Cost	CFPP Transportation Maintenance Cost	CFPP Transportation Operation Cost	Secondary Transport Cost	**Total Cost**	CFPP offshore transportation Facility Cost	CFPP offshore transportation Maintenance Cost	CFPP offshore transportation Operation Cost	Secondary Transport Cost	**Total Cost**	
2015									**1.50**					**0.00**	**(1.50)**
2016									**0.00**					**0.00**	**0.00**
2017									**0.00**					**0.00**	**0.00**
2018									**2.00**					**0.00**	**(2.00)**
2019									**9.50**					**0.00**	**(9.50)**
2020									**0.00**					**0.00**	**0.00**
2021	85.29				18.89				**106.68**	207.76				**207.76**	**101.08**
2022	118.56	66.45			18.89				**207.41**	207.76				**207.76**	**0.36**
2023	118.56	66.45			18.89				**208.41**	207.76				**207.76**	**(0.64)**
2024	118.56	66.45			18.89				**208.41**	207.76				**207.76**	**(0.64)**
2025	78.57	66.45	6.33	40.62	18.89	2.02	8.50	11.44	**234.82**	207.76	6.48	56.10	62.40	**332.74**	**97.91**
2026	81.50	65.35	6.33	35.64	18.89	2.02	8.50	11.44	**231.69**	207.76	6.48	56.10	62.40	**332.74**	**101.05**
2027	81.50	65.35	6.33	36.86	18.89	2.02	8.50	11.44	**234.91**	207.76	6.48	56.10	62.40	**332.74**	**97.83**
2028	81.50	65.35	6.33	36.89	18.89	2.02	8.50	11.44	**234.94**	207.76	6.48	56.10	62.40	**332.74**	**97.80**
2029	81.50	65.35	12.59	77.01	18.89	2.02	8.50	67.36	**336.23**	207.76	10.79	93.50	153.60	**465.65**	**129.42**
2030			12.59	77.01		2.02	8.50	67.36	**167.48**		10.79	93.50	153.60	**257.89**	**90.41**
2031			12.59	77.09		2.02	8.50	67.36	**167.56**		10.79	93.50	153.60	**257.89**	**90.33**
2032			12.59	77.18		2.02	8.50	67.36	**167.65**		10.79	93.50	153.60	**257.89**	**90.24**
2033			12.59	77.28		2.02	8.50	67.36	**167.75**		10.79	93.50	153.60	**257.89**	**90.15**
2034			12.59	77.39		2.02	8.50	67.36	**167.85**		10.79	93.50	153.60	**257.89**	**90.04**
2035			12.59	78.61		2.02	8.50	67.36	**169.07**		10.79	93.50	153.60	**257.89**	**88.82**
2036			12.59	78.74		2.02	8.50	67.36	**169.20**		10.79	93.50	153.60	**257.89**	**88.69**
2037			12.59	64.83		2.02	8.50	67.36	**155.29**		10.79	93.50	153.60	**257.89**	**102.60**
2038			12.59	64.98		2.02	8.50	67.36	**155.45**		10.79	93.50	153.60	**257.89**	**102.44**
2039			12.59	65.15		2.02	8.50	67.36	**155.62**		10.79	93.50	153.60	**257.89**	**102.27**
2040			12.59	64.21		2.02	8.50	67.36	**154.68**		10.79	93.50	153.60	**257.89**	**103.21**
2041			12.59	62.36		2.02	8.50	67.36	**152.82**		10.79	93.50	153.60	**257.89**	**105.07**
2042			12.59	47.21		2.02	8.50	67.36	**137.67**		10.79	93.50	153.60	**257.89**	**120.22**
2043			12.59	47.46		2.02	8.50	67.36	**137.93**		10.79	93.50	153.60	**257.89**	**119.97**
2044			12.59	47.74		2.02	8.50	67.36	**138.20**		10.79	93.50	153.60	**257.89**	**119.69**
2045			12.59	40.50		2.02	8.50	67.36	**130.96**		10.79	93.50	153.60	**257.89**	**126.93**
2046			12.59	38.76		2.02	8.50	67.36	**129.22**		10.79	93.50	153.60	**257.89**	**128.67**
2047			12.59	39.13		2.02	8.50	67.36	**129.59**		10.79	93.50	153.60	**257.89**	**128.30**
2048			12.59	39.53		2.02	8.50	67.36	**130.00**		10.79	93.50	153.60	**257.89**	**127.89**
2049			12.59	39.98		2.02	8.50	67.36	**130.44**		10.79	93.50	153.60	**257.89**	**127.45**
2050			12.59	27.65		2.02	8.50	67.36	**118.11**		10.79	93.50	153.60	**257.89**	**139.78**
2051			12.59	28.19		2.02	8.50	67.36	**118.65**		10.79	93.50	153.60	**257.89**	**139.24**
2052			12.59	28.78		2.02	8.50	67.36	**119.24**		10.79	93.50	153.60	**257.89**	**138.65**
2053			12.59	29.43		2.02	8.50	67.36	**119.90**		10.79	93.50	153.60	**257.89**	**138.00**
2054			12.59	30.15		2.02	8.50	67.36	**120.61**		10.79	93.50	153.60	**257.89**	**137.28**
														IRR=	**89.55%**

Source: JICA Study Team

Table 7.1.4 EIRR of Sensitivity Analysis (Base Plan, Cost+10%、Benefit－10%)

	Base Cas			Sensibity Analysis		
	Cost	Benefit	Net Benefit	Cost (+10%)	Benefit (-10%)	Net Benefit
2015	1.50	0.00	(1.50)	1.65	0.00	(1.65)
2016	0.00	0.00	0.00	0.00	0.00	0.00
2017	0.00	0.00	0.00	0.00	0.00	0.00
2018	2.00	0.00	(2.00)	2.20	0.00	(2.20)
2019	9.50	0.00	(9.50)	10.45	0.00	(10.45)
2020	0.00	0.00	0.00	0.00	0.00	0.00
2021	87.79	188.87	101.08	96.57	169.98	73.41
2022	188.51	188.87	0.36	207.37	169.98	(37.38)
2023	189.51	188.87	(0.64)	208.47	169.98	(38.48)
2024	189.51	188.87	(0.64)	208.47	169.98	(38.48)
2025	193.97	291.89	97.91	213.37	262.70	49.33
2026	190.84	291.89	101.05	209.92	262.70	52.78
2027	194.06	291.89	97.83	213.46	262.70	49.24
2028	194.08	291.89	97.80	213.49	262.70	49.20
2029	239.46	368.88	129.42	263.41	331.99	68.59
2030	89.60	180.01	90.41	98.56	162.01	63.45
2031	89.68	180.01	90.33	98.65	162.01	63.36
2032	89.77	180.01	90.24	98.75	162.01	63.26
2033	89.87	180.01	90.15	98.85	162.01	63.16
2034	89.97	180.01	90.04	98.97	162.01	63.04
2035	91.19	180.01	88.82	100.31	162.01	61.70
2036	91.32	180.01	88.69	100.46	162.01	61.55
2037	77.41	180.01	102.60	85.15	162.01	76.86
2038	77.57	180.01	102.44	85.32	162.01	76.69
2039	77.74	180.01	102.27	85.51	162.01	76.50
2040	76.80	180.01	103.21	84.48	162.01	77.53
2041	74.94	180.01	105.07	82.44	162.01	79.57
2042	59.79	180.01	120.22	65.77	162.01	96.24
2043	60.05	180.01	119.97	66.05	162.01	95.96
2044	60.32	180.01	119.69	66.35	162.01	95.66
2045	53.08	180.01	126.93	58.39	162.01	103.62
2046	51.34	180.01	128.67	56.48	162.01	105.53
2047	51.71	180.01	128.30	56.88	162.01	105.13
2048	52.12	180.01	127.89	57.33	162.01	104.68
2049	52.56	180.01	127.45	57.82	162.01	104.19
2050	40.23	180.01	139.78	44.26	162.01	117.75
2051	40.77	180.01	139.24	44.85	162.01	117.16
2052	41.36	180.01	138.65	45.50	162.01	116.51
2053	42.02	180.01	138.00	46.22	162.01	115.79
2054	42.73	180.01	137.28	47.01	162.01	115.00
			89.55%			50.97%

Table 7.1.5 EIRR of Sensitivity Analysis (Base Plan, Cost+20%、Benefit－20%)

	Base Cas			Sensibity Analysis		
	Cost	Benefit	Net Benefit	Cost (+20%)	Benefit (-20%)	Net Benefit
2015	1.50	0.00	(1.50)	1.80	0.00	(1.80)
2016	0.00	0.00	0.00	0.00	0.00	0.00
2017	0.00	0.00	0.00	0.00	0.00	0.00
2018	2.00	0.00	(2.00)	2.40	0.00	(2.40)
2019	9.50	0.00	(9.50)	11.40	0.00	(11.40)
2020	0.00	0.00	0.00	0.00	0.00	0.00
2021	87.79	188.87	101.08	105.35	151.10	45.75
2022	188.51	188.87	0.36	226.22	151.10	(75.12)
2023	189.51	188.87	(0.64)	227.42	151.10	(76.32)
2024	189.51	188.87	(0.64)	227.42	151.10	(76.32)
2025	193.97	291.89	97.91	232.77	233.51	0.74
2026	190.84	291.89	101.05	229.00	233.51	4.51
2027	194.06	291.89	97.83	232.87	233.51	0.64
2028	194.08	291.89	97.80	232.90	233.51	0.61
2029	239.46	368.88	129.42	287.35	295.11	7.76
2030	89.60	180.01	90.41	107.52	144.01	36.49
2031	89.68	180.01	90.33	107.62	144.01	36.39
2032	89.77	180.01	90.24	107.72	144.01	36.29
2033	89.87	180.01	90.15	107.84	144.01	36.17
2034	89.97	180.01	90.04	107.97	144.01	36.04
2035	91.19	180.01	88.82	109.43	144.01	34.58
2036	91.32	180.01	88.69	109.59	144.01	34.42
2037	77.41	180.01	102.60	92.89	144.01	51.12
2038	77.57	180.01	102.44	93.08	144.01	50.93
2039	77.74	180.01	102.27	93.29	144.01	50.72
2040	76.80	180.01	103.21	92.16	144.01	51.85
2041	74.94	180.01	105.07	89.93	144.01	54.08
2042	59.79	180.01	120.22	71.75	144.01	72.26
2043	60.05	180.01	119.97	72.06	144.01	71.95
2044	60.32	180.01	119.69	72.39	144.01	71.62
2045	53.08	180.01	126.93	63.70	144.01	80.31
2046	51.34	180.01	128.67	61.61	144.01	82.40
2047	51.71	180.01	128.30	62.06	144.01	81.95
2048	52.12	180.01	127.89	62.54	144.01	81.47
2049	52.56	180.01	127.45	63.08	144.01	80.93
2050	40.23	180.01	139.78	48.28	144.01	95.73
2051	40.77	180.01	139.24	48.93	144.01	95.08
2052	41.36	180.01	138.65	49.64	144.01	94.37
2053	42.02	180.01	138.00	50.42	144.01	93.59
2054	42.73	180.01	137.28	51.28	144.01	92.73
			89.55%			12.14%

Source: JICA Study Team

Table 7.1.6 EIRR of Option Plan (Base Case)

Unit million USD	With Case									Without Case					Net Project Benefit
	CTT Construction Cost	CTT Equipment Cost	CTT Maintenance Cost	CTT Operation Cost	CFPP Transportation Facility Cost	CFPP Transportation Maintenance Cost	CFPP Transportation Operation Cost	Secondary Transport Cost	**Total Cost**	CFPP offshore transportation Facility Cost	CFPP offshore transportation Maintenance Cost	CFPP offshore transportation Operation Cost	Secondary Transport Cost	**Total Cost**	
2015									**1.50**					**0.00**	**(1.50)**
2016									**0.00**					**0.00**	**0.00**
2017									**2.00**					**0.00**	**(2.00)**
2018									**9.50**					**0.00**	**(9.50)**
2019	61.30				15.79				**80.59**	186.99				**186.99**	**106.40**
2020	122.61	53.36			15.79				**195.25**	186.99				**186.99**	**(8.27)**
2021	159.89	53.36			15.79				**232.54**	186.99				**186.99**	**(45.55)**
2022	75.41	92.88	3.11	40.62	15.79	0.94	3.95	11.44	**247.63**	186.99	6.48	56.10	62.40	**311.96**	**64.33**
2023	33.70	66.20	6.30	40.62	15.79	0.94	3.95	11.44	**179.93**	186.99	6.48	56.10	62.40	**311.96**	**132.03**
2024			6.30	40.62		0.94	3.95	11.44	**63.24**		6.48	56.10	62.40	**124.98**	**61.74**
2025	40.55		6.30	40.62	15.79	0.94	3.95	11.44	**121.58**	186.99	6.48	56.10	62.40	**311.96**	**190.38**
2026	55.04	26.14	6.30	35.64	15.79	0.94	3.95	11.44	**157.73**	186.99	6.48	56.10	62.40	**311.96**	**154.23**
2027	98.48	104.57	6.30	36.86	15.79	0.94	3.95	11.44	**282.32**	186.99	6.48	56.10	62.40	**311.96**	**29.64**
2028	118.76	104.57	6.30	36.89	15.79	0.94	3.95	11.44	**302.63**	186.99	6.48	56.10	62.40	**311.96**	**9.33**
2029	34.76	26.14	12.50	77.01	15.79	1.87	7.90	67.36	**245.84**	186.99	10.79	93.50	153.60	**444.88**	**199.04**
2030			12.50	77.01		1.87	7.90	67.36	**166.65**		10.79	93.50	153.60	**257.89**	**91.24**
2031			12.50	77.09		1.87	7.90	67.36	**166.73**		10.79	93.50	153.60	**257.89**	**91.16**
2032			12.50	77.18		1.87	7.90	67.36	**166.82**		10.79	93.50	153.60	**257.89**	**91.07**
2033			12.50	77.28		1.87	7.90	67.36	**166.91**		10.79	93.50	153.60	**257.89**	**90.98**
2034			12.50	77.39		1.87	7.90	67.36	**167.02**		10.79	93.50	153.60	**257.89**	**90.87**
2035			12.50	78.61		1.87	7.90	67.36	**168.24**		10.79	93.50	153.60	**257.89**	**89.65**
2036			12.50	78.74		1.87	7.90	67.36	**168.37**		10.79	93.50	153.60	**257.89**	**89.52**
2037			12.50	64.83		1.87	7.90	67.36	**154.46**		10.79	93.50	153.60	**257.89**	**103.43**
2038			12.50	64.98		1.87	7.90	67.36	**154.62**		10.79	93.50	153.60	**257.89**	**103.28**
2039			12.50	65.15		1.87	7.90	67.36	**154.79**		10.79	93.50	153.60	**257.89**	**103.10**
2040			12.50	64.21		1.87	7.90	67.36	**153.85**		10.79	93.50	153.60	**257.89**	**104.05**
2041			12.50	62.36		1.87	7.90	67.36	**151.99**		10.79	93.50	153.60	**257.89**	**105.90**
2042			12.50	47.21		1.87	7.90	67.36	**136.84**		10.79	93.50	153.60	**257.89**	**121.05**
2043			12.50	47.46		1.87	7.90	67.36	**137.09**		10.79	93.50	153.60	**257.89**	**120.80**
2044			12.50	47.74		1.87	7.90	67.36	**137.37**		10.79	93.50	153.60	**257.89**	**120.52**
2045			12.50	40.50		1.87	7.90	67.36	**130.13**		10.79	93.50	153.60	**257.89**	**127.76**
2046			12.50	38.76		1.87	7.90	67.36	**128.39**		10.79	93.50	153.60	**257.89**	**129.50**
2047			12.50	39.13		1.87	7.90	67.36	**128.76**		10.79	93.50	153.60	**257.89**	**129.13**
2048			12.50	39.53		1.87	7.90	67.36	**129.17**		10.79	93.50	153.60	**257.89**	**128.73**
2049			12.50	39.98		1.87	7.90	67.36	**129.61**		10.79	93.50	153.60	**257.89**	**128.28**
2050			12.50	27.65		1.87	7.90	67.36	**117.28**		10.79	93.50	153.60	**257.89**	**140.61**
2051			12.50	28.19		1.87	7.90	67.36	**117.82**		10.79	93.50	153.60	**257.89**	**140.07**
														IRR=	**158.17%**

Source: JICA Study Team

Table 7.1.7 EIRR of Sensitivity Analysis
(Option Plan, Cost+10%、Benefit－10%)

	Base Cas			Sensibity Analysis		
	Cost	Benefit	Net Benefit	Cost (+10%)	Benefit (-10%)	Net Benefit
2015	1.50	0.00	(1.50)	1.65	0.00	(1.65)
2016	0.00	0.00	0.00	0.00	0.00	0.00
2017	2.00	0.00	(2.00)	2.20	0.00	(2.20)
2018	9.50	0.00	(9.50)	10.45	0.00	(10.45)
2019	64.80	171.20	106.40	71.28	154.08	82.80
2020	179.47	171.20	(8.27)	197.41	154.08	(43.34)
2021	216.75	171.20	(45.55)	238.43	154.08	(84.35)
2022	215.52	279.85	64.33	237.07	251.86	14.79
2023	147.81	279.85	132.03	162.60	251.86	89.27
2024	46.91	108.65	61.74	51.61	97.79	46.18
2025	89.47	279.85	190.38	98.41	251.86	153.45
2026	125.62	279.85	154.23	138.18	251.86	113.69
2027	250.21	279.85	29.64	275.23	251.86	(23.37)
2028	270.52	279.85	9.33	297.57	251.86	(45.70)
2029	152.92	351.96	199.04	168.21	316.76	148.55
2030	89.52	180.76	91.24	98.47	162.69	64.21
2031	89.60	180.76	91.16	98.56	162.69	64.13
2032	89.69	180.76	91.07	98.66	162.69	64.03
2033	89.78	180.76	90.98	98.76	162.69	63.92
2034	89.89	180.76	90.87	98.88	162.69	63.81
2035	91.11	180.76	89.65	100.22	162.69	62.46
2036	91.24	180.76	89.52	100.37	162.69	62.32
2037	77.33	180.76	103.43	85.06	162.69	77.62
2038	77.49	180.76	103.28	85.23	162.69	77.45
2039	77.66	180.76	103.10	85.42	162.69	77.26
2040	76.72	180.76	104.05	84.39	162.69	78.30
2041	74.86	180.76	105.90	82.35	162.69	80.34
2042	59.71	180.76	121.05	65.68	162.69	97.00
2043	59.96	180.76	120.80	65.96	162.69	96.73
2044	60.24	180.76	120.52	66.26	162.69	96.42
2045	53.00	180.76	127.76	58.30	162.69	104.38
2046	51.26	180.76	129.50	56.39	162.69	106.30
2047	51.63	180.76	129.13	56.79	162.69	105.89
2048	52.04	180.76	128.73	57.24	162.69	105.45
2049	52.48	180.76	128.28	57.73	162.69	104.96
2050	40.15	180.76	140.61	44.17	162.69	118.52
2051	40.69	180.76	140.07	44.76	162.69	117.93
			158.17%			94.24%

Table 7.1.8 EIRR of Sensitivity Analysis
(Option Plan, Cost+20%、Benefit－20%)

	Base Cas			Sensibity Analysis		
	Cost	Benefit	Net Benefit	Cost (+20%)	Benefit (-20%)	Net Benefit
2015	1.50	0.00	(1.50)	1.80	0.00	(1.80)
2016	0.00	0.00	0.00	0.00	0.00	0.00
2017	2.00	0.00	(2.00)	2.40	0.00	(2.40)
2018	9.50	0.00	(9.50)	11.40	0.00	(11.40)
2019	64.80	171.20	106.40	77.76	136.96	59.20
2020	179.47	171.20	(8.27)	215.36	136.96	(78.40)
2021	216.75	171.20	(45.55)	260.10	136.96	(123.15)
2022	215.52	279.85	64.33	258.62	223.88	(34.74)
2023	147.81	279.85	132.03	177.38	223.88	46.50
2024	46.91	108.65	61.74	56.30	86.92	30.62
2025	89.47	279.85	190.38	107.36	223.88	116.52
2026	125.62	279.85	154.23	150.74	223.88	73.14
2027	250.21	279.85	29.64	300.25	223.88	(76.37)
2028	270.52	279.85	9.33	324.62	223.88	(100.74)
2029	152.92	351.96	199.04	183.50	281.57	98.06
2030	89.52	180.76	91.24	107.42	144.61	37.19
2031	89.60	180.76	91.16	107.52	144.61	37.09
2032	89.69	180.76	91.07	107.62	144.61	36.99
2033	89.78	180.76	90.98	107.74	144.61	36.87
2034	89.89	180.76	90.87	107.87	144.61	36.74
2035	91.11	180.76	89.65	109.34	144.61	35.27
2036	91.24	180.76	89.52	109.49	144.61	35.12
2037	77.33	180.76	103.43	92.80	144.61	51.81
2038	77.49	180.76	103.28	92.98	144.61	51.63
2039	77.66	180.76	103.10	93.19	144.61	51.42
2040	76.72	180.76	104.05	92.06	144.61	52.55
2041	74.86	180.76	105.90	89.83	144.61	54.77
2042	59.71	180.76	121.05	71.66	144.61	72.95
2043	59.96	180.76	120.80	71.96	144.61	72.65
2044	60.24	180.76	120.52	72.29	144.61	72.32
2045	53.00	180.76	127.76	63.60	144.61	81.01
2046	51.26	180.76	129.50	61.52	144.61	83.09
2047	51.63	180.76	129.13	61.96	144.61	82.65
2048	52.04	180.76	128.73	62.44	144.61	82.17
2049	52.48	180.76	128.28	62.98	144.61	81.63
2050	40.15	180.76	140.61	48.18	144.61	96.43
2051	40.69	180.76	140.07	48.83	144.61	95.78
			158.17%			16.62%

Source: JICA Study Team

7.1.7. Project EIRR depends on Phased Plan

If coal demand will not increase as predicted, the project would be implemented up to the 1st Phase without developing the facilities for the 2nd Phase. The JICA Study Team also estimated the EIRR of such cases, which is valuable in terms of risk evaluation.

(1) 1st Phase

The EIRR is calculated as 66.16% under the assumption that coal demand would not increase after 2029; coal imports will hover around 10.40 Mt.

Based on these results, the JICA Study Team can conclude that this project would be feasible in terms of the national economy when demand reaches 10.40 Mt, which is forecasted to be achieved in 2029 and the facilities in the 1st Phase are constructed to meet the demand.

Table 7.1.9 Project EIRR in the Case of 1st Phase

Unit million USD	With Case									Without Case					Net Project Benefit
	CTT Construction Cost	CTT Equipment Cost	CTT Maintenance Cost	CTT Operation Cost	CFPP Transportation Facility Cost	CFPP Transportation Maintenance Cost	CFPP Transportation Operation Cost	Secondary Transport Cost	Total Cost	CFPP offshore transportation Facility Cost	CFPP offshore transportation Maintenance Cost	CFPP offshore transportation Operation Cost	Secondary Transport Cost	Total Cost	
2015									1.00					0.00	(1.00)
2016									0.00					0.00	0.00
2017									0.00					0.00	0.00
2018									5.00					0.00	(5.00)
2019									0.75					0.00	(0.75)
2020									0.00					0.00	0.00
2021	85.29				21.25				109.04	179.58				179.58	70.53
2022	118.56	66.45			21.25				209.77	179.58				179.58	(30.19)
2023	118.56	66.45			21.25				210.77	179.58				179.58	(31.19)
2024	118.56	66.45			21.25				210.77	179.58				179.58	(31.19)
2025	33.27	66.45	6.33	96.09	21.25	1.01	5.30	11.44	243.15	179.58	5.07	44.90	62.40	291.94	48.79
2026			6.33	75.87		1.01	5.30	11.44	99.95		5.07	44.90	62.40	112.37	12.42
2027			6.33	62.72		1.01	5.30	11.44	86.81		5.07	44.90	62.40	112.37	25.56
2028			6.33	53.40		1.01	5.30	11.44	77.48		5.07	44.90	62.40	112.37	34.89
2029			6.33	44.98		1.01	5.30	11.44	69.07		5.07	44.90	62.40	112.37	43.30
2030			6.33	38.73		1.01	5.30	11.44	62.82		5.07	44.90	62.40	112.37	49.55
2031			6.33	33.35		1.01	5.30	11.44	57.43		5.07	44.90	62.40	112.37	54.94
2032			6.33	29.04		1.01	5.30	11.44	53.12		5.07	44.90	62.40	112.37	59.24
2033			6.33	25.60		1.01	5.30	11.44	49.68		5.07	44.90	62.40	112.37	62.68
2034			6.33	22.85		1.01	5.30	11.44	46.94		5.07	44.90	62.40	112.37	65.43
2035			6.33	20.67		1.01	5.30	11.44	44.75		5.07	44.90	62.40	112.37	67.62
2036			6.33	18.93		1.01	5.30	11.44	43.01		5.07	44.90	62.40	112.37	69.36
2037			6.33	17.55		1.01	5.30	11.44	41.64		5.07	44.90	62.40	112.37	70.73
2038			6.33	16.47		1.01	5.30	11.44	40.55		5.07	44.90	62.40	112.37	71.82
2039			6.33	15.61		1.01	5.30	11.44	39.70		5.07	44.90	62.40	112.37	72.67
2040			6.33	14.96		1.01	5.30	11.44	39.04		5.07	44.90	62.40	112.37	73.33
2041			6.33	14.45		1.01	5.30	11.44	38.54		5.07	44.90	62.40	112.37	73.83
2042			6.33	14.07		1.01	5.30	11.44	38.16		5.07	44.90	62.40	112.37	74.21
2043			6.33	13.80		1.01	5.30	11.44	37.89		5.07	44.90	62.40	112.37	74.48
2044			6.33	13.62		1.01	5.30	11.44	37.70		5.07	44.90	62.40	112.37	74.67
2045			6.33	13.51		1.01	5.30	11.44	37.59		5.07	44.90	62.40	112.37	74.78
2046			6.33	13.46		1.01	5.30	11.44	37.55		5.07	44.90	62.40	112.37	74.82
2047			6.33	13.47		1.01	5.30	11.44	37.56		5.07	44.90	62.40	112.37	74.81
2048			6.33	13.53		1.01	5.30	11.44	37.61		5.07	44.90	62.40	112.37	74.76
2049			6.33	16.18		1.01	5.30	11.44	40.27		5.07	44.90	62.40	112.37	72.10
2050			6.33	16.18		1.01	5.30	11.44	40.27		5.07	44.90	62.40	112.37	72.10
2051			6.33	16.18		1.01	5.30	11.44	40.27		5.07	44.90	62.40	112.37	72.10
2052			6.33	16.18		1.01	5.30	11.44	40.27		5.07	44.90	62.40	112.37	72.10
2053			6.33	16.18		1.01	5.30	11.44	40.27		5.07	44.90	62.40	112.37	72.10
2054			6.33	16.18		1.01	5.30	11.44	40.27		5.07	44.90	62.40	112.37	72.10
														IRR=	66.16%

Source: JICA Study Team

7.2. Financial Analysis

7.2.1. Applicable Project Scheme

(1) Investment Structure of SPC

The Special Purpose Company (SPC) is assumed to be established as a joint venture (JV) under the Quick Supply of Power and Energy Enhancement (Special Act) Law 2010 and Companies Act 1994. The PPP Law has not been enacted yet, and the timing of the enactment is still yet to be determined. Therefore, it was decided to base the establishment of the SPC based on the existing laws of the Quick Supply of Power and Energy Enhancement (Special Act) Law 2010 and Companies Act 1994.

The SPC is assumed to be established by the investment coming from a Bangladesh company at 50% shares and a Japanese company at 50% shares.

(2) Anticipated Role Sharing between the Public and Private Portions

The private sector can only expect their investment return in case most of the lower infrastructure such as coal loading/unloading berth and coal storage yard are expected to be constructed by the public sector using the official development assistance (ODA) yen loan, and the upper infrastructure such as coal loader and unloader are to be constructed by the private sector. The JICA Study Team analysed Case 1, Case 2, and Case 3 below, and set Case 2 as the base case. Case 1 was assumed to obtain ODA funding for a part of the upper infrastructure, however, it is difficult to find any reason to apply ODA to fund only a part of the equipment. Case 3 is not included in the analysis since the construction cost of the coal loading/unloading berth are too high, which would result in a high tariff, thus giving a big burden on the Bangladesh government.

Table 7.2.1 Anticipated Role Sharing between the Public and Private Portions

Port and Terminal Facilities	Case 1	Case 2	Case 3
Coal Unloading Berth	ODA	ODA	Private
Coal Loading Berth	ODA	ODA	Private
Loader and Unloader	ODA	Private	Private
Breakwater and Training Dike	ODA	ODA	ODA
Coal Storage Yard	ODA	ODA	ODA
Conveyer Belt, Stacker, Reclaimer	Private	Private	Private
Landside facilities (Administration Building, Coal Mixing Equipment, Substation, Workshop, etc.)	Private	Private	Private
Dredging	ODA	ODA	ODA
Aids for Navigation	ODA	ODA	ODA
Access Road	ODA	ODA	ODA

Source: JICA Study Team

7.2.2. Financial Analysis

The JICA Study Team simulated the financial model for the SPC established by the Bangladeshi and Japanese entities, with some assumptions written in the following chapters. Feasibility is evaluated by calculating the terminal handling charge (THC) per ton, which fulfills the equity internal rate of return (IRR) of the SPC required by the private investor.

It is common to calculate a minimum rate of return on a capital investment project (hurdle rate) for investment by “capital cost plus spread between domestic and overseas interest rates”. The JICA Study Team set the hurdle rate as 20% by calculating the weighted average cost of capital (WACC), the spread between the Bangladesh and Japan interest rates and included a country risk premium. This ratio is on the assumption that other risks of SPC, to be mentioned later in other chapters, are properly minimised. Therefore, the Financial Internal Rate of Return (FIRR) for the project is set at 20%.

7.2.3. Assumptions

(1) Description of Business

Scope of business of SPC in the financial analysis is unloading from vessels, inventory control, and loading to small barges for secondary transshipment to the CFPPs. The secondary transshipment cost is not included in this analysis. The cost of the secondary transshipment is mentioned in Chapter 4 above.

(2) Term of the Project

The term of project is 34 years. From the start of the 1st Phase in 2021 to 25 years from the start of the 2nd Phase in 2030, which is 2055.

(3) Exchange Rate (reference rate as of June 2015)

USD 1 ＝ BDT 78
USD 1 ＝ JPY 122.0

(4) Demand of Coal Handling

In accordance with the draft PSMP 2015, the CTT handles all coal volume mentioned in Chapter 3.

(5) Operation and Maintenance (O/M) Cost

As mentioned in Chapter 6 above.

(6) Land Usage Fee

As mentioned in Chapter 6 above.

(7) Tax Cost

1) Corporate Tax
Corporate income tax for the SPC is 35%.
2) Value-added Tax (VAT)
VAT of 15% is included in this analysis for the EPC construction costs.

(8) Capital Expenditure

- Investment plan is mentioned in Chapter 6 above.
- It is planned to expand CTT and invest in the upper infrastructure at each phase.
- Major equipment such as unloader, loader, stacker-reclaimer, dust protection wall and belt conveyer are planned to be used for 25 years. Other equipment are planned to be replaced by their deprecation period.

(9) Financing Plan

1) It is assumed that 30% of the total project costs be funded by equity and 70% of the total project costs be funded by debt.
2) JICA Private Sector Investment Finance (PSIF)
   It is assumed to loan from JICA PSIF.
   - Interest : expected 5～6% per year*
   - Currency : USD
   - Term of loan : 20 years
   - Debt service coverage ratio (DSCR) : minimum 1.2
   *Subject to market conditions. However, we assumed 5% for the analysis in this report.
3) Amount of Funds and Loans

Table 7.2.2 Amount of Funds and Loans

(Unit：USD million)

	Equity	Debt	Total
1st Phase	138.8	323.9	462.8
2nd Phase	141.4	329.9	471.3
Total	280.2	653.8	934.1

Source：JICA Study Team

7.2.4. Business Income / Terminal Handling Charge (THC)

(1) Basic Concept

Income from the project is generated from the THC, which consists of the Capacity Payment and Variable Payment from the Bangladesh Entity. The Bangladesh Entity will charge a fee to each CFPP that will be using the CTT, and such fees would be used to pay the Capacity Payment and Variable Payment to the SPC. It is difficult to refer the standard level of such fee in Bangladesh since there is no CTT in Bangladesh. However, the level of the Capacity Payment has to be set to fulfill the hurdle rate of SPC, and at the same time, the fees to be paid by the CFPP's has to be within a reasonable level so that the CFPPs can enjoy the economic benefits by utilizing the CTT compared with alternative means to import coal. Although this project will be the first of its kind, the scheme is very similar to that of the IPP model, thus the structure of the THC and the risk allocation between the CTT and the Bangladesh Entity will be in accordance with IPP model. The IPP model is based on the Private Sector Power Generation Policy of Bangladesh, (PSPGP) (1996), thus this project will also be in accordance with the PSPGP. The PSPGP is as per Appendix 12.

(2) THC Structure

Generally, the THC structure of CTTs in Japan consists of charges for receiving coal, storing coal, and supplying coal to CFPPs. In addition to these charges, there are other additional charges such as the charge for long-term storage and secondary transportation fee depending on the distance between CTT and CFPP. However, the additional charge for long-term storage and secondary transportation cost are not considered in this study since it is difficult to set a detailed storage period required by each CFPP.

1) THC is assumed to be based on a take-or-pay mechanism, which consists of capacity charge (fixed charge for installed capacity of CFPP) and variable charge.

   A take-or-pay system is a common payment system for an infrastructure investment project with project financing, which guarantees stable income from the project.

   Take-or-pay contracts between SPC and CFPP, and payment bonds from the Bangladesh government are necessary for a private investor to make an investment in the project..

   i) The capacity charge consists of compensation for the financing cost, its interest and capital cost including dividend and tax cost, and compensation for the fixed O&M cost such as labor and periodic maintenance costs. The capacity charge guarantees the agreed income amount of SPC as long as CTT maintains of its good performance which is mutually agreed in advance.
   ii) The variable charge is compensation for the variable cost of CTT such as utility expenses and some portions of the labor costs and maintenance costs. This charge is variable depending on the actual demand of CFPPs.

Table 7.2.3 THC Structure

	Item for Compensation	Example
Capacity Charge	Capital cost, Financing cost	Investment, interest, tax and profit
	O&M fixed charge	Labor cost
	O&M fixed charge	Insurance, maintenance
Variable Charge	O&M variable charge	Utility cost, labor cost, insurance
	O&M variable charge	Maintenance and other variable cost

Source：JICA Study Team

2) Price Adjustment Factor

   THC has to be adjusted by inflation and foreign exchange fluctuation. The rule of adjustment will be agreed among related parties in a take-or-pay contract. In this financial analysis, the impacts of fluctuation of inflation and foreign exchange fluctuation are not considered since it is assumed that such fluctuation risk will be borne by CFPPs or the Bangladesh government.

3) THC by Each Phase

   The CTT is supposed to be expanded by each phase, and the required investment cost and fixed cost of the CTT will be different in each phase. Therefore, the capacity charge will also be different in each phase. The capacity charge in each phase is calculated by the required income of SPC to justify the investment in each phase.

(3) THC

The THC based on the assumptions above is shown in Table 7.2.4 below. In case the coal demand in each phase will not increase during the project term, the prices in each phase as given by the table will be applied through the project term.

Table 7.2.4 Terminal Handling Charge (THC)

(Unit: USD million)

	1st Phase	2nd Phase
Capacity charge per t	7.45	6.08
Variable charge per t	1.04	0.85
Total charge per t	8.58	6.93
Handling volume per year	10.8 Mt	15.7Mt

Source: JICA Study Team

The following is a sensitivity analysis of the THC when the EPC Cost is increased by 10% and decreased by 10%.

Table 7.2.5 Project FIRR

(Unit: USD)	FIRR (%)		
	Base Case	Sensitivity Analysis (EPC Cost: +10%)	Sensitivity Analysis (EPC Cost: -10%)
Total THC Phase 1	8.58	9.35	7.79
Total THC Phase 2	6.93	7.57	6.31

Source: JICA Study Team

Although the lower infrastructure is assumed to be procured by the Bangladesh Government using ODA Loan, as mentioned in Chapter 6, if the repayment of the ODA Loan for the lower infrastructure would be included in the THC for the CTT Project, the THC would be as follows.

Table 7.2.6 THC including Lower Infrastructure

(Unit: USD)	1st Phase	2nd Phase
Capacity charge per ton	8.25	6.57
Variable charge per ton	1.05	0.86
Total charge per ton	9.30	7.43
Handling volume per year	10.8 Mt	15.72 Mt

Source: JICA Study Team

The terms of the repayment of the ODA Loan is mentioned in Chapter 6, and since the repayment of the ODA Loan is longer than the operation period of the CTT Project, only the repayment of the ODA Loan during the operation period is considered.

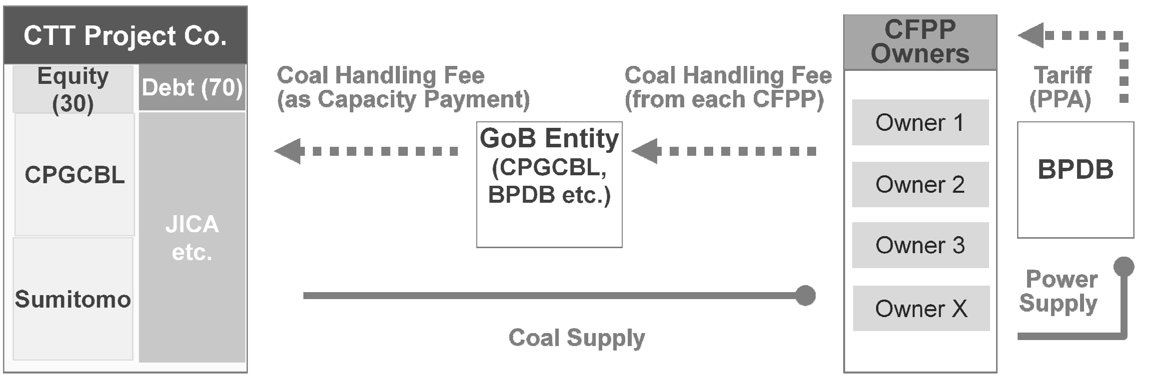
Meanwhile, as per discussions with CPGCBL, even if the Lower Infrastructure were to be financed by the ODA Loan by the Bangladesh Government, it is expected that the Bangladesh Government will grant a sub-loan to CPGCBL at a rate of 2% p.a., for the usage of the Lower Infrastructure. If the repayment of this sub-loan for the lower infrastructure would be included in the THC for the CTT Project, the THC would be as follows.

Table 7.2.7 THC including Lower Infrastructure

(Unit: USD)	1st Phase	2nd Phase
Capacity charge per ton	8.62	6.82
Variable charge per ton	1.05	0.86
Total charge per ton	9.67	7.68
Handling volume per year	10.8 Mt	15.72 Mt

Source: JICA Study Team

7.2.5. Financing and Payment Flow



Source: JICA Study Team

Figure 7.2.1 Financing and Payment Flow

Chapter 8. Concerned Local Laws and Regulations

8.1. Concerned Local Laws and Regulations

8.1.1. General Legal Framework for PPP

(1) General

(a) Currently, projects developed jointly by the private and public sector, whether as a build-operate-transfer (BOT), build-own-operate (BOO), build-own-operate-transfer (BOOT) or otherwise, are subject to Bangladeshi Law generally. Whilst exemptions may be negotiated with the government on a project by project basis e.g. with respect to public procurement, transfer restrictions, and foreign exchange rules etc. there is currently not yet a dedicated legal regime for PPP projects.

(b) The government issued in August 2010 the Policy and Strategy for Public-Private Partnership, 2010 and related guidelines for the formulation, appraisal, and approval of PPP projects with a view to creating a more streamlined and consistent framework and procedure for developing PPP projects.

(c) In 2014, the cabinet approved the draft PPP Law, reflecting the broad principles laid down in the 2010 PPP Policy, which is now being considered by the parliament. Once enacted, the PPP Law will replace and repeal the 2010 PPP Policy and associated guidelines. Based on information to date it is expected that the PPP Law will be passed during 2015.

(d) The PPP Law and related secondary legislation will create a special legal regime which will apply to PPP projects and which will hopefully create a more favourable investment environment for private investors and address some of the issues for which specific exemptions have to be sought currently. It is not certain when the secondary legislation which will set out the detailed procedures and exemptions would be enacted, but it can be reasonably expected that they would largely follow the current policies, guidelines and procedures in relation to PPP.

(e) Based on the indicative time schedule of the project, it is likely that the PPP Law would have been passed by the time the CTT project is being tendered, but it is uncertain to what extent secondary legislation would have been promulgated at that point.

(2) Applicable Legal Texts

(a) Policy and Strategy for Public-Private Partnership, 2010

(b) Guidelines for Formulation, Appraisal and Approval of Large Projects, 2010

(c) Guidelines for Formulation, Appraisal and Approval of Medium Projects, 2010

(d) Guidelines for Formulation, Appraisal and Approval of Small Projects, 2010

(e) Guideline for Public-Private Partnership Technical Assistance Financing, 2012

(f) Guideline for Viability Gap Financing for Public-Private Partnership Projects, 2012

(g) Procedure for Implementation of PPP Policy and Strategy for Unsolicited Proposals, 2014

(h) Draft of the Public Private Partnership Act

(i) Draft of the Public Private Partnership Rules

(3) Outline of the PPP Policy

(a) The 2010 PPP Policy sets out the government's general policies with respect to promoting public private partnerships in order to achieve its "Vision 2021" goal of becoming a middle income country by 2021. The 2010 PPP Policy replaces the Bangladesh Private Sector Infrastructure Guidelines, 2004.

(b) The 2010 PPP Policy is merely a policy, not a law, therefore it is judicially non-binding, and any existing law, rule or regulation covering some of the same matters as the 2010 PPP Policy would take precedence. However, public authorities would in practice try to give effect to the 2010 PPP Policy and to take it into account when taking executive actions and decisions, to the extent that they are permitted to do so under existing laws, rules and regulations.

(c) Set out below is a summary of the main content of the 2010 PPP Policy:

i) **Objectives** – The objectives of the 2010 PPP Policy are to (a) spell out the principles of partnership with the private sector for undertaking various projects related to infrastructure as well as public service delivery; (b) define an institutional framework, which is conductive and efficient in handling the PPP projects as well as effective in protecting the public interest; and (c) ensure balance between risk and reward for both the government and private sector partners whilst aiming to keep the undertaking attractive for the private sector.

ii) **Applicability**– Any project that generates public goods and services (other than outsourcing of a public service, creating a government-owned enterprise or providing sovereign debt) may be considered under the PPP scheme, if any one of the following apply:

A) Iimplementation of the project is difficult using the financial resources or expertise of the government alone;

B) Private investment would increase the quality or level of service or reduce the time to implement compared with what the government could accomplish on its own;

C) There is an opportunity for competition, where possible, among prospective private investors, which may reduce the cost of providing a public service;

D) Private investment in public service provides an opportunity for innovation; and

E) There are no regulatory or legislative restrictions in taking private investment in the delivery of public service.

iii) **Sector Coverage** – Certain sectors are considered "priority sectors" for PPP, including transmission and distribution of coal, power generation and deep sea port development. The CTT project would be considered a "priority sector" PPP for the purpose of the 2010 PPP Policy.

iv) **Eligibility of Private Sector** – The private sector entity participating in the PPP can be a Bangladeshi or a foreign entity but, at the time of contract awarding, any foreign entity is required to be registered as a legal entity in Bangladesh (i.e., foreign investors must set up a subsidiary in Bangladesh as the project company).

v) **Classification of Projects by Size –** PPP projects are classified into three groups depending on the total investment value (as identified in the pre-feasibility report and excluding on-going capital for expansion):

A) Large – above BDT 2.5 billion (approximately USD 32 million);

B) Medium – between BDT 500 million and 2.5 billion (approximately USD 6.4 – 32 million); and

C) Small – below BDT 500 million (approximately USD 6.4 million).

The thresholds above are subject to change.

vi) **Financial Participation of the Government** – Depending on the nature and the PPP model of the project, the government may provide:

A) Technical assistance financing: financing of project start-up costs such as in relation to the preparation of feasibility studies, RFPs, contract regulation etc.;

B) Viability gap financing: capital grant or annuity payment, payable after "private investment" has been expended as stipulated in the concession agreement; or

C) Infrastructure financing: financing facilities (debt or equity) through the Bangladesh Infrastructure Finance Fund and Infrastructure Development Company Limited, subject to necessary budget provision

vii) **Linked Components** – Depending on the nature of the PPP project involved, the line ministry/implementing agency involved can consider the financing and implementation of linked activities such as acquisition of land, rehabilitation and re-settlement, and provision of utility services, etc. in the following two forms:

A) Financing will be part of the PPP project (the implementation may be done by the private investor or by the relevant line ministry/implementing agency, as appropriate), or

B) Financing as well as the implementation will be done by the government using government funds.

viii) **Incentives to Private Investor** – Fiscal and non-fiscal incentives may be available from the government to private investors for launching PPP projects in priority sectors, including reductions in import tax on capital items and tax reduction or exemption on operating profit for a period of time.

ix) **Institutional Framework** – This section describes the various government bodies involved in the identification, formulation, appraisal, approval, monitoring and financing of PPP projects and delineates their respective roles to ensure a more streamlined PPP process.

x) **Formulation, Appraisal and Approval of the PPP Projects** – Given that the CTT project is likely to be a "Large Project", the final approval authority would be the Cabinet Committee on Economic Affairs (CCEA). The detailed procedures will be set out in the relevant guidelines. In relation to the appraisal and approval of unsolicited proposals, competitive bidding, such as the "Bonus System", the "Swiss Challenge System" or another appropriate method, must be followed (please see Section 8.1.2(5)).

(d) **Exit Policy** – This section provides that the PPP contract will specify the terms and conditions of exit of a current private investor, possible transfer of ownership to a new investor, or partial or complete divestiture of ownership to capital markets and identify a minimum lock-in period after the commercial operation date.

8.1.2. Public Procurement

(1) Applicable Legal Texts

(a) Public Procurement Act, 2006

(b) Public Procurement Rules, 2008

(c) Quick Supply of Power and Energy Enhancement (Special Act) Law, 2010

(d) 2010 PPP Policy

(e) Guidelines for Formulation, Appraisal and Approval of Large Projects, 2010

(f) Unsolicited Proposals Procedure

(2) General

(a) Currently, any public procurement (as described in section 3 of the Public Procurement Act) must be carried out in accordance with the Public Procurement Laws, unless specific exemptions are agreed with the government. However, the Public Procurement Laws allow the government to develop BOT/BOO/BOOT projects in accordance with other guidelines and directives issued by it, notwithstanding anything in the Public Procurement Laws.

(b) The government would in practice follow the process set out in the 2010 PPP Policy and the applicable guidelines and procedures in relation to PPP projects.

(c) Upon enactment of the PPP Law, the procurement and award of PPP contracts (as defined in the PPP Law) will be exclusively governed by the PPP Law and related secondary legislation and will override the Public Procurement Laws and the 2010 PPP Policy and associated guidelines.

(3) Public Procurement Procedure under the Public Procurement Laws

(a) Under Section 33 of the Public Procurement Act, the procuring entity may undertake public procurement by way of an open international procurement method in accordance with the Public Procurement Act where it is not feasible to undertake procurement by inviting competitive tenders within Bangladesh, i.e. the government should generally try to procure projects domestically first before opening them to international tender.

(b) The general procurement process under the Public Procurement Laws can be summarised as follows:

i) Publication of expression of interest;

ii) Preparation of tender documents;

iii) Publication of tender documents;

iv) Pre-bid conference;

v) Amendment of tender documents in light of the outcome and findings of the pre-bid conference (if applicable) and notification thereof;

vi) Opening of tender and evaluation of offers; and

vii) Notification of award.

(4) Procurement Procedure under the 2010 PPP Policy and Guidelines

The approval procedures vary depending on the size of the project. For “Large Projects”, the following procedures should be followed:

(a) **Project Identification** – A project is identified by the line ministry/implementing agency itself, through the PPP Office, or through an unsolicited proposal submitted by a private investor. The PPP Office and the line ministry/implementing agency will conduct pre-feasibility studies, if necessary.

(b) **“In Principle” approval by CCEA** of proposals recommended by the PPP Office.

(c) **Feasibility Study and Preparation of Documents** – the PPP Office, together with consultants, prepares a detailed feasibility study as well as the Request for Qualification (RFQ) and Request for Proposal (RFP) (including draft concession agreements). The Finance Division appraises the requirements of Viability Gap Financing in consultation with the responsible line ministry/implementing agency.

(d) **Request for Qualification** – The line ministry/implementing agency calls for an RFQ and the QTEC established by the line ministry/implementing agency shortlists investors based on screening criteria as provided in the RFQ documents (other than for unsolicited proposals).

(e) **Request for Proposal -** The line ministry/implementing agency issues an RFP to the private investors shortlisted as a result of the RFQ process. The QTEC evaluates the investors’ proposals first for compliance with the technical criteria or specifications and then prepares an RFP evaluation report ranking the technically compliant proposals based on the financial evaluation criteria. The line ministry/implementing agency notifies the selected bidder to initiate the negotiation process

(f) **Negotiation and Contract Award** – The line ministry/implementing agency negotiates the contract with the selected bidder. The concession agreement must be then vetted by the Legislative and Parliamentary Affairs Division and be approved by the CCEA before it can be entered into.

The indicative timing set out in the Guidelines for Formulation, Appraisal and Approval of Large Projects, 2010 is as follows:

#	Phase	Indicative Time Frame
1	Project identification	On-going
2	'In Principle' Approval by CCEA	2—4 weeks
3	Feasibility Study	8—20 weeks
4	Request for Qualification	4—8 weeks
5	Request for Proposals	8—12 weeks
6	Negotiation and Contract Award	4—8 weeks

(5) Unsolicited Proposals

(a) Currently, the Public Procurement Laws stipulate that, notwithstanding anything contained in any other provision of the Public Procurement Laws, the government may, in accordance with directives and model contract documents issued by it, enter into a concession agreement with a person for the provision and operation of public utilities and services incidental thereto through a BOO, BOT or BOOT agreement with joint public and private financing or with entirely private financing.

(b) In addition, the 2010 Special Act was passed to facilitate development of power and energy-related projects to address urgent energy needs in Bangladesh. Under the 2010 Special Act the government can accept proposals from, and enter into concession agreements with, the private sector without having to comply with the Public Procurement Laws. The government has recently procured a number of power and energy-related projects under the 2010 Special Act. At present, the 2010 Special Act is in application until 11 October 2018 and the government could potentially negotiate and enter into the Concession Agreement for the CTT project before that date, without an open tender. The detailed steps and procedures to be followed in respect for the CTT project to be procured under the 2010 Special Power Act are as follows;

i) A private company submits a letter to MOPEMR stating that they are willing to develop the project under that Special Power Act 2010.

ii) In response to the above letter, MOPEMR can issue a letter requesting the private company to submit a detailed proposal for development of the project. (Section 6 of Special Power Act 2010. Invitation for proposal can be made to a single entity, and does not require multiple invitations.)

iii) MOPEMR will form a “Procurement Committee”, which will be the entity to evaluate and process the proposal from the private company. The Procurement Committee is to be constituted of members with the relevant technical or other expertise that will be required for implementation of the proposal. (Section 5 of Special Power Act 2010)

iv) The Procurement Committee will evaluate the financial and technical credentials of the private company that has put forth the proposal, and shall have the responsibility to negotiate with them the particulars of the proposal. Based on its evaluation, the Procurement Committee can decide whether or not to present the proposal to the relevant government ministries, e.g. the Ministry of Finance, Ministry of Commerce, CCEA, etc.

v) If is it decided to present the proposal, the proposal formulated by the Procurement Committee in relation to the project will be presented before the relevant ministries, and once approved by these ministries, with the final approving authority being the CCEA, measures to implement the proposal/project will be taken.

vi) If the proposal is returned by the relevant ministry with recommendations/suggestions, then the Procurement Committee shall consider the recommendations and revise the proposal and present the same to the relevant ministry/ministries for their re-evaluation.

(c) Although this project will be the first of its kind, the scheme is very similar to that of the IPP model, thus it is expected that the proposal from the private company shall be similar to that of the proposal for the IPP. There is no template or format for the proposal, but taking into consideration the past proposals for IPP’s, the following information shall be included;

i) Cover Letter – explaining the proposal.

ii) Power of Attorney – empowering individuals to conduct all business for and on behalf of the company during the selection process and, in the event the company is awarded the contract, during the execution of the project, and in this regard, to do all or any of such acts, deeds or things as necessary or required or incidental to the submission of its proposal for the project, including but not limited to signing and submission of all applications, proposals and other documents and writings, respond to queries, submit information/ documents, sign and execute contracts and undertakings consequent to acceptance of the bid and generally to represent the company in all its dealings with the authority, and/ or any other authority agency or any person, in all matters in connection with or relating to or arising out of the proposal for the project and/ or upon award thereof till the occurrence of the financial closure in accordance with the project agreement. The power of attorney has to be executed (and if executed outside Bangladesh, duly authenticated).

iii) Board Resolution - approving the submission of the proposal and contents thereof.

iv) Commercial Terms (tariff etc).

v) Financial Data – debt equity ratio, project cost, support letter from lenders, equity commitment,

vi) Technical Data- description of project, specifications, layout, operating principal, source of major components, infrastructure requirements, design etc.

vii) Sponsor's Details (along with certificate of incorporation etc) and experience in similar project.

From the date of submission of proposal until approval by the cabinet (including a couple of rounds of follow ups) could take between six to eight months, but this would depend on the urgency of the project and cooperation from the relevant ministries. In order to prepare the proposal smoothly and to avoid any delays and rejections to the proposal, it is advised that the Private Company sets up a "Joint Working Team" with MoPEMR and/or CPGCBL, and to jointly prepare the proposal together. Therefore, it is advised that the Private Company enters into an MOU with MoPEMR and/or CPGCBL, which states that both parties will jointly develop and implement the CTT Project under the 2010 Special Power Act, and that the set up of the Joint Working Team" and the joint preparation of the proposal will be one of the main tasks to be conducted.

(d) The 2010 Special Power Act is shown in Appendix 11.

8.1.3. Principal Project Agreements with the Government

(1) Concession Agreement

(a) Form of the Concession Agreement

i) Under the 2010 PPP Policy Government has, through the PPP Office, drafted certain model concession agreements. However, this does not mean that such model contracts are prescribed for all projects. In relation to the CTT project, the government, through MoPEMR and the PPP Office, would draft and negotiate a specific concession agreement, which would be vetted by the Ministry of Law, Justice and Parliamentary Affairs, but the government may use certain provisions of implementation agreements and power purchase agreements used for power projects as a precedent, for example in relation to the capacity payment structure.

ii) The concession agreement should contain a clause that in case of existence of a bilateral treaty between Bangladesh and the country of origin of the developer, the developer should be able to benefit from favourable treaty provisions (if any).

(b) Parties to the Concession Agreement

i) Pursuant to Article 145 of the Constitution of Bangladesh, all contracts and deeds made in exercise of the executive authority of Bangladesh must be expressed to be made by the President, and so the President of the People's Republic of Bangladesh would be entering into the main Concession Agreement, and he would be represented by an authorised officer of the MoPEMR.

ii) Under the PPP Law the "contracting authority" which will enter into the concession agreement could also be a statutory body as prescribed by the government, e.g. CPGCBL. However, if the Concession Agreement contains provisions that the private investor will wish to bind the government as a whole, e.g. exemptions from laws and regulations, sovereign guarantees and undertakings etc., it would be more prudent for it to be entered into by the MoPEMR in accordance with Article 145 of the Constitution of Bangladesh.

(c) Who will be bound by the Concession Agreement

i) Pursuant to Article 145 of the Constitution of the People's Republic of Bangladesh, a contract entered into in the name of the President of the People's Republic of Bangladesh on behalf of the nation, represented by the relevant ministry of the government, will be tantamount to a state contract, and as such will bind all public and statutory bodies of the People's Republic of Bangladesh.

ii) However, certain statutory public authorities, such as the NBR or BB, being independent from the executive government, may argue that they are not bound by the terms of the concession agreement. Therefore, express exemptions will still need to be sought from the relevant statutory public authority, e.g., even if fiscal incentives and exemptions were to be set out in the Concession Agreement, it would still be necessary for such fiscal incentives and exemptions to be expressly ratified or granted by the NBR. Although the risk that statutory public authorities would refuse to grant exemptions agreed to by the government in the Concession Agreement is fairly remote, the Concession Agreement should clearly allocate the risk of procurement of the necessary ratifications and approvals from other statutory public authorities to the government.

(2) Coal Transshipment Service Agreement (if separate from Concession Agreement)

(a) The customary practice for PPP projects in Bangladesh is to have a Concession Agreement or implementation agreement with the government and a separate off-take/services contract with the relevant government entity which would be purchasing the service or goods.

(b) Therefore, for the CTT project, the JICA Study Team would expect there will be a separate coal transshipment services agreement (**CTSA**) between CPGCBL/Bangladesh Power Development Board (BPDB) and the project company.

(3) Sovereign Guarantee (if separate from Concession Agreement)

(a) Since the government entity which is a party to the CTSA would likely be either a state-owned company of the government (e.g., CPGCBL), or a statutory public authority (e.g., BPDB) which does not have the power to bind the government as a whole, the private investors would require a guarantee from the government to the project company in respect of that government entity payment obligations under the CTSA. The sovereign guarantee could be included in the Concession Agreement, or in a stand along agreement between the government (represented by the MoPEMR) and the project company. In accordance with the 1996 Business Law, in order to issue a sovereign guarantee, the approval from the Ministry of Finance is required. The application for such approval will be done be the relevant line ministry (for CTT it would be MoPEMR).

(b) Typical language of a sovereign guarantee is as follows:

"(to be executed by THE PEOPLE'S REPUBLIC OF BANGLADESH represented by [relevant line ministry])

'In consideration of the Company entering into the Concession Agreement with the Guarantor, …, the Guarantor hereby irrevocably and unconditionally guarantees and promises to pay the Company any and every sum of money [off taker/ lessor/counter party] are obligated to pay to the Company under or pursuant to the[names of agreement] that [off taker / lessor/counter party] has failed to pay when due in accordance with the terms of the relevant agreement or agreements, which obligation of the Government shall include monetary damages arising out of any failure by [off taker / lessor / counter party] to perform its obligations under the [names of agreements], respectively, to the extent that any failure to perform such obligations gives rise to monetary damages.'

This Guarantee shall be a continuing security and, accordingly, shall extend to cover (i) the balance due to the Company at any time from [off taker/ lessor/counter party], as the case may be, under each of the respective agreements. No demand made by the Company hereunder shall prejudice or restrict the right of the Company to make further or other demands.

Assignment by the Company

The Company may not assign or transfer all or any part of its rights or obligations hereunder without the prior written consent of the Guarantor. Notwithstanding the provision of the immediately preceding sentence, for the purpose of construction or permanent financing of theFacility, the Company may assign or create a security interest over its rights and interests in and to this Guarantee in favour of the Lenders."

(c) The sovereign guarantee should, as a minimum, cover all payment obligations of the government entity under the, including all capacity payments and any termination payments. However, it would be preferable for the private investor to negotiate with the government to extend the sovereign guarantee to all obligations of any government entity under the project agreements, including the CTSA, the Land Lease Agreement and the Port Use Agreement.

(4) Land Lease Agreement

The relevant government entity which is a party to the CTSA, would also enter into a Land Lease Agreement to lease the site to the project company.

(5) Port Use Agreement

(a) For use of the deep sea port the project company will have to enter into an agreement with the relevant port authority responsible for the Matarbari deep sea port or the Ministry of Shipping.

(b) The Ministry of Shipping is responsible for sea ports other than Chittagong and Mongla. Each port is headed by a conservator (port officer, harbor master, etc.). However, pursuant to Section 7(4) of the Ports Act, 1908: "The conservator shall be subject to the control of the government, or of any intermediate authority which the government may appoint." The Ports Act, 1908 is neutral on the issue of private sector participation in sea ports (or in any port in general).

(c) The Bangladesh Water Transport Policy 2000, whilst acknowledging that sea ports will continue to be built, operated and maintained by state bodies, states that the construction, operation and maintenance of such ports will be open in the future to both the public and private sectors. The government's hope is that over time port authorities will be limited to planning and regulatory responsibilities whilst the services will be provided by commercial enterprises on the basis of leases or contracts. The participation of national and foreign private entrepreneurs in the provision of container services and the operation of related facilities will be encouraged.

(d) Therefore, it is likely that a specific port authority would be created for the Matarbari Deep Sea Port, and that the project company would have to execute the port use agreement with that port authority with permission from the Ministry of Shipping.

8.2. Risk Analysis and Security Package

Implementing a large infrastructure project such as the CTT Project will involve various kinds of project risk. The principal categories of risks are as follows:

- Country/political risks;
- Natural risks;
- Legal risks; and
- Commercial risks.

These are the typical types of risks which investors would carefully consider and which should be carefully allocated as between the government and the private investor in order to ensure the commercial viability and bankability of the CTT project.

8.2.1. Country/Political Risks

The CTT project could be affected by a wide range of political risks applicable to Bangladesh. Whilst private investors could seek to allocate some of these risks to the government under the Concession Agreement, as with all PPP projects, a certain degree of political risk will often have to be accepted by the private investors.

(1) Uncertainties in the PPP Legal Framework

(a) Whilst the Government of Bangladesh (GOB) is in the process of developing a specific legal framework for PPP projects, it is likely that during the timeframe in which the CTT project is intended to be developed, the precise legal framework will still be in the process of being developed through secondary legislation, guidance and procedures. In addition, government entities themselves will require some time to become accustomed to new procedures and practices.

(b) In particular, although this project is expected to be developed under the 2010 Special Power Act, this project may become the first infrastructure project to be developed under the new PPP legal framework. In such a case, it is all the more likely to be subject to delays due to uncertainties as to the legal process and the detailed procedures to be followed. Additionally, the government may take a harder stance in negotiations in order to set a precedent for future PPP projects with international investors.

(c) Whilst private investors can build certain protections into the Concession Agreement, e.g. through the change of law regime, in practice such risks will equally need to be managed through careful diligence and planning in relation to the approval process, and, on the ground, close liaison with all government entities involved.

(d) As this Project is assumed to be procured under the 2010 Special Power Act, which has precedents for IPP projects, using the similar legal framework of the IPP would limit the risks related to uncertainties in the legal framework of the Project.

(2) Change in Law

(a) In addition to the uncertainties around the legal framework and institutional processes, there is generally a risk that laws and regulations which are changed or introduced after the entry into the Concession Agreement, may increase the costs necessary to implement the CTT project, or reduce the returns of the private investor, or otherwise adversely affect the CTT project, including aspects relating to its financing. Such changes could include changes in Labour Laws, imposition of new taxes, changes in industrial and environmental standards etc. However, it is expected that this project will receive the same benefits as a coal power IPP developer, such as exemption of corporate income tax for the first 15 years, in accordance with the PSPGP.

(b) In many PPP projects around the world change in taxes on profits is seen as a risk of doing business in the country, although in emerging PPP markets such as Bangladesh, the government may be able to agree to certain “stabilisation provisions”, such as a special tax regime for the project for its whole life (or at least for a certain number of years) in order to incentivize private investment.

(c) Private investors should, at the very least, seek protections against change in law that is discriminatory, i.e. focused on the CTT project or this type of project, for instance through rights and remedies under the Concession Agreement, such as extension of time for the project company’s obligations, compensation for increased costs, and adequate termination payments.

(d) Private investors could also seek additional protection through a “most favoured nation” clause in the Concession Agreement which would place an obligation on the government to accord the same or better treatment to Japanese investors in the CTT project as investors from other countries, and by choosing a foreign law as the governing law of the Concession Agreement (see Section 8.2.3(1)).

(e) The provision of the 2010 Special Power Act has precedence over other laws, thus any change in laws shall not affect the development of this project through the 2010 Special Power Act.

(3) Government Authorisations

(a) The project company may be unable to develop or construct the CTT project or to enter into operation on time (or at all) or may not be able to secure project financing if it cannot obtain the required government authorisations.

(b) Various government authorisations will be required by the project company to do business and implement the CTT project. There is currently no “one-stop-shop” regime for obtaining all governmental authorisation. Even if private investors negotiate and agree with the exemptions and consents of the government in the Concession Agreement, specific exemptions will need to be sought from the relevant responsible government entities, who will have their own procedures and requirements that will need to be followed, and may have certain discretions to refuse government authorisations required by the project company

(c) Usually for PPP projects, it would be preferable for necessary government authorisations to be issued at the beginning of the project for the entire life of the project. To the extent this is not possible for the CTT project, the private investor should seek firm undertakings from the government in the Concession Agreement to support the project company in managing the approval process and to procure, or at least use its best endeavours to procure the necessary government authorisations to be issued and renewed in a timely manner.

(4) Government Breach of Project Agreements

(a) Implementing the CTT project may require project agreements with various government entities, e.g., the MoPEMR, CPGCBL, the relevant port authority operating the deep sea port, etc.

(b) Breach by any of those government entities of their obligations under the respective project agreements, or repudiation by such government entities of the relevant project agreement could lead to significant losses for the Project Company and delays to the CTT project, and in the worst case scenario, termination of the Concession Agreement.

(c) However, it may not be appropriate to include remedies in each Project Agreement; therefore the normal treatment is for remedies for breach or repudiation of any Project Agreement by any government entity to be comprehensively addressed in the Concession Agreement.

(d) Including a mechanism for receiving termination payments, which would be calculated to cover the private investors investments including their returns, if there is a breach of contract by the Government, would be a way to mitigate such Government Breach risks.

(5) Political Force Majeure Events

(a) Force majeure events of a political nature could include war, armed conflict, terrorism, civil war, widespread strikes, or expropriation or nationalisation of any part of the CTT project.

(b) Recently, political tension within the government has led to civil unrest and wide-spread national strikes. The JICA Study Team also understands that there have been a number of public protests in relation to coal related projects in the past, although this may be less of an issue if the CTT project is situated in an area of low environmental and social impact. Therefore, such risks are relevant and should be carefully considered by private investors seeking to develop projects in Bangladesh.

(c) Often in PPP projects governments will want to limit political force majeure events to a finite, short list in order to put pressure on private investors to bear risks which are not strictly force majeure or to address such risks through insurance. The JICA Study Team understand that commercial insurance for political risks is not readily available in Bangladesh at commercially reasonable rates. Therefore international private investors may wish to seek political insurance from non-commercial sources, such as multilateral agencies or export credit agencies.

(6) Policy Change

(a) More generally, the JICA Study Team understand that the government's current policy is to shift from using natural gas to coal for power generation and that as a result, a large number of CFPPs are currently being planned.

(b) Future shifts in government policy away from use of coal, e.g. due to change in government, or increase in coal prices in the future, may affect the viability of the CTT project, although given Bangladesh's acute need for power generation and the recent drop in coal prices, this risk may be remote, at least in the near future.

(7) Land

(a) Acquiring the necessary land ownership and land rights is often a major obstacle and risk in many infrastructure projects. The JICA Study Team understands that the land acquisition will probably be carried out by the government through a compulsory acquisition process under Bangladeshi Law, and that the relevant land will then be leased to the project company.

(b) Whilst this ensures that the land required for the CTT project will be made available, compulsory acquisition often brings with it risks of legal challenge and disruption by the previous inhabitants, especially if the price paid for the land is not adequate or reflective of market price.

(c) In addition, in order to enable international project financing, such compulsory acquisitions must be carried in accordance with international social standards. In the case of the CTT Project, in order to benefit from the use of JICA's ODA loan, any resettlement must be conducted in compliance with the JICA Environmental and Social Guidelines.

(d) The JICA Study Team understand that the optimal location of the Project will be studied as part of the FS, taking into account potential need for resettlement and impact on local inhabitants and communities. In addition, if it is necessary to relocate people, a resettlement action plan will be prepared in compliance with Bangladeshi laws and the JICA Environmental and Social Guidelines.

(e) If it is contemplated that debt financing might be sought from other sources, such as international commercial banks or export credit agencies it would be prudent for any resettlement to be carried out in a manner which is also consistent with those institutions' environmental and social guidelines.

Considering Bangladesh's geography, the current Matarbari location is the most feasible location for constructing a deep sea port, and with the land already acquired for the adjacent Matarbari CFPP, the Bangladesh Government is familiar with the land acquisition process in this area, thus the risks that the land acquisition would not be done is rather limited.

8.2.2. Natural Risks

(1) Natural Force Majeure

(a) Natural force majeure are generally natural events which are outside the control of either parties, including epidemic, plague and quarantine; explosion, accident, contamination, radiation, fire; acts of God; and accidents of navigation, air crashes, shipwrecks, etc. Such risks could cause significant delays to, damage to or even total loss of the CTT Project, both during construction and operation.

(b) Natural force majeure risks should be considered when choosing the optimal location for the CTT Project. Private investors will seek protection from such risks through insurance and risk allocation under the Concession Agreement, although it can be expected that such risk, at least to the extent not insurable, would be shared to some degree between the Government and the private investor.

(c) To mitigate some of the natural force majeure risk, such as flooding due to monsoon and cyclones, the CTT Project is proposed to be constructed at a height of +8 m from M.S.L. This height of +8 m from M.S.L. was decided based on the flooding data of previous years in the surrounding areas, which is described in more detail in Chapter 5.

(2) Environment

(a) Construction of the CTT Project may have an adverse impact on the environment. The CTT Project will have to comply with both Bangladeshi environmental laws, as well as the environmental and social criteria of any Project Lenders.

(b) The JICA Study Team understand that an initial environmental survey will be carried out in accordance with the JICA Environmental and Social Guidelines, and that when choosing the location of the CTT Project, the potential impact on the environment will be carefully considered.

(c) If it is contemplated that debt financing might be sought from other sources, such as international commercial banks or export credit agencies it would be prudent for any resettlement to be carried out in a manner which is also consistent with those institutions' environmental and social guidelines..

8.2.3. Legal Risks

(1) Governing law

(a) The JICA Study Team understand that in relation to government contracts the Government generally prefers to use Bangladesh law as the governing law and tends to resist attempts to use any foreign law as the governing law. Bangladeshi law is primarily derived from English law and India law and Bangladesh courts are able to draw on English and Indian jurisprudence in relation to the interpretation of the law. As such, it will be similar to English law in many respects.

(b) Nevertheless, from the private investor's perspective it would be preferable to use English law as the governing law as it is well developed and certain, supported by a strong body of case law, and more familiar to international players, especially in relation to PPP projects, and to protect themselves further against change in law risk. Particularly where the intention is to use international contractors who are likely to want to use English law as the governing law of their contracts (e.g. the Engineering, Procurement and Construction (EPC) contract or O&M contract) it would best to align the governing laws to ensure the back-to-back position with the Concession Agreement. That being said, investors often do get comfortable with Bangladesh law as the governing law, provided that relevant contracts, mostly where such contracts provide for international arbitration as the dispute resolution mechanism (see Section 8.2.3(2)) and certain other further risk mitigants, such as stabilisation arrangements.

(c) Considering the past projects of IPP's, in the past projects English Law and Singapore Law has been accepted, thus negotiating for acceptance of English Law or Singapore Law would be preferable.

(2) Dispute Resolution

(a) The JICA Study Team understand that in the contracts between the Government and international investors, arbitration is commonly specified as the dispute resolution mechanism, rather than litigation in the Bangladeshi courts or the courts of a third country (although the JICA Study Team understand that judgments of a foreign court, such as an English court, would be enforceable).

(b) It is not uncommon for the Government to agree to arbitration under international arbitration rules such as International Chamber of Commerce (ICC) or Singapore International Arbitration Centre (SIAC) rules. However, increasingly, the Government insists on the “place” of arbitration being in Bangladesh. It is not entirely clear whether this means that (i) the “seat” of the arbitration would be Bangladesh, i.e. the arbitration would be subject to the arbitration laws of Bangladesh, namely the Arbitration Act 2001, and/or (ii) that the arbitration would physically be held in Bangladesh. It seems though that the Government’s primary aim seems to be to have the arbitration physically take place in Bangladesh and that the Government has accepted to specify a foreign seat of arbitration in the past.

(c) It would generally be preferable for private investors to provide for the seat of arbitration, i.e. the jurisdiction whose laws should apply to the arbitration, to be in a predictable and familiar jurisdiction such as England or Singapore, even if the arbitration proceedings would be physically held in Bangladesh.

(d) Foreign arbitral awards are enforceable in Bangladesh, subject to certain exceptions, including if enforcement of the arbitral award would be contrary to public policy. Therefore there is a theoretical risk that arbitration awards against the Government could be set aside on public policy ground, although the JICA Study Team understand this to be extremely rare..

(e) Considering the past projects of IPP’s, in past projects Singapore has been accepted as the place for arbitration, thus negotiating for acceptance of Singapore would be preferable.

(3) Foreign Exchange Regulations

(a) There are a large number of legal restrictions on the Project Company’s ability to incur foreign debt, transact in foreign currency, remit funds abroad, operate offshore accounts etc. that require special permission from the Bank of Bangladesh and Bangladesh Board of Investment.

(b) Whilst exemptions may be readily granted in relation to loans provided by JICA due to JICA’s strong relationship with the Government, such restrictions may render it difficult to seek debt financing from other international lenders.

(c) Certain restrictions on repatriation of funds abroad could also restrict the ability of private investors in the CTT Project to extract their equity investment from Bangladesh.

(d) However, given that the BIT provides expressly for the freedom of payments, remittance and transfer of funds or financial instruments between Japan and Bangladesh (including in respect of payments, loans, proceeds of sales and process of the total or partial liquidation of an investment), and that exchange restrictions may only be imposed in exceptional financial and economic circumstances, private investors from Japan would be in a good position to negotiate exceptions from a number of or even all of those foreign exchange restrictions.

(4) Mandatory listing requirement

(a) The JICA Study Team understand that under Bangladeshi law, it is likely that the Project Company will need to be converted into a public limited company (once its share capital exceed approximately USD 5 million) and that it would also become subject to a mandatory listing requirement (within one year of its share capital exceeding approximately USD 6.4 million).

(b) Whist it may be acceptable for the Project Company to be a public limited company (and may even have certain advantages such as lower tax rates), private investors would normally want to seek an exemption from the mandatory listing requirement.

8.2.4. Commercial Risks

(1) Capacity Payments

(a) The principal source of revenue for the CTT Project would be payments under the CTSA which would be based on the availability of the facility. The private investor would largely depend on such fixed capacity payments to recuperate its capital costs and service any debt. In addition, payments could include volumetric elements to adjust for how much the facility is actually used and the variable costs of operation.

(b) This kind of structure has significant benefits to the private investors in removing market and demand risk to a large degree and creating a secure revenue stream to recover their capital costs (leaving the investor to rely on the credit worthiness of the payor of the availability payments – see Section 8.2.4(3)). The private investor should seek to provide for "deemed availability" under the CTSA to adjust payments for events that result in unavailability but which are not the responsibility of the Project Company.

(c) Considering the past projects of IPP's, this kind of Capacity payment structure has been applied, thus such same kind of payment structure for the CTT Project shall be negotiated.

(2) Demand Risk

(a) Although capacity payments go a long way in removing demand risk, demand will still drive the fundamental need for the CTT Project in practice. Since the economic rationale for the CTT is primarily to service a number of CFPPs in Bangladesh and that most of those CFPPs are still in a development or planning stage.

(b) For example, if a number of the CFPPs are never constructed and the Government does not receive sufficient coal handling fees, it may simply be unable to pay the capacity payments under the CTSA. In that case, the Project Company could probably exercise its rights to terminate the Concession Agreement and CTSA and demand termination payments from the Government.

(c) This means that the viability of the CTT could be fundamentally affected if all or a number of those CFPPs cannot be successfully developed within the anticipated time frame. Currently it is not clear how exactly all of those CFPPs would be developed. However, the Government’s ability to develop a sufficient number of the CFPPs to justify having a CTT should be carefully considered as part of the FS.

(d) In particular, the development of the Matarbari CFPP would need to be carefully considered since the CTT Project is dependent on that project not only as an end-user (excluding Units 1 and 2), but also because a number of the ancillary infrastructure required for the CTT Project would be developed as shared facilities between the Matarbari CFPP and the CTT, e.g. the deep sea port and harbour (see Section 8.2.4(5)). In addition to coordination with the Government, coordination with private developers of the CFPP and the deep sea port and harbour and their respective financiers (if relevant) would be advisable.

(e) Whilst coal import risk would not be a direct risk for the Project Company if the coal supply agreements are entered into directly between international coal suppliers and Bangladeshi end-users (e.g. the CFPPs), if the import of coal became difficult or impossible for any reason (e.g. price, availability, environmental concerns, transport etc.), then this would similarly create a risk for the CTT Project if the underlying economic rationale (i.e. servicing import of coal) was materially impaired.

(f) Considering the Bangladesh Governments policy to vastly increase import coal based CFPP’s in the future, as described in more detail in Chapter 3, there is a very high possibility that construction of CFPP’s in the future will be done.

(3) Credit risk and sovereign guarantee

(a) The current intention is for the counterparty to the Project Company under the CTSA to be the CPGCBL or BPDB (**Government Party**). This means that the Project Company will be subject to the credit risk of such entity, rather than the credit of the end users.

(b) Whilst the credit of the relevant Government Party may be supported by a sovereign guarantee, the Project Company would ultimately be subject to the credit of the Government as a whole.

(c) In reality, it may not be practicable to call on the sovereign guarantee in all instances, e.g. if the Government Party fails or delays in making a few payments. Whereas it may be possible to request commercial users to provide letters of credit or other security in respect of payments, the JICA Study Team understand that the Government would not generally agree to offer any alternative forms of security for payments.

(d) Currently most PPP projects in Bangladesh benefit from a sovereign guarantee. However, as a result of requests from the International Monetary Fund (IMF) due to the number of sovereign loans issued by the Government in relation to various projects, the Government introduced guidelines in August 2014 in relation to the grant of further sovereign guarantees and now requires the relevant line ministry to apply to the Ministry of Finance before agreeing to a sovereign guarantee in a concession agreement. Given JICA's involvement the Government may be amenable to providing a sovereign guarantee for the CTT Project, but it may depend on how many other projects are seeking approvals for sovereign guarantees at the same time.

(4) Related Infrastructure

(a) The construction, completion and operation of the CTT is dependent on the successful construction, completion and operation of a number of ancillary facilities, such as the deep sea port and the harbour, dredged access channels, roads, electricity, gas, water, and lower infrastructure related to the transport of coal to the end-users (**Related Infrastructure**). The private investor should ensure in the Concession Agreement that the Government is comprehensively responsible for such Related Infrastructure. Nevertheless, since the viability of the CTT Project is dependent on major infrastructure works such as the port, harbour, dredging and lower infrastructure which requires high capital investment, it may not be sufficient to rely on contractual protections alone, but careful coordination with and monitoring of the development and financing of such other projects may also be required.

(b) Unlike the CFPPs mentioned above, which affect the ultimate demand for the services provided through the CTT Project (but which the Project Company will largely be protected against through availability payments), the CTT's interface and dependency on the Related Infrastructure mentioned above is much higher.

(c) During the construction phase, delays in the construction of the Related Infrastructure could cause significant delays to the construction of the CTT Project, for example if the necessary access roads or electricity lines cannot be completed in time needed for the construction of the CTT Project. This would need to be addressed through careful construction planning, if necessary with the contractors implementing the related projects, and protections against delays in the construction and completion of such Related Infrastructure in the Concession Agreement and the construction contracts, e.g. provisions for extension of time, coverage for increased construction costs due to delay, etc.

(d) During the operational phase, operation and maintenance of the Related Infrastructure could affect the availability and performance of the CTT. In particular, the operational interface with the port and harbour, as well as downstream transportation to the CFPPs, will be high. Such risk can be addressed in the CTSA through "deemed availability payments", i.e. the Project Company would still be paid if the lack of availability was caused by inadequate operation or maintenance of such Related Infrastructure. However, if the Government cannot receive revenues from the end-users due to poor operation of a Related Infrastructure, it may ultimately lead to default under the CTSA and termination of the Concession Agreement. Such risk may be mitigated through careful drafting and risk allocation under the Concession Agreement under other project agreements (including construction contract, O&M agreement and financing agreements).

(5) Shared Facilities

(a) The JICA Study Team understands that the use of the deep sea port and harbour will be shared between the Matarbari CFPP and the CTT Project. It would be prudent for detailed procedures for shared use of those facilities, and risk allocation between the users, to be agreed in a "facilities sharing agreement" or other similar agreement.

(b) In addition, since there are likely to be other users of the port and harbour, such as shipping companies, or downstream transporters, it would be prudent for the Project Company to seek protection through deemed availability payments under the CTSA if the CTT is unavailable due the Matarbari CFPP not being operated in accordance with the facilities sharing agreement or caused by other users of the port and careful drafting and risk allocation under the port use agreement and/or shipping agreements which it may enter into in relation to its use of and other activities relating to the port.

(6) Currency Risk

(a) If the revenues received by the Project Company under the CTSA are in Taka, whereas it project costs (including financing costs) are payable in a foreign currency, e.g. yen or USD, the Project Company may be subject to exchange rate risk between Taka and such foreign currency.

(b) The JICA Study Team understand that the Government has accepted in certain other PPP projects with international investors to make capacity payments in USD, which may remove some of the foreign exchange risk for the private investor if its costs are also payable in USD or if it is able to hedge against exchange risk vis-a-vis USD. An alternative approach to shifting exchange risk to the Government is to include an adjustment mechanism under the CTSA which would allow for adjustments to the availability payments to compensate the Project Company for large fluctuations in exchange rate from the exchange rate which was used in the initial financial model.

(c) Even if the Government were to agree to payments under the CTSA to be denominated in a foreign currency, it may not be able to make such payments if it does not have sufficient foreign currency reserves. Although Bangladesh’s international reserves has improved for the last few years according to IMF reports, the FS should consider the potential availability of foreign reserves, especially if the Government is intending to develop a number of other projects at the same time which will also require payments to be made in foreign currency.

(d) In the IPP Model, which is in accordance with the PSPGP, the Off-taker and Government has taken on the Taka and USD currency risk. In accordance with the PSPGP, the tariff can be adjusted to reflect the fluctuation in the currency.

(7) Inflation Risk

(a) Bangladesh has in the past experienced high rates of inflation. Although in recent years inflation rate has been reduced significantly, private investors should take into account the risk of potentially rising inflation rates in the future.

(b) Availability payments under the CTSA should be adjusted for inflation, in order to ensure that the Project Company is adequately compensated if the inflation rates are higher than those assumed in the initial financial model.

(c) In the IPP Model, which is in accordance with the PSPGP, the Off-taker and Government has taken on the inflation risk. In accordance with the PSPGP, the tariff can be adjusted to reflect the inflation based on a certain index.

Chapter 9. PPP Project Assessment

9.1. Investment Structure for the Coal Transshipment Terminal (CTT) Project

(1) Investment Structure for CTT Project

As mentioned in Chapter 8, currently, projects developed jointly by the private and public, whether as a BOT, BOO, BOOT or otherwise, are subject to Bangladeshi law generally. Whilst exemptions may be negotiated with the Government on a project by project basis e.g. in respect of public procurement, transfer restrictions, foreign exchange rules etc. there is currently not dedicated legal regime for PPP projects yet.
Based on the indicative time schedule of the project, it is likely that the PPP Law would have been passed by the time the CTT Project is being tendered, but it is uncertain to what extent secondary legislation would have been promulgated at that point.

(2) Coverage of Government Support

Although the list of concerns to be covered in the government support depends on the exact nature of the project, government support to SPC should be considered.

1) Principal Project Agreements with the Government or Government entities. (Refer to the Chapter 8.1.3.)

   i) Concession Agreement

   ii) Coal Transshipment Service Agreement (if separate from Concession Agreement)

   iii) Sovereign Guarantee (if separate from Concession Agreement)

   iv) Land Lease Agreement

   v) Port Use Agreement

2) Basic conditions and principles to be agreed in the Principal Agreement with the Government or Government entities above.

   i) Allocation of Governmental Risks: Allocation of governmental risks and buy out of the investors' interest in the Project Company if;
   - there is a default by the Bangladesh JV partner in the performance of its obligations (including its obligations to secure the performance of actions by the relevant government authorities or state-owned companies);
   - certain events of political force majeure occur;
   - certain agreed events of natural force majeure occur.

ii) Ancillary infrastructure such as responsibility for dredging should be performed without imposing a load and cost on the SPC.

iii) Permits, approvals and licenses: The relevant ministry(ies) or government department(s) should assist the Project Company in obtaining government permits, approvals and licenses. The Project Company should be protected against any inability to procure all government permits, approvals and licenses required under the financing documents.

iv) Change in law: There should be a mechanism that goes beyond the inadequate provisions in the law to protect the Project Company against a change in law. If a change in law results in an adverse impact to the Project Company/investors, then the Project Company should be entitled to the reimbursement of additional costs or expenses or decreased revenues, either in the form of direct compensation or some other agreed adjustment.

v) Cost overrun: If there is an increase in the Terminal Project cost resulting from (i) a request for change, in the appraised design or otherwise, by any relevant authority, (ii) force majeure or governmental force majeure, or (iii) costs relating to land, the Project Company should be compensated, either through a direct payment and/or some other agreed adjustment.

vi) Delay of Terminal Project: In the event of delay of the Terminal Project caused by any force majeure or by default of the Bangladesh side, the commercial operations date (if the Project Company commits to one) should be extended by the duration of the delay. In addition, the relevant ministry or government department should pay the Project Company for such delay an amount sufficient to compensate the Project Company for the cost incurred arising from such event, including the cost incurred by the Project Company under the financing documents.

vii) Nationalisation or expropriation: If nationalisation and expropriation of the Terminal Project occurs, the Project Company should be entitled to terminate the Terminal Project by serving a notice on the relevant ministry or government department and to claim the agreed termination payments.

viii) Foreign Exchange

Investor should obtain guarantees of the convertibility, availability and remittability of foreign currency by the Bangladesh government. It is necessary for the investor to have discussion to obtain protection from Bangladesh government so that the Special Purpose Company (SPC) would not suffer from foreign exchange loss.

ix) Capacity Payment

The principal source of revenue for the CTT Project would be payments under the Coal Transshipment Service Agreement with the off-taker (it is assumed to be a Government entity) which would be based on the availability of the facility.

x) Sovereign Guarantee

The sovereign guarantee should, as a minimum, cover all payment obligations of the Government Entity under the, including all capacity payments and any termination payments.

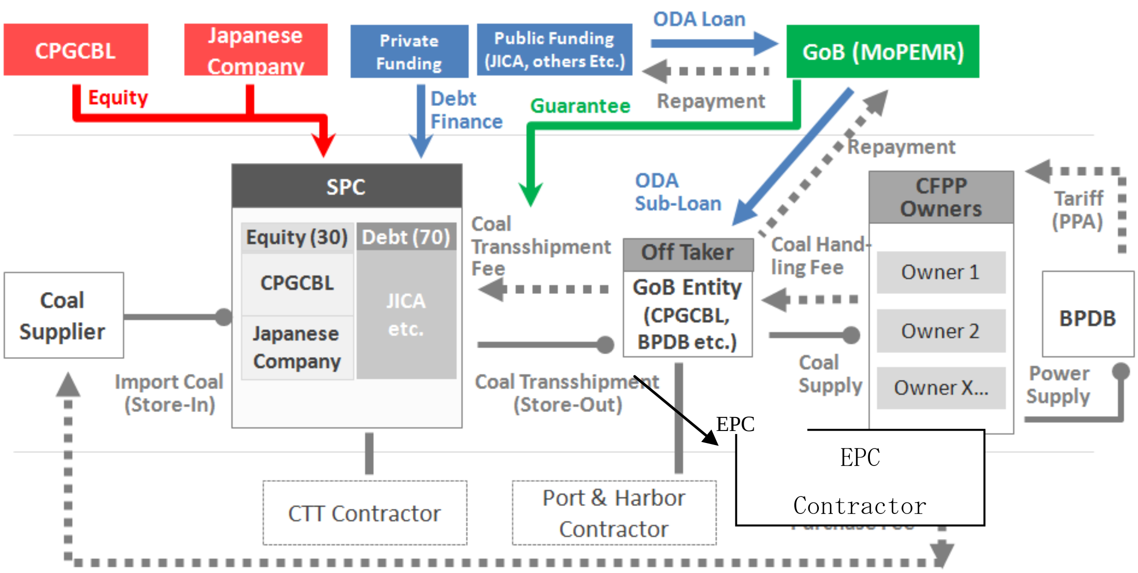
9.2. Project Execution Plan

This section proposes the project execution structure during the construction and operation phase.

(1) Project Execution Structure (Upper Infrastructure)

The SPC is supposed to be founded by joint investment of the Government entity and private company. SPC will raise the funds for the construction cost of the upper infrastructure of the CTT and will construct the upper infrastructure of the CTT. Debt financing under the JICA Private Sector Investment Finance (PSIF) which is long-term and low interest non-recourse project finance, referred to in chapter 9.4 below, is the most probable option to improve the profitability of the Project. Then, SPC will be responsible for its management and operation after completion of the construction.

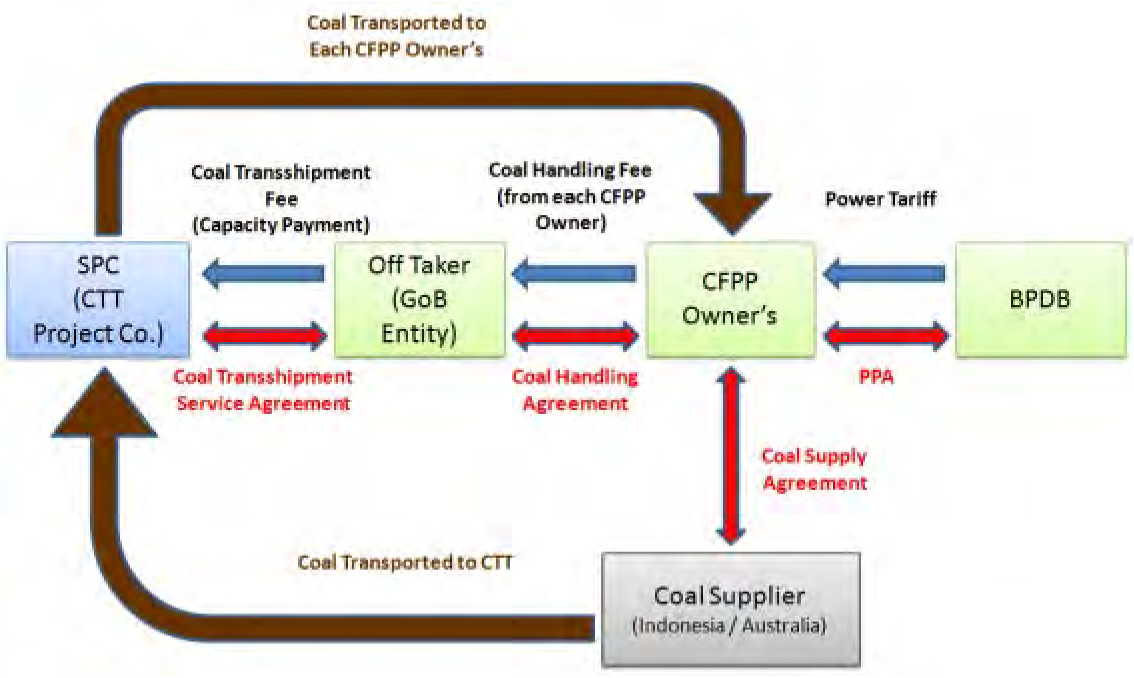
The scope of the service of SPC under the Coal Transshipment Agreement concluded between PSC and Off-taker will be receiving, stocking and making shipment of coal to a designated area of the coal transshipment terminal. (Secondary transshipment to CFPPs is not included as the scope of SPC.) The project execution structure is shown in Figure 9.2.1 below.



Source: JICA Study Team

Figure 9.2.1 Project Execution Structure for the Upper Infrastructure of the CTT

The coal and cash flow in the project is shown in Figure 9.2.2 below.

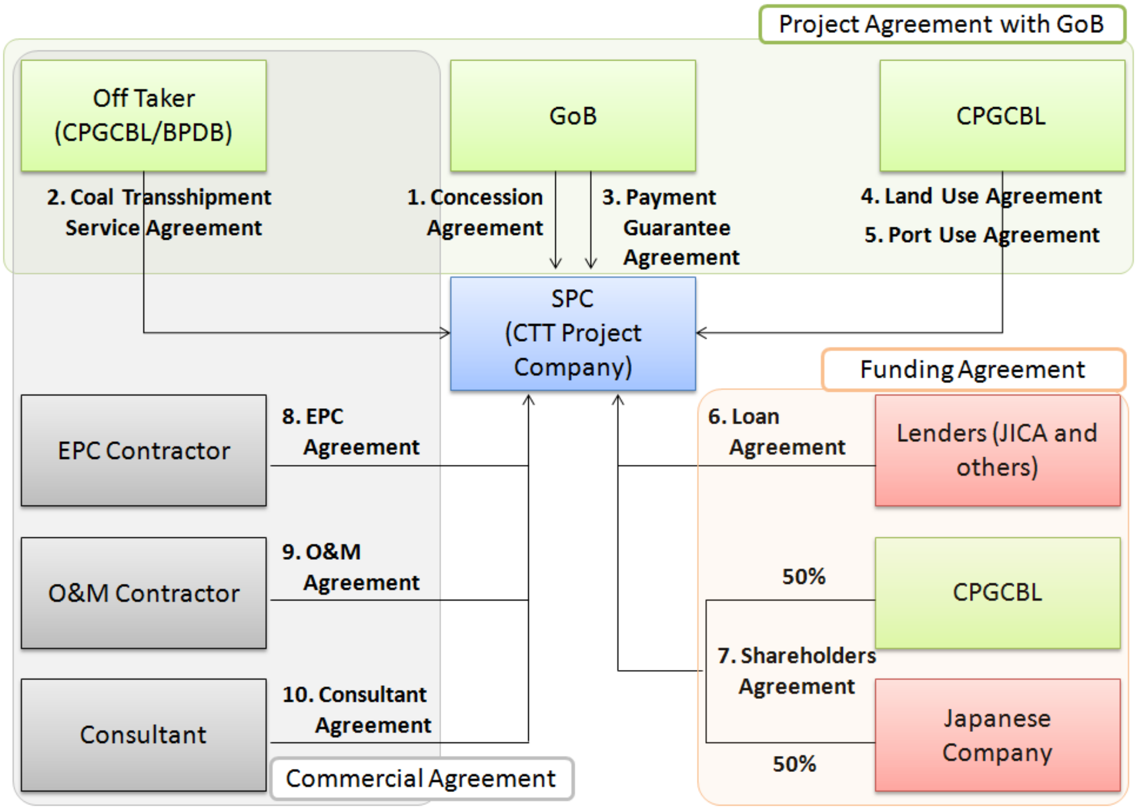


Source: JICA Study Team

Figure 9.2.2 Coal and Cash Flow of the Project

(2) Principal agreements to be concluded by SPC

The SPC will make contracts stipulating the construction of the upper infrastructure of the CTT and its operation and management with the Government of Bangladesh, referred to in chapter 9.1(2) above, and will order the construction, engineering, and procurement of the CTT to the EPC contractor. SPC will order the operation and maintenance of the CTT as necessary. Principal agreements to be concluded by SPC are shown in Figure 9.2.3 below.



Source: JICA Study Team

Figure 9.2.3 Principal Agreements to be Concluded by SPC

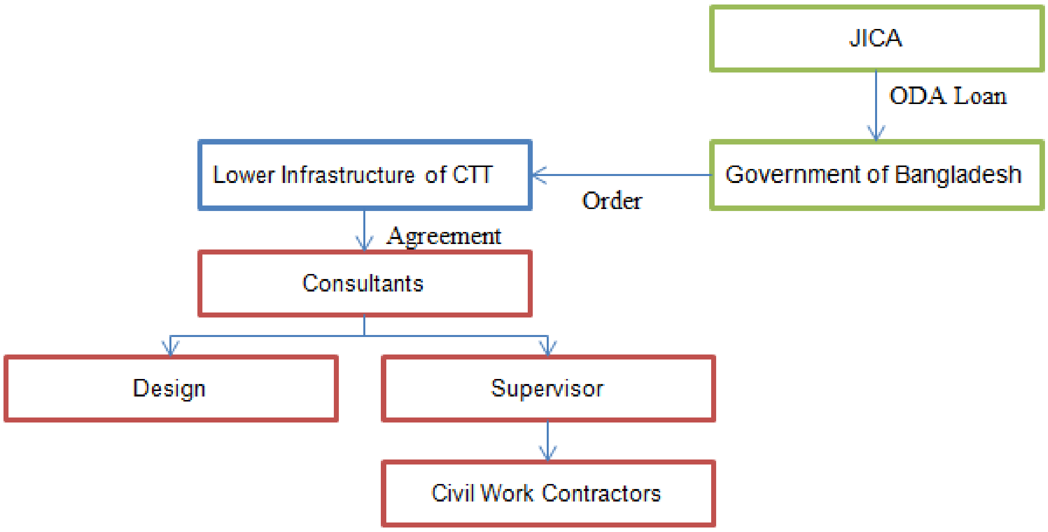
(3) Investor of SPC

It is recommended that the SPC, which raises funds, constructs, manages, and operates the upper infrastructure of the CTT, should have an experience of operating and managing the CTT in Bangladesh or some other countries and of procuring and supplying coal domestically and internationally and is a coal user, such as IPP operators.

(4) Project Execution Structure (Lower Infrastructure)

Utilising public funds, such as ODA, the Government of Bangladesh will raise the funds for the construction cost of the lower infrastructure of the CTT and then construct it. After completion of the construction, the Government of Bangladesh will maintain, manage, and operate it.

The project execution structure of the lower infrastructure of the CTT is shown in Figure 9.2.4. The Government of Bangladesh will order the operator of the lower infrastructure of the CTT. The operator of the lower infrastructure of the CTT will hire a consultant who is responsible for the design and construction management of the lower infrastructure of the CTT. The operator will enter into civil construction contract with each civil contractor. The consultant will support the procurement activities related to invitation of tenders, evaluation, and selection of the successful bidders. After completion of the lower infrastructure of the CTT, the operator will manage and operate it.



Source: JICA Study Team

Figure 9.2.4 Project Execution Structure for the Lower Infrastructure of the CTT

(5) Possibility of Enlarging the Scope of Business

At this moment, coal importer has not been clearly decided yet. But as there is high possibility that CPGCBL should be appointed as coal importer, it is assumed that the scope of CTT business in this survey will be receiving, stocking and making shipment of coal considering that the customers of the CTT are CFPPs or coal importers. In case that the SPC operating the CTT becomes a coal importer and enlarge its business scope to coal procurement, coal stock management, and coal sales, it can possibly contribute to mitigate and minimise the commercial risks of the SPC. Main customers of the CTT, i.e., CFPPs, will also possibly enjoy reducing coal procurement cost and coal stock cost and improving their bargaining power in negotiating with coal shippers and shipping companies. In this case, it is essential that SPC has not only the know-how of the CTT operation, but also cooperation with business partners having ability to procure coal from shippers which are able to stably and competitively supply coal.

9.3. Project Execution Plan

After this FS study is completed, the potential private investor and CPGLBL will form a Joint Working Team, and commence discussion on Principal agreements to be concluded between the SPC and the Government or Government entities. It is important to materialise the project as soon as possible under the 2010 Special Power Act. Besides, forming the Joint Working Team could bring the smooth discussion on the shared use of coal handling facilities of Matarbari CFPP mentioned in Chapter 10 of this report so that the CTT and CFPP can maximise benefits of each project. Followings are the plan of project implementation up to the selection of the private investor.

1. MOU Conclusion

   The private investor and CPGCBL conclude a Memorandum of Understanding (MOU) to agree to proceed, develop and implement the project under the 2010 Special Power Act.

2. Forming Joint Working Team

   Joint Working Team is formed by the private investor and CPGCBL, and the project is implemented and developed by this working team.

3. Negotiation of the Principle Project Agreements

   The potential private investor and CPGCBL will negotiate the Principle Project Agreements to reach a mutual agreement each other.

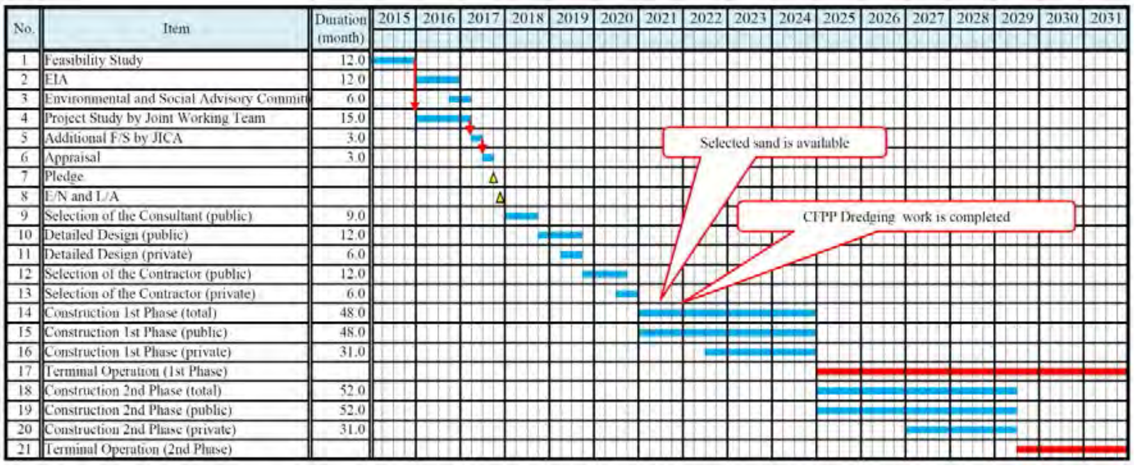
4. Detailed Proposal by the Private Company to MoPEMR

   In parallel with 3. Above, the Private Company will make detailed proposal and submit to MoPEMR.

5. Approval of the proposal

   After MoPEMR and Cabinet Committee on Economic Affairs (CCEA) approve the proposal, the Private Company can implement the project.

<Base Case>



Source: JICA Study Team

Figure 9.3.1 Tentative Project Schedule

9.4. Operation and Effectiveness Index

Table 9.4.1 shows the operation and effectiveness index in terms of technologies, economics and finances, investment regime, and environmental and social considerations.

Table 9.4.1 Operation and Effectiveness Index

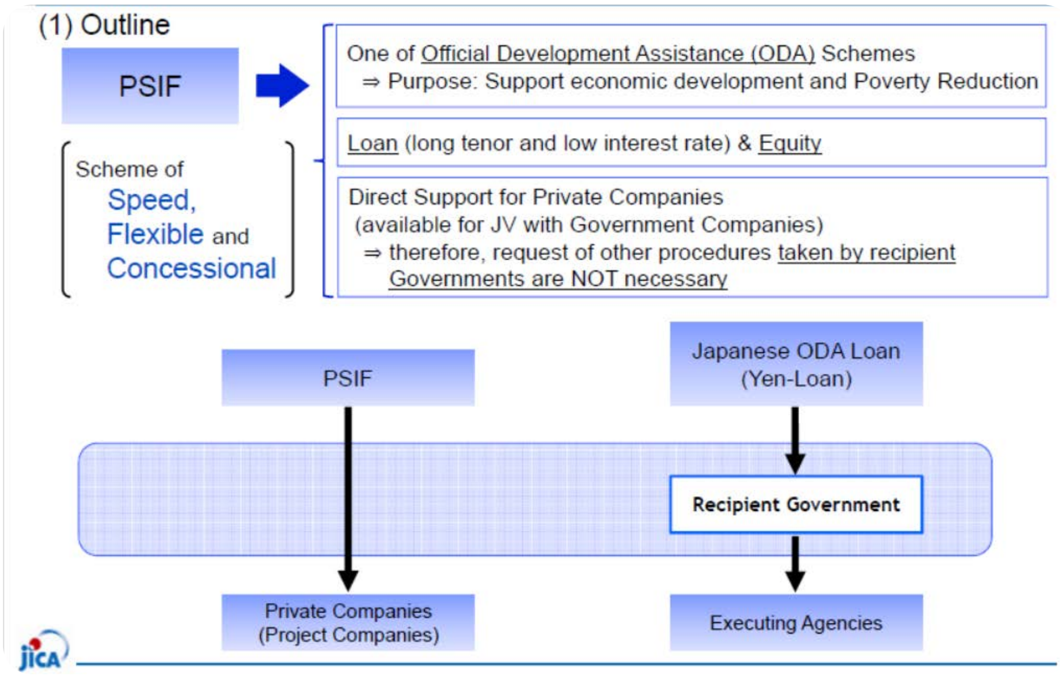
Item	Before Project Execution	Project Execution Phase
Objective	Evaluating the possibility of project execution	Securing sustainability of the project
Technologies	Validity of plan, design and selection of equipment	-
	Validity of construction techniques	-
	Validity of maintenance and management plan	-
Economic and Finance	Benefits to economics in Bangladesh (Economic IRR: min. 12%)	Maintaining benefits directly or indirectly by the project
	Investment possibility by private investors	Maintaining profitability, financial stability, and effectiveness of assets
	Validity of price decision based on forecasting precise demand	Appropriate action for changes based on forecasting precise demand
	Validity of investment and operation cost	Additional investment depending on demand increment, management of investment cost, and continuous operation improvement
Investment Regime	Compliance with Bangladesh Laws	Action for change in law
	Validity of risk allocation Risk mitigation (Support from the government)	Action for risks
	Selection of JV partners	Validity of role allocation of the private and public sectors
Environmental and Social Considerations	Consideration on social environment	Consideration on social environment

Source: JICA Study Team

9.5. Possibility of Private Sector Investment Finance

(1) JICA Private Sector Investment Finance

The JICA Private Sector Investment Finance (PSIF) supports projects which contribute to development in developing countries by the private sectors through its financing and investment. The aim is that JICA, which has a lot of experiences in investments in developing countries, makes the projects viable when the projects cannot receive financial supports from the private banking sectors through taking risks by JICA.



Source: JICA

Figure 9.5.1 JICA Private Sector Investment Finance (JICA)

(2) Feature of PSIF

As shown in Figure 9.5.1, JICA PSIF is a long-term and low interest loan. Unlike ODA, JICA PSIF does not need governmental guarantee and provides loans equivalent to non-recourse project finance. The project can get JICA PSIF on the condition that Japanese private sectors join the project. The maximum financed amount of JICA PSIF is 70% of the total investment cost.

Table 9.5.1 Principal conditions of PSIF and ODA loan

	PSIF	ODA Loan
Type of Project	Private	Public
Equity / Loan	Equity / Loan	Loan
Currency	JPY Local currency (only when swap market is available) USD	JPY
Terms of Loan		(For Bangladesh)
- Interest	JPY Fixed (Base rate: GoJ Bond plus Risk Premium), Local Currency (Floating rate decided by swap from JPY fixed rate above), USD(Base rate: 6 month Libor plus Risk Premium)	General Terms : 1.4% Preferential Terms : 0.2% General Terms: up to 30years Preferential Terms : up to 40 years (To be revised periodically) Generally up to 5years
- Repayment period	Generally up to 20 years	85% of total project cost
- Grace Period	Generally up to 5 years	
- Maximum Share	70% of total project cost.	
Procedure	Initiated by the private company's request	Initiated by official request by government of recipient countries
Security Package	Sovereign guarantee is not required	Sovereign guarantee or Government borrowing

Source: JICA

(3) Merits of PSIF

PSIF is able to improve the profitability of the private sectors as its interest is lower than the long-term loan interest of commercial banks in Bangladesh. Improvement of the profitability will increase the investment amount by the private sector, which will then reduce the investment amount by the public sector. Therefore, PSIF can reduce the amount where the public sector has to bear in the PPP infrastructure project. This can also reduce the amount where the Government of Bangladesh has to bear in the Project as well as improve the profitability. As PSIF can also provide 20 years (maximum 25 years) long-term loan, it is desirable for the CTT Project which lasts for many years.

(4) Other Possible Options in Raising Funds

Other than the loan directly lent to SPC by JICA, another option is the two-step loan in which SPC obtains loan through commercial banks in Bangladesh. However, considering the huge investment amount required in the CTT Project, it is difficult for commercial banks in Bangladesh to lend this amount taking their capital capacity in finance into account.

It may be another option to use the Export Credit Agency (ECA), such as International Finance Corporation, but it may require very rigorous review to fund coal-fired power plant-related projects given that the World Bank, European Investment Bank, and European Bank for Reconstruction and Development are following the policy of the "National Climate Change Action Plan" of the United States of America.

It is also difficult to find non-recourse project finance from Japanese commercial banks because they will have difficulty taking risks for huge and long-term loan in a developing country without any guarantee from ECA, and obtaining the guarantee from ECA will be difficult as explained above.

Considering the above, it is very important to utilise JICA PSIF in order to realise the CTT Project.

(5) Subjects of JICA PSIF

As JICA PSIF is denominated in yen only, the private sector receiving this loan will manage to transfer the exchange rate risks to the Government of Bangladesh or off-takers as it is impossible for the private sector to bear exchange rate risks. JICA studies the possibility of introducing PSIF denominated in local currency. However, the Bangladesh currency is not subject to this consideration by JICA. It is expected that loan denominated in US dollar is realised at an early date as it is also the agenda for the Government of Bangladesh to bear exchange rate risks.

Chapter 10. Proposed Plan of CTT

10.1. Unified Management of Coal Handling Facilities of Matarbari CFPP and CTT

The recommendation plan is proposed for efficiency of the CTT project. The plan is to manage coal handling facilities of Matarbari CFPP No.1 and No.2 and the CTT integrally. The Matarbari CFPP No.1 and No. 2 plan to construct coal unloading berth and coal stockyard of which capacity have leeway of operation. Therefore, it is possible to make the operation more efficient by unified management of the CFPP and CTT.

The detail of proposal plan is as follows.

(1) <u>Unloader capacity installed for Matarbari CFPP is improved to 2,500t/h</u>

(2) <u>Coal unloading berth and coal stock yard for Matarbari CFPP are shared with CTT project</u>

(3) <u>CTT supplies fuel coal to Matarbari CFPP.</u>

One of the advantages of the proposed plan is to reduce quantities of coal handling facilities for CTT. The facilities which can be reduced and quantities of the facilities are shown as follows. The detailed comparative study of each facility is shown in the next section.

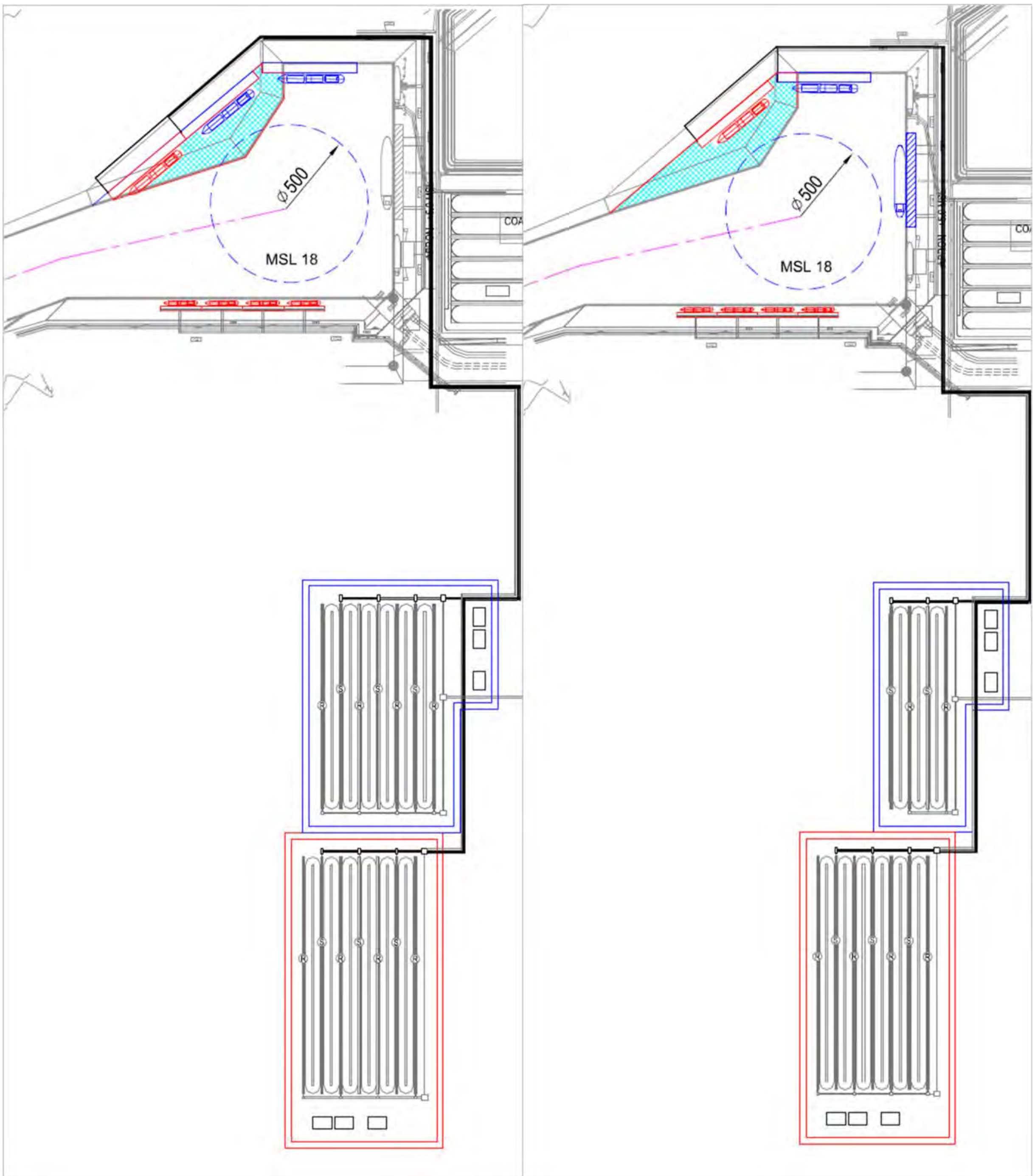
The investment cost of the project at the initial phase is also reduced with decreasing quantities of the facilities. The expected reduction cost is roughly estimated as follows:

		Current Plan (non-shared)		Unified Management Plan
Unloading Berth	(Unit)	4	⇒	3
Unloader	(Unit)	8	⇒	6
Coal Stockyard	(ha)	120	⇒	105
Stacker / Reclaimer	(Unit)	18	⇒	16

The advantage of the unified management plan is explained as follows. It is possible to save initial investment cost.

<u>1. Save of Initial Construction Cost</u>

Direct Cost	non-shared	929 mil USD	⇒	shared	831 mil USD
				Save	98 mil USD



Source：JICA Study Team

Figure 10.1.1 Layout of CTT Facilities （Left：non-shared、Right：shared）

10.2. Comparative Study of Each Coal Handling Facility

10.2.1. Port Planning under Common Use

The coal unloading berth of the Matabari CFPP is equipped with two unloaders, each with a capacity of 800t/h. The capacity of this berth is sufficient to meet the demand if this berth is dedicated only to the CFPP. However, this berth has only 1/3 of the capacity of the ones of the CTT. If the port facilities and terminal facilities are utilised commonly and the CTT provide fuel coal even for the CFPP No1~No2, the efficiency of terminal operation could be vastly improved. The total investment cost could also be reduced.

Coal handling demand of the CTT is estimated as below in case the CTT provides fuel coal to the Matabari No.1 and No.2 CFPP.

Table 10.2.1 Import and Transshipment Volumes of Coal (unit: million tonnes)

Year	Import Volume	Supply by Land Transportation	Transshipment Volume
2025	13.5	13.5	0
2029	29.0	21.1	8.0

Source: JICA Study Team

(1) Required Number of Coal Unloading Berths

1) 1st Phase: Handling volume of coal is 13,500,000 t/year.

Total number of calling vessels in a year is 178 (13,500,000/76,000 = 177.6)

Two berths are necessary to meet the UNCTAD Standard. The berth occupancy rate is 39.7% ((178x1.49/350=0.758)/2=0.379) and the average waiting time drops to between 0.06~0.13 days.

By common use of the port facilities of the CFPP and the CTT, the required number of coal unloading berths could be reduced. Then only one coal unloading berth is required.

	λ (=178/350)	μ (=1/1.49)	ρ	wQ
M/M/1	0.5086	0.671	0.562	1.911
M/D/1	0.5086	0.671	0.562	0.956
M/M/2	0.5086	0.671	0.281	0.128
M/D/2	0.5086	0.671	0.281	0.064

2) 2nd Phase: Handling volume of coal is 29,000,000 tonnes.

Design vessel and the method to determine the number of berths are the same as in the 1st Phase.
Average berthing days: 1.49 days
Number of calling vessels per year: 382 (29,000,000/76,000=381.6)
Number of berths: 3 ((382 x 1.49) / 350=1.626)/3 =0.542)

Therefore, the number of berths is three and berth occupancy ratio becomes 54.2 % which satisfies the criteria of UNCTAD. The average waiting time of vessels is calculated to fall within a range of 0.15 to 0.31 days. The required number of coal unloading berths in the 2nd Phase is set as three. Therefore, one additional berth will be developed to accommodate Panamax-size vessels.

	λ (=382/350)	μ (=1/1.49)	ρ	wQ
M/M/2	1.091	0.671	0.813	2.905
M/D/2	1.091	0.671	0.813	1.452
M/M/3	1.091	0.671	0.542	0.308
M/D/3	1.091	0.671	0.542	0.154

(2) Required Number of Coal Loading Berths

The coal loading berths are exclusively used by the CTT instead of the CFPP, and thus the required number of coal loading berths would be the same as in the case of independent operation. In case the oil berth of the CFPP could also be used as a coal loading berth, the number of coal loading berths could be reduced.

10.2.2. Staged Plan (Port Facilities of the CFPP are Under Common Use)

The staged plan for port and terminal planning is proposed as follows. The plan is divided into 2nd Phases depending on the increasing coal demand.

(a) 1st Phase Development Plan

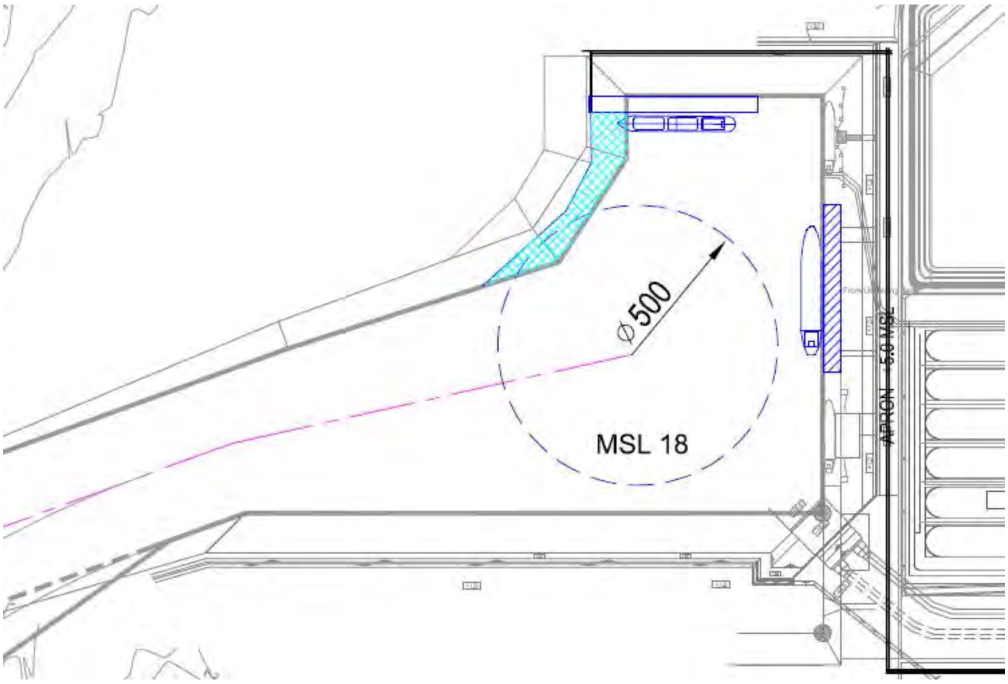
The 1st Phase Development Plan with the target year of 2025 is shown below.

Table 10.2.2 Short Term Development Plan (excluding the CFPP)

Coal Demand		1,350 million tonnes	
Port Facility		Unloading Berth	Loading Berth
	Design Vessel	Over Panamax (80,000DWT)	－
	Berth (Number, Length Depth)	(2,300m,16m)	(－,－)
	Approach Channel (Breadth, Depth)	(250m,16m)	－
	Turning Basin (Depth)	16.0m	－
	Handling Equipment	Unloader 4 Capacity 2,500t/h	－
Layout of Port and Terminal		Figure 10.2.1	

Source: JICA Study Team

The number of the coal unloading berths could be reduced by one. The coal unloading berths can be located at the north side of the turning basin (Area A) as shown in Figure 10.2.1. Since all the large ship berths will face the turning basin, effective berthing/leaving becomes possible. In addition, the distance between the berths and coal stock yard could be minimised. Since more than one large vessel will stay in the port, it is necessary to secure a turning basin that is 50 m apart from the quay wall in order to let a large vessel turn whilst another vessel is at berth. Expansion of the water area of 5.0 ha is necessary.



Source: JICA Study Team

Figure 10.2.1 1st Phase Coal Loading Berth Layout Plan (1)

(b) The 2nd Phase Development Plan

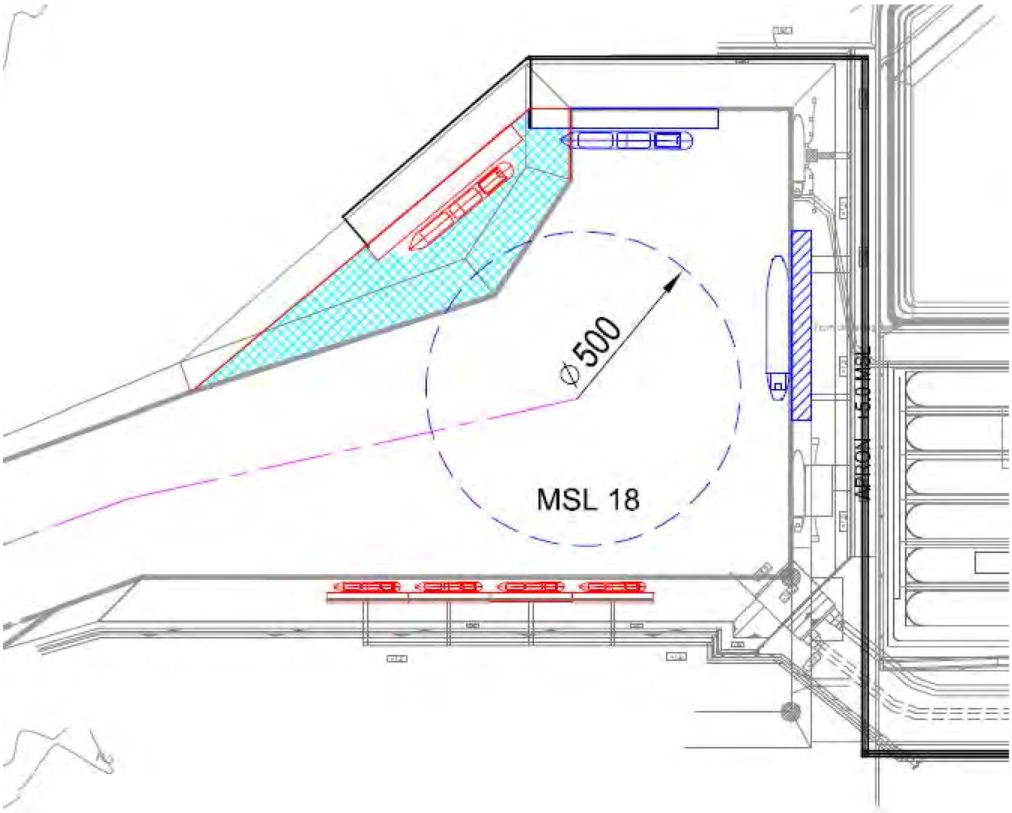
The 2nd Phase Development Plan with the target year of 2029 is shown below.

Table 10.2.3 Short Term Development Plan (excluding the CFPP)

Coal Demand	29.0 million tonnes	
Port Facility	Unloading Berth	Loading Berth
Design Vessel	Over Panamax (80,000DWT)	5000DWT-
Berth (Number, Length Depth)	(3, 300m, 16m)	(4, 130m, 7.5m)
Approach Channel (Breadth, Depth)	(250m ,16m)	—
Turning Basin (Depth)	(16.0m)	(7.5m)
Handling Equipment	Unloader 6 Capacity 2,500t/h	Loader 4 Capacity 1,500t/h
Layout of Port and Terminal	Figure 10.2.2	

Source: JICA Study Team

In the 2nd Phase Development Plan, one more coal unloading berth is required in addition to the one constructed in the 1st Phase Development Plan. It is possible to secure the necessary length of the water front line and water area of the mooring basin for the new berth as shown in Figure10.2.2.



Source: JICA Study Team

Figure 10.2.2 2ndPhase Coal Unloading Berth Layout Plan (1)

In case the berths cannot be located at the north side of the turning basin due to the close proximity to inhabited areas or the channel for discharging heated water, large ship berths could be located along the north side of the main channel by expanding the main channel northward as shown in Figure10.2.2. Expansion of the water area of 6.0ha is necessary. In this plan, it takes a long time for the large ships to berth since the new berth is located far from the turning basin. On the other hand, leaving the berth is easy and takes less time. The distance between the new berth and the coal stock yard would be longer than the other layout plan

10.2.3. Terminal Planning under Common Use Plan

The coal stock yard for Matarbari CFPP No1 and No2 are planned to storage coal of which volume is equivalent to consumption of coal used for electric generation at Matarbari CFPP under condition of 100% of continuous operation for 60 days. The volume of storage capacity is 830,000 tonnes and area of stock yard is 25 ha.

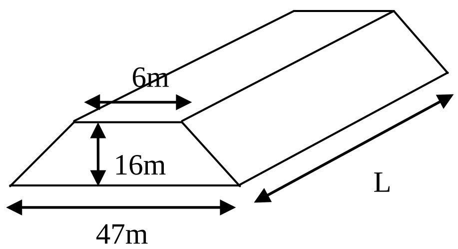
The following conditions for terminal planning are set up.

- Coal handling volume at terminal (stock): 13.5 million t/year (Phase 1), 30 million t/year (Phase 2)*
- Specific gravity: 0.9
- Coal stock volume at terminal: for 30 days
- Yard operation efficiency: 0.75
- Unloader: continuous type 2,500t/h
- Ship loader: 1,500t/h
- Stacker / reclaimer: 5,500t/h, 3,000t/h
- Belt conveyor (unloading): 6,000t/h
- Belt conveyor (discharging): 3,600t/h

* Supply coal volume for Matarbari CFPP No1 and No2 is estimated as 3.5 million ton.

(1) Required Coal Stock Volume at 1st Phase

The dimensions of stock pile are determined as illustrated below.



The sectional area is calculated as follows. A＝(6 + 47) x 16 ÷ 2＝424 m^2.

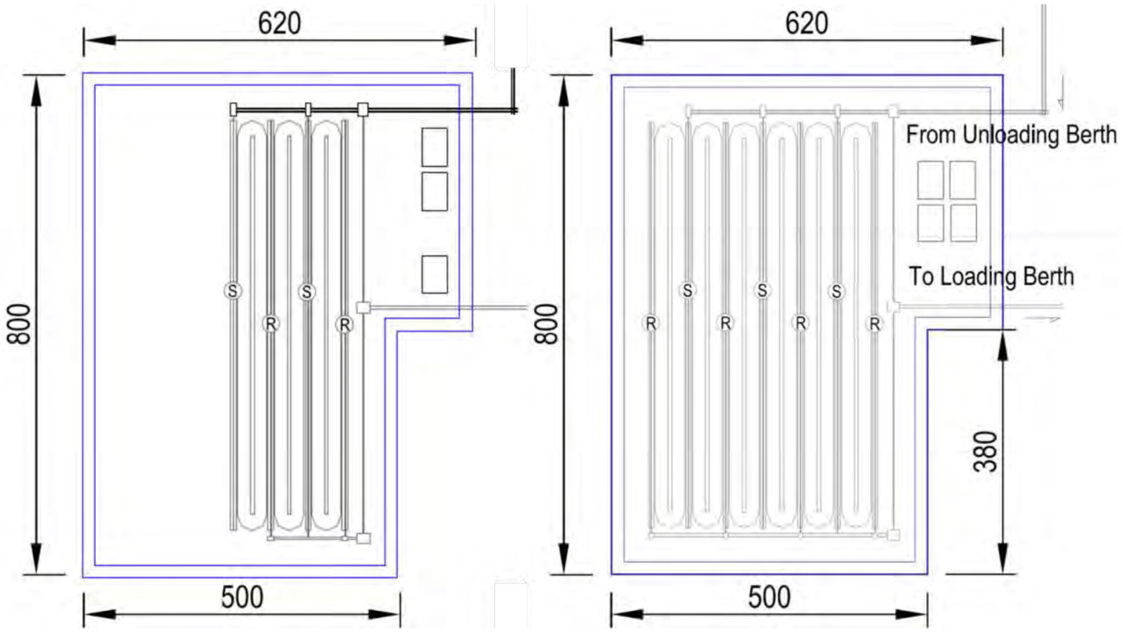
Coal stock volumes, length, and number of stock piles and the required terminal areas for the 1st Phase plan are computed and summarised below. It is assumed that coal will be transported with belt conveyor from unloading berth to coal fired power plant, which Singapore enterprise has a plan to invest and develop.

Table 10.2.4 Required Area (1st Phase)

	Coal Stock Volume	Efficiency of Coal Stock	Length of Stock Pile (m)	Number of Stock Pile	Required Area (ha)
	Total：125 CFPP：83 CTT：42	0.75	CFPP：540 CTT：600	6 3	CFPP：25 CTT：30

Source：JICA Study Team

Required area for coal stock yard of CTT is 31 ha, and it is possible to reduce 14 ha compared with the case under non-common use. The volume of stock pile and equipment such as stacker or reclaimer are also reduced.



Source：JICA Study team

Figure 10.2.3 Layout of Coal Stockyard（1st Phase Left：Shared、Right：Non-shared）

(2) Required Coal Stock Volume in the 2nd Phase

Coal stock volumes, length and number of stock piles and the required terminal areas for the 2nd Phase plan are computed and summarised below.

Table 10.2.5 Required area (2nd Phase)

	Coal Stock Volume	Efficiency of Coal Stock	Length of Stock Pile (m)	Number of Stock Pile	Required Area (ha)
1st Phase	Total：130 CFPP：83 CTT：47	0.75	CFPP：540 CTT： 600	CFPP：6 CTT：3	CFPP：25 CTT：30
2nd Phase	CTT：125	0.75	CTT： 700	CTT：6	CTT：50

Source：JICA Study Team

Chapter 11. ENVIRONMENTAL AND SOCIAL CONSIDERATION

11.1. ENVIRONMENTAL CONSIDERATION

11.1.1. Legal and Policy Framework related to Environmental Assessment in the Country

The Bangladesh Environmental Conservation Act, 1995(amended 2010) provides environmental protection of Bangladesh as the principal law. An Environmental Clearance Certificate (ECC) is obligated to obtain prior to any project implementation. Under the act, environmental assessment process is provided by the Environmental Conservation Rules, the ECR, 1997 and its amendment. For the first step of the environmental application, Initial Environmental Examination (IEE) level information is required even for the environmental impact assessment (EIA) required projects (subscribed in the Environmental Conservation Rules (ECR) 1997). Then, other steps such as approval of EIA TOR and EIA submission can be continued within the process. Major legislation related to currently proposed projects are shown below (Table 11.1.1). Regarding the Natural environment, there are no significant gaps between legislation related to environmental assessment in Bangladesh (provided in Environmental Conservation Rule 1997 and others) and the JICA Guidelines for Environmental and Social Consideration 2010 (JICA Environmental and Social Guidelines 2010) in terms of the objectives of the EIA.

The naturally important areas in the country such as environmentally critical area ecologically critical area (ECA) are provided in the Environment Conservation Act 1995. The other protected areas are provided in the Wildlife (Conservation and Security) Act, 2012. In the act, various sanctuaries, National parks, community conservation area, safari park, eco-park, botanical garden and wild animal breeding center are defined.

Besides the above mentioned areas, Forest Act 1927 (amended 2000) provides protection to forests in the country. This act defines various protected forests such as “Reserved Forest”, “Protected Forest” and “Village Forests” and providing those forest management including penalties and procedures.

Table 11.1.1 Major Legislation to Environmental Assessment

Legislation	Contents
Environment Conservation Act (ECA)1995	The act is the principal law for general environment in the country. The act, including 21 articles, stipulates (1) the conservation of the environment, (2) the authority to regulate development and environmental pollution, (3) the setting of ambient and discharge standards, (4) clearance certificates, (5)inspection of factories and production facilities, and (6) violation penalties.
Environment Conservation Rules (ECR)1997	The rules provide detail environmental process under the ECA and it stipulates (1) the setting of national standards for air and water quality, discharges of gas and water for industries, and noise and vehicle exhaust; (2) the process of Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA); and (3) the designation of specific areas that are important for environment conservation.
EIA Guidelines for Industries, 1997	This is a handbook of guidelines outlining procedures for preparing EIAs and for reviewing them. The handbook consists of the following: • EIA procedures • Screening of industrial projects • Application for Environmental Clearance • Review of EIA Report • Methodology for the EIA Process.
Environment Court Act, 2000	The aim and objective of the Act is to materialize the Environmental Conservation Act, 1995 through judicial activities. The main features of this Act are: • The Government will establish Environmental Courts, one or more in every Division • Jurisdiction of the Courts • Procedure of activities and power of the Courts • Right of Entry for judicial inspection, and • Appeal and constitution of Appeal Court.
Wildlife (Conservation and Security) Act, 2012 (Act No. XXX of 2012)	This is an act to provide for the conservation and safety of biodiversity, forest and wildlife of the country. The previous Wildlife (Preservation) Order, 1973 was repealed with enactment of the act. Sanctuaries such as wildlife sanctuary, elephant sanctuary, wetland dependent animal sanctuary, marine protected area, national parks, community conservation area, safari park, eco-park, botanical garden and wild animal breeding center.
Forest Act 1927 (amended 2000)	This is an act to consolidate the law relating to forests, the transit of forest-produce and the duty leviable on timber and other forest-produce. This act consists of 13 chapters defining protected forests such as “Reserved Forest”, “Protected Forest” and “Village Forests” and providing those forest management including penalties and procedures. The act includes declaration process for the reserved forests and protected forests from forest lands or waste land.

Source: JICA Survey Team, FAO Lex,

The environmental legislation in the country, Bangladesh is analysed in line with the principles of the JICA Environmental and Social Guidelines as shown in the table below.

Table 11.1.2 GAP Analysis between the JICA Environmental and Social Guidelines and Environmental Legislation in the Country, Bangladesh

Items	JICA Guidelines (Environmental and Social Considerations Required for Intended Projects)	Environmental Legislation in Bangladesh	Measure to be held in the Current Project
1. Underlying Principles	1. The earliest possible environmental assessment to incorporate the avoidance/minimization /mitigation of the impact into the project plan. 2. Quantitative and qualitative analysis covering social and environment harmonizing economic, financial, institutional, social and technical analysis. 3. Consideration on provision of alternatives and mitigation measures. EIA report for the large adverse impact. 4. Organizing a committee of experts for the particularly large adverse impacts)	Principally, all project activities are mandatory for the conduct of environmental studies to mitigate impacts prior to project implementation. The details of principles are described in the ECA 1995. The assessment covered the evaluation of the impact depending on the scale of the projects which is categorised into four as mentioned below. The process is provided in the laws, namely: ECA 1995, ECR 1997, and also the guidelines from the Department of Environment (DoE) (in this CTT case, EIA Guidelines for Industries). Alternative study is also included as an item to be reviewed by DoE in the EIA Guidelines for Industries (Section 5). In the EIA Guideline for industries (1.7 Methodology for EIA Process) describes the responsibility of the DoE to review the report by themselves or with the Environmental Assessment Committee appointed by DoE.	No particular large gap in between.
2. Examination of Measures	1. Examination of the multiple alternatives to avoid, minimize mitigate of the impact.) 2. Preparation of appropriate follow up plans and systems such as monitoring plans and environmental management plans.	The assessment covered evaluation of the impact depending on the scale of the projects, which is categorised into four as mentioned below. The process is provided in the laws, namely: ECA 1995, ECR 1997, and guidelines from the Department of Environment (in this CTT case, EIA Guidelines for Industries). Alternative study is also included as an item to be reviewed by DoE in the EIA Guidelines for Industries (Section 5). The requirement of the follow-up plans such as EMP and EMoP are described in the EIA guideline for Industries. Also, the plans are followed up at the process of the annual extension of the Environmental Clearance Certificate (ECC) and annual environmental audit.	No particular large gap in between.

3. Scope of Impacts to Be Assessed	1. Impacts on human health and safety, as well as on the natural environment, transmitted through air, water, soil, waste, accidents, water usage, climate change, ecosystems, fauna and flora, including trans-boundary or global scale impacts. 2. Examining derivative, secondary, and cumulative impacts indivisible from the project.	The contents of assessment covered evaluation of the impact depending on the scale of the projects which is categorised into four as mentioned below. The process is provided in the laws, namely; ECA 1995, ECR 1997, and the guidelines from the Department of Environment (in this CTT case, EIA Guidelines for Industries). Alternative study, cumulative impact and secondary impact as project caused impact are also included as items to be reviewed by DoE in the EIA Guidelines for Industries (Section 5).	No particular large gap in between.
4.Compliance with Laws, Standards, and Plans	1. Compliance with the laws, standards, policies, and plans. 2. Avoidance of the protected and conservation area of natural or cultural heritage designated by laws and ordinances. 2. Avoidance of the protected and conservation area of natural or cultural heritage designated by laws and ordinances.	Legal compliance is one of the items to be evaluated by the authority and these are: -Comparison with laws, regulations, or accepted standards; - Reference to pre-set criteria such as protected sites, features, or species; -Consistency with government policy objectives; -Acceptability to the local community or the general public; -Severity of the impact (reversible or irreversible); -Prevalence (eventual extent of impact); -Duration and frequency of the activity causing adverse impact; -Risk (probability of serious environmental effects); -Importance (local, regional, or national) -Mitigations (are solutions available to prevent or reduce severity of adverse impact to acceptable level).	No particular large gap in between. The environmental study can be conducted in accordance with the Bangladesh legislation and JICA Environmental and Social Guidelines (2010).
5. Social Acceptability	1. Adequate social coordination for their acceptance. In case of a large impact, sufficient consultation with local stakeholders via information disclosure at the early stage to be incorporated into the project plan.) 2. Consideration of the vulnerable people	Public participation is required in the EIA process to be incorporated into the EIA report (4.11 Public Participation in EIA Guidelines for Industries). It recommends to communicate with the public, as many people as possible, as early as possible, and through many different ways as possible.	Overall recognition of the importance of the public participation such as public consultation meeting are shared. Referring the other project experiences, adequate public consultation (public participation) should be conducted/considered.
6. Ecosystem and Biota	1. Avoidance of degradation of the natural resource 2. Avoidance of illegal logging	Section 2, Criteria for Locating Industrial Plants, in the EIA Guidelines for Industries, “environmentally or otherwise sensitive area” is listed as one of the most important factors for consideration in site selection. Also, clearly described as “forest land or prime agricultural land should be	No particular large gap in between.

		avoided as far as practical".	
7. Involuntary Resettlement	1. Avoidance and minimisation of involuntary resettlement 2. Sufficient compensation to project affected persons (PAPs) with timely manner 3. Appropriate participation of PAPs throughout the planning, implementation, and monitoring of the RAPs with appropriate grievance mechanisms 4. In a large-scale involuntary resettlement, advance information disclosure to the PAPs should be made in an understandable way covering the elements in the World Bank Safeguard Policy, OP 4.12, Annex A.)	Section 2 in the EIA Guidelines for Industries, "human settlement" is listed as one of the most important factors for consideration in site selection. Also, the resettlement is described in the checklist of the EIA guidelines as an important environmental component. However, there is no particular description on the minimisation of the resettlement.	No particular large gap in between. The compensation scheme should include proper compensation to the informal occupants in the area in accordance with the JICA Environmental and Social Guidelines (2010). There is a concern that the informal occupants in the area do not properly obtain eligibility of compensation.
8. Indigenous Peoples	1. Avoidance and minimising impacts to indigenous people 2. Respect for indigenous people's right obtaining their consent in a process of free, prior and informed consultation 3. Adequate measure to the adverse impact for indigenous people in the Indigenous Peoples Plan must be made in an understandable way covering the elements of the World Bank Safeguard Policy, OP4.10, Annex B.	There is no particular description in the EIA assessment. However, in the country, the matters on indigenous peoples including their rights are generally applied in the legislation on the Chittagong Hill Tracts such as the CHT Accord of 1997 and the CHT Regional Council Act of 1998 (Act XII of 1998).	No particular large gap in between.
9. Monitoring	1. Adequate monitoring of the predicted mitigation measures and occurrence of unforeseeable situation. 2. Feasible monitoring plan at the planning stage 3. Available monitoring process to local project stakeholders 4. Resolving problems through discussion and examination in public with sufficient stakeholder's participation	Monitoring program is recognized as one of the most important contents of the EIA (Section 4 in EIA Guideline for Industries 1997).	No particular large gap in between.

Source: JICA Study Team based on the JICA Environmental and Social Guidelines 2010, Environment Conservation Act (ECA)1995, Environment Conservation Rules (ECR)1997 and EIA Guidelines for Industries, 1997

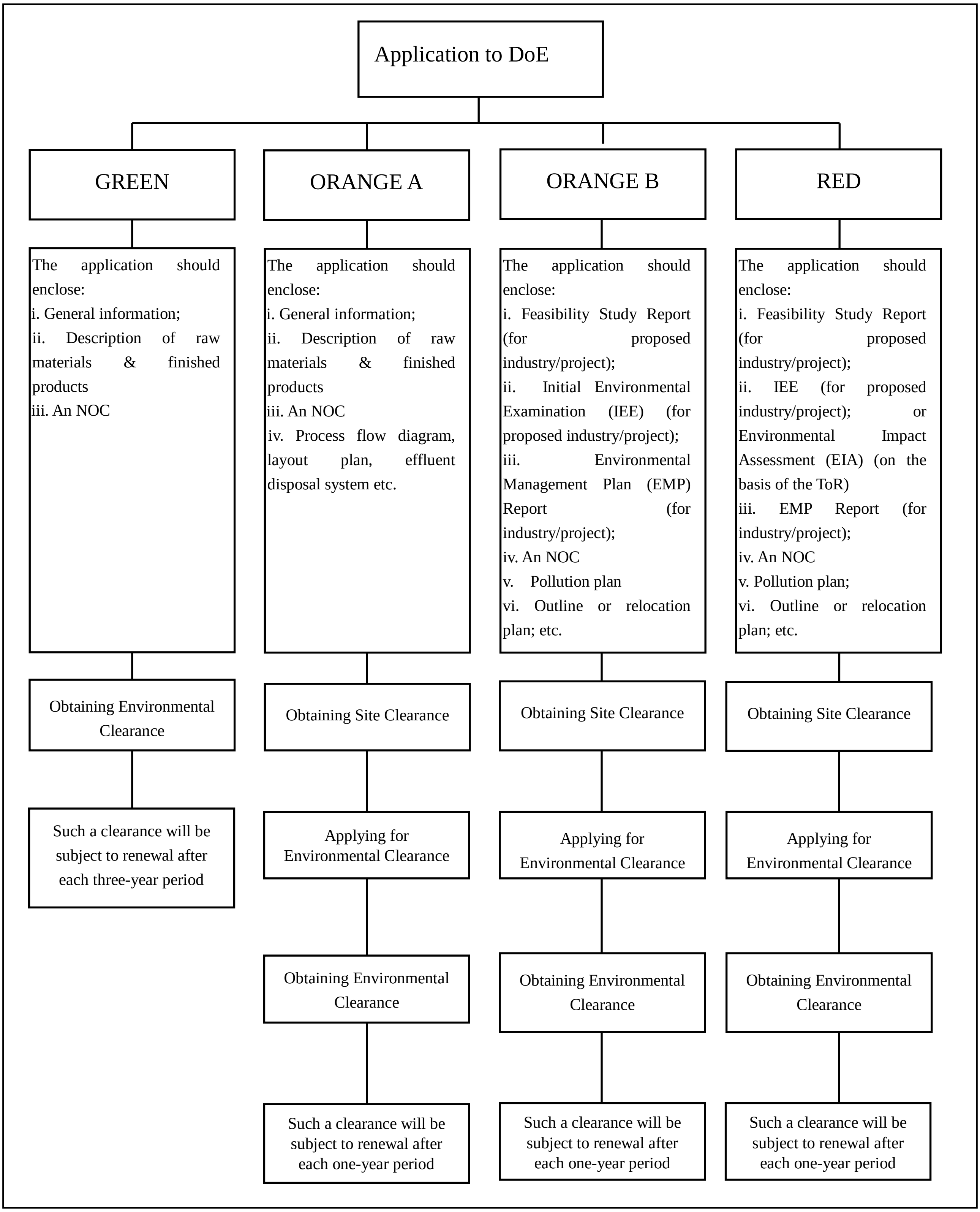
11.1.2. Environmental Assessment Process

The Department of Environment (DoE), and the Ministry of Environment and Forests (MOEF), are in charge of all the environmental assessment processes in the country. The Environmental Clearance Certificate (ECC) application process should be implemented according to the category into which the proposed project falls in line with the schedules stipulated in the Environmental Conservation Rules 1997(ECR 1997) and its amendments. The categories for industrial units and projects have been classified into four categories depending on the environmental impact and location. The DoE determines category for the proposed project at the project application. The categories and those required information are shown in Table 11.1.3 and the flow of the process in each category is shown in Figure 11.1.1.

Table 11.1.3 Category and Requirement of Each Category Provided in ECR 1997

Categories in BD.	Required Information
(a) Green	General information, no objection certificate (NOC) from the local authority, etc.
(b) Orange A	General information, NOC, Process flow diagram, Layout plan showing Effluent Treatment Plant (ETP), Waste discharge arrangement, Relocation plan if any
(c) Orange B	Feasibility Study(F/S), Initial Environmental Examination(IEE), EMP, NOC, ETP, etc.
(d) Red	F/S, IEE including TOR for Environmental Impact Assessment(EIA), ETP, EIA, EMP, NOC, etc.

Source: Environmental Conservation Rules 1997



Source: EIA Guidelines for Industries

Figure 11.1.1 Steps Involved in Environmental Clearance

11.1.3. Environmental Standard

Details of the environmental standards applicable in Bangladesh are described in the Environmental Conservation Rules (ECR) 1997. Regulated areas cover all industries, and regulated items are air quality, water quality (surface water, drinking water), noise (boundary, source), emissions from motor vehicles or ships, odor, sewage discharge, waste from industrial units and industrial effluents or emissions. In relation to the current Coal Transhipment Terminal Project, depending on the proposed project scheme, applicable standards should be followed referring to the ECR 1997(Appendix 2).

11.2. SOCIAL CONSIDERATIONS

11.2.1. Preparatory Social Survey

In order to identify a footprint of candidate CTT sites, the JICA Study Team undertook a preparatory social survey in the southern area of Matarbari CFPP and its associated port excavation with a local sub-consultant. It was observed that around the proposed area several villages and houses sporadically existed. The main purposes of the preparatory social survey are to map out the villages and houses and to count the number of residents/houses in the area around the candidate locations. It was confirmed that there are four villages with 467 households and 2,576 people in the south side of Matarbari CFPP development (see the following figure and table). Each of the villages is fairly populated. If a footprint of the CTT site overlaps one of the villages, large-scaled involuntary resettlement would take place.

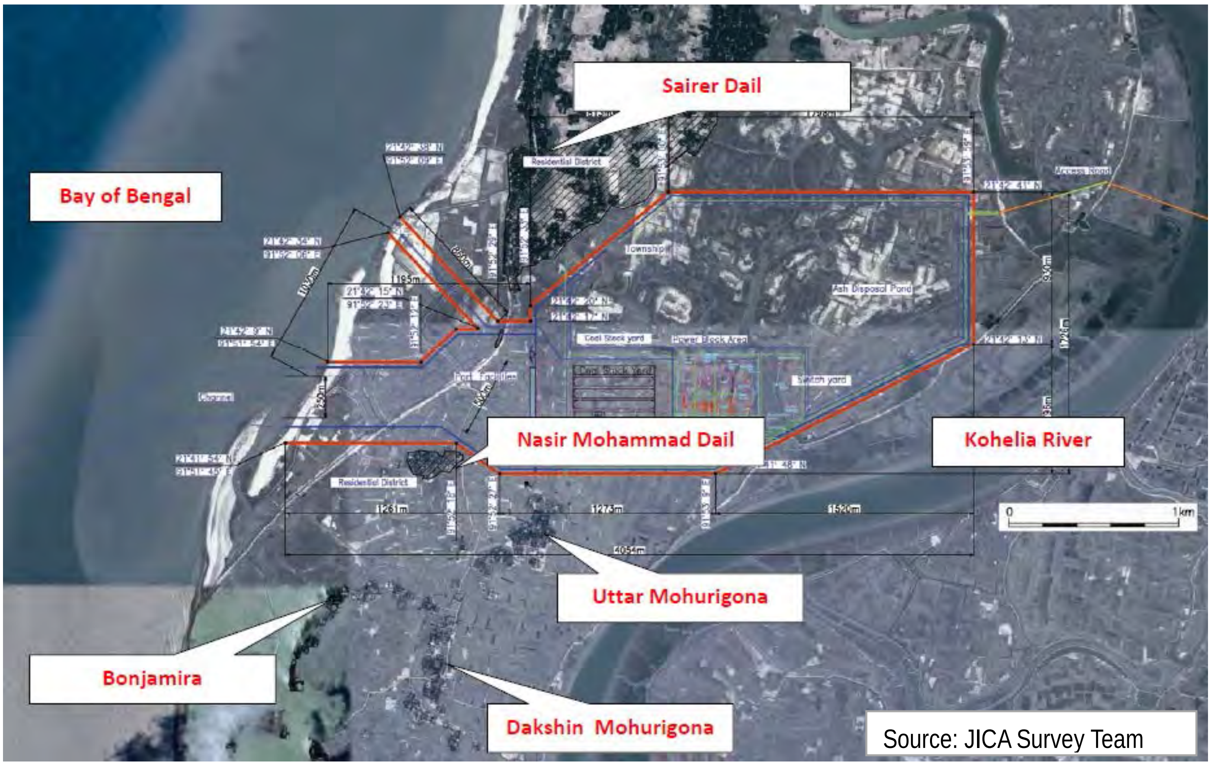


Figure 11.2.1 Villages Location Map near Matarbari CFPP

Table 11.2.1 Number of Households and People Living in the Four Villages in Dhalghata Union

Sl. No.	Name of Village	Union	Total number of households	Total number of population
1.	Nasir Mohammad Dail	Dhalghata	99	601
2.	Uttar Mohurigona	Dhalghata	211	1123
3.	Dakshin Mohurigona	Dhalghata	40	228
4.	Bonjamira	Dhalghata	117	624

Source: JICA Survey Team

Based on the results of the preparatory survey, the JICA Study Team has selected the area in the south of Matarbari CFPP avoiding Uttar Mohurigona Village, where there is possibility of large-scale involuntary resettlement, on the right bank of the Kohelia River is the most promising candidate site for the coal storage field, the main facility of CTT.

11.2.2. Legal/Regulatory Framework for Social Considerations

As of November 2015, there is no explicit legal or regulatory requirements for social considerations for a development project except for land acquisition in Bangladesh. Involuntary resettlement, land acquisition, and compensation for loss of livelihood of project affected persons (PAPs) are anticipated during the implementation of a project, the environmental authority, DOE, recommends that the project proponent formulates a Land Acquisition and Resettlement Action Plan (LARAP) in line with guidelines for environmental and social considerations of International Financial Institutions (IFIs) such as the World Bank (WB) and Asian Development Bank (ADB) as well as key donor agencies from advanced economies such as JICA and the United States Agency for International Development (USAID). The framework fills the gap between existing legal requirements in the country and IFI standard for social considerations. The LARAP for the proposed CTT Project is as follows. Details of the framework shall be attached in the Draft Final Report of the Project.

11.2.3. Land Acquisition, Resettlement and Compensation for Loss of Livelihood

The proposed CTT Project consists mainly of coal transhipment facilities, such as unloading berth, internal coal transporting, coal storage, and loading/unloading equipment, and secondary transport facilities such as belt conveyors connected to coal-fired thermal power plants nearby in the north and the same or barge for power plants located in the south of CTT. Regarding the footprint of the CTT, as the site selection plan in the previous chapter indicates, the JICA Study Team has selected among several alternatives an area avoiding any involuntary resettlement in the Phase I development. Coal storage field requires 45 hectares (ha). And for the Phase II development, as is shown in the layout map in Figure 4.2.6 in Chapter 4, the expansion with additional plot of land, which again avoids large-scale involuntary resettlement, is envisaged.

Land ownership for the selected area will be confirmed with MOUSA map in the course of the survey. However, referring to the on-going economic activities through the year, salt production in the dry season and shrimp cultivation in the wet season, it is estimated that the land around the proposed CTT site belongs to the private owner(s). In case that the land owners and the beneficiaries are different, it is required to formulate a policy framework for compensation for loss of livelihood of the beneficiaries in addition to the framework for land acquisition.

The survey formulates the outline of framework for land acquisition, resettlement and livelihood compensation with reference to the Acquisition and Requisition of Immobile Property Ordinance of 1982 (the Ordinance 1982), which stipulates requirements for acquisition of private land for the development project in Bangladesh. In case that there is any significant deviation between the requirements for land acquisition, resettlement, and livelihood compensation set out in the Ordinance 1982 and the JICA Environmental and Social Guidelines (2010), the Survey proposes a revision on the framework outline. The framework outline will be applicable both to the 1st Phase and 2nd Phase. Details of the framework will be elaborated and finalized in the upcoming LARAP Study.

11.2.4. Access Road to the Southern Area of Moheshkhali Island

The construction of CTT facilities adjacent to Matarbari CFPP completely blocks land surface access to Dhalghata Union in the south of Moheshkhali Island. However, the current plan locates the loading/unloading berths and coal storage yards separately with each other. By installing the belt conveyor over the existing access load, the division of the two unions is avoided.

11.3. Scope of Environmental Study

11.3.1. Environmental Situation of the Current Project

(1) Project Categorization

The current study was categorised by JICA as category B because the environmental impacts are not significantly critical adverse impacts and they are site-specific and mitigable by normal mitigation measures. Considering the case with small-scale resettlement at the planning stage, the study covers the environmental study at the IEE level and the framework of the resettlement action plan (RAP), and the term of reference (TOR) for the required study such as EIA and RAP.

(2) Current environmental situation

In the 1^{st} trip in April 2015, the settlement situation in the candidate project site and natural environment were observed in the field. Also, the required environmental procedure was consulted through the interview with the Director in the Department of Environment in MoE. According to the director, it is highly possible to be classified into RED if the project involves large scale resettlement although the project scale is small. The brief environmental condition is summarized in the following table and there is no any significant reason to revise the previously classified “category B” at this stage (Table 11.3.).

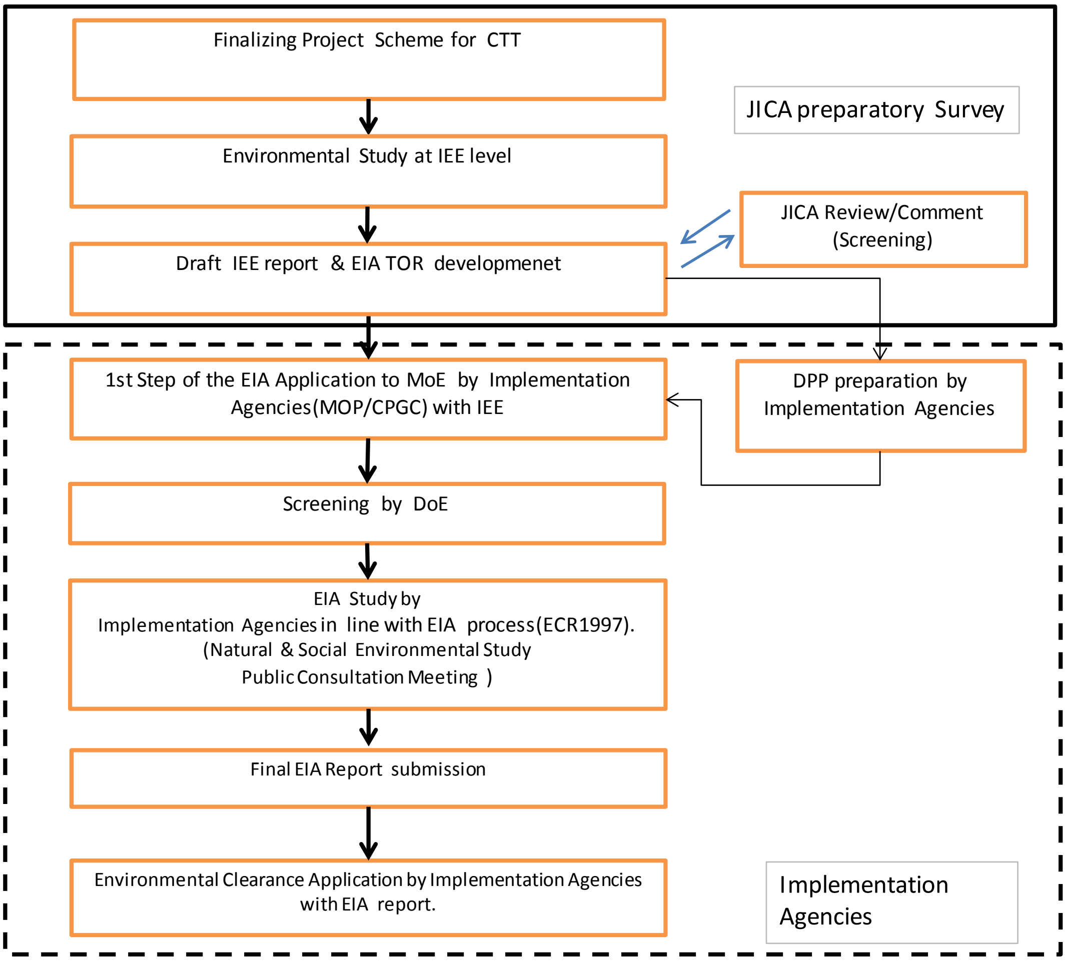
Table 11.3.1 Environmental Items to be Considered at the Project Screening

Environmental Items	Sub-items	Situation
Environmentally Sensitive items	Involuntary resettlement Large scale groundwater pumping Large scale Land reclamation, land development, and/or land-clearing Large scale Logging	At the Coal Thermal Power Station Project sites in the Matabari Island, DhalghataUnion, Uttar Mohiraghona, Nasir Mohammaddhil and Banjamila villages in DhalghataUnion are located at the south side. Also, Sairer Dail Village in Matabari Union is located at the north side of the project. Involuntary resettlement should be considered to be avoided/minimized at the planning stage. Currently, the CTT project for 1st Phase is planned at the south side of the thermal power project area, in the saltpan at the east side of Uttar Mohiraghona Village. The CTT project for 2nd Phase is also planned at saltpan the south side of the 1st Phase. There is no any structure identified in the area at the moment based on available satellite image and involuntary resettlement is not associated.
Environmentally sensitive area	＜Natural Environment＞ 1) Protected area (national parks, etc.) 2)Primeval forests, tropical natural forests 3)Ecologically important habitats 4)Habitats of endangered species protected under local laws or international treaties 5)Areas that run the risk of a large scale increase in soil salinity or soil erosion 6)Remarkable desertification areas	In the EIA study for thermal power project, the habitats of the sea turtle and spoon-billed sandpiper as endangered animal species were concerned. The project site selection and mitigation measures were considered based on the continuous field monitoring study conducted in different seasons. Current study for the CTT project is considered to avoid/minimise those environmental impacts. The project is principally been planning not to affect the coastline through avoiding large scale land reclamation and land development.
	＜Social Environment＞ 1)Areas with unique archeological, historical, or cultural value 2)Areas inhabited by ethnic minorities, indigenous peoples, or nomadic peoples with traditional ways of life, and other areas with special social value	No particular impact has been identified in the area at the moment.
Permits and Explanation		All infrastructure project basically requires to obtain an Environmental Clearance Certificate (ECC) prior to construction. At the registration of the project, IEE report, pre-F/S report and TOR for EIA study should be submitted to DoE. After the current CTT study, official process and EIA study may be required.

Source: JICA Study Team

11.3.2. Applicable Environmental the Study for Current Study

The current JICA CTT project study aims to grasp the overall environmental situation which is affected by proposed project scheme. To meet the requirements of official process on the EIA, the environmental study should be continued by the implementation agency after the current JICA study by submitting IEE report and TOR for EIA to obtain DoE's approval. The environmental study applicable for the current study is briefly explained in the following chart (Figure 11.3.1).



Source: JICA Study Team

Figure 11.3.1 Expected Environmental Study for CTT project

11.4. Result of the Environmental and social consideration study

The environmental and social consideration study at the IEE level was conducted to grasp the environmental situation associated with the presented Coal Transmission Terminal Development in Matabari area during the current JICA study.

11.4.1. Summary of Project Components

Project components include construction of port facilities, coal stockyard, control terminal etc., related to the coal transshipment and those operations including secondary ship operation. The location of the facility is at southern side of the planned Matarbari CFPP and Port area in Matarbari Union. The area is expected to have two locations in the Matabari area for approximately 45-50 ha of stock yard to accommodate above mentioned facilities and the detail of the facilities are shown below.

Table 11.4.1 Project Component

No.	Project Components	Specification/ Quantities	Remarks
1	Port Facilities	Unloading Berth L: 300 m, D:16.0 m 3 unit Unloader C: 2,500 t/h 6 unit Loading Berth L:130 m, D:7.5 m 5 unit Ship Loader C: 1,500 t/h 5 Unit	Unloading berth is planned to construct at the northern side of harbour of CFPP. Loading berth is planned to be constructed at the southern side of harbour of CFPP.
2	Coal Stockyard	Coal handling volume: 11.0 mil t/year Area：45ha (1st Phase) Coal handling volume: 26.5 mil t/year Area : 50ha (2nd Phase), Total 95ha(1st and 2nd Phase) Stacker/Reclaimer total of 14 unit Belt Conveyor : approximately 2.5 km(only internal transport between harbour and CTT) Facilities of disaster prevention or dust control	Coal stockyard is planned to be constructed around the southern side of the power plant
3	Control tower, maintenance shop	Building Maintenance yard	Control tower of maintenance shop is planned to be constructed in the coal stockyard around the power plant
4	Dredging and land reclamation	Expand of inner harbor : Approximately 8.5ha and 1.7 million m3. Secondary transportation in the river (if any) Land reclamation for coal Stockyard: 95ha for 1st and 2nd phases with the height of 5m	
5	Handling vessel at operation of the CTT	Handling Vessel : Phase -1: 171 vessels for Panamax Phase-2: 375 vessels for Panamax 1,600 vessels for 5,000t	

Source: JICA Study Team

11.4.2. Alternative Comparison

It is planned to acquire the land of about 95 ha for the proposed Coal Transshipment Terminal (CTT). “Without Case” is studied in Chapter 7.1 “Economic Analysis”. Utilization of neighboring counties port for coal unloading and transportation by land is considered. Therefore, it is estimated that the impact of “Without Case” affect to large area comparing with the “With Case”.

The three sites to accommodate CTT facilities with the approximately 100 ha was proposed in this alternative comparison. The proposed sites are as follows:

Site-1: This site will be located along the Bay of Bengal stretching from the southern (west) boundary of the Matarbari CFPP to Shekhpara Village bypassing Nasir Mohammad dail village, alongside the flood protection dyke.

Site-2: This site will be located along the Kohelia River stretching from the southern part of Uttar Mohurigona Village to south-east corner of Dakshin Mohurigona Village. Both uttar Mohurigona and Dakshin Mohurigona Vllages will be bypassed.

Site-3: This site will be located along the southern boundary of the Matarbari CFPP covering Nasir Mohammad Dail and Uttar Mohurigona Village.

Table 11.4.2 Comparative Statements of Alternative Sites

Sl. No.	Description of Item	Site-1	Site-2	Site-3
1.	Location	Southern side of Matarbari CFPP along the Bay of Bengal	Southern side of Matarbari CFPP along the Kohelia River	Southern side of Matarbari CFPP
2.	Area in ha	100	100	100
3.	Affected number of households	45	0	392
4.	Affected number of Population	274	0	2,134
5.	Proximity to Moheshkhali Energy hub	Far	Nearby	Nearby

Source: JICA Study Team

From the above comparative statement, no permanent residents will be affected in Site2. Moreover, this site is very close to Moheshkhali Energy Hub where several coal fired power plants will be installed. Hence, it may be concluded that Site -2 is the suitable site for the proposed CTT.

11.4.3. Current Status of the Natural and Social environment

(1) Social Environment

The proposed CTT will be located in Dhalghata Union of Moheshkhali Upazila under Cox’s Bazar District on the west bank of the Kohelia River. The required area for CTT is 95 ha in total, which will be acquired in a two-phased manner. The project site encroaches over the three unions, namely: Matarbari, Dhalghata and Kalarmarchara of Moheshkhali Upazila. Under this survey, an IEE field study was carried out in those three unions, which will be indirectly affected through CTT preparation, construction and operation. Socio-economic statistic data and the status of existing infrastructure in the three unions are summarized in the following table.

Table 11.4.3 Basic Socio-economic Information in Dhalghata, Matarbari, and Kalarmarchhara

Sl. No.	Item description	Unit	Quantity		
			Dholghata Union	Matarbari Union	Kalarmarchhara Union
1	Area	Ha	2,077	2,630	2,744
2	Villages	Nos.	14	21	33
3	House Holds	Nos.	2,250	8,168	8,930
4	Population	Nos.	12,877	44,936	49,268
	a. Male	Nos.	6,688	22,801	25,615
	b. Female	Nos.	6,189	22,135	23,653
5	Average Family Size	Nos. per family	5.72	5.5	5.51
6	Literacy	%	31.7	27.7	33.1
	a. Male	%	29.8	26.1	32.2
	b. Female	%	33.8	29.1	34.1

Source: BBS Population Census 2011

表 11.4.4Basic Existing Information in Dhalghata, Matarbari, and Kalarmarchhara Unions

Sl.No	**Name of Institute**	**Name of Union Parishaed**			**Total (Nos.)**
		Matarbari (Nos.)	**Dhalghata (Nos.)**	**Kalarmarchhara (Nos.)**	
1	Primary School	2	4	3	9
2	High School	3	1	1	5
3	Junior High School	1	0	0	1
4	Madrasha	1	2	1	4
5	FWC(Health Service)	1	1	1	3
6	Community Clinic	3	1	4	8
7	NGO*	3	1	6	10
8	Mosque	6	4	5	15
9	Eidgaon	1	0	1	2
10	Eatimkhana	3	2	1	6

Sl.No	Name of Institute	Name of Union Parishaed			Total (Nos.)
		Matarbari (Nos.)	Dhalghata (Nos.)	Kalarmarchhara (Nos.)	
11	Graveyard	1	2	1	4
12	Temple	2	1	1	4
13	Tomb	2	0	1	3

Source : Upazila Office and Union Information Center.

* Name of NGO : BGS,Protashe,Grameen,RICk,S.R.P.D,WFP,Codake

Notes: Madrasha: Islamic Educational Institute, Eidgaon: Religious Festival Site, Eatimkhana: Orphanage

During the IEE study, socio-economic survey was undertaken in August 2015. The outline of the survey findings are described in the following sections.

(a) Education and Literacy

About 51% of the household members are literate and 43% of the household members are illiterate. The educational level of the household members in the project area is shown in Table 11.4.5.

Table 11.4.5 Education Level of the Residents

No.	Education Level	Nos.	%
1	Do not Read & Write	480	42.55
2	Only Can Sign	38	3.37
3	Class I-V (primary school)	199	17.64
4	Class VI-X (secondary school)	211	18.71
5	S.S.C (post-X-grade certificate)	87	7.71
6	H.S.C (high school graduate certificate)	51	4.52
7	BA/Fajil (Bachelor’s of Art)	43	3.81
8	M.A/Kamil (Master of Art)	16	1.42
9	Hafez (Those who have memorized all the Koran chapters)	3	0.27
Total		1128	100.00

Source：JICA Study Team

(b) Occupation

In the project site, most of the house hold heads do salt cultivation in their entitled land in the dry season and shrimp cultivation as secondary occupation in the rainy season. About 152 household (HH) heads (72%) are salt cultivators in the dry season and 103 HH heads out of the 152 salt cultivators (46% of the total HH heads) are shrimp cultivators in the rainy season. Twenty HH heads (9.4% of the total) are slat field laborers. Apart from the above occupation, the house hold heads are involved in many other occupations.

Table 11.4.6 Occupation of Houehold Heads

Sl.No	Name of Occupation	Nos of HH	%
1	Salt Cultivator/Shrimp Cultivator	152/103	71.70
2	Salt Laborer	20	9.43
3	Salt Mazi (Leader of Salt Laborers)	7	3.30
4	Business	12	5.66
5	Teacher	4	1.89
6	Imam	1	0.47
7	House Wife	6	2.83
8	Abroad	2	0.94
9	Fisher Man	1	0.47
10	Driver	1	0.47
11	Quack	3	1.42
12	Service	2	0.94
13	Electrician	1	0.47
		212	100.00

Source: JICA Survey Team

(c) Source of Drinking Water

Approximately 98.6% of the households use tube well and 1.4% of the households use traditional well as source of drinking water.

(d) Types of Latrine

Thirty-three percent of the household use katcha latrines with wooden board walls, 54.72% slab and 29.72% Pucca latrines with concrete structure.

(e) Building Materials

The roof of 83% of the houses are made up of tin. Walls of 74% of houses are made up of bamboes and floor of 83% of the houses are made up of soil/earth.

(f) Household Assets

In the survey, it has been observed that about 96% have mobile phones, 42% radio, 19% television, 39% native-boats, 77% farming tools, 43% fans, 10% safe drinking water machine, 10.85% engine boat, 6% stitching machine, 3% bicycle, 5% motorbike, 5% computer, 6% refrigerator, and 3% washing machine. Some households even own rickshaws and CNG auto-rickshaws. Due to the production of salt and fish farming, the financial status of the people in the area are strong, hence, penetration rates for mobile phones and house electric appliances are relatively higher in those unions.

(g) Household Monthly Income

The monthly income of 23.58% of households is in the range of BDT 10,001 to BDT 20,000; 18.87% of households in the range of BDT 40,001 to BDT 50,000 and 16.51% in the range of BDT 20,001 to BDT 30,000. The number of low income group households (BDT 5,000- BDT10,000) and high income group (BDT 60,000 and above) are very less. Most of the households are of medium income group (BDT 10,001 to BDT 50,000).

(2) Natural Environment

(a) Climate

The proposed Coal Transshipment Terminal (CTT) is located in Matarbari island of Moheshkhali upazila which lies in the south-eastern part of Bangladesh, where monsoon comes in July and recede in late October. The monthly minimum temperature was 10.3°C in Cox;s Bazar. It is observed that the average relative humidity in Cox's Bazar area varies from 62% to 91% and in Kutubdia from 67% to 92%. The total yearly rainfall varies from 3,821 mm to 4,707mm in Cox's Bazar and from 2,320 mm to 4,677 mm in Kutubdia. Rainfall is concentrated between May and October; while very little or no rain is recorded from November to April. Wind directions in the project area are mostly from the south during the period from March to September and from the north during the period from October to February.

(b) Air quality

Air quality was tested in the dry season and rainy season at the Matarbari 1200MW CFPP site in 2012 and 2013 in its EIA study. The three aspects, i.e., SPM, SO2 and NO2 were monitored. The values were retained under the standard values.

(c) Water quality

As available water quality in the area, the water quality of the river (Kohelia River), sea water, and groundwater, near the power plant site was surveyed in the rainy season and dry season in 2012 in the EIA for CFPP. The result showed that no particular water contamination was observed and the value of salinity suggested that the surveyed area has brackish water that is under the influence of sea water in the rainy season. Suspended solids (SS) (only in the rainy season) and chemical oxygen demand (COD) showed high concentration levels similar to the sea water quality survey results. Also, the results of the groundwater analysis (CFPP area in both rainy and dry seasons) in the aspects of Ch, un-ionised ammonia (NH3), iron (Fe), hardness (Ca), arsenic (As), dissolved oxygen (DO), biochemical oxygen demand (BOD), COD, SS, and coliform satisfied the drinking water standards of Bangladesh except a slight lower case of DO (detail water quality data is shown in Appendix 3).

(d) Noise in the area

As available information of the noise in the area, actual survey in both rainy and dry season in 2012 was conducted in the EIA study for CFPP. The noise measurement results indicated that the day time noise level was above the environmental standards for residential areas at one sampling point. Matarbari Island is, as cited above, not an industrial area and therefore vehicles used for local transportation were the noise source. These vehicles are not used during the night.

(e) Natural Hazard (Cyclone, Seismicity)

The southeastern region of Bangladesh is cyclone prone area. Severe cyclones like cyclones in 1970 and 1991 damaged the structures. Enough protection against cyclones is required to avoid accidents. Bangladesh and northeast Indian states have long been one of the seismically active regions of the world, and have experienced numerous large earthquakes during the past 200 years at an average rate in every 30 years.

(f) Topography

The area is generally flat without any particular topographical feature. The project site is located in the flat area on the coastal peninsula developed at the east side of the Bengal Bay, namely; Matarbari Island. Elevation is almost the same as the sea level approximately +1 m in general.

(g) Land Use and Ownership

The proposed CTT site is located in Dhalghata Union. Dhalghata Union comprised one mouza having an area of 2,077 ha of which the net cultivable land is only 78ha (4%), (the detail PAP’s occupations such as tenant-farmer are shown in Table 11.4.6 Occupation of HH Heads). The areas under salt cultivation are about 1,163ha (56%). The land use of the project site is categorized as “Salt-Shrimp Area”.

About 90% of the lands of the proposed CTT project are owned by private owners and 10% of the lands are owned by the Government of Bangladesh. The government owned lands are mostly canal, roads, embankment etc. Salt fields are mostly owned by the private owners. The detailed study should be done in the EIA study.

(h) Biological resources

Biological resources in the area is considered not particularly rich because the area is generally used by local peoples for shrimp farming and salt pans to the area over several generations. As available information, four endangered sea turtle species, Olive ridley turtle (*Lepidochely solivacea*), Loggerhead turtle (*Caretta caretta*), Green turtle (*Chelon iamydas*), and Hawksbill turtle(*Eretmochelys imbricate*) were observed in the dry season, December-March in 2012 at the sandy beach in Cox’s Bazar including the area in front of the Matarbari 1200MW CFPP Project. The area is used for spawning by those species. Also, Spoon billed sandpiper (*Calidris pygmaea*), an endangered migratory bird was observed in the area in the dry winter season. Fishery resources on the coastal area and river mouth are 29 species of freshwater fishes and 29 species of marine fishes. Based on the detailed survey in the rainy season and dry season, the CFPP Project proposed mitigation measures.

(i) Protected area

In Bangladesh, there are seven kinds of protected area and these are: national park, wildlife sanctuary, game reserve, botanical gardens, eco-parks, reserved forests, and protected forests which are declared under the Wildlife (Conservation and Security) Act, 2012. Surrounding areas of the Matarbali Island, are the Moheshkhali Reserve Forest which is 5 km away from the project site and Sonadia Ecologically Critical Area (ECA) located about 15 km away from the project site and no significantly large impact is identified.

11.4.4. Environmental Evaluation based on the IEE study

Based on the result of IEE study, the anticipated environmental impacts are assessed. For each environmental items, anticipated impacts are described below (Table 11.4.7). Also, related to the assessed impacts, the JICA Environmental Checklist and Screening Form are shown in Appendix 4 and 5. The Checklist and Screening Form should be updated and revised if necessary prior to the JICA environmental review on the project.

Table 11.4.7 Anticipated Environmental Impact on the CTT Project at IEE Study Phase

(Result of scoping for CTT)

Item	No.	Impact	Rating: Pre- / construction Phase	Rating: Operation Phase	Reason and Description for Evaluation
Pollution Control	1	Air Quality	B-	B-	**Construction phase:** Generation of dust by land preparation and other construction work is expected, but the impact will be temporary. Generation of air pollutant (SOx, NOx, and others) from operation of heavy machines and trucks is predicted, but the impact will be limited only within the surrounding area. Watering the access road and construction site, especially in the dry season, and using cover sheets on trucks for the transportation of soil will be undertaken to reduce dust generation. Periodic machineries and management of all the construction machinery and vehicles will be conducted to reduce exhaust gas discharged from construction machineries and vehicles. **Operation phase:** Associated with CTT operation such as loading and unloading of coal from the vessel, air pollution mainly coal dust is anticipated in windy condition. The countermeasure to minimize the dust dispersion such as frequent watering and prevention net should be taken.
	2	Water Quality	B-	B-	**Construction phase:** Soil runoff from the exposed soil of the embankment and cut slope may increase turbidity of water at the downstream area of the Kohelia River in the rainy season. Earth work in the rainy season should be limited to controllable area. **Operation phase:** Water pollution may occur on the downstream of the surrounding river due to run off coal dust in the rainy days, during loading and unloading of coal. Adequate erosion prevention/control measures such as vegetation and terracing should be applied.
	3	Waste	B-	B-	**Construction phase:** General waste and hazardous waste such as paints, solvents /motor oil/ batteries etc are generated by the construction work. Proper disposal of the waste should be applied. Some dredged earth material should be disposed if these are unsuitable for construction use. Those are expected to be treated on the site dumping place in the project area of CFPP. **Operation phase:** General waste and hazardous waste sre generated. Proper disposal of the waste should be applied.

Item	No.	Impact	Rating		Reason and Description for Evaluation
			Pre- / construction Phase	Operation Phase	
	4	Noise and Vibration	B-	B-	**Construction phase:** Impact of noise and vibration is predicted caused by operation of heavy machines and trucks, but will be limited to the surrounding area. Regular maintenance of the equipment should be conducted. Low-noise/low vibration machinery will be applied. **Operation phase:** Impact of noise and vibration is predicted caused by plant operation of equipment and machineries used for loading, unloading and transportation of coal. Regular maintenance of the equipment should be conducted. Low-noise/low vibration machinery will be applied.
	5	Odor	B-	B-	**Construction and Operation phases:** In case domestic waste from the workers' camp is not appropriately treated, bad odors of rotten waste may occur.
	6	Soil Quality	B-	B-	**Construction phase:** Possibility of soil pollution caused by leakage of lubricants and fuel oil from construction vehicles and machinery. **Operation phase:** Possibility of soil pollution caused by penetration of coal dust water into the soil from the coal pile.
	7	Sediment	B-	B-	**Construction phase:** Possibility of sediment pollution in case construction wastewater flows into the sea and surrounding rivers. **Operation phase:** Possibility of sediment pollution in case CTT wastewater and domestic wastewater flows into the surrounding rivers.
Natural Environment	8	Protected Areas	D	D	**Construction phase:** Moheshkhali Reserve forest is 5 km away from the project site and Sonadia Ecologically Critical area is also located about 15km away from the project site. No impact of air pollution, noise and vibration due to construction work is anticipated. **Construction and Operation phases:** Sonadia ECA has been designated pursuant to the Environmental Protection Law in Bangladesh, located 15km south of the proposed project site.
	9	Ecosystem	B-	B-	**Construction phase:** Four endangered sea turtle species, Olive ridley turtle (*Lepidochely solivacea*), Loggerhead turtle (*Caretta caretta*), Green turtle (*Chelonia mydas*), and Hawksbill turtle(*Eretmochelys imbricate*) were observed in the dry season, December-March on the sandy beach in Cox's Bazar including the area in front of the Matarbari 1200MW Thermal Power Station Project. The area is used for spawning by these species and

Item	No.	Impact	Rating		Reason and Description for Evaluation
			Pre- / construction Phase	Operation Phase	
					detailed study was conducted to minimize the impact in the EIA study oh the Thermal Plant. The CTT site was selected to avoid disturbance of the beach. Spoon billed sandpiper (*Calidris pygmaea*), a migratory bird was observed in the area in the dry winter season. Fishery resource on the coastal area and river mouth were found with 29 species of freshwater fishes and 29 species of marine fishes. The habitat of these species may be affected. **Operation phase:** The impact of air pollution, water pollution, noise and vibration due to operation of heavy equipment and conveyor belt during loading and unloading of coal is anticipated on the terrestrial and aquatic ecosystem.
	10.	Geography and geology	C	C	The impact is unknown. Geo-technical investigation of the CTT area may be conducted during EIA study.
Social Environment	11.	Land acquisition and Resettlement	B-	D	**Pre-construction phase**: Approximately 100 ha of land will be acquired. It was observed that there were no permanent households in the project area. But about 9/10 houses were available beside the project boundary occupying more than one family in each house. Only three temporary sheds for security people employed for fish (shrimp and other fishes) cultivation were available in the project area. Land owners to be identified in the conduct of topographic survey in the EIA study will lose their lands. Employers/ employees of salt farms, shrimp farms, and fishermen will lose their means of livelihood.
	12	Disturbance to Poor People	C	C	**Pre-construction phase:** In the area, approximately 8.49% of the population are living under the poverty line. These poor people may lose their livelihood if the CTT is constructed. **Construction phase:** There are poor households who will lose their means of livelihood. However, their living conditions will not deteriorate compared with their current ones, and they will have job opportunities at the construction site. **Operation phase:** Poor people who currently have deteriorated living standards without proper facilities will have better access to social services throughout the year if roads are improved along with the construction of the power plant, especially access during the rainy season.

Item	No.	Impact	Rating		Reason and Description for Evaluation
			Pre- / construction Phase	Operation Phase	
	13	Disturbance to Ethnic Minority Groups and Indigenous People	D	D	There are no ethnic and indigenous people found in or around the project site.
	14	Deterioration of Local Economy such as Losses of Employment and Livelihood Means	C	C	**Pre-construction phase:** It is anticipated that employers/ employees of salt farms, shrimp farms, and fishermen will lose their means of livelihood. Fishing activities around the site will also be affected due to water pollution and restriction of fishing. **Construction phase:** Although some poor households may be worse off by losing their means of livelihood, local people will be employed for construction work. **Operation phase:** There will be permanent losses or reduction of livelihood means in salt farming, shrimp farming and fishing activities. Employment opportunities will be offered at CTT for local people.
	15	Land Use and Utilization of Local Resources	C	C	The acquisition of 100 ha land currently dedicated to salt/shrimp cultivation and fishing will change the traditional land use pattern and utilization of local resources.
	16	Disturbance to Water Usage, Water Rights, etc.	C	C	**Construction phase:** Local economy may be affected by the turbid water discharged from the construction site. Outflows of street dust and oil whilst it rains may also cause certain effects. **Operation phase:** Local economy may be affected by the discharged water from the CTT into the Kohelia River..
	17	Disturbance to the Existing Social Infrastructure and Services	C	C	**Construction phase:** Material and equipment transportation will be mainly conducted by ship, so that increased marine traffic may disturb the existing marine traffic including fishing boats. In addition, commuting of CTT workers will increase the traffic volume of the surrounding roads, possibly leading to traffic jams. **Operation phase:** Traffic volume will increase. Road improvement will increase local access to social services and markets throughout the year, especially during the rainy season.
	18.	Social Institutions such as Social Infrastructure and Local Decision-making Institutions	B-	D	**Pre-construction phase:** The Deputy Commissioner’s Office of Cox’s Bazar District is responsible for taking the initiative to conduct local consultations and detailed measurement surveys for land acquisition and resettlement, and these actions will affect social infrastructure and local decision-making institutions.

Item	No.	Impact	Rating		Reason and Description for Evaluation
			Pre- / construction Phase	Operation Phase	
	19.	Misdistribution of Benefits and Compensation	B-	B+	There may be feelings of resentment, because people living around the project site will benefit through the improvement of social infrastructure and services. People those who lose their means of livelihoods will receive certain compensation.
	20	Local Conflicts of Interest	B-	B-/B+	**Pre-construction phase**: People to be resettled and those who will lose their means of livelihoods will receive certain compensation. Local conflicts of interest may occur between residents, and between local administration bodies and local political leaders. **Construction phase:** Conflicts between local residence and external workers may occur because of changes in local customs if the external workers cannot understand local customs. People living around the project site will benefit through improvement of social infrastructure and services. Those who will lose their means of livelihoods will receive certain compensation. Local conflicts of interest may occur between employers and employees of salt farms, shrimp farms and fishing industry, and between local administration bodies and local political leaders. **Operation phase:** There may be feelings of resentment and reconciliation, because people living around the project site will benefit through the improvement of social infrastructure and services. People who lose their means of livelihood will receive certain compensation. Conflicts amongst local residents may occur if such benefits were misdistributed.
	21	Cultural Heritage	D	D	There is no historical, cultural and archaeological property and heritage existing on or around the site.
	22	Landscape	C	C	Loading/unloading berths are part of normal port facilities, leading to no serious impact on landscape. On the other hand, depending on how closely the coal storage yards is located from residential areas, there may be adverse impact on landscape.
	23	Gender	B-/B+	B+	**Pre-construction phase:** There are women who will lose their livelihood. Wives of men who lose their land or jobs may suffer from adverse effects on their household economy. **Construction phase:** Amongst those who will lose their livelihood are women. However, their living conditions will not deteriorate compared with their current living conditions. **Operation phase:** Women will have better access to social services throughout the year if roads are improved

Item	No.	Impact	Rating: Pre- / construction Phase	Rating: Operation Phase	Reason and Description for Evaluation
					along with the construction of the CTT, especially access during the rainy season without relying on heavy vehicles or boats.
	24	Children's Rights	B-	B-/B+	**Pre-construction phase:** There are children who will lose their livelihood. Children from households losing their land or jobs may suffer from adverse impact on their household economy, such as dropping-out of school. **Construction phase:** Children's rights to go to school may further deteriorate if the access way to their school is physically blocked by the construction site. The number of children who drop out of school may increase because of the huge demand of unskilled workers at the construction site. **Operation phase:** The number of children who drop out of school may increase if there are no age restrictions of unskilled workers at the CTT site. Children will have better access to social services throughout the year if roads are improved along with the construction of the CTT, especially access during the rainy season.
	25	Infectious Diseases such as HIV/AIDS	B-	D	**Construction phase:** A temporary influx of migrant labor during the construction period may increase the risk of sexual transmitted diseases, etc.
	26	Work Environment (Including Work Safety)	B-	B-	**Construction phase:** High risk rate of accidents is predicted in the construction work. **Operation phase:** Work accidents of workers may occur.
Others	27	Accidents	B-	B-	**Construction phase:** Marine traffic and land traffic accidents may occur if there is no proper safety education. **Operation phase:** Marine traffic and land traffic accidents may occur. Fire caused by spontaneous ignition of stored coal may occur, and traffic accidents due to increased traffic may occur.

A+/-: Significant positive/negative impact is expected.

B+/-: Positive/negative impact is expected to some extent.

C+/-: Extent of positive/negative impact is unknown. (Further examination is needed, and the impact may be clarified as the study progresses.)

D: No impact is expected.

11.4.5. Environmental Mitigation Measure (Tentative Environmental Management Plan)

Based on the IEE study, the Environmental Management Plan (EMP) should be finalized at the time for EIA process in accordance with the further detailed study. Here, EMP at IEE stage is tentatively presented as outlined below and details are shown in the Appendix 6.

Table 11 4.8 Outline of Environmental Management Plan for Transmission Lines (Nov. 2015 Tentative Version and this Should be Revised with EIA Process)

Environmental Item	Environmental Management Plan
Air Quality	**[Construction phase]** - Taking preventive measures for air pollution
Water Quality	**[Construction phase]** - Taking preventive measures for water pollution **[Operation phase]** - Taking preventive measures for soil runoff
Noise and Vibration	**[Construction phase]** - Taking preventive measures for noise and vibration
Ecosystem	**[Construction phase]** - Appropriate construction activity time and method should be selected in consideration of the behavior of the precious species. **[Operation phase]** - Taking preventive measures for undisturbed ecosystem
Topography and Geology	**[Construction phase/ Operation Phase]** - Preventing soil loss by stabilizing any slopes of construction area with concrete, as necessary based on geological survey
Land acquisition and compensation	**[Pre-construction Phase]** - Land acquisition for CTT to be done with proper compensation - Compensation should be conducted in compliance with relevant laws and regulations
Deterioration of Local Economy such as Losses of Employment and Livelihood Means	**[Pre-construction phase/ Construction phase]** - Compensation should be conducted in compliance with relevant laws and regulations **[Operation phase]** - Employ as many local residents as possible
Land Use and Utilization of Local Resources	**[Construction phase]** - Employ as many local residents possible
Disturbance to Water Usage, Water Rights etc	**[Construction phase]** - Taking preventive measures for water pollution **[Operation phase]** - Taking preventive measures for dustl runoff
Social Institutions such as Social Infrastructure and Local Decision-making Institutions	**[Pre-construction phase]** - Compensation should be conducted in compliance with relevant laws and regulations
Cultural Heritage	**[Construction phase]** - If potential impact of the project on historical, cultural and archaeological property and heritage is predicted, protective measures should be taken.
Infectious Diseases such as HIV/AIDS	**[Construction phase]** - Development of occupational health plan during construction phase.
Working Environment (including Work Safety)	**[Construction phase]** - Development of occupational health plan during construction and operation phase.
Accidents	**[Construction phase/ Operation phase]** - Taking preventive measures for soil runoff during construction and operation phase - Prevention/Evacuation measure at the time of spontaneous ignition.

Source: JICA Study Team

11.4.6. Tentative Environmental Monitoring Plan

With the same manner as the EMP, Environmental Monitoring Plan (EMoP) should be finalised at the time for EIA process in accordance with the further detailed study. Here, EMoP at IEE stage is tentatively presented in Appendix 7 and 8.

11.4.7. Feedback from Stakeholder

In the current study, prior to interviewing the abovementioned stakeholders, representatives of local residents, opinions of the relevant governmental officials and experts who know the situation of project site, were referred. The received comments from the relevant governmental officials and expert are shown below (Table 11.4.10).

Table 11.4.10 Feedback from Relevant Governmental Officials and Experts

		Comment on the project
DoE Cox's Bazar District Office	29 July,2015	- About the EIA of coal power generation in Matarbari At the time of EIA process of the coal power generation, the office is concerned with the discharging water from the plant so as not to influence fishery in the area. Also, some suggestions for greenbelt establishment surrounding the project area were consider to prevent noise and dust impact to the residential areas. -About Sonadia ECA The office is in charge of the management of the Sonadia ECA. The office recognised that the Matarbari area is far enough from the Sonadia ECA. There is no particular guideline on allowable distance for development activities in the area. However, the area is surrounded with mangrove vegetation functioning as a buffer zone of the area and it cannot be damaged physically.
Moheshlaki Upazila Office	1 August 2015	-Local people's view for the development projects In general, feeling of the local people on the development project in the Matabari area is supportive and acceptable now. At the beginning, they are confused with the activities. After getting compensated at CFPP, gradually they changed their minds and became supportive. -Availability of the land for resettlement There are some vacant lands in Moheshkali Upazilla (some belong to the government). In case of resettlement is required, those land may be utilised. Close to the project area, Kalamasala Union at the east side of the Kohelia River may be one of the possible locations. -About suspension of the land transfer in the Moheshkali area There are 31 land administration units in Moheshkali area. Amongst those 31 *mouza*, 16 *mouza* are for land transfer suspension. The major development plan in the Moheshkali area are: power generation plant in northern Matabari, special economic zone (SEZ) in south Dalgata, Chinese thermal power plant at the east side of the Koheli River and deep sea port in southern Moheshkali. -Concerns about the projects Pollution such as dust generation from the new CTT, should be minimised applying the Japanese technologies that are already used in the country. In case of Japan, the coal terminal can be maintained

		in clean condition even under open storage with systematically sprinkling of water and wind protection fencing. -About natural environment There are Sonadia ECA and reserve forest in Pahalmuza as environmentally important areas in Moheshkali. The project area for thermal power plant in Matarbari is already recognised that the distance from these important areas is far enough.
Cox's Bazar District Office Deputy Commissioner	1 August 2015	-About the development in the Matabari area The development of the area is recognised as one of the most important projects in the country. The Deputy Commissioner (DC) expressed that the District Office have intention to assist in the JICA's study to their full extent. -About the environmental study Although the people in the Matarbari area became supportive to the large-scale development in the area, environmental consideration is required. The DC suggests the importance of sensitive analysis on the environment. -About the security in the area Currently, the security in the area is stable and no security problems are expected. However, if the JICA Study Team requires security, the district will assist them for safety. -Compensation to illegal occupants The necessity of compensation based on the JICA Environmental and Social Guidelines is understandable. However, there are many illegal occupants in the governmental land in Bangladesh and majority of these are deliberately occupied by people who are not poor and in bad faith. So, it is difficult to deal with illegal occupants in regard to compensation but the DC has no objection for what the CPGC or JICA will give as compensation to the people in the Matabari area even if they are illegal occupants.
Additional Deputy Commissioner (Revenue) Cox's Bazar Resettlement Department	3 August 2015	-Problems in land acquisition in the area Related to the land acquisition of the Coal Thermal Power Project, there were some confusions encountered by the local people at the beginning. However, through continuous communication from the government, the people became supportive now. And no difficulties for land acquisition are expected. -About restriction of land transfer in Moheshkali Upazilla The circular was issued in February 2015 with seven fast track development projects. In the circular, the land transfer in the 16 *mauza* (administration units) is restricted.
Mr. Mohammad Muslem Uddin, Assistant Professor of Marine Science and Fisheries, University of Chittagong	3 August 2015	-About the ecological survey and EIA of the Coal Thermal Power Station The field survey was conducted in the surrounding areas of the thermal power project from March-April (40 days) in the EIA of the Coal Thermal Power Project. The study covered the breeding season of the sea turtles. Two species of sea turtles, Hawksbill (*Eretmochelys imbricata*) and Olive ridley (*Lepidochelys olivacea*) which are listed in the red list of IUCN were found. Near the area, at the sandbar at the southern edge of the Dalghata Union, the highest number of turtles amongst the survey points is found. -Mitigation measure for sea turtles Sea turtles are generally sensitive during spawning. Although currently, the proposed project avoids disturbing the coastline, it is better to consider minimising further impacts. Especially, in the area to be developed further, in addition to the Coal Thermal Power, long-term monitoring even after the

		operation is recommended. Awareness raising on the ecological conservation, alternative hatch ground can be one of the mitigation measures. Therefore, a new project also may require some study related to those fauna and flora in the area. -Study requirement for the CTT project As mentioned, some ecological study related to the CTT may be required. Especially, fishery environment can be considered in the new project if the project site is determined on the river side of the Koheri River. Recently, the government banned fishery activities on the coastal and river mouth during breeding season to protect fish biodiversity because the biodiversity in the coastal area is recognised as very important issue due to declined yield. -Fishing Ban (May, June 2015) Fishing in the whole coastal area in Bangladesh is banned for about two months (20 May–23 July 2015) in order to protect fish species in breeding season. The regulation may be continued having certain period each year. -Conservation activities in ECA in Cox's Bazar There are three ECAs in Cox's Bazar, i.e., Sonadia, St. Martin, and the Teknaf Peninsula. Amongst these, there was a natural conservation activity conducted by an NGO in Sonadia for five years and it was already finished. Some improvement works in the ECA are still needed. If the area will be developed further influencing the flora and fauna, conservation works for those ECA can be improved through hard and soft measures, e.g.; Awareness raising of the wild animal conservation (sea turtle) to prevent poaching, construction of fence to protect sea turtles from dogs, artificial incubation of the eggs to increase their survival rate, etc. One of the reasons for poaching by local people is to sell the turtles and eggs to the tribal people not to be consumed by themselves. Also, dogs can be another enemy of the turtles in the area eating eggs, as well as hunters. -Balance between ecology and economy The economic development in Bangladesh is important. However, it may be needed to take a balance with ecology for sustainability. -Mitigation measures for the activities Monitoring is important. Also, afforestation programs including mangrove species can be considered to prevent impact to the residence and also protection of the facility from erosion.

Source: JICA Study Team

11.4.8. Tripartite Meeting

In December 2015, in order to share outline of the draft IEE Report, a tripartite meeting among the project implementing agency (CPGCBL), the environmental clearance authority (DOE) and the Consultant was held. Additional items to be considered in the proposed EIA process such as the impact of polluted water due to maintenance of coal vessels were pointed out. DOE stressed that it was important for the project proponent to finalize the IEE and submit formally to DOE immediately. The minutes of meeting are attached in Appendix 9

11.5. Land Acquisition and Involuntary Resettlement

11.5.1. Necessity of Land Acquisition· Resettlement

Although the proposed CTT location requires permanent and temporary land acquisition, there is no involuntary resettlement envisaged. Coal storage yards (approximately 45 ha for the 1st Phase and 50 ha for the 2nd Phase, in total of 95 ha) and the right of way (ROW) for the belt conveyor from the loading/unloading berths to the storage (20 m wide and 2,500 m long, thus 50,000 m^2, or 5 ha) will be acquired. The construction period for the belt conveyor is 12 months, during which, in addition to the ROW, use of the land for access roads for the construction may prevent land owners and users from undertaking any commercial activities. The land owners will lose opportunities for income generation out of cropping or production during the construction period, whilst labourers such as share croppers, waged cultivators, and seasonal workers will lose opportunities for labour temporarily.

The project proponent will formulate the land acquisition and resettlement action plan (LARAP) after having thoroughly surveyed in light of Bangladesh legal requirement as well as JICA Environmental and Social Guidelinesns. In the following sections, the framework for land acquisition, resettlement and livelihood compensation based on the findings in the IEE Study undertaken in the Survey is outlined. Draft ToRs for the LARAP will be attached in Appendix 10.

11.5.2. Legal Framework for Land Acquisition· Resettlement in the country

(1) Key Legislations in Bangladesh

The Acquisition and Requisition of Immovable Property Ordinance of 1982 and its subsequent amendments in 1993 and 1994 and the Electricity Act 1910 provide the key legal instrument for the acquisition of private land for development activities in Bangladesh. Salient provisions of the Ordinance which show tangible gaps with the JICA Environmental and Social Guidelines are as follows:

Avoiding/ minimizing land acquisition: The Ordinance only implicitly discourages unnecessary acquisition as land acquired for one purpose cannot be used for a different purpose. There are, however, no mechanisms to monitor if this condition is actually adhered to.

Eligibility for compensation: The Ordinance stipulates compensation only for persons who appear in the land administration records as the owners (i.e., titleholders). It does not recognize the rights of those without legal title to the land, who live in or make a living from it.

Compensation paid for: The Ordinance provides for compensation of land and other objects built and grown on it (structures, trees and orchards, crops and any other developments on the land like ponds, built amenities, etc.). There are no provisions to assess and restore lost income streams or income sources caused by the land acquisition to the PAPs.

Compensation standards: Landowners receive compensation under the law (CUL) as per the market value of the property at the publication date of the notice[1] with a premium of 50% on the assessed price. Any damage to standing crops or trees on the property, expenses incidental to compelled changes to the residence or place of business, and reduction of profits of the property in the acquisition period are also entitled to a sum of 50% on top of such market value[2]. The 1994 amendment made provisions for payment of crop compensation to tenant cultivators (*"bargadar"*). Although the Ordinance stipulates 'market prices' of the acquired land as just compensation, the legal assessment method almost always results in prices far below the actual market prices. Certain pricing standards, which are regarded as unrealistic, are used to assess other losses like structures and various built amenities, trees, and crops, etc.

Relocation of homestead losers: There is no legal obligation to relocate, or assist with the relocation of, those whose homesteads have been acquired.

Ensuring payment/ receipt of compensation: Even with the given legal provision, the compensation process is time-consuming. There is, moreover, no certainty as to when an affected landowner will obtain the stipulated compensation or whether he will obtain it at all. Land is legally acquired and handed over to the project proponent as soon as the acquisition authority identifies the owners ('awardees') by examining the records, and sends a legal notice advising them to claim compensation ('awards'). And it also turns out that it is an obligation of the PAPs to prove that the acquired land legally belongs to them.

Socio-economic rehabilitation: The provisions are so restricted that the Ordinance shows no concern about the long-term socio-economic changes the PAPs might undergo in the post-acquisition period. Except for the compensation at the legal 'market price', there are no other provisions in the acquisition or other-laws that require the government to mitigate the resultant adverse impacts caused by the acquisition. Socio-economic rehabilitation of the involuntarily displaced persons is absent in the legal regime of Bangladesh.

(2) JICA's policy on land acquisition and resettlement

The key principles of JICA policies on involuntary resettlement are summarized below:

(a) Avoidance or minimization of land acquisition and involuntary resettlement

Land acquisition and involuntary resettlement will be avoided where feasible, or minimized, by identifying possible alternative project designs that have the least adverse impact on the communities in the project area.

(b) Entitlement and assistance for restoration and improvement in social and economic conditions.

Where displacement of households is unavoidable, all PAPs (including communities) losing assets, livelihoods or resources will be fully compensated and assisted so that they can improve, or at least restore, their former economic and social conditions.

(c) Compensation and rehabilitation support

People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standards of living, income opportunities and production levels to pre-project levels.

(d) Application of the principle of the replacement cost

Compensation must be based on the full replacement cost as much as possible.

(e) Actions prior to displacement

Compensation and other assistance required for relocation should be given prior to displacement. Acquisition of assets, payment of compensation, and the resettlement and start of the livelihood rehabilitation activities of PAPs, should be completed prior to construction activities, except when a court of law orders so in expropriation cases. Sufficient civic infrastructure must also be provided at relocation sites before displacement takes place.

(f) Assistance in transition period

Resettlement assistance will be provided not only for immediate loss, but also for a transition period needed to restore livelihoods and standards of living of PAPs. Such support could take the form of short-term jobs, subsistence support, salary maintenance, or similar arrangements.

(g) Assistance to the vulnerable

The needs of those most vulnerable to the adverse impacts of resettlement are to be fully considered. Assistance should be provided to help them improve their socio-economic status.

(h) Consultation and participation of the Affected People

In preparing a resettlement plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. Appropriate participation of affected people must be promoted in the planning, implementation, and monitoring of resettlement action plans.

(i) Grievance Mechanisms

Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.

In addition, as the JICA Environmental and Social Guidelines maintain that a JICA project must be in line with the World Bank’s Safe Guard Policies, aforementioned JICA policies have to be supplemented with the OP 4.12. Based on the WB OP 4.12, what needs to be augmented are as follows:

(a) Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advantage of such benefits;

(b) Eligibility of Benefits include the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to the land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying;

(c) Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based;

(d) Provide support for the transition period (between displacement and livelihood restoration);

(e) Particular attention must be paid to the needs of vulnerable groups among those displaced, especially those below the poverty line, the landless, elderly, women and children, ethnic minorities etc.; and

(f) For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, an abbreviated resettlement plan is to be prepared.

In addition to the above core principles of the JICA policy, it also lays emphasis on a detailed resettlement policy inclusive of all the above points; project specific resettlement plan; institutional framework for implementation; monitoring and evaluation mechanism; time schedule for implementation; and, detailed financial plan etc.

In terms of categories of PAPs and types of lost assets, the gaps in the existing legal framework of Bangladesh and requirements of the JICA Environmental and Social Guidelines are identified as presented in the table below.

Table 11.5.1 Gap Analysis between Bangladeshi Laws and JICA Environmental and Social Guidelines

No.	JICA Environmental and Social Guidelines	Laws of Bangladesh	GAP between JICA GL/ WB OP and Laws of Bangladesh	Remarks
1.	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. (JICA GL)	Under "the acquisition and requisition of immovable property ordinance 1982 and amendments", the land can be acquired for the public interest in spite of involuntary resettlement and loss of means of livelihood unless any complaints raised by the PAPs.	A significant gap between JICA GL & laws of Bangladesh. GOB can acquire any land for the interest of public if no complaints are raised by the legal land owner.	A series of public consultation meetings will be held in the course of EIA/LARAP in order to gain understanding of PAPs' on necessity of land acquisition and the magnitude of loss of livelihood means for the Project and formulate fair land acquisition and compensation packages.
2.	When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken. (JICA GL)	Effective measures to minimize the impact and to compensate for losses should be taken.	No gap between JICA GL & laws of Bangladesh	
3.	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels. (JICA GL)	The involuntary resettlement and restoration of livelihood means of the PAPs should be compensated as much as possible.	A minor gap between JICA GL & Laws of Bangladesh In Bangladesh, restoration of livelihood means of the PAPs is done for restoring up to certain level. It can be not at pre-project level or above.	LARAP will define livelihood restoration and improvement plan to raise the PAPs' living standard to an acceptable extent.
4.	Compensation must be based on the full replacement cost as much as possible. (JICA GL)	Compensation is 1.5 times the average market value in the last 12 months.	A minor gap between JICA GL & Laws of Bangladesh Replacement cost under JICA GL may be different from the practice adopted in Bangladesh	The gap identified is somewhat satisfactory in that compensation refers to the average market value and some top-up (50%). Therefore, the Project accept the application of the national requirement.
5.	Compensation and other kinds of assistance must be provided prior to displacement. (JICA GL)	Compensation and other kinds of assistance are provided or deemed to have paid prior to displacement or acquisition.	A minor gap between JICA GL & Laws of Bangladesh. Compensation is supposed to be provided before the land acquisition in Bangladesh. But	the responsible party confirm compensation and other kinds of assistance to be undertaken well before land acquisition and displacement.

No.	JICA Environmental and Social Guidelines	Laws of Bangladesh	GAP between JICA GL/ WB OP and Laws of Bangladesh	Remarks
			sometimes, compensation is provided after land acquisition	
6.	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. (JICA GL) For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared. (WB OP4.12 Para.25)	Resettlement Action Plan should be prepared if land acquisition or involuntary resettlement of any number is required.	Minor gap between JICA GL, WB OP4.12 & Laws of Bangladesh RAP is must if land acquisition and involuntary resettlement is to be done in Bangladesh.	LARAP Study will be performed.
7.	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. (JICA GL)	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance	No gap between JICA GL & laws of Bangladesh	
8.	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. (JICA GL)	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.	No gap between JICA GL & laws of Bangladesh	
9.	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans. (JICA GL)	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.	No gap between JICA GL & laws of Bangladesh	
10.	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities. (JICA GL)	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.	No gap between JICA GL & laws of Bangladesh	
11.	Affected people are to be identified and recorded as early as possible in order to establish their eligibility	Affected people are to be identified and recorded as early as possible in order to	No gap between WB Op 4.12 & laws of Bangladesh	

No.	JICA Environmental and Social Guidelines	Laws of Bangladesh	GAP between JICA GL/ WB OP and Laws of Bangladesh	Remarks
	through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits. (WB OP4.12 Para.6)	establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits		
12.	Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP4.12 Para.15)	Eligibility of benefit includes the PAPs who have legal rights to land only.	A significant gap between WB Op 4.12 & Laws of Bangladesh. Only legal owners are eligible for benefits in Bangladesh	LARAP will ensures that the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying be eligible for compensation.
13.	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WB OP4.12 Para.11)	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based	No gap between WB Op 4.12 & laws of Bangladesh	
14.	Provide support for the transition period (between displacement and livelihood restoration). (WB OP4.12 Para.6)	Provide support one time only.	A significant gap between WB Op 4.12 & Laws of Bangladesh. In Bangladesh, support is provided at one time only.	LARAP will define livelihood restoration and improvement plan to raise the PAPs' living standard to an acceptable extent.
15.	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc. (WB OP4.12 Para.8)	No particular attention is paid for vulnerable groups irrespective of vulnerability.	A significant gap between WB Op 4.12 & Laws of Bangladesh. In Bangladesh, no particular attention is paid to all legally affected people irrespective of	LARAP will formulate specific measures including income rehabilitation assistance to be provided to vulnerable groups.

No.	JICA Environmental and Social Guidelines	Laws of Bangladesh	GAP between JICA GL/ WB OP and Laws of Bangladesh	Remarks
			vulnerability.	

Source: JICA Study Team

As per Bangladesh law, no illegal occupiers of the land are compensated. But according to JICA Environmental and Social Guidelines, illegal occupiers should also get compensation. In order to meet the JICA's requirement, compensation for the illegal occupiers can be assessed at cutoff date and the project proponent may be asked to allocate the budget for compensation. This compensation funds can be disbursed to the illegal occupiers through the district administration.

(3) Land Acquisition Procedure

Under the Ordinance of 1982, the DC at the District level is entrusted to acquire land for agencies requiring land for any public or private infrastructure projects. The procedures of land acquisition will follow the following steps:

Step 1: After identifying and selecting the exact ground locations of the required land, the project proponent will carry out the detailed engineering surveys and design the construction work and lay them out on mouza maps. The project proponent will prepare the land acquisition proposals to obtain administrative approval by the line ministry.

Step 2: The project proponent, after obtaining the approval of the administrative ministry, will make a request to the DC, with sufficient information including the amount of land to be acquisitioned from each plot, and the ownership status such as private and public lands, for the acquisition of the land as per the proposal.

Step 3: Within 90 days, the DC will appraise the application through a) site observation, b) consultation with local politicians and residents, c) develop project profiles, and d) cost estimates. The DC will then develop and submit a proposal on land acquisition to the Ministry of Land for an appraisal by the central government within 90 days.

The DC will publish a notice as stipulated in Section 3 of the Ordinance of 1982 stating that there is a proposal for the property to be acquired. The persons to be displaced may submit an objection to the land acquisition to the DC within 15 days after the notice is served. All the legal titleholders will be advised to show their identification (ID) cards and other documents that verify their rights. For those with no registrations, the DC Office will call for circumstantial evidence from community leaders, local elite people, and religious leaders, etc., to add these people to the list.

The DC will consult with the Public Works Department (PWD), Forest Department (BFD), Department of Agricultural Marketing (DAM) and Department of Fisheries (DOF) to assess the value of structures, trees, crops and aqua products for their existing rates.

Under Section 6, a second public notice will be served stating the GOB's decision on the land acquisition and taking possession thereof. The DC Office will confirm the PAPs, exact land area and size for acquisition, number of relocated houses, agriculture land, forestry and fishing areas that will be lost. The persons to be displaced will be requested to submit their statements of property, amounts and particulars of the claims to compensation after 15 days of the second notice being served. The DC Office will respond to any grievances made by the PAPs in order to agree to the assistance package.

The project proponent shall deposit the estimated amount of the award of compensation with the DC within 60 days from the receipt of the estimate given by the DC.

Upon serving the last notice (Section 7), the DC shall pay the amount to the owners of the acquired property within another 60 days from the date of deposit by the project proponent. The DC will take possession of the property after completion of the compensation payment to the PAPs and immediately declare this in the official gazette, and hand the property over to the project proponent.

11.5.3. Scope and Area of Land Acquisition and Resettlement

There is no involuntary resettlement envisaged out of the CTT project. Land acquisition and compensation for losses of livelihood are foreseen on the coal stockyard (approximately 90 ha) and belt conveyer corridor (approximately 5 ha). The following entitlement matrix shows eligible persons for land acquisition and compensations, their rights and responsible entities for implementation of land acquisition and compensations.

Table 11.5.2 Entitlement Matrix for CTT

No.	Type of Loss	Entitled Persons (EP)	Entitlements (Compensation Package)	Responsible Organizations
1	Permanent loss of private land	Legal land owner	Compensation under Law (CUL) for all private land: average of the last 12 month's sales values of same kind of land plus 50 % premium	Implementation : DC, LAO Monitoring: CPGCBL
			Top-up grant to cover ✓ Gap between the average of the last 12 months' sales values of same kind of land, and the current market value of the private land ✓ Maximum allowable replacement value (RV) to purchase new land with equal productive value, preparation cost, and registration cost (such as stamp duty and tax)	Implementation : Contractor Monitoring: CPGCBL Advisor: DC
		Tenants and	✓ Provision for another land	

No.	Type of Loss	Entitled Persons (EP)	Entitlements (Compensation Package)	Responsible Organizations
		Leaseholders	✓ One-time assistance for lost income based on three years' harvest/production sales	LAO
		Sharecroppers	✓ Provision for another land ✓ One-time assistance for lost income based on three month's income and sharecropping	
2	Loss of khas land	Occupants	✓ Provision for another land ✓ One-time assistance for lost income based on three month's income at minimum wage rates	Implementation : DC, LAO Monitoring: CPGCBL
3	Permanent loss of means of livelihood / source of income	Legal tenants / bargadars (sharecroppers) / employers of salt farms, shrimp farms and fishing sites	✓ One time assistance for annual cropping volume (three years) ✓ Support in transitional period	Implementation : DC Monitoring: CPGCBL
4	Loss of residential / commercial structures	Legal title holders Owners of structures	✓ Cash compensation for affected portion of the structure and other fixed assets at replacement cost ✓ Option to compensated for entire structure if remaining structure is no longer viable ✓ Provision of all taxes, registration costs and other fees incurred for replacement structure ✓ Shifting allowance based on actual cost of moving	Implementation : DC (in cooperation with Public Works Department: DWP) Monitoring: CPGCBL
		Legal tenants / lease holders of the structure	✓ Cash compensation equivalent to replacement cost of structure (or part of structure) for the portions of the structure erected by the tenant / leaseholder ✓ Reconstruction / repair of the remaining structure ✓ Shifting allowance based on actual cost of moving	
		Unauthorized Occupants	✓ Cash compensation equivalent to replacement cost of structure (or part of structure) for the portions of the structure erected by the displaced person ✓ Reconstruction / repair of the remaining structure ✓ Shifting allowance based on actual cost of moving ✓ Additional allowance equivalent to 50% of structure value.	
5.	Loss of standing crops at home	Owner/ Sharecroppers/	✓ CUL and 50% premium according to the estimated current market values	Implementation : DC

No.	Type of Loss	Entitled Persons (EP)	Entitlements (Compensation Package)	Responsible Organizations
	garden, shrimp and fish	Lessee/ unauthorized occupant of land	✓ Cash grant as transition allowance equivalent to one year income	Monitoring: CPGCBL
6.	Loss of timber and fruit bearing trees	Legal owner of land / non-titled user of land	✓ CUL and 50% premium according to the estimated current market values ✓ Cash grant that covers the difference between CUL and the current replacement cost	Implementation : DC Monitoring: CPGCBL
7.	Temporary Loss of land during construction	Owners with legal title, tenants, leaseholders	✓ Rental assistance for the period for which the land is temporarily requisitioned ✓ Temporarily requisitioned land will be returned to owners rehabilitated to original or preferably better condition	Implementation : Contractor Monitoring: CPGCBL
8	Temporary Loss of access to land, structure, common property resource during construction	Owners with legal title, tenants, leaseholders	✓ Provision of temporary access and relocation where possible ✓ Restoration of access to the land, structure, utilities Temporarily requisitioned land will be returned to owners rehabilitated to original or preferably better condition	Implementation : Contractor Monitoring: CPGCBL
9.	Temporary loss of livelihood/ source of income during construction	Business owners, tenants, leaseholders, employees, vendors	✓ Provision of alternative sites for continued economic activities ✓ One-time assistance for lost income for the actual period of disruption in income / tax statement, minimum wage rates or based on actual income, verified through incomes of comparable businesses in the area.	Implementation : Contractor Monitoring: CPGCBL

Source: JICA Survey Team

It should be noted that this entitlement matrix is tentative and the matrix shall be revised and finalized, as necessary, in the course of the LARAP Study, through a series of public consultations and consensus-making processes.

11.5.4. Methods of Valuing Affected Assets and Compensation Framework

Compensation for legal land owners will be based on the principle of replacement costs. Replacement costs are the amounts calculated before displacement which are needed to replace any affected assets without depreciation and without deduction for taxes and/or costs of transaction.

The Land Acquisition Officer (LAO) of the Deputy Commissioner's Office and Land Officer of Upazila Nirbahi Office will support the sub-registrar's office in determining the price of land.

Land price averages from the sub-registrar's office for the previous one year from the date of the notice given under Section 3 of the Ordinance of 1982 are considered for the land valuation. The transacted price, recorded price, existing prices and expected prices should be averaged to reach the replacement value (RV).

A land and property valuation survey based on the prices recorded from formal and informal sources as shown below will determine the RV of land and structures:

- Government price
- Potential sales price
- Potential buyer price
- Enumerated price collected in the socioeconomic survey
- Price deemed appropriate as quoted by a retired government officer living in the vicinity
- Price deemed appropriate as quoted by local intellectuals
- Price deemed appropriate as quoted by religious leaders

CPGCBL will allocate budget to fill the difference between the RV and the cash compensation under law (CUL) as the top-up payment. In the case of any depreciation costs deducted from affected structures in the CUL by the DC, CPGCBL will pay the same as additional construction grants to re-settlers. It will also pay stamp duty and land registration fees when replacement land purchase is confirmed.

Once the budget for land acquisition and livelihood compensations is secured, CPGCBL makes relevant payment to the Cox's Bazar DC's Office. Then the DC's Office kicks off the official disbursement process for the land acquisition and livelihood compensations stipulated in Ordinance 1982 and Land Acquisition Act 1870.

11.5.5. Grievance Mechanism

Endorsed by the Ministry of Power, Energy and Mineral Resources (MPEMR), a formal grievance redress committees (GRCs) will be formed at the union level for any grievances involving resettlement benefits, relocation and other assistance. The purpose of establishing GRCs is to promptly address the concerns and complaints using a process that is accessible and transparent to the PAPs. GRCs can comprise the following members whose standing is neutral and independent:

- CPGCBL Officer
- Resettlement Officer
- Representative from local NGOs

- Head of Union Committee
- Representatives of Displaced Persons
- Local intellectuals
- Legal advisor.

The core function of GRC will be further discussed and determined in due course.

11.5.6. Institutional Framework for Land Acquisition· Resettlement Implementation

CPGCBL is the implementing agency of the project, and the Deputy Commissioner's Office of Chittagong District is the immediate organization for affected people to consult with regard to compensation as stipulated in the Ordinance 1982.

CPGCBL will prepare and submit an application for administrative approval to MPEMR and make a request to DC of Chittagong for taking necessary actions in estimating the degree of land acquisition and cost. It will also prepare and submit an action plan for land acquisition and livelihood compensation to MoPEMR.

CPGCBL will submit the Development Project Proposal (DPP) to GOB for allocation of the required budget for cash CUL and an additional grant for 'top-up payment', which shall be approved by the GOB.

11.5.7. Implementation Schedule for Land Acquisition and Resettlement

The LARAP, which the project proponent formulates as necessary, shall outline an implementation schedule for land acquisition and resettlement including livelihood compensation.

11.5.8. Cost and Budgetary Source

The land acquisition cost is roughly estimated at BDT 7.2 million, based on actual payment made under the Matarbari Coal-Fired Thermal Power Plant Project. As for the cost of livelihood compensation, it is far too difficult to specifically estimate as of now due to its locally specific nature. Detailed costs for land acquisition as well as livelihood compensation will be calculated in the LARAP Study. It is very important that the project proponent secure enough budget for land acquisition and livelihood compensation during the agreed implementation schedule.

In addition to compensation requirements set out in the Ordinance 1982 as well as the Electricity Act 1910, all the compensation will be undertaken according to the principle of replacement cost, which will require CPGCBL to pay any gap between CUL and the replacement value (top-up).

Table 11.5.3 Land Acquisition and Livelihood Compensation Cost（Unit：BDT million）

Area		Land Acquisition		Livelihood Compensation				Total
				Permanent Losses		Temporary Losses		
		CUL	Top-up	CUL	Top-up	CUL	Top-up	
1	Phase I Land（45ha）	166.7	50.0	N/A	N/A	N/A	N/A	N/A
2	Phase II Land (50ha)	185.3	55.6	N/A	N/A	N/A	N/A	N/A
3	Belt Conveyor RoW (5.0ha)	18.5	5.6	N/A	N/A	N/A	N/A	N/A
Total		370.5	111.2	N/A	N/A	N/A	N/A	N/A

(Source: JICA Survey Team)

11.5.9. Monitoring Form

Appropriate reporting (including auditing and redress functions), monitoring and evaluation mechanisms, will be identified and set in place as part of the management system of land acquisition and livelihood restoration. An external monitoring group will be hired by the Project and will evaluate the whole process and final outcome.

An Environmental Management Plan (EMP) has been prepared to provide guidelines for the monitoring during pre-construction, construction and operation activities of the CTT Project.

The purposes of creating an EMP are as follows:

- Confirm that the mitigation measures shall reduce any negative impacts on the environment to allowable levels during the construction and operation phases.
- Set up an organization that is responsible for the implementation of monitoring plan.
- Perform appropriate monitoring during the construction and operation phases.

The environmental components that will be monitored are those that will be positively or negatively affected, or expected to be affected.

11.5.10. Public Consultation

The PAPs and their communities will be consulted about the Project, the rights and options available to them, and proposed mitigation measures for adverse effects, and to all extents possible be involved in the decision-making process concerning land acquisition.

PAPs will be involved in the process of developing and implementing the LARAP. The PAPs will receive prior notification of the compensation, relocation and other assistance available to them.

CPGCBL will be responsible, in close coordination with the DC, for holding and conducting a number of consultations with primary and secondary stakeholders and information dissemination on the following issues:

- Rrelevant details of the project

- LARAP and various degrees of project impact
- Details of entitlements under the LARAP and what is required of PAPs in order to claim their entitlements
- Compensation process and compensation rates
- Relocation and resettlement site development operation in order to obtain agreement and support of affected people in participating in these operations
- Implementation schedule and timetable for the delivery of entitlements

Public participation will be spontaneously performed and information will be made available during preparation and implementation of the Action Plan and, at the minimum, include community meetings and focus group discussions.

11.6. Recommendation for Further Study

11.6.1. Environmental and Social Consideration Study (Draft TOR for the Environmental Impact Assessment)

The draft TOR for further study is proposed in the IEE report. The study includes public consultation meeting to the project affected persons (PAPs) and stakeholders in the area. Items which will be surveyed are shown below. The information should be updated in the study and some environmental aspects such as socio-economic survey of PAPs in social environment, biological survey in natural environment, air quality, water quality, noise and vibration in pollution control require further detailed site specific survey in the study area. Also, a tentative table of contents (TOC) for the EIA report based on the guideline provided by the Department of Environment in Bangladesh is shown in Table 11.6.3.

Table 11.6.1 Environmental Aspect to be studied in EIA (2015 Nov. tentative version)

Category	Aspects	Items to be surveyed	Methodology
Social Environment	Involuntary Resettlement	Number of household and persons to be resettled and their economic condition	- Collecting information through Information Population Census and Socio-economic baseline survey(Census for all PAPs and Socio-economic survey at least 20 % of PAPs in the area)
	Local Economy	Regional economic condition	
	Land Use	Existing condition of land use	
	Transportation	Existing traffic condition	
	Social Infrastructure	Existing social infrastructure condition	
	Splitting of Communities	Distribution of local community	
	Indigenous Peoples	Distribution of tribes and low-level income group	
	Heritage	Distribution of heritages	
	Religious facility	Distribution of religious facilities	
	Water right	Record of water right	
	Risk of infection disease	Regional infection rate	
	Accident	Number of traffic accidents	
Natural	Topography and	Regional topographical and geological	- Field survey for flora and fauna

Environment	Geology	condition	at the project site -Result of topographic survey in the project area
	Soil Erosion	Regional soil condition	
	Water System	Regional river system	
	Flora, fauna, and Biodiversity	Local flora and fauna Distribution of recorded forest	
Pollution	Air Pollution	Air quality condition around the project site	-Monitoring of air, waster and noise at the project site
	Water Pollution	Water quality condition in the river system around the project site	
	Solid Waste	Local management system of municipal and hazardous solid waste	
	Noise and Vibration	Noise and vibration condition around the project site	

Source: JICA Study Team

Table 11.6.2 Expected TOC of EIA Report (2015 Nov. tentative version)

Chapters	Contents
1. Executive summary.	
2. Introduction	Brief description of background, scope of study, methodology, limitation, EIA team, references.
3. Legislative, regulation and policy consideration	Covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared.
4. Project Description 4a. Project activities: 4b. Project schedule: 4c. Resources and utilities demand 4d. Map and survey information	4a: A list of the main project activities to be undertaken during site clearing, construction and operation, Project Plan, Design, Standard, Specification, Quantification, etc. 4b: The phase and timing for development of the Project. 4c: Resources required to develop/support the project, such as soil and construction material and demand for utilities, as well as infrastructure (road, drains, and others). 4d: Location map, Cadastral map showing land plots, Topographical map. Geological map.
5 Analysis of Suitability for Different Alternatives	-
6. Baseline Environmental Condition:	• Physical Environment- Geology, Topology, Geomorphology, Land-use, Soils, Meteorology, and Hydrology • Biological Environment- Habitats, Aquatic life and fisheries, Terrestrial Habitats and Flora and Fauna • Environment Quality -:Air, Water, Noise, Vibration, Soil and Sediment Quality • Relate baseline in both Quantitative and Qualitative term with the anticipated outcomes, achievement of goals, objectives and changes due to project interventions.
7. Socio-economic environment	• Population: Demographic profile and ethnic composition • Settlement and housing • Traffic and transport • Public utilities: water supply, sanitation and solid waste • Fisheries: fishing activities, fishing communities, commercial important species, fishing resources, commercial factors. • Economy and employment: employment structure and cultural issues in employment
8. Identification, Prediction and Evaluation of Potential Impacts	Identification, prediction and assessment of positive and negative impacts likely to result from the proposed project.
9. Management Plan/Procedures:	An outline of the Environmental Management Plan shall be developed for the project covering technical and financial aspects. In the Environmental Monitoring Plan, a detail technical and financial

	proposal shall be included for developing an in-house environmental monitoring system to be operated by the proponent's own resources.
10. Consultation with Stakeholders/Public Consultation	Consultation with interested parties and the general public will take place and their views taking into account in the planning and execution of the project. Beneficial Impacts summarizing the benefits of the project to the Bangladesh nation, people and local community.
11. Risk assessment	Risk management, system of valuation of environmental and properties damage, damage compensation issues shall be addressed.
12. Conclusion and Recommendations.	-

Source: Based on the EIA Guidelines for Industries, 1997 compiled by JICA Study Team

11.6.2. Formulation of the Land Acquisition and Resettlement Action Plan (LARAP)

In the IEE report, terms of reference (ToRs) for the LARAP Study was drafted. The LARAP Study includes public consultation meetings amongst PAPs and stakeholders for the CTT Project. The outline of scope of the IEE Study is shown as follows:

- Social Impact Assessment
  - Socio-economic Survey (demographic census, property/land/asset assessment, field survey for social minority, etc.) and focused group discussions
  - Assessment outline
  - Assessment results
  - Detailed description on social impacts and categories of PAPs
- Anticipated Social Impact
  - Pre-construction phase and construction phase
  - Operation Phase
  - Entitlement for Different Types of Losses
  - Livelihood Restoration and Improvement Plan
  - Cut-off date setting
- Organizational Responsibilities and Implementation Procedures
  - Finalization of LARAP
  - Data collection and entitled persons (EP) identification
  - Local consultation and information management
  - Finalization of budget for land acquisition, resettlement and compensation
  - Implementation of land acquisition and resettlement
  - Monitoring
- Grievance Redress Mechanisms
- Specific Measures provided to Vulnerable Groups and Income Rehabilitation Assistance
- Estimated Land Acquisition and Resettlement Cost
- Local Consultation, Participation, Monitoring and Evaluation Procedures

It should be ensured that LARAP Study undertakes a socio-economic survey and update/review/revise the entitlement matrix proposed in this survey based on the socio-economic survey results. In addition, it is also prerequisite that the LARAP Study holds a series of public consultation meetings on the socio-economic survey and the land acquisition/compensation framework and reaches consensus by reflecting opinions of local people to the final framework.

11.6.3. Additional Impact associated with the CTT in the Operation Phase

The current plan is designed on the assumption of adequate planning of the secondary transportation such as belt conveyor, barge, and tracks under the responsibility of the coal consumer, i.e.; thermal power plants. Those additional facilities related to the expanding transportation from the CTT should be environmentally and socially considered in the construction of these new facilities referring to the JICA Environmental and Social Guidelines, if the facility recognised as inseparable. The consideration should be made under the responsibility of a new thermal power station. One of the possible transportation is that coal will be transported to the proposed CTT from the Matarbari CFPP Harbour by a conveyor belt. It is also planned that the coal will be transported from the proposed CTT to Moheshkhali Energy Hub by conveyor belt crossing the Kohelia River. Another conveyor belt will be used to transport coal from the Matarbari CFPP Harbour to North Matarbari 700 MW CFPP. The proposed lengths of the route of conveyor belts are as follows:

Table 11.6.3 Anticipated Impact associated with Additional Facilities to the CTT at Operation Phase

Possible Route of Secondary Transport Directly Connecting CTT	Potential Impact
Matarbari CFPP Harbour to North Matarbari 700MW CFPP	**Construction phase:** · Temporary Loss of land · Trees to be cut · Infrastructure (house/ shops) to be relocated · Salt cultivation and shrimp cultivation to be affected **Operation phase:** · Air pollution · Noise pollution · Accidents
CTT to Moheshkhali Energy Hub	**Construction phase:** · Temporary Loss of land · Temporary loss of Mangrove forest · Infrastructure (house/ shops) to be relocated · Salt cultivation and shrimp cultivation to be affected **Operation phase:** · Air pollution · Noise pollution · Accidents

Source: JICA Study Team

- Appendix -

<Appendix 1>

SCHEDULE – 1

Classification of industrial units or projects based on its location and impact on environment.
[See Rule 7(2)]

(A) GREEN Category

1. Assembling and manufacturing of TV, Radio, etc.
2. Assembling and manufacturing of clocks and watches.
3. Assembling of telephones.
4. Assembling and manufacturing of toys (plastic made items excluded).
5. Book-binding.
6. Rope and mats (made of cotton, jute and artificial fibers).
7. Photography (movie and x-ray excluded).
8. Production of artificial leather goods.
9. Assembling of motorcycles, bicycles and toy cycles.
10. Assembling of scientific and mathematical instruments (excluding manufacturing).
11. Musical instruments.
12. Sports goods (excluding plastic made items).
13. Tea packaging (excluding processing).
14. Re-packing of milk powder (excluding production).
15. Bamboo and cane goods.
16. Artificial flower (excluding plastic made items).
17. Pen and ball-pen.
18. Gold ornaments (excluding production) (shops only).
19. Candle.
20. Medical and surgical instrument (excluding production).
21. Factory for production of cork items (excluding metalic items).
22. Laundry (excluding washing).

Foot Notes:

(a) Units of all kinds of cottage industries other than those listed in this Schedule shall remain outside the purview of Environmental Clearance Certificate (Unit of cottage industry means all industrial units producing goods or services in which by full-time or part-time labour of family members are engaged and the capital investment of which does not exceed Taka 5 (five) hundred thousand).

(b) No industrial unit listed in this Schedule shall be located in any residential area.

(c) Industrial units shall preferably be located in areas declared as industrial zones or in areas where there is concentration of industries or in vacant areas.

(d) Industrial units likely to produce sound, smoke, odor beyond permissible limit shall not be acceptable in commercial areas.

(B) ORANGE-A Category

1. Dairy Farm, 10 (ten) cattle heads or below in urban areas and 25 cattle heads or below in rural areas.
2. Poultry (up to 250 in urban areas and up to 1000 in rural areas).
3. Grinding/husking of wheat, rice, turmeric, pepper, pulses (up to 20 Horse Power).
4. Weaving and handloom.
5. Production of shoes and leather goods (capital up to 5 hundred thousand Taka).
6. Saw mill/wood sawing.
7. Furniture of wood/iron, aluminum, etc.,(capital up to 5 hundred thousand Taka).
8. Printing Press.
9. Plastic & rubber goods (excluding PVC).
10. Restaurant.
11. Cartoon/box manufacturing/printing packaging.
12. Cinema Hall.
13. Dry-cleaning.
14. Production of artificial leather goods (capital up to 5 hundred thousand Taka).
15. Sports goods.
16. Production of salt (capital up to 10 hundred thousand Taka).
17. Agricultural machinery and equipment.
18. Industrial machinery and equipment.

19. Production of gold ornaments.
20. Pin, U Pin.
21. Frames of spectacles.
22. Comb.
23. Production of utensils and souvenirs of brass and bronze.
24. Factory for production of biscuit and bread (capital up to 5 hundred thousand Taka).
25. Factory for production of chocolate and lozenge. (capital up to 5 hundred thousand Taka).
26. Manufacturing of wooden water vessels.

(C) ORANGE-B Category

1. PVC items.
2. Artificial fiber (raw material).
3. Glass factory.
4. Life saving drug (applicable to formulation only).
5. Edible oil.
6. Tar.
7. Jute mill.
8. Hotel, multi-storied commercial & apartment building.
9. Casting.
10. Aluminum products.
11. Glue (excluding animal glue).
12. Bricks/tiles.
13. Lime.
14. Plastic products.
15. Processing and bottling of drinking water and carbonated drinks.
16. Galvanizing.
17. Perfumes, cosmetics.
18. Flour (large).
19. Carbon rod.
20. Stone grinding, cutting, polishing.

21. Processing fish, meat, food.
22. Printing and writing ink.
23. Animal feed.
24. Ice-cream.
25. Clinic and pathological lab.
26. Utensils made of clay and china clay/sanitary wares (ceramics).
27. Processing of prawns & shrimps.
28. Water purification plant.
29. Metal utensils/spoons etc.
30. Sodium silicate.
31. Matches.
32. Starch and glucose.
33. Animal feed.
34. Automatic rice mill.
35. Assembling of motor vehicles.
36. Manufacturing of wooden vessel.
37. Photography (activities related to production of films for movie and x-ray).
38. Tea processing.
39. Production of powder milk/condensed milk/dairy.
40. Re-rolling.
41. Wood treatment.
42. Soap.
43. Repairing of refrigerators.
44. Repairing of metal vessel.
45. Engineering works (up to 10 hundred thousand Taka capital.)
46. Spinning mill.
47. Electric cable.
48. Cold storage.
49. Tire re-treading.
50. Motor vehicles repairing works (up to 10 hundred thousand Taka capital).

51. Cattle farm: above 10 (ten) numbers in urban area, and above 25 (twenty five) numbers in rural area.
52. Poultry: Number of birds above 250 (two hundred fifty) in urban area and above 1000 (one thousand) in rural area.
53. Grinding/husking wheat, rice, turmeric, chilly, pulses – machine above 20 Horse Power.
54. Production of shoes and leather goods, above 5(five) hundred thousand Taka capital.
55. Furniture of wood/iron, aluminum, etc., above 5(five) hundred thousand Taka capital.
56. Production of artificial leather goods, above 5(five) hundred thousand Taka capital.
57. Salt production, above 10(ten) hundred thousand Taka capital.
58. Biscuit and bread factory, above 5 (five) hundred thousand Taka capital.
59. Factory for production of chocolate and lozenge, above 5(five) hundred thousand Taka capital.
60. Garments and sweater production.
61. Fabric washing.
62. Power loom.
63. Construction, re-construction and extension of road (feeder road, local road).
64. Construction, re-construction and extension of bridge (length below 100 meters).
65. Public toilet.
66. Ship-breaking.
67. G.I. Wire.
68. Assembling batteries.
69. Dairy and food.

Foot Notes:

(a) No industrial unit included in this list shall be located in any residential area.

(b) Industrial units shall preferably be located in areas declared as industrial zones or in areas where there is concentration of industries or in vacant areas.

(c) Industrial units likely to produce sound, smoke, odor beyond permissible limit shall not be acceptable in commercial areas.

(D) RED Category

1. Tannery.
2. Formaldehyde.
3. Urea fertilizer.
4. T.S.P. Fertilizer.
5. Chemical dyes, polish, varnish, enamel.
6. Power plant.
7. All mining projects (coal, limestone, hard rock, natural gas, mineral oil, etc.)
8. Cement.
9. Fuel oil refinery.
10. Artificial rubber.
11. Paper and pulp.
12. Sugar.
13. Distillery.
14. Fabric dying and chemical processing.
15. Caustic soda, potash.
16. Other alkalis.
17. Production of iron and steel.
18. Raw materials of medicines and basic drugs.
19. Electroplating.
20. Photo films, photo papers and photo chemicals.
21. Various products made from petroleum and coal.
22. Explosives.
23. Acids and their salts (organic or inorganic).
24. Nitrogen compounds (Cyanide, Cyanamid etc.).
25. Production of plastic raw materials (PVC, PP/Iron, Polyesterin etc.)
26. Asbestos.
27. Fiberglass.

28. Pesticides, fungicides and herbicides.
29. Phosphorus and its compounds/derivatives.
30. Chlorine, fluorine, bromine, iodine and their compounds/derivatives.
31. Industry (excluding nitrogen, oxygen and carbon dioxide).
32. Waste incinerator.
33. Other chemicals.
34. Ordnance.
35. Nuclear power.
36. Wine.
37. Non-metallic chemicals not listed elsewhere.
38. Non-metals not listed elsewhere.
39. Industrial estate.
40. Basic industrial chemicals.
41. Non-iron basic metals.
42. Detergent.
43. Land-filling by industrial, household and commercial wastes.
44. Sewage treatment plant.
45. Life saving drugs.
46. Animal glue.
47. Rodenticide.
48. Refractories.
49. Industrial gas (Oxygen, Nitrogen & Carbon-dioxide).
50. Battery.
51. Hospital.
52. Ship manufacturing.
53. Tobacco (processing/cigarette/Biri-making).
54. Metallic boat manufacturing.
55. Wooden boat manufacturing.
56. Refrigerator/air-conditioner/air-cooler manufacturing.
57. Tyre and tube.
58. Board mills.

59. Carpets.
60. Engineering works: capital above 10 (ten) hundred thousand Taka.
61. Repairing of motor vehicles: capital above 10 (ten) hundred thousand Taka.
62. Water treatment plant.
63. Sewerage pipe line laying/relaying/extension.
64. Water, power and gas distribution line laying/relaying/extension.
65. Exploration/extraction/distribution of mineral resources.
66. Construction/reconstruction/expansion of flood control embankment, polder, dike, etc.
67. Construction/reconstruction/expansion of road (regional, national & international).
68. Construction/reconstruction/expansion of bridge (length 100 meter and above).
69. Murate of Potash (manufacturing).

Foot Notes:

(a) No industrial unit included in this list shall be allowed to be located in any residential area.

(b) Industrial units shall preferably be located in areas declared as industrial zones or in areas where there is concentration of industries or in vacant areas.

(c) Industrial units likely to produce sound, smoke, odor beyond permissible limit shall not be acceptable in commercial areas.

(d) After obtaining location clearance on the basis of Initial Environment Examination (IEE) Report, the Environmental Impact Assessment (EIA) Report in accordance with the approved terms of reference along with design of ETP and its time schedule shall be submitted within approved time limit.

<Appendix 2>

Environmental Standards

Table A.2.1 Standards for Air quality in Bangladesh [1]

No.	Parameter	Concentration (mg/m^3)		Exposure Time
		ECR	IFC Guideline (General: 2007)*	
a)	Carbon Mono-oxide	10	-	8 hours
		40	-	1 hour
b)	Lead (Pb)	0.5	-	Year
c)	Nitrogen Oxide	0.1	0.04	Year
		-	0.2	1 hour
		-	0.2	1 hour
d)	Suspended Particulate Matter (SPM)	0.2	-	8 hours
e)	Particulate Matter 10µm (PM_{10})	0.05	0.02	Year
		0.15	0.05	24 hours
f)	Particulate Matter 2.5µm ($PM_{2.5}$)	0.015	0.01	Year
		0.065	0.025	24 hours
g)	Ozone	0.235	-	1 hour
		0.157	0.160	8 hours
h)	Sulfur Dioxide	0.08	-	Year
		0.365	0.125	24 hours

Notes: * Air quality standard of IFC Guideline is quoted from WHO Guideline.

(Source: Bangladesh Gazette July 19, 2005, IFC Environmental Health and Safety Guidelines 2007

Table A.2.2 Ambient water quality standards (inland surface water)[2]

No.	Best Practice Based Classification	pH	BOD mg/1	Dissolved Oxygen (DO), mg/l	Total Coliform Bacteria quantity/ml
a)	Potable water source supply after bacteria freeing only	6.5-8.5	2 or less	6 or above	50 or less
b)	Water used for recreation purpose	6.5-8.5	3 or less	5 or above	200 or less
c)	Potable water source supply after conventional processing	6.5-8.5	6 or less	6 or above	5000 or less
d)	Water used for pisci-culture	6.5-8.5	6 or less	5 or above	5000 or less
e)	Industrial use water including chilling & other processes	6.5-8.5	10 or less	5 or above	5000 or less
f)	Water used for irrigation	6.5-8.5	10 or less	5 or above	5000 or less

(Source：The Environmental Conservation Rules,1997)

[1] Not exceed one time in year
[2] Textual annotations are as follows.
(1) Maximum amount of ammonia presence in water are 1.2 mg/l (as nitrogen molecule) which is used for pisciculture.
(2) For water used in irrigation Electrical Conductivity-2250 micro mho/cm (at 25oC). Sodium less than 26 mg/l, Boron less than 2 mg/l

Table A.2.3 Standards for Sound [3]

<table>
<tr><th rowspan="3">No</th><th rowspan="3">Zone Class</th><th colspan="4">Limits in dBA</th></tr>
<tr><th colspan="2">ECR</th><th colspan="2">IFC Guideline (General: 2007)</th></tr>
<tr><th>Day</th><th>Night</th><th>Day</th><th>Night</th></tr>
<tr><td>a)</td><td>Silent Zone</td><td>45</td><td>35</td><td rowspan="2">55</td><td rowspan="2">45</td></tr>
<tr><td>b)</td><td>Residential Zone</td><td>50</td><td>40</td></tr>
<tr><td>c)</td><td>Mixed Zone (this area is used combining residential, commercial and industrial purposes)</td><td>60</td><td>50</td><td rowspan="3">70</td><td rowspan="3">70</td></tr>
<tr><td>d)</td><td>Commercial Zone</td><td>70</td><td>60</td></tr>
<tr><td>e)</td><td>Industrial Zone</td><td>75</td><td>70</td></tr>
</table>

(Source: The Environmental Conservation Rules, 1997 IFC Environmental Health and Safety Guidelines 2008)

[3] Textual annotations are as follows.
(1) The day time is considered from 6 a.m. to 9 p.m. and the night time is from 9 p.m. to 6 p.m.
(2) From 9 at night to 6 morning is considered night time.
(3) Area within 100 meters of hospital or education institution or educational institution or government designated / to be designated / specific institution / establishment are considered Silent Zones. Use of motor vehicle horn or other signals and loudspeaker are forbidden in Silent Zone.

<Appendix 3>

Table A.3.1 Surface water quality in the CFPP project site

Parameter	Unit	Results		Standards for Inland Surface Water					
		Rainy season: 7/Oct/2012	Dry season: 30/Jan/2013	A	B	C	D	E	F
Depth	M	0.5	0.5	-	-	-	-	-	-
Temperature	^{o}C	30.6	18.0	-	-	-	-	-	-
Salinity	-	9.8	35.8	-	-	-	-	-	-
pH	-	7.82	8.00	6.5-8.5	6.5-8.6	6.5-8.7	6.5-8.8	6.5-8.9	6.5-8.9
DO	mg/L	5.5	5.8	6 or above	5 or above	6 or above	5 or above	5 or above	5 or above
BOD	mg/L	0.8	0.4	2 or less	3 or less	3 or less	6 or less	10 or less	10 or less
COD	mg/L	97	241	-	-	-	-	-	-
Oil&Grease	mg/L	4.2	-	-	-	-	-	-	-
SS	mg/L	613	-	-	-	-	-	-	-

Source EIA Report of Matarbari 1200MW CFPP

Notes: Category of water body is as below.

A: Potable water source supply after bacteria freeing only

B: Water used for recreational purposes

C: Potable water source supply after conventional processing

D: Water used for pisciculture

E: Industrial use water including chilling and other processes

F: Water used for irrigation

Table A.3.2 The ground water quality in the CFPP project site

Parameter	Unit	Results		Standards for Drinking Water
		Rainy season 7/October/2012	Dry season 30/January/2013	
Temperature	^{o}C	29.7	20.1	20 – 30
pH	-	7.48	7.20	6.5 8.5
Chloride	mg/L	167	167	150 – 600
NH_3	mg/L	0.04	0.04	0.5
Iron (Fe)	mg/L	0.92	0.92	0.3 1.0
Hardne	mg/L	164	164	200 – 500
Arsenic (As)	mg/L	0.01	0.01	0.05
DO	mg/L	3.5	4.7	6.0
BOD	mg/L	0.4	0.2	0.2
COD	mg/L	0	0	4.0
SS	mg/L	0.2	-	10
Coliform	N/100mL	0	-	0
Salinity	-	0.3	0.7	-

Source EIA Report of Matarbari 1200MW CFPP

<Appendix 4>

A.4.1 Environmental Checklist(Other Infrastructure Project) (Tentative Version at IEE stage in Nov. 2015: This should be updated and finalized prior to the JICA Environmental Review)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process?	(a) N	Draft IEE report was prepared in the JICA preparatory survey. TOR for the EIA study is proposed in the IEE report. EIA study should be conducted after TOR approval by DoE.
		(b) Have EIA reports been approved by authorities of the host country's government?	(b) N	Following the comment on the IEE report from the DoE, EIA report should be prepared under responsibility of the CGCBL.
		(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	(c) N	The IEE report has not been submitted and the actual EIA process is required hereinafter.
		(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(d) N	The IEE report has not been submitted and the actual EIA process is required hereinafter.
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders?	(a) Y	The contents of the project was explained stakeholder in the area. Most of the opinions and comments made by local stakeholders were mere concerns and worries without articulate understanding on the environment. Anticipated impacts were properly explained, leading to proper understanding on those impacts. It is necessary that a series of public consultations be held in the course of EIA process for adequate information sharing with local stakeholders.
		(b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(b) Y	
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	To minimize the impact, 3 alternatives were compared in the draft IEE report.
2 Pollution Control	(1) Air Quality	(a) Do air pollutants, (such as sulfur oxides (SOx), nitrogen oxides (NOx), and soot and dust) emitted from the proposed infrastructure facilities and ancillary facilities comply with the	(a) Y (b) N/A	The dust caused by the earth works at the construction phase and coal dust caused by the winds at the operation phase, are likely occurred. The facility allocation should be planed considering the

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		country's emission standards and ambient air quality standards? Are any mitigating measures taken? (b) Are electric and heat source at accommodation used fuel which emission factor is low?		location with the existing residents. Also, adequate mitigation measure such as wind prevention net, frequent watering should be applied to minimize those impacts.
	(2) Water Quality	(a) Do effluents or leachates from various facilities, such as infrastructure facilities and the ancillary facilities comply with the country's effluent standards and ambient water quality standards?	Y	The facilities should be designed to meet the country’s effluent standards.
	(3) Wastes	(a) Are wastes from the infrastructure facilities and ancillary facilities properly treated and disposed of in accordance with the country's regulations?	Y	Waste from the infrastructure should be properly treated to meet the country’s standard and regulation.
	(4) Soil Contamination	(a) Are adequate measures taken to prevent contamination of soil and groundwater by the effluents or leachates from the infrastructure facilities and the ancillary facilities?	Y	Effluent from the facilities should be treated properly to meet the country’s effluent standards before discharge.
	(5) Noise and Vibration	(a) Do noise and vibrations comply with the country's standards?	Y	The impact should be minimized applying the low noise equipments to meet the country's standards.
	(6) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	N	(a) Ground water is not planned to be used for construction and operation. No large impact is anticipated.
	(7) Odor	(a) Are there any odor sources? Are adequate odor control measures taken?	N	(a)General waste at the terminal operation should be properly treated to meet the country’s standard and regulation.
3 Natural Environment	(1) Protected Areas	(a) Is the project site or discharge area located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) The project site is not located in the protected area. Sonadia ECA, the nearest protected area in Cox’s Bazar district is located approximately 15km south of the project site and no large impact is anticipated at the moment.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	(a) N	The project site is used for salt and shrimp cultivation.
		(b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	(b) N	There is no particular observed endangered species at project site. However, at the beach at the other side of the Matarbari island , some sea turtle and spoon billed sandpiper, endangered species, were seasonally observed for their spawning and impact to those species should be minimized.
		(c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	(c) N	No large impact to the ecosystem is anticipated at the moment.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(d) Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife and livestock?	(d) N	No large impact on the migration routes and habitat fragmentation of wildlife is anticipated at the moment.
		(e) Is there any possibility that the project will cause the negative impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystem due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered?	(e) N	No large impact to the ecosystem is anticipated at the moment.
		(f) In cases where the project site is located in undeveloped areas, is there any possibility that the new development will result in extensive loss of natural environments?	(f) N	The project site is used for salt and shrimp cultivation by the local residents for long period.
	(3) Hydrology	(a) Is there a possibility that hydrologic changes due to the project will adversely affect surface water and groundwater flows?	(a)N	The project does not involve large alteration of the permanent water body and no large impact to the hydrology is anticipated at the moment.
	(4)Topography and Geology	(a) Is there a possibility the project will cause large-scale alteration of the topographic features and geologic structures in the project site and surrounding areas?	(a)N	No large impact to the topography and geology is anticipated at the moment.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?	(a) N	Although approximately 100ha of private land will be acquired, no involuntary resettlement is envisaged.
		(b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement?	(b) N	IEE Report recommends to hold public consultations. Based on this, proper consultation process will be arranged in the future LARAP Study.
		(c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement?	(c) N	IEE Report recommends compensation based on the principle of replacrement costs and the formulation of the action pland for land acquisition and livelihood compensation. Based on the proposal, the action plan will be formulated in the course of the future LARAP Study.
		(d) Is the compensations going to be paid prior to the resettlement?	(d) N	LARAP will set the timing of payments of compensation.
		(e) Is the compensation policies prepared in document?	(e) Y	IEE formulates overall land acquisition and livelihood compensation framework and the upcoming LARAP will finalize details including entitlement matrix.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?	(f) Y	LARAP Study will undertake focused group meetings with local residents. Based on consultations with local residents including socially vulnerable people, whenever necessary, a livelihood restoration and improvement plan will be formulated.
		(g) Are agreements with the affected people obtained prior to resettlement?	(g) N	LARAP will seek consesus with PAPs.
		(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	(h) Y	The Ordinance 1982 stipulates that it is the Deputy Commissioner's Office of the concerned district that is responsible for handling the land acquisition and compensation on behalf of the project owner. CPGCBL will follow the official framework for any possible resettlement in order not to do any harm to other similar resettlement cases. The Project Management Unit (PMU) will keep in close touch with DC Office and monitor the procedure. CPGCBL has undertaken land acquisition, resettlement, and livelihood compensation for Matarbari CFTP project and been versed with the process.
		(i) Are any plans developed to monitor the impacts of resettlement?	(i) Y	PMU will work in accordance with the Ordinance 1982 and the Electricity Act 1910, and keep in close touch with DC Office.
		(j) Is the grievance redress mechanism established?	(j) Y	Grievance is legitimately mentioned in the Ordinance 1982, and CPGCBL will be in close touch with DC Office to handle it. PMU will be the entry point for any grievance from the project affected people.
	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	(a) Y	By acquiring land for the CTT, land owners and sharecroppers will lose their means of livelihood.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	There are no such religious heritage places etc., in and around CTT designated area.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken? (b) Is there a possibility that landscape is spoiled by construction of high-rise buildings such as huge hotels?	(a) N	There are no such places designated by law in and around CTT designated area.
	(5)Ethnic Minorities and	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	(a) N/A	There is no ethnic minority or indigenous people confirmed in and around the CTT designated area.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	Indigenous Peoples	(b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(b) N/A	Not applicable
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?	(a) N	CPGCBL will not violate any laws and ordinances associated with the working conditions of Bangladesh.
		(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?	(b) Y	The construction company shall establish a work safety plan and submit it to CPGCBL for prior approval. The work safety plan will include mitigation measures on safety training, etc. and on provision of appropriate protective equipment to the workers, etc.
		(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?	(c) Y	
		(d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(d) Y	
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	(a) Y	During construction period, air pollution, noise, increase water turbidity and solid waste is anticipated. The impact should be mitigated with the adequate measure such as frequent watering to the working road, applying low noise and vibration equipments, construction of sedimentation ponds and enhancement of recycle/reuse.
		(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?	(b) N	Associated with the earth works and facility construction, the impact to surrounding natural environment is anticipated but those expected temporally and within limited area.
		(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(c) N	The employment of local people will be promoted for increased employment opportunities for various subcontract work resulting from the CTT construction activity. Local people will be employed to the maximum extent possible. Lodgings of project workers will be equipped with sufficient living facilities so that workers remain at the project site as much as possible.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				Labor contracts between the construction industry and children shall be prohibited. Regular patrols to check for child workers will be conducted Local people will be recruited for simple work to the extent possible, which will lower the potential risk of infectious diseases transmitted from external workers. Pre-employment and periodic medical check-ups will be conducted for external workers (technical workers, etc.).
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?	(a) Y	The Monitoring Plan should be established and strictly observed by the responsible bodies, especially for the items to be classified what the monitoring is required.
		(b) What are the items, methods and frequencies of the monitoring program?	(b)Y	The detail description should be compiled in EIA report.
		(c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?	(c) Y	CPGCBL should organize required measure for the monitoring.
		(d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(d)Y	The report should be conducted based on the legislation.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Roads, Railways and Bridges checklist should also be checked (e.g., projects including access roads to the infrastructure facilities).	(a) N	No large impact to the existing roads.
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N	The emission gas associated with the construction is negligible and no large impact to global warming.

1) Regarding the term “Country's Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made. In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).

2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.

<Appendix 5>

Screening Format (Tentative at IEE Stage, Nov. 2015: This should be revised based on the EIA process)

Name of Proposed Project:

Construction and Operation of Coal Transshipment Terminal (CTT) Project at Matarbari Area, Moheshkhali, Cox's Bazar, Bangladesh

Project Executing Organization, Project Proponent or Investment Company:

Coal Power Generation Co. (Bangladesh) Limited (CPGCBL)

Name, Address, Organization, and Contact Point of a Responsible Officer:

Name:

Address:

Organization:

Tel:

Fax:

E-Mail:

Date:

Signature:

Check Items

Please write "to be advised (TBA)" when the details of a project are yet to be determined.

Question 1: Address of Project Site
Dhalghata Union, Moheshkhali Upazila, Cox's Bazar District, Bangladesh.

Question 2: Scale and contents of the project (approximate area, facilities area, production, electricity generated, etc.)
2-1. Project profile (scale and contents)

Project components include construction of Port Facilities, Coal Stock Yard and Control Terminal etc., related to the coal transshipment and those operations including secondary ship operation. The location of the facility is at the south of the planned Matarbari Coal Power Plant and Port area at Matarbari Union. The area is expected 2 locations in the Matabari area for approximately 45-50 ha of stock yard to accommodate above mentioned facilities and the detail of the facilities are shown in **Table-1.**

Table-1: Project Components

No.	Project Components	Specification/ Quantities	Remarks
1	Port Facilities	Unloading Berth L: 300 m, D:16.0 m 3 unit Unloader C: 2,500 t/h 6 unit Loading Berth L:130 m, D:7.5 m 5 unit Ship Loader C: 1,500 t/h 5 Unit	Unloading berth is planned to construct at northern side of harbor of CFPP. Loading berth is planned to construct at southern side of harbor of CFPP.
2	Coal Stock Yard	Coal handling volume: 11.0 mil ton/year Area：45ha (1st Phase) Coal handling volume: 26.5 mil ton/year Area : 50ha (2nd Phase), Total 95ha(1 and 2 Phase) Stacker/Reclaimer total 14 unit Belt Conveyor : approximately 2.5 km(only internal transport between harbor and CTT) Facilities of disaster prevention or dust control	Coal stock yard is planned to construct around southern side of power plant
3	Control tower, maintenance shop	Building Maintenance yard	Control tower of maintenance shop is planned to construct in coal stock yard around power plant
4	Dredging and land reclamation	Expand of inner harbor : Approximately 8.5ha and 1.7 million m3. Secondary transportation in river (if any) Land reclamation for coal Stock Yard: 95ha for 1 & 2 phases with the height of 5m	
5	Handling vessel at operation of the CTT	Handling Vessel : Phase -1: 171 vessels for Panamax Phase-2: 375 vessels for Panamax 1,600 vessels for 5,000tones	

2-2. How was the necessity of the project confirmed?

Is the project consistent with the higher program/policy?

☒YES: Please describe the higher program/policy.

（To be advised (TBA)）

☐NO

2-3.Did the proponent consider alternatives before this request?

☒YES: Please describe outline of the alternatives

（With/Without project and adequate site selection are considered.　　　　　）

☐NO

2-4.Did the proponent implement meetings with the related stakeholders before this request?

☒Implemented ☐Not implemented

<u>If implemented</u>, please mark the following stakeholders.

☒Administrative body

☒ Local residents

☒ NGO

☐Others（ ）

Question 3:

Is the project a new one or an ongoing one? In the case of an ongoing project, have you received strong complaints or other comments from local residents?

☒New ☐Ongoing(with complaints) ☐Ongoing (without complaints)

☐Other

As relevant projects for this CTT, the Coal Fire Power Plant (CFPP) development project is ongoing in the same area without objection.

Question 4:

Is an Environmental Impact Assessment (EIA), including an Initial Environmental Examination (IEE), required for the project according to a law or guidelines of a host country? If yes, is EIA implemented or planned? If necessary, please fill in the reason why EIA is required.

☒Necessity (☐Implemented ☒Ongoing/planning)

(Reason why EIA is required: This project is categorized as **RED category** according to DoE guidelines, which requires both IEE and EIA study)

☐Not necessary

☐Other (please explain)

Question 5:

In the case that steps were taken for an EIA, was the EIA approved by the relevant laws of the host country? If yes, please note the date of approval and the competent authority.

☐Approved without a supplementary condition	☐Approved with a supplementary condition	☐Under appraisal

(Date of approval: Competent authority:)

☐Under implementation

☒Appraisal process not yet started

☐Other( )

Question 6:

If the project requires a certificate regarding the environment and society other than an EIA, please indicate the title of said certificate. Was it approved?

☐Already certified

Title of the certificate: (No objection Certificate from Local Government authority -Union Chairman))

☒Requires a certificate but not yet approved

☐Not required

☐Other ( )

Question 7:

Are any of the following areas present either inside or surrounding the project site?

☒ Yes ☐No

If yes, please mark the corresponding items.

☐ National parks, protection areas designated by the government (coastline, wetlands, reserved area for ethnic or indigenous people, cultural heritage)

☐ Primeval forests, tropical natural forests

☐ Ecologically important habitats (coral reefs, mangrove wetlands, tidal flats, etc.)

☒ Habitats of endangered species for which protection is required under local laws and/or international treaties

☐ Areas that run the risk of a large scale increase in soil salinity or soil erosion

☐ Remarkable desertification areas

☐Areas with special values from an archaeological, historical, and/or cultural points of view

☐ Habitats of minorities, indigenous people, or nomadic people with a traditional lifestyle, or areas with special social value

Question 8:

Does the project include any of the following items?

☒ Yes ☐No

If yes, please mark the appropriate items.

☐Involuntary resettlement (scale: households persons)

☐Groundwater pumping (scale: m3/year)

☒ Land reclamation, land development, and/or land-clearing (scale: 95hectors)

☐Logging (scale: hectors)

Question 9:

Please mark related adverse environmental and social impacts, and describe their outlines.

☒ Air pollution

☒ Water pollution

☒ Soil pollution

☒ Waste

☒ Noise and vibrations

☐ Ground subsidence

☒ Offensive odors

☐ Geographical features

☒ Bottom sediment

☒ Biota and ecosystems

☐ Water usage

☒ Accidents

☐ Global warming

☒ Involuntary resettlement

☒ Local economies, such as employment, livelihood, etc.

☒ Land use and utilization of local resources

☒ Social institutions such as social infrastructure and local decision-making institutions

☐ Existing social infrastructures and services

☐ Poor, indigenous, or ethnic people

☒ Misdistribution of benefits and damages

☒ Local conflicts of interest

☒ Gender

☒ Children’s rights

☐ Cultural heritage

☒ Infectious diseases such as HIV/AIDS

❒ Other ( )

Outline of related impact:

The project site is located in the coastal low land that is used for salt and shrimp farming depending on the natural weather. Although the project site is selected in the land where the actual resettlement can be avoided, the private land for those cultivations should be acquired.

Associated with the land development, the land level will be elevated for the facility construction in entire 95ha of the project site in the height of 5m-8m. Although the area is not included activity to modify actual water body, the land for salt and shrimp farming will be reclaimed for securing disaster prevention from flood. Additional dredging also is associated with the port improvement to meet transshipment of coal and 8.5ha and 1.7 million tons of dredging and is required for expansion of water area at the port.

Natural Environment:

Current study for the CTT project is considered to avoided/minimized those environmental impacts. The project is principally been planning not to affect coastline through avoiding large scale land reclamation and land development. Project site is used for salt and shrimp farms and not primeval forests or tropical rain forests. A sandy beach is located in front of the proposed project site, with no mangrove forests and tidal flats. The area is the presumed habitat of birds, dolphins, and sea turtles of IUCN (International Union for Conservation of Nature and Natural Resources) Red list (endangered species, etc.) at the EIA study in Matarbari 1200MW Thermal Power Station Project(CFPP), and there is the possibility of impact caused by construction on the rare species and ecosystem even its scale is not large.

Social Environment:

Principally, the involuntary resettlement associated with the project was avoided. However, with the 95 ha of land acquisition of salt and shrimp farming land, it is anticipated that employers/ employees of salt farms, shrimp farms, and fishermen will lose their means of livelihood. Fishing activities around the site will also be affected due to a rise of water pollution and restriction of fishing.

Pollution control:

Construction and operation phase, dust related pollution such as air pollution, water pollution and noise should be considered to minimize impact to surrounding communities with the mitigation measure following the environmental standard. Especially, at the operation phase, coal dust related pollution such as suspended particles in the air and run-off water to the surrounding area should be minimized with the adequate prevention measures such as wind prevention net, frequent watering for the air and water treatment plant for the water.

Question 10:

In the case of a loan project such as a two-step loan or a sector loan, can sub-projects be specified at the present time? TBA

☐Yes ☒No

(To be advised –TBA)

Question 11:

Regarding information disclosure and meetings with stakeholders, if JICA's environmental and social considerations are required, does the proponent agree to information disclosure and meetings with stakeholders through these guidelines?

☐Yes ☐No

(To be advised –TBA)

<Appendix 6>

Table A.6.1 : EMP during Pre-construction & Construction Phase(Tentative at IEE Stage, Nov. 2015: This should be revised based on the EIA process)

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
Pre-construction Phase									
1	Land acquisition	- Loss of land at CTT	- the Acquisition and Requisition of Immovable Property Ordinance 1982 - JICA Guidelines for Environmental and Social Considerations (2010)	- Consideration for land owners, sharecroppers and compensation for standing agriculture products	- - Land acquisition should be conducted in compliance with relevant laws and regulations - Cost related to relocation (if any) will be given to the relocated residents	- Construction Area	- During land acquisition process	- Office of the Deputy Commissioner - CPGCBL	Expenses to be paid by CPGCBL
2	Social Institutions such as Social Infrastructure and Local Decision-making Institutions	- Changes in people's thinking through interacting with local government officers, local residents and others in the land acquisition procedure	-----	- Consideration to affected peoples' emotions	- Compensation should be conducted in compliance with relevant laws and regulations	- Construction Area	- Prior to the start of construction	- Office of the Deputy Commissioner - CPGCBL	Expenses to be paid by CPGCBL

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
Construction Stage									
1	Air Quality	1) Dust resulting from construction work 2) Exhaust gas from construction machinery and vehicles used for mobilization of equipment 3) Air pollution arising from incineration of construction materials and waste	1) - 3) - Ambient Air Quality Standard	1) - 3) - Prevention of air pollution in the surrounding construction area	1) Dust prevention - Watering access roads and construction site, especially in the dry season - Using cover sheet on trucks for the transportation of soil 2) Gas emission prevention - Periodic maintenance and management of all construction machinery and vehicles 3) Waste management - Prohibit open burning and illegal dumping	1) - 3) - Construction area	1) - 3) -During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
2	Water Quality	1) Run off water from construction area 2) Domestic wastewater of workers 3) Inappropriate disposal of waste	1) -3) - Waste water standards	1) - 3) - Prevention of water pollution in the surrounding construction area	1) Run off water - CTT - Preventing soil loss by stabilizing any slopes of the construction area with concrete, as necessary based on geological survey 2) Domestic wastewater	1) - 3) - Construction area	1) - 3) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					- Install wastewater treatment facility for workers, such as septic tanks 3) Waste management - Prohibit illegal waste disposal				
3	Waste	1) Construction waste from construction work 2) Domestic waste from workers 3) Hazardous waste such as dry batteries, etc.	1) - 3) -Waste Management Rule	1) - 3) - Prevention of inappropriate waste disposal	1), 2) Construction and domestic waste - Conduct separate waste collection and promote recycling and reuse - Appropriate disposal of non-recyclable waste according to rules 3) Hazardous waste - Hazardous waste should be treated under the related regulations	1) - 3) - Construction area	1) - 3) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
4	Noise and Vibration	1) Noise and vibration caused by construction machinery 2) Noise caused by vehicles used for mobilization	1), 2) - Noise level standards	1), 2) - Reduction of noise level from construction activities	1) Construction machinery - Optimizing construction schedule - Perform construction work during daytime, especially piling	1), 2) - Construction area	1), 2) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
		of equipment and workers			work -Using low-noise/ low vibration equipment, as much as possible 2) Mobilization - Limit truck speed, especially around residential areas				
5	Ecosystem	1) Removal of vegetation 2) Loss of protected species	1) Cover of vegetation and trees 2) Existence of protected species	1), 2) - Mitigation of environmental impact on the loss of vegetation and protected species	1) Vegetation -Boundary of CTT construction area should be re-vegetated with native plants 2) Protected species - Consult with specialists about moving individual animals if any protected species are discovered	1), 2) - Construction area	1), 2) - During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
6	Topography and Geology	- Soil runoff	-Soil runoff	-Prevention of soil runoff	- CTT site was selected avoiding any steep sloped areas - Preventing soil loss by stabilizing any slopes of construction areas with concrete, as necessary based on geological survey	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
7	Deterioration of Local Economy	- Loss of Salt / shrimp field	- Employment of local residents	- Consideration of local	- Employ as many local residents as	- Construction area	- During construction	- Implementation: Contractor/	Expenses included in

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
	such as Losses of Employment and Means of Livelihood			residents' feelings	possible - Use the services (i.e., laundry and catering services, etc.) and products offered by the local community		phase	Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	contract cost by Contractor
8	Land Use and Utilization of Local Resources	- Changing the traditional land usage patterns and utilization of local resources	- Employment of local residents	- Consideration of local residents' feelings	- Employ as many local residents possible - Use the services (i.e., laundry and catering services, etc.) and products offered by the local community	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: PGCB/ Supervision Consultant	Expenses included in contract cost by Contractor
9	Disturbance to Water Usage, Water Rights, etc.	- Water pollution caused by soil runoff	-----	- Prevention of water pollution in downstream areas	- CTT was selected avoiding any steep sloped areas - Preventing soil loss by stabilizing any slopes of construction areas with concrete, as necessary based on geological survey -Re-greening in construction areas	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor
10	Cultural Heritage	- Further destruction of buried cultural heritage due to engineering work	- Loss of cultural heritage	- Protect cultural heritage	- Stop construction work if any cultural heritage area is discovered and immediately consult with specialists	- Construction area	- During construction phase	- Implementation: Contractor/ Environmental Consultant - Supervisor: CPGCBL/ Supervision Consultant	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
11	Infectious Diseases such as HIV/AIDS	- Temporary influx of migrant labor during construction may increase risk of infection	-----	- Consideration of sanitation of local residents	- Establish medical center and implementation of periodic medical check-ups - Education and training on workers' health care	- Construction area	- During construction phase	- Implementation: Contractor - Supervisor: CPGCBL	Expenses included in contract cost by Contractor
12	Work Conditions (including work safety)	Labor accidents	- Handling heavy loads - Working at heights - Electric shocks	- Prevention measures against labor accidents, accidents, and health problems	- Prepare a manual for labor accident prevention including safety education and training - Provide workers with appropriate protective equipment - Inspect and ensure that any lifting devices, such as cranes, are appropriate for expected loads - Keep lifting devices well maintained and perform maintenance checks as appropriate during the construction period - Use facilities and equipment that protects against	- Construction area	- During construction phase	- Implementation: Contractor - Supervisor: CPGCBL	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					electric shocks				
13	Accidents	1) Traffic accidents 2) Soil runoff and Construction equipment breakages	1) Traffic accidents - Land traffic 2) Soil runoff and tower breakages	1) Prevention of traffic accidents 2) Prevention of soil runoff	1) Traffic accidents - Observation of traffic regulations, installation of traffic signs and education on safe driving - Training safe operation of vehicles 2) Soil runoff and tower breakages - CTT was selected avoiding any steep sloped areas - Preventing soil loss by stabilizing any slopes of the construction area with concrete, as necessary based on geological survey	1) Construction area 2）Roads near the construction area	1), 2) - During construction phase	- Implementation: Contractor - Supervisor: CPGCBL	Expenses included in contract cost by Contractor

<Appendix 7

Table-A.71 Environmental Monitoring Plan(Tentative at IEE stage, Nov. 2015: This should be revised based on the EIA process)

Item	Mitigation measure	Parameters to be Monitored	Location	Frequency	Implementing Organization
Pre-construction phase					
All items	- Prepared alignment for Conveyer Belt and Coal Transshipment Terminal (CTT) shall be chosen to avoid land issues and environmental sensitive issues. - The project design shall be prepared to meet the technical standard, budget, and environmental mitigation measures.	Checking the final engineering design and layout of the CTT and Conveyer Belt	Project area	One time for draft final design and one time for final design	CPGCBL
Construction phase					
Air Quality, Noise and vibration	Protection air pollution, noise and vibration from all construction activities and transportations.	Checking dust, noise, the construction site, construction activities and transportation and storage of construction materials.	In construction sites	Monthly	CPGCBL
Water pollution	Prevention of the water pollution of suspended solid or turbidity	Checking the turbidity and soil sediment visually	Surface water near the construction sites	Every 15 days	CPGCBL
Waste management	Proper disposal of solid waste	Check waste management status	In construction sites and field office	Monthly	CPGCBL
Workers safety	Safety tools/equipment/clean water should be provided to workers	Worker's condition	In construction sites	Twice par day in construction period	CPGCBL
Traffic	Traffic facilitator shall be provided at crossing busy road.	Patrol	Around the construction site	During construction of crossing active road	CPGCBL

Operation phase					
Safety Management	Provide warning sign at the high-risk place	Checking the warning sign	CTT and Conveyer Belt	Twice in a year	CPGCBL
Air Quality, Noise and vibration	Protection air pollution by coal dust , noise and vibration from coal transportation activities	Checking dust, noise and vibration from coal transportation activities	CTT and Conveyer Belt	Twice in a year	CPGCBL
Soil and water pollution	Prevention of soil and water pollution by the run-off water from CTT	Checking the run-off water from CTT	CTT	Twice in a year	CPGCBL
Secondary Transportation facility	Prevention of the additional environmental impact associated with the CTT operation. The facilities should be constructed based on the adequate environmental consideration.	Environmental study	Adjacent area of CTT	One time for project design stage prior to the approval	CPGCBL

<Appendix8>
Monitoring Form

A.8.1 Sample Monitoring Form (During Construction) (Tentative Version at IEE stage in Nov. 2015: This should be updated and finalized prior to the JICA Environmental Review)

The latest results of the below monitoring items shall be submitted to the lenders as part of Quarterly Progress Report throughout the construction phase

Construction Phase

1. Response/ Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Number and contents of formal comments made by the public	
Number and contents of responses from Government agencies	

2. Pollution

- Water Quality

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Standards for Contract	Referred International Standards	Measurement Point	Frequency
pH	-							Quarterly
BOD	mg/1							
COD	mg/1							
Oil	mg/1							

- Air Quality (Ambient Air Quality)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Standards for Contract	Referred International Standards	Measurement Point	Frequency
Dust								Quarterly

- Noise

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Standards for Contract	Referred International Standards	Measurement Point	Frequency
Noise Level. Leq.	dB(A)							Daily

3. Natural Environment

- Ecosystem

Monitoring Item	Monitoring Results during Report Period	Measures to be Taken
Ecosystem	Details of survey results, such as findings.	

4. Social Environment

- HIV/AIDS and other STDs

Monitoring Item	Monitoring Results during Report Period	Measures to be Taken

HIV/AIDS and other STDs	Incidences per 1000 inhabitants	

A.8.2 Sample Monitoring Form (Operation) (Tentative Version at IEE stage in Nov. 2015: This should be updated and finalized prior to the JICA Environmental Review)

The latest results of the below monitoring items shall be submitted to the lenders on biannual basis for the first two years of operation.

Operation Phase

1. Response/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period	Frequency
Number and contents of formal comments made by the public		Upon receipt of comments/complaints
Number and contents of responses from Government agencies		

2. Natural Environment

- Ecosystem

Monitoring Item	Monitoring Results during Report Period	Measures to be Taken	Frequency
Ecosystem	Details of survey results, such as findings		

- Replanting / Reforestation

Monitoring Item	Monitoring Results during Report Period	Measures to be Taken	Frequency
Completion of reforestation (%)	Details of survey results, such as findings.		

3. Social Environment

- HIV/AIDS and other STDs

Monitoring Item	Monitoring Results during Report Period	Measures to be Taken	Frequency
HIV/AIDS and other STDs	Incidences per 1000 inhabitants		Annually

A.8.3 Sample Monitoring Form (Resettlement & Land Acquisition) (Tentative Version at IEE stage in Nov. 2015: This should be updated and finalized prior to the JICA Environmental Review)

Preparation of Resettlement Sites (where necessary)

No.	Explanation of the site (e.g. Area, no. of resettlement HH,	Status (Completed (date) / not	Details (e.g. Site selection, identification of candidate sites, discussion with PAPs, Development of the site etc)	Expected Date of Completion
1				
2				

Public Consultation

No.	Date	Place	Contents of the consultation / main comments and answers
1			
2			

Resettlement Activities	Planned Total	Unit	Progress in Quantity			Progress in %		Expected Date of Completion	Responsible Organization
			During the Quarter	Till the Last Quarter	Up to the Quarter	Till the Last Quarter	Up to the Quarter		
Preparation of RAP									
Employment of Consultants		Man-month							
Implementation of Census Survey (including Socioeconomic Survey)									
Approval of RAP			Date of Approval:						
Finalization of PAPs List		No. of PAPs							
Progress of Compensation Payment		No. of HHs							
Lot1		No. of HHs							

Resettlement Activities	Planned Total	Unit	Progress in Quantity			Progress in %		Expected Date of Completion	Responsible Organization
			During the Quarter	Till the Last Quarter	Up to the Quarter	Till the Last Quarter	Up to the Quarter		
Lot 2		No. of HHs							
Lot 3		No. of HHs							
Lot 4		No. of HHs							
Progress of Land Acquisition (All Lots)		ha							
Lot 1		ha							
Lot 2		ha							
Lot 3		ha							
Lot 4		ha							
Progress of Asset Replacement (All Lots)		No. of HHs							
Lot 1		No. of HHs							
Lot 2		No. of HHs							
Lot 3		No. of HHs							
Lot 4		ha							
Progress of Relocation of People (All Lots)		No. of HHs							
Lot 1		No. of HHs							
Lot 2		No. of HHs							
Lot 3		No. of HHs							
Lot 4		ha							

<Appendix 9>

Minutes of the Tripartite Meeting on Draft IEE

IEE for the Construction and Operation of Imported Coal Transshipment Terminal (CTT) Project

Minutes of Tripartite Meeting (DoE, CPGCBL & Consultant)

Venue : Board Room of CPGCBL
Date : 15 December, 2015
Time : 4:30pm

Following officials were present in the meeting:

1) Keisuke Kusuhara, Nippon Koei
2) Toshi Ohashi, TEPCO RPC
3) Mizanur Rahman Khan, EAL
4) Nafisa Sher, CPGCBL
5) Mohammed Humayun Kabir Mazumder, SE, CPGCBL
6) Md. Shahjahan, Environmental Consultant, CPGCBL
7) Syed Nazmul Ahsan, Director (E.C), DOE
8) Md. Samsuzzaman Sarker, DOE
9) Md. Abul Quasem, CPGCBL
10) Nazrul Islam, CPGCBL
11) Rama Nath Roy, EAL

The following discussions were held and decisions were taken in the meeting:

1. Some technical items are to be included in the comparative statement of alternative sites of the CTT to justify the best site for the CTT.

2. “Environmental Conservation Act 1995” is to be rewritten as “Environment Conservation Act, 1995 (Amended 2010)” and “Environmental Conservation Rules 1997” is also to be rewritten as “Environment Conservation Rules 1997”.
3. DoE standards are to be added in separate column in the table for air quality, water quality to compare the measured values with the standard values instantly.
4. During operation phase of the CTT, air will be polluted due to not only coal dust but also exhaust gas discharged from the ships and vessels etc. This should be also included in the impacts of air pollution.
5. Similarly, during operation phase of the CTT, water will be polluted due to maintenance works of the ships or vessels during berthing period. This should also be included in the impacts of water pollution.
6. It was raised that after completion of phase -2 of the CTT, about 375 panamex ships will operate in the port channel in a year. That means, two ships will be required to pass through the channel in a day. Question arises whether two ships can be handled in a day in the port channel or not. This should be taken into consideration.
7. Possible mitigation measures for the impacts are to be included in the IEE report and power point presentation as well.
8. The representative of DOE pointed out that it is very necessary to finalize the project proponent immediately so that the project proponent can submit the IEE report to the DOE within the contract period of the foreign consultant.

Registration for the meeting on feedback of "IEE for the construction and operation of Imported Coal Transshipment Terminal (CTT) Project"

Date- 15th December, 2015 ; CPGCBL's Board Room

Sl No	Name & Designation	Organization	Signature
1	Keisuke Kusuhara	Nippon Koei	楠原
2	Toshi Ohashi	TEPCO RPC	
3	M. Rahman	EAL	
4	NAFISA SHER	CPGCBL	
5	MOHAMMED HUMAYUN KABIR MAZUMDER, SE	CPGCBL	
6	Md. Shahjahan, Environmental Consultant	CPGCBL	
7.	Syed Nazmul Ahsan Director (E.C)	DOE	
8.	Md. Samsuzzaman Sarker	DOE	
9	Md. Abul Quasem Managing Director	CPGCBL	
10.	Nazrul Islam	CPGCBL	
11.	Rama Nath Roy	EAL	

<Appendix 10>

Terms of Reference for LARAP Study

The Study proposes terms of reference (ToRs) for the study on the Land Acquisition and Resettlement Action Plan (LARAP) as follows. It should be noted that the project proponent shall review and revise the contents of ToRs whenever the status of the proposed CTT area and the project components are updated or altered.

Action Plan (LARAP) for Construction and Operation of Imported Coal Transshipment Terminal Project in Matarbari Area in Bangladesh

1. Introduction

Electric generating capacity of Bangladesh was 7,356MW as of Mar., 2014, but electric power demand at the peak-hour is 8,200MW and electric power outage has frequently occurred. Electrification of Bangladesh is 62% and further increase of electric power demand will be expected along with the expected economic growth of Bangladesh.

Bangladesh has a plan to raise the proportion of thermal power plant by imported coal. Based on this basic principle, many thermal power generation plants were planned by Power Generation Company under MoPEMR and IPP and some others were joint investment plant with other country. Because most of the coastal area of Bangladesh has a shoaling beach and candidate site for deep sea port that can accommodate the large coal carriers were very limited, construction of Coal Transshipment Terminal that can accept the large coal carries is indispensable to the realization of above mentioned many coal fired power plants As the Matarbari area at Cox's Bazar district under Chittagong Division is the only one promising site that have easy access to the deep sea area and have limited adverse impact on the surrounding environment, construction of this Coal Transshipment Terminal with deep sea port that can accommodate the large coal carrier at this Matarbari area and to realize the economic and efficient import coal supply to the coal fired power plant constructed in the country are considered imperative.

Japan International Cooperation Agency (JICA) has undertaken a project for Preparatory Survey on Construction and Operation of Imported Coal Transshipment Terminal (CTT) in Matarbari Area in People's Republic of Bangladesh.

So, JICA has appointed a Study Team comprising of **Nippon Koei Company Limited (NK)** and **Tokyo Electric Power Company (TEPCO)** of Japan hereafter "JICA Study Team" to conduct Preparatory Survey on Construction and Operation of Imported Coal Transshipment

Terminal (CTT) in Matarbari Area in People's Republic of Bangladesh.

2. Project components

The project includes construction of loading and unloading berth at the port of Matarbari 1200MW CFPP, Coal Stockyard, control tower of maintenance shop, conveyer belt from the port to Coal Stock Yard., The activities are civil works, building works, electrical and mechanical works etc.

3. Study Area:

The proposed Coal Transshipment Terminal will be located at Dhalghata union of Moheshkhaliu upazila under Cox's Bazar district on the west bank of Kohelia river. So, the study area for IEE study has been identified as 5km radius around the proposed CTT site. The study area covers the three unions of Moheshkhali Upazila. Unuions are as follows:

1. Matarbari union
2. Dhalghata union
3. Kalarmarchara union.

A google earth map showing the location of the study area is given in **Figure-1**.

Figure- 1 Google earth Map showing location of the Study Area

4. Scope of the Study:

The scope of services under the LARAP Study is as follows:

a) Study on Legislations in Bangladesh, JICA's policy on land acquisition and resettlement, procedures for land acquisition etc.

b) Carry out social impact survey through focus group discussion, stakeholder meetings, in-depth interview etc.

c) Identification of impacts and category of PAPs

d) Livelihood restoration and improvement Plan

e) Organizational responsibilities and implementation procedures

f) Grievance Redress Mechanism

g) Estimate land acquisition and resettlement cost

h) Local consultation, participation, monitoring and evaluation procedures etc

5. Output

The study should produce an LARAP report on construction of the CTT containing the following:

- Project description;

i) Legislations in Bangladesh and JICA's policy on land acquisition and resettlement, procedures for land acquisition etc.

- Description of impacts and category of PAPs
- Livelihood restoration and improvement Plan
- Organizational responsibilities and implementation procedures
- Grievance Redress Mechanism
- Estimate land acquisition and resettlement cost
- Local consultation, participation, monitoring and evaluation procedures etc

6. Methodology

LARAP study of construction of CTT to be constructed under this project should be conducted on the basis of the information of the project activities supplied by the project proponent (CPGCBL). After reviewing the IEE report, the LARAP study should be conducted following the DOE Guidelines for selected industries (DOE, 1997), and also JICA Environment and Social Consideration Guideline (2010). The Consultant's multi-disciplinary team of experts should conduct social survey to identify the impacts and project affected people (PAP) through questionnaire survey, focus group discussion, in-depth interview, stakeholder meetings etc. The study team will prepare livelihood restoration and improvement plan, grievance redress mechanism, estimate the cost of land acquisition and resettlement, monitoring and evaluation procedures etc.

7. Contents of LARAP

The table of contents of LARAP report is given below:

List of Tables and Figures

Abbreviations

Definitions

1. Summary

9. Estimated Land Acquisition and Resettlement Cost

10. Local Consultation, Participation, Monitoring and Evaluation Procedures

    10.1 Further Consultation Process

    10.2 Monitoring and Evaluation Procedures

8. Staffing

The LARAP of construction of CTT at matarbari area in Bangladesh should be carried out by a multi-disciplinary team supported by field researchers as given in the table below:

SI. No.	Position
1.	Team Leader
2.	Social Expert
3	Civil Engineer
4.	Socio-Economist
5.	Legal specialist

<Appendix 11>

Registered No. D.A.-1

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

Bangladesh Gazette

Additional Copy

Published by the Authority

Tuesday, October 12, 2010

Bangladesh Jatiya Sangshad

Dhaka, 12 October, 2010/27 Aashin, 1417

The following Act, passed by the Parliament, received the assent of the President on 7 October 2010 (22 Aashin 1417) and is hereby published for the information of the general public:-

Act No. 54 of 2010

An Act to provide for procedures to be followed in order to ensure continuous supply of electricity and energy as per demand of agriculture, industry, commercial business and household needs in order to ensure an increase in their production, transmission, transportation and marketing measures to facilitate the effective means to quickly, and if necessary, plan to import electricity and fuel from abroad and the rapid implementation of the decision on retrieval and use of minerals related to energy.

Whereas the shortage of **electricity** and energy is acute in the country; and

Whereas the planning for the growth of electricity production cannot be implemented rapidly for the shortage in the supply of energy; and

Whereas due to the shortage of **electricity** and energy in the country, the activities in agriculture, industry, trade-commerce and household works are greatly being hindered and investments in these sectors are not being done as desired; and

Whereas due to inadequate supply of **electricity**, the target of high economic growth, achieving the development goal of the new millennium, technology development, poverty alleviation programs, agricultural production and overall economic development targets are being hindered and discomfort is prevailing in the lives of common people.

Whereas, at present, resolving the shortages of **electricity** and energy following the procedures under the prevailing law/act is a time-consuming matter; and

Price: TK. 4.00

Whereas it is essential to quickly resolve the shortages and inadequacy of **electricity** and energy; and

Whereas in order to ensure uninterrupted supply of **electricity** and energy, for increasing its production, transmission, transportation and marketing as per demand of agricultural, industrial, business-commercial and household purposes, effective means to facilitate action, and if necessary for the quick implementation of plan for importing **electricity** and energy from abroad and for quick implementation of the decision on extraction and use of energy related minerals, the use of the following special provisions shall be expedient.

Now, therefore, it is hereby enacted as follows:

1. Short title and term.- (1) This Act shall be called The Increase in Rapid Supply of Electricity And Energy (Special Provision) Act, 2010.

(2) Unless abolished or the term is extended, this Act shall be in force for two (2) years from the date of its commencement.

2. Definitions. - (1) In this Act, unless there is anything repugnant in the subject or context.-

(a) "**Rule**" means rules made under this Act;

(b) "**Energy**" means-

(i) Natural Gas, Natural Liquid Gas (NGL), Liquefied Natural Gas (LNG), Compressed Natural Gas (CNG), Synthetic Natural Gas (SNG) or such natural hydrocarbon gas mixture, such matter that is converted to gas due to general pressure and temperature, etc;

(ii) Coal;

(iii) Petrol, Diesel, Kerosene, Furnace Oil and other petroleum substances; and

(iv) Renewable Energy.

(2) The meanings of the words or expressions which are not defined in this Act will carry the same meaning as in Bangladesh Gas Act, 2010 (Act No. 40 of 2010), Bangladesh Energy Regulatory Commission Act, 2003 (Act No. 13 of 2003), Mines and Mineral Resources (Control and Development) Act, 1992 (Act No.39 of 1992) and The Electricity Act, 1910 (Act IX of 1910).

3. This Act's precedence over other laws- The Public Procurement Act, 2006 (Act No.24 of 2006) or notwithstanding anything contained in any other law, the provisions of this Act shall prevail.

4. Acceptance of plans and preparations of proposals- The Government and all the establishments owned or controlled by the Government can accept any plans for the rapid growth of production, transmission, transportation and marketing of Electricity and Energy or accept any plans regarding the importation of Electricity or Energy from foreign countries, its transmission, transportation and marketing thereon and can accept any proposal for the rapid implementation of the same, under this Act.

5. Proposal Processing Committee and its Scope of Work:- **(1)** For the purposes of this Act, the Government, with an aim to implement any accepted plans and proposals, maintaining a conformity with the technical and other aspects, shall form a processing committee consisting of necessary numbers of members with experience in that particular technical and other aspects of the plan, and such committee shall have the decision-making capacity from the initial phase of the plan up to the preparation of the proposal and until the matter reaches the stage of representation to the Economic Affairs or the Cabinet Committee on Economic Affairs (CCEA).

(**2**) For implementing the plan, the processing committee shall formulate such a recommendable proposal through communication, consultation and negotiation with any organization associated with the plan that the qualification, experience and financial capability of that organization will be considered by preserving the highest public interest.

6. Promoting the Plans or Proposals- (1) The implementing authority can invite participants through advertisement for purchasing and implementing investment plans or proposals, as mentioned below;

(a) Newspaper advertising granting a limited time,

(b) Advertisement through the website of 'Central Procurement Technical Unit (CPTU) under implementation, monitoring and evolution division of the Ministry of Planning.

(c) Advertisement through their own website.

(d) Through communication with the concerned establishment by issuing a letter or sending e-mail or any other means.

(2) Notwithstanding anything contained in Sub-Section (1), for any purchase, investment plan or proposal, after obtaining consent of the responsible minister for Ministry of Power, Energy and Mineral Resources, the processing committee as referred in section 5, will nominate the same for the referred position upon communication and bargaining with the limited number of organizations or single organization and shall forwarding to the Cabinet Committee on Economic Affairs (CCEA) or Cabinet Committee on Government Purchase (CCGP) by following the process as mentioned in section 7.

7. Presentation of proposal to the Cabinet Committee on Economic Affairs (CCEA) or Cabinet Committee on Government Purchase (CCGP):- (1) By following the procedure, the related division shall present the proposal prepared by the processing committee under the section 5 to the Cabinet Committee on Economic Affairs (CCEA) or Cabinet Committee on Government Purchase (CCGP).

(2) When the proposal is approved by the Cabinet Committee on Economic Affairs (CCEA) or Cabinet Committee on Government Purchase (CCGP), the administrative ministry or department shall take necessary steps for the proper implementation of that proposal.

(3) If the Cabinet Committee on Economic Affairs (CCEA) or Cabinet Committee on Government Purchase (CCGP) returns the proposal with their recommendation, it shall have to be presented to the processing committee and by considering the recommendation of the Cabinet

Committee the processing committee shall take decision for re-submission to the Cabinet Committee for re-consideration and approval of the same.

8. Assistance for the works of the committee: - For the implementation of any project the committee may ask for assistance from any individual, government, Non government or autonomous body.

9. Abolishing the jurisdiction of court, etc: - No question can be raised to any court regarding the legality of any work done under or considered to be done under this Act, of any actions taken, direction or order given under this Act.

10. Preservation of works done in good faith: No civil or criminal or other proceedings can be brought to any court against any officer or staff for the work done or considered as done in good faith in accordance with any rule, general or special order of this Act.

11. Power to make rules: - For the purposes of this Act, the Government may, by notification in the official Gazette, make rules.

Provided that, until any rule is made, if necessary, the Government can make any provisions regarding the acceptance and execution of any project through general or special order, provided that the same is compliant with the provisions of this Act.

12. Power of Government in reducing complexity: - If any problem arises to implement a provision of this Act, due to vagueness of that provision, the Government, by a notification in the official gazette, can publish any direction on that provision, compliant with the other provisions of this Act, after having ascertained and explained it for clear understanding.

13. **Publication of Translated English Text**: After preparation of this Act, the Government shall publish a reliable Translated Authentic English Text of this Act, through notification in the official gazette, which will be called as the reliable 'Authentic English Text'.

Provided that in case of a conflict between the Bengali Text and English Text, the Bengali Text shall prevail.

14. **Preservation of works under this Act**: - Even after expiration of this Act, the works executed or actions taken for execution of works under this Act shall continue in such a manner as if the term of this Act has not expired.

Ashfaq Hamid

Secretary

Registered No. D.A.-1

Bangladesh Gazette

Additional Copy
Published by the Authority

Monday, February 02, 2015

Bangladesh Jatiya Sangshad

Dhaka, 02 February 2015/ 20 Magh, 1421

The following Act, passed by the Parliament, received the assent of the President on 02 February 2015 (20 Magh 1421) and is hereby published for the information of the general public:-

Act No. 03 of 2015

An act duly passed for the amendment of the Increase of Speedy Power & Energy Supply (Special Provision) Act, 2010

Hence it is more necessary to amend the Increase of Speedy Power and Energy Supply (Special Provision) Act, 2010 (Act No. 54 of 2010) to serve the following purposes,

It has been enacted as follows:-

1. **Short Title and Commencement-**
   I. This law will be regarded as the increase of Speedy Supply of Power and Energy (Special Provision) (Amendment) Act, 2015
   II. This law will be considered to be effective from 7th October 2014.

2. **The amendment of clause 1 of act No. 54 of 2010-** In sub clause (2) of clause 1 of Speedy Power and Energy Supply (Special Provision) Act 2010 (Act No. 54 Of 2010), the word "4 (Four) Years", number & bracket will be replaced by the word "8 (Eight) Years", bracket & number therein.

Md. Ashraful Maqbul

Senior Secretary

<Appendix 12>

PRIVATE SECTOR POWER GENERATION POLICY OF BANGLADESH

MINISTRY OF ENERGY AND MINERAL RESOURCES
GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

OCTOBER 1996

REVISED NOVEMBER 2004

DHAKA

CONTENTS

Page

1.0 INTRODUCTION

1.1 Bangladesh needs to achieve and sustain an annual economic growth rate of at least 6/7 percent to alleviate poverty and realize desirable socio-economic and human development. To achieve the growth target of GDP, it is absolutely essential that the minimum electricity growth rate is maintained at a factor of 1.5 of GDP growth. The provision of adequate and reliable supply of electricity at a reasonable cost is a pre-requisite to attain this goal. Besides, Bangladesh is still at a very low level of electrification, with only 15 percent of its population (about 120 million) having access to electricity and per capita generation is only 95 Kwh per annum. Hence, there is a great need to expand the electrification programme. The government of Bangladesh (GOB) recognizes that the pace of power development has to be accelerated in order to achieve overall economic development targets of the country and avoid looming power shortages. Power is the prime mover. Any big push of the economy would need accelerated power development.

1.2 Presently, three state-owned utilities under the Ministry of Energy and Mineral Resources are responsible for electricity development in the country. These are:

i) Bangladesh Power Development Board (BPDB), responsible for generation and transmission of power in the country and distribution in urban areas except the area under Greater Dhaka;

ii) Dhaka Electric Supply Authority (DESA), responsible for distribution of electricity in the greater Dhaka area including the metropolitan city of Dhaka; and

iii) Rural Electrification Board (REB), responsible for distribution of electricity in rural areas.

1.3 In comparison to the 11666 GWh electricity generated annually at present, the Power System Master Plan (PSMP) projects a requirement of 16500 GWh in 2000 and 24160 GWh in the year 2005. This implies an increase in peak demand from the present 2200 MW to 3150 MW by 2000 and 4600 MW by 2005 for which capacity addition of about 3350 MW will be required by 2005. Hence on average, additional 300 MW of generation capacity has to be added every year. The total investment between now and 2005, required to achieve such capacity enhancement, is Taka 176 billion or US$ 4.4 billion. The corresponding investment requirement for expansion & reinforcement of transmission and distribution system would be about US$ 2.2 billion for the same period, bringing the grand total to US$ 6.6 billion.

1.4 The likelihood of securing such a substantial volume of investment for power generation alone through the public sector is remote. Besides, competing demands on government resources and declining levels of external assistance from multilateral/bilateral donor agencies further constrain the potential for public investment in the power sector. Recognizing these trends, GOB amended its industrial policy to enable private investment in the power sector. GOB also adopted the recommendations contained in the report on Power Sector Reforms, prepared by a high level Inter-Ministerial Working Group, for restructuring the power sector and promoting private sector participation in the generation of electricity in order to attain higher economic efficiency. The Government is strongly committed to attract private investment for installing new power generation capacity on a build-own-operate (BOO) basis.

2.0 GOB POLICY AND THE POWER CELL

In order to translate this explicit policy commitment into actual investment projects, GOB created and set up a Power Cell under the Ministry of Energy & Mineral Resources (MEMR) in 1995. The Power Cell has a mandate to lead private power development, recommend power sector reforms & restructuring, conduct study on tariffs and formulation of a regulatory framework for the power sector. The Power Cell shall facilitate all stages of promotion, development, implementation, commissioning and operations of private power generation projects and suitably address the concerns of project sponsors. It will also assist project sponsors to secure necessary consents and permits from GOB where such consents and permits would be needed.

3.0 MODALITY FOR IMPLEMENTATION OF PRIVATE POWER PROJECTS

3.1 One Window Operation :

The designated institution to facilitate the development of private sector power projects shall be the Power Cell, MEMR. The Power Cell shall articulate and promote the private power policy of GOB and shall solicit and evaluate proposals, negotiate and process award of contracts, and finalize various agreements related to these projects. The Power Cell would also represent GOB interest in private power projects.

3.2 Solicitation of Proposals :

Independent Power Producers' (IPP) projects will be implemented on Build-own-operate (BOO) basis. International solicitation for specific projects will be processed by the Power Cell. The pre-qualification of the bidders will be made through advertisements in the national and international press. The evaluation criteria for pre-qualification will be given along with the pre-qualification documents to be issued to the intending bidders. The RFP (Request For Proposal) documents will be issued only to pre-qualified bidders.

After final evaluation of commercial bids from pre-qualified sponsors they will be ranked as per criteria set in the RFP. The first ranked bidder will be given a stipulated period to: (a) submit a performance guarantee and (b) reach financial closure. Failure to perform in either case will result in forfeiture of the guarantee, if any, and an invitation to the second ranked bidder, under similar conditions. The RFP may include provision for time extension for financial closure, subject to an increase in the performance guarantee amount. In the event of a sponsor chosen on the basis of an unsolicited proposal, similar provisions on performance guarantees and specified time period for financial closure will apply.

3.3 Financing Arrangements :

(a) BOO projects may involve limited recourse financing and the funds for the projects will be raised without any direct sovereign guarantee of repayment. Instead, the investors and lenders to the project sponsor(s) must look to the revenues earned by the sale of electricity for their returns on equity and debt servicing.

(b) Minimum requirement for equity investment will be 20 percent.

(c) The Government of Bangladesh may establish a Private Sector Infrastructure Development Fund (PSIDF), with the assistance of the World Bank and or other aid agencies, which may provide part of the capital cost of the project as subordinated debt. The debt would be available on market based interest rates and carry extended maturity periods.

(d) To facilitate the creation and encouragement of a corporate debt securities market essential for raising local financing for power development projects, the following provisions will be allowed:

i) Permission to power generating companies to issue Corporate Bonds both bearer and registered with the consent of the Securities and Exchange Commission (SEC).

ii) Permission to issue shares at discounted prices upto the limit of 10% of the face value to enable venture capitalists to be provided higher rates of return proportionate to the risks.

iii) Permission to foreign banks to underwrite the issue of shares and bonds by the private power companies with the recognition by SEC of such underwriting.

iv) Tax facilities for private sector instruments as available to Non-Banking Financial Institutions.

v) Modification of Prudential Regulations to allow 80:20 debt equity ratio, if necessary.

3.4 Security Package :

(a) Model Implementation Agreement (IA), Power Purchase Agreement (PPA) and Fuel Supply Agreement (FSA) will be prepared for private power projects to eliminate the need for protracted negotiations between GOB and Sponsors.

(b) The Power Purchase Agreement (if executed by Government Agencies) will be guaranteed by the GOB for performance obligations of the concerned utilities.

(c) In case the fuel is to be supplied by a public sector organisation, the performance of the fuel supplier will be guaranteed by the GOB under the terms of Fuel Supply Agreement.

(d) For private power projects the Government will provide:

i) Standard protection against specific *force majeure* risk.

ii) Protection against changes in certain taxes and duties.

3.5 Allocation of Project/Plant Site and Provision of Fuel :

The plant sites will be selected by GOB in consultation with the investor/project sponsor. Fuel for such projects will be determined by GOB keeping in view preference for indigenous resources like Natural Gas, Coal and any other fossil fuels. However, in case of any limitations, if and when deemed necessary, GOB may also allow other fossil fuels including imported fuels. A fuel supply agreement in that event will be entered into by the project sponsors and fuel supplier. Investors may also be asked to bid for projects based on hydro or other renewable and/or non-conventional sources of energy, such as the sun, wind, biomass etc. For such projects, IA & PPA would be different, for obvious reasons.

4.0 TARIFF FOR BULK PURCHASE OF POWER AT BUSBAR

4.1 The power produced by the IPP shall be purchased (as per Power Purchase Agreement) by BPDB/DESA/REB or any other transmission or distribution company which may be established in future, or any large consumer. The Power Cell as the GOB agent will indicate which organisation will be the power purchaser at the time of issuance of RFP.

The tariff structure would consist of two parts:

(a) **Capacity Payment:** This will cover debt service, return on equity, fixed operation and maintenance cost, insurance and other fixed costs. The capacity payment would be further divided into an escalating non-escalating portions. The capacity payment will be made in Bangladesh currency (Taka), but denominated in both dollars (to repay foreign loans and fixed costs) and local currency (to repay local loans and investment and local fixed costs). The capacity payment will be linked to a certain level of availability of the power plant which will be made known to the bidders at the time of issuance of RFP.

(b) **Energy Payment:** This will cover the variable costs of operation and maintenance, including fuel and be paid in Taka. The payment would be further divided into fuel component which would be a pass-through and a non-fuel component which escalates. The energy payment will be denominated in local currency to the extent to which the variable costs are in local currency.

4.2 In the solicited bids, the bidders shall offer bulk power tariff based on the capacity payment and energy payment and also provide the equivalent levelized tariff over the contract period in US cents/Kwh (to be paid in Taka), based on discount rate, tariff profile restriction and plant factor to be specified during the solicitation of bids. The evaluation will be based on the criteria to be provided in the RFP.

4.2.1 In case of Small Power Plant (SPP) upto 30 MW Installed capacity promoted by the local entrepreneur, the bidders will be allowed to provide the equivalent levelized tariff over the contract period in taka/ Kwh. The evaluation will be based on the criteria to be provided in the Request For Proposal (RFP).

4.3 The sponsors of private power project will provide year wise tariff profile over the contract period in a manner that will match their annual debt service requirements.

4.4 A mechanism shall be provided for the adjustments of certain tariff components to variations in Taka/ Dollar exchange rate, fuel price and inflation rates. In determining this adjustment/indexation, the issue of efficiency gains would be taken into consideration.

4.5 **Interconnection of IPP to Transmission System :**

The power will be purchased from the IPP at a specified voltage at the outgoing terminal (interconnection point) of the sub-station of the power plant. The transmission line for interconnection with the national grid will be provided by the appropriate agency. The costs of interconnecting facilities upto outgoing terminals of the private power projects (including step up auto transformers, circuit breakers and associated switchgear) will be borne by the private power producers.

5.0 FISCAL INCENTIVES

5.1 The private power companies shall be exempt from corporate income tax for a period of 15 years.

5.2 The companies will be allowed to import plant and equipment and spare parts up to a maximum of ten percent (10%) of the original value of total plant and equipment within a period of twelve (12) years of Commercial Operation without payment of customs duties, VAT (Value Added Tax) and any other surcharges as well as import permit fee except for indigenously produced equipment manufactured according to international standards.

5.3 Repatriation of equity along with dividends will be allowed freely.

5.4 Exemption from income tax in Bangladesh for foreign lenders to such companies.

5.5 The foreign investors will be free to enter into joint ventures but this is optional and not mandatory.

5.6 The companies will be exempted from the requirements of obtaining insurance/reinsurance only from the National Insurance Company, namely Sadharan Bima Corporation (SBC).

Private power companies will be allowed to buy insurance of their choice as per requirements of the lenders and the utilities.

5.7 The Instruments and Deeds required to be registered under local regulations will be exempted from stamp duty payments.

5.8 Power generation has been declared as an industry and the companies are eligible for all other concessions which are available to industrial projects.

5.9 The private parties may raise local and foreign finance in accordance with regulations applicable to industrial projects as defined by the Board of Investment (BOI).

5.10 Local engineering and manufacturing companies shall be encouraged to provide indigenously manufactured equipment of international standard to private power plants.

6.0 OTHER FACILITIES AND INCENTIVES FOR FOREIGN INVESTORS

The following facilities and incentives would be provided to private power producers:

6.1 Tax exemption on royalties, technical know-how and technical assistance fees, and facilities for their repatriation.

6.2 Tax exemption on interest on foreign loans.

6.3 Tax exemption on capital gains from transfer of shares by the investing company.

6.4 Avoidance of double taxation in case of foreign investors on the basis of bilateral agreements.

6.5 Exemption of income tax for upto three years for the expatriate personnel employed under the approved industry.

6.6 Remittance of upto 50% of salary of the foreigners employed in Bangladesh and facilities for repatriation of their savings and retirement benefits at the time of their return.

6.7 No restrictions on issuance of work permits to project related foreign nationals and employees.

6.8 Facilities for repatriation of invested capital, profits and dividends.

6.9 Provision of transfer of shares held by foreign shareholders to local shareholders/ investors.

6.10 TAKA, the national currency, would be convertible for international payments in current account.

6.11 Re-investment of remittable dividend to be treated as new foreign investment.

6.12 Foreign owned companies duly registered in Bangladesh will be on the same footing as locally owned companies with regard to borrowing facilities.

7.0 ISSUE OF SEPARATE STATUTORY REGULATORY ORDER (SRO)

A separate SRO will be issued for private sector power plants so that the incentives and concessions given under various regulations and directives are consolidated and placed together in one document.

8.0 RIGHT OF INTERPRETATION

In case of any ambiguity with regard to interpretation of any provision of this policy document, the GOB interpretation shall be final.

GLOSSARY OF ABBREVIATIONS/ ACRONYMS/ TERMS

BPDB	-	Bangladesh Power Development Board.
BOI	-	Board of Investment.
BOO	-	Build-Own-Operate.
DESA	-	Dhaka Electric Supply Authority.
FSA	-	Fuel Supply Agreement.
GDP	-	Gross Domestic Product.
GOB	-	Government of Bangladesh.
IA	-	Implementation Agreement.
IPP	-	Independent Power Producer.
MEMR	-	Ministry of Energy & Mineral Resources.
PPA	-	Power Purchase Agreement.
PSIDF	-	Private Sector Infrastructure Development Fund.
PSMP	-	Power System Master Plan.
REB	-	Rural Electrification Board.
RFP	-	Request for Proposal.
SBC	-	Sadharan Bima Corporation (A public sector general insurance company).
SPP	-	Small Power Plant.
SRO	-	Statutory Regulatory Order.
VAT	-	Value Added Tax.