

No. 03

THE PEOPLE'S REPUBLIC OF BANGLADESH

FEASIBILITY STUDY REPORT

FOR

BHERAMARA-FARDPUR-MADARIPUR-BARISAL

132KV TRANSMISSION LINE

AND

ASSOCIATED SUBSTATION

November 1979

JAPAN INTERNATIONAL COOPERATION AGENCY

MPN
79-114

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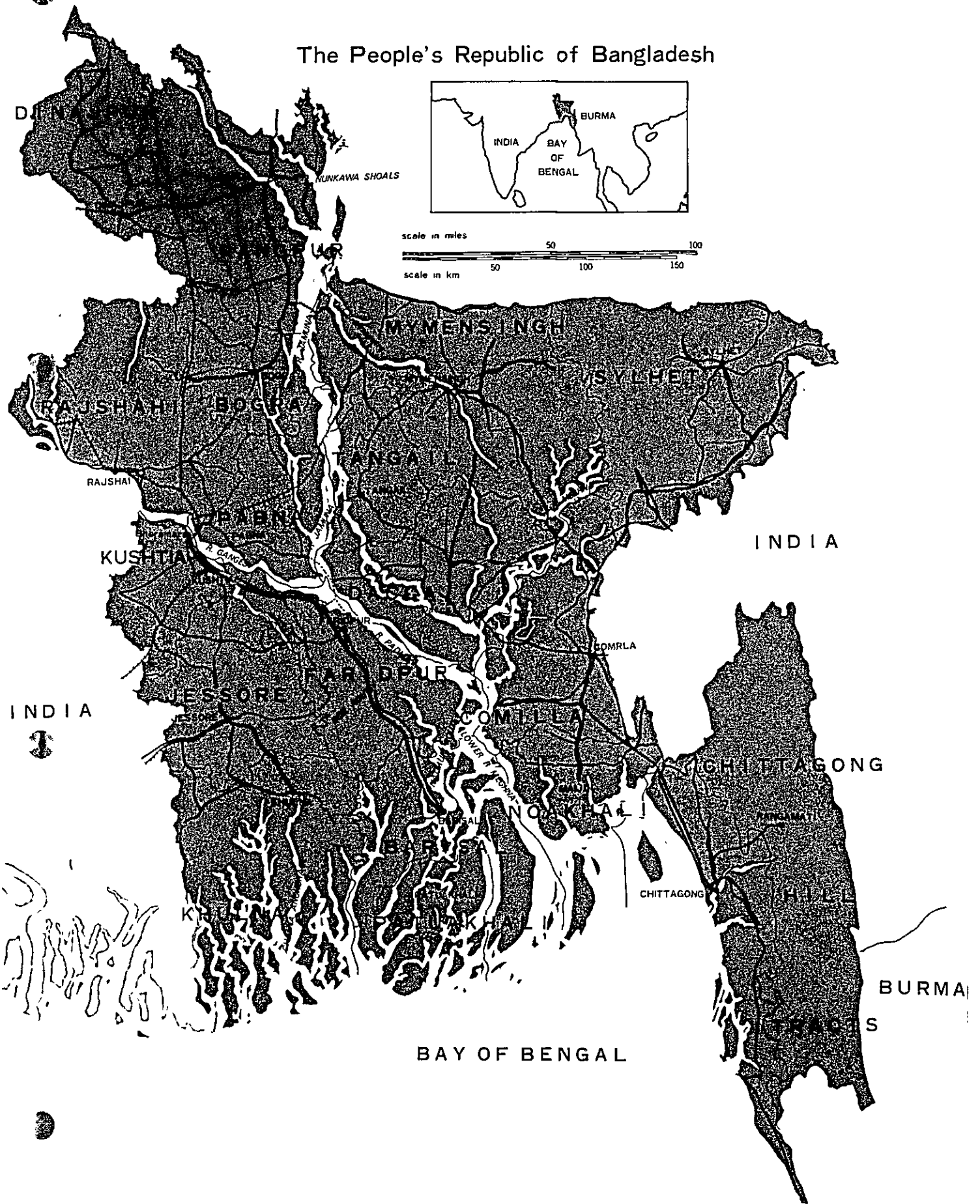
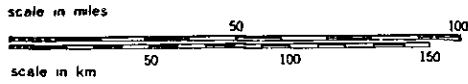
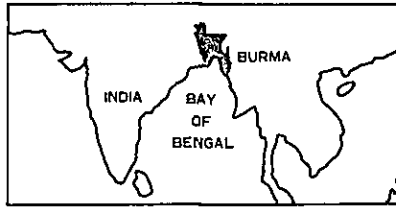
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The People's Republic of Bangladesh



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PREFACE

At the request of the Government of the People's Republic of Bangladesh, the Government of Japan agreed to undertake a feasibility study of the development project of the 132 kv transmission line extending through Bheramara-Faridpur-Barisal in the western zone of Bangladesh, and commissioned the Japan International Cooperation Agency (JICA) to conduct the study.

The Agency, in consideration of the importance of this transmission line development project, dispatched a survey team consisting of eight specialists in various fields headed by Mr. Tsuneya Sato of the Japan Consulting Institute for the period from February 12 to March 24, 1979 to carry out a field survey with the cooperation of government organs concerned of the People's Republic of Bangladesh.

This report has been prepared from the results of the studies made upon returning to Japan based on the field survey and data collected.

I hope this report will prove to be useful for the development of electric power in the People's Republic of Bangladesh, and contribute to enhance the economic relations and friendship between Japan and Bangladesh.

I wish to express my deep appreciation to the officials of the People's Republic of Bangladesh for their close cooperation extended to the Japanese team.

November 1979



Shinsaku Hogan
President
Japan International
Cooperation Agency

C O N T E N T S

CHAPTER .1	INTRODUCTION	
1-1	Background and Purposes of this Study	1
1-2	Scope of Survey	2
1-3	Method of Survey and Schedule	2
1-4	Outline of Study	3
1-5	Survey Team Members	5
1-6	Survey Activities	5
CHAPTER 2	CONCLUSIONS	13
CHAPTER 3	OUTLINE OF BANGLADESH	
3-1	Territory and Geographical Conditions	19
3-2	Climate Conditions	19
3-3	Population and Labour	21
3-4	Outline of the Economy	23
CHAPTER 4	OUTLINE OF POWER SYSTEM	
4-1	Current Status of Power Stations, Transmission Lines and Transformation Facilities	27
4-2	Power Transmission System	29
4-3	Load Dispatching System	34
CHAPTER 5	POWER DEMAND AND SUPPLY	
5-1	Power Demand Forecast	37
5-2	Power Generation Plants	51
5-3	Power Situation and System Reinforcement Plan in the District Covered by the Project	57

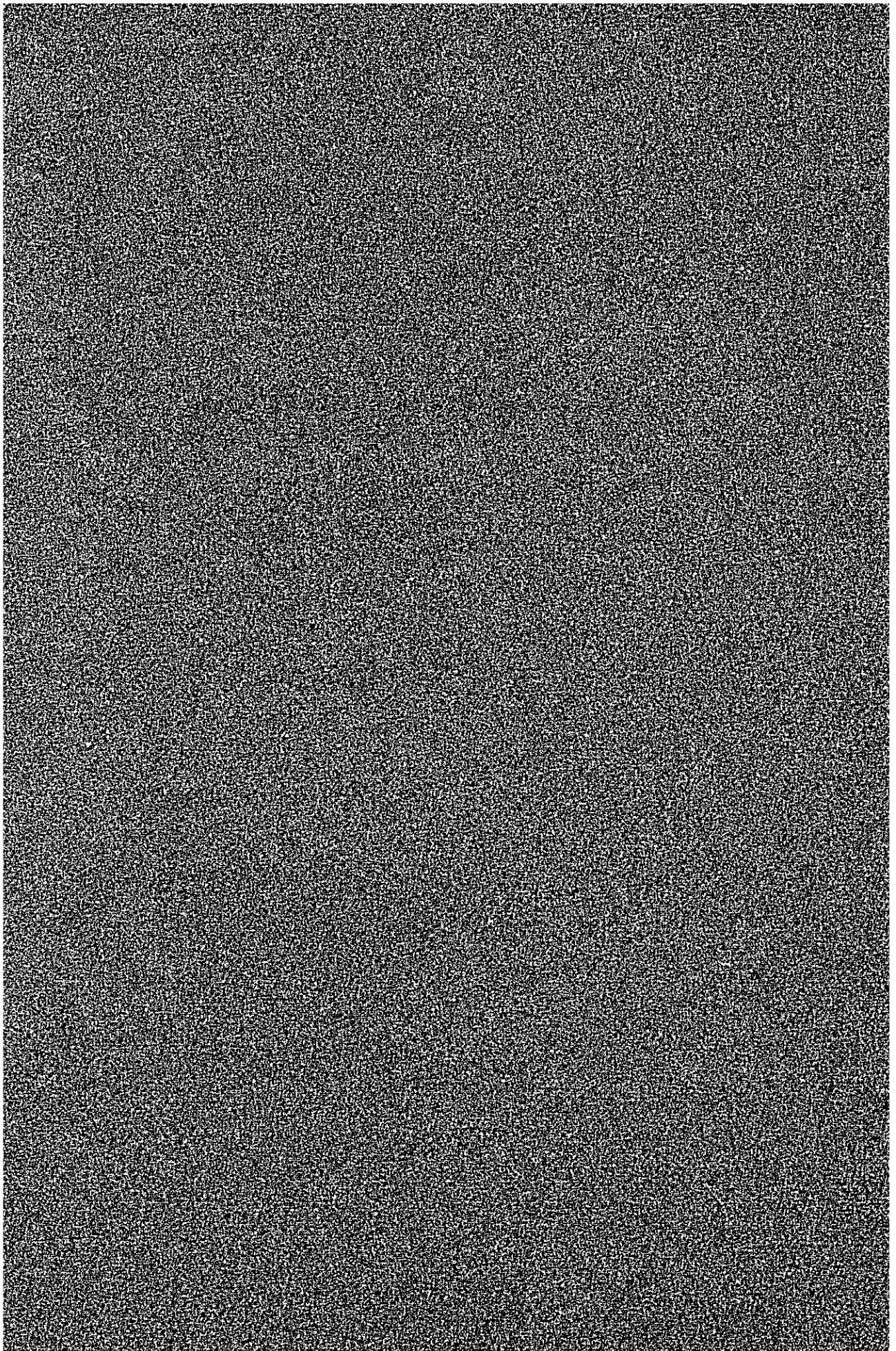
CHAPTER 6	POWER SYSTEM ANALYSIS AND OPERATION	
6-1	Basic Criteria for Power System Study	61
6-2	Power Flow Analysis	61
6-3	Transient Stability Calculation	74
6-4	Transmission Line Scale	77
6-5	System Operation	81
6-6	Protection Relay System	84
CHAPTER 7	CONSTRUCTION OF TRANSMISSION LINE	
7-1	Selection of Transmission Line Route	85
7-2	Geological Features	93
7-3	Conditions of Design	98
7-4	Stringing Method	111
7-5	Required Materials	112
7-6	Material Transportation Method	115
CHAPTER 8	CONSTRUCTION OF SUBSTATIONS	
8-1	Installation of Substations	117
8-2	Scale of Substations	121
8-3	Configuration of Busbars of Substations	124
CHAPTER 9	CONSTRUCTION SCHEDULE	
9-1	Construction Schedule	127
9-2	Transmission Line	127
9-3	Substations	128
CHAPTER 10	REQUIRED TOTAL INVESTMENT AND DISBURSEMENT PLAN	
10-1	Conditions of Construction Cost Estimation	131
10-2	Investment Cost	139
10-3	Disbursement Program	148
CHAPTER 11	ECONOMIC EVALUATION	
11-1	Cost Comparison of Alternatives	151
11-2	Project Benefits for the Region and Industry	156
11-3	Social Benefits	159

ANNEX

ANNEX I	METEOROLOGICAL DATA	A-1
ANNEX II	DATA FOR SYSTEM POWER FLOW ANALYSIS	A-11
ANNEX III	CALCULATION RESULT OF SYSTEM STABILITY	A-21
ANNEX IV	TRANSMISSION LINE ROUTE	A-25
ANNEX V	BORING LOG	A-27
ANNEX VI	STRUCTURAL DRAWING OF TRANSMISSION TOWER	A-33
ANNEX VII	TRANSMISSION SYSTEM FOR WESTERN GRID AND DRAWINGS CONCERNED WITH SUBSTATION	A-37
ANNEX VIII	ENERGY COST AND SALES REVENUE IN THE BPDB	A-46
ANNEX IX	ARRANGEMENT OF EQUIPMENT FOR THERMAL POWER STATION AS ALTERNATIVE	A-49
ANNEX X	ESTIMATION OF BENEFIT AND COST RATIO (B/C RATIO) ON THIS PROJECT (FOR REFERENCE)	A-54

CHAPTER 1

INTRODUCTION



CHAPTER 1 INTRODUCTION

1-1 Background and Purposes of this Study

As a part of the program for development of electric power in the People's Republic of Bangladesh, studies concerning the construction of a 132kV transmission line with an extension of approx. 230km in length, extending through Bheramara-Faridpur-Barisal, which will compose the main power system in the western zone have been executed mainly by the Government of Bangladesh and the Bangladesh Power Development Board (BPDB).

Completion of this transmission line will establish 132kV trunk transmission line "loop" connecting Bheramara-Faridpur-Barisal-Mongla-Bagerhat-Goalpara-Bheramara. Consequently the entire Faridpur District will be covered by the power supply network. Upon commissioning, this "loop" will contribute to the supply of economical and stable electric power in the western zone as a whole.

The BPDB, which is directly responsible for this project, has carried out feasibility studies. A Project Report, based upon the results obtained was published in September of 1976 which shapes the concrete plans for the project. This report was deliberated upon an EC-NEC (Executive Committee of the National Economic Council) meeting held in May 1978 and the project was finally given government approval. The BPDB has commenced to take shape of this project.

With a view towards pushing forward the concretization of this project, the Government of Bangladesh has requested the support and cooperation of the Government of Japan. In order to obtain a detailed outlook of the project, and to study concretely the construction aspects of the plan, the Government of Japan has entrusted the JICA (Japan International Cooperation Agency) with the duty of executing the required survey. This survey is intended to serve as a check of the contents of the project feasibility study executed by the BPDB and to study globally and in detail the feasibility of this project through preparation of a more realistic construction plan, taking into consideration the background described above.

This survey includes aerial surveying of a transmission line route which will form the basic route in this project, field investigation of the said route and soil boring, samplings on the banks of the Gorai River, where will be located the widest river crossing along the route.

1-2 Scope of Survey

According to the targets described above, the scope of this survey is determined as follows:

- a. Study and analysis of power demand and supply.
- b. Study of power system configuration and system operation.
- c. Study and selection of power transmission line and transformation equipment.
- d. Selection of transmission line route.
- e. Geological survey along transmission line route.
- f. Study concerning construction of the transmission line.
- g. Study concerning evaluation of financial and economical aspects.

Detailed studies and analysis of each of the above are presented in this report.

1-3 Method of Survey and Schedule

A team of eight (8) specialists in various fields, lead by Tsuneya Sato, was created. In addition, two (2) assistants were included in the team to aid in smooth execution of the survey work. Activities of this survey team commenced on February 12th 1979, upon arrival in Bangladesh, and continued for 41 days. After return of the team to Japan, a transmission line construction plan based upon detailed study and analysis of the data obtained during the survey was prepared. Throughout the local survey period, detailed discussions and data collection were carried out in cooperation with the BPDB counterparts.

Team members responsible for surveying the transmission line route carried out two (2) days of aerial surveys as a preliminary study for route selection. Following this, the same group performed a field survey of the route and made the borings at two (2) important points in order to study basic aspects and problematic points concerning the route.

Team members responsible for the electric power market carried out a study of the actual electric power situation in Bangladesh as a whole, a study of the power demand and supply in the region covered under this project and power systems existing there, aiming at analysis of power demand and supply and data collection.

Upon completion of field activities, the survey team presented an Interim Report, dated March 21st 1979, to the Government of Bangladesh and to the BPDB. This report covers items confirmed in the local survey, basic aspects of the project and various problematic points.

Prior to presentation of this Final Report, the contents have been discussed in detail with the BPDB staff members, over a period of 10 days in early August 1979, in order to reflect the opinions and point of view of the Bangladesh side, which included in the final draft of this report.

1-4 Outline of Study

This project covers the construction of a 132kV transmission line between Bheramara-Pang-Rajbari-Faridpur-Madaripur-Barisal of approx. 230km, the construction of 10MVA substations in Faridpur and Madaripur and the extension of existing Bheramara and Barisal substations.

In the western zone, where this project is focused, there is a 132kV trunk transmission line between Saidpur-Ishurdi-Bheramara-Khulna running in a north-south direction. On the Bheramara-Khulna section of this transmission line, work on installation of one (1) additional circuit is in progress and installation of additional circuits on the Bheramara-Ishurdi-Saidpur section is being planned.

Between Khulna-Barisal, construction of a transmission line composed of single circuit steel towers is in progress under the direction of the BPDB. This transmission line, extending in an east-west direction, is scheduled to be completed in 1980.

The transmission line planned in this project will be started from Barisal, describing an arc toward the north, and joining Bheramara (North Bengal Power Station) at an intermediate point on the existing transmission line and will compose a section of a 132kV transmission line loop in Western Bangladesh.

The principal power sources will be the North Bengal Power Station (Bheramara) and the Khulna Power Station (Goalpara). With completion of the 230kV east-west connection transmission line in the future (1983/84), economic power generated in the eastern zone of the country can be fed into the power system in the western zone. After completion of the described transmission lines, the power systems in the eastern and western zones will be unified and substantially reinforced, and an extremely stable and smooth supply of power, will consequently be realized.

This study takes into consideration the aspects described above, paying special attention to integration of the new transmission line with existing ones in the western zone, examining power system operation and route selection. This study also examines the market for electric power in the Faridpur district (mainly for agricultural use), taking into consideration the influential economic effects of this project on the region.

1-5 Survey Team Members

Chief	Tsuneya Sato	Japan Consulting Institute
Power transmission & distribution	Hiroshi Okada	Ditto
Demand study	Ken Matsushima	Tokyo Electric Power Services Co., Ltd.
Geology, foundations	Haruo Yamada	Ditto
Transmission lines	Susumu Sasaki	Ditto
Transmission line route	Jiro Asakawa	Ditto
Construction materials	Yoshihito Ogura	Ditto
Economic and financial analysis	Hiroshi Ohto	Ditto

1-6 Survey Activities

Group A: Electric power market study team (3 members)
Sato, Matsushima, Ohto

Global study of the actual electric power situation in Bangladesh, detailed study of power demand in the region through which the transmission line will be constructed, study of existing power system facilities (power plants, substations, etc.) in the western zone, considerations concerning power systems and power flow and survey of other fundamental aspects in connection with the construction of the proposed transmission line.

Group B: Transmission line construction study team
Okada, Asakawa, Yamada, Ogura, Sasaki

Aerial survey by means of Cessna aircraft, field survey along the route by vehicle and on foot, geological survey, soil boring at the river crossing point, and other survey activities related to the basic design of the transmission line and preparation of the construction plan.

The Team Activities

No.	Date	Day	Place	Time	Activity	Participant	Contents
1	2/12	Mon.	Bangkok	10:30	Lv. Narita	Groups A & B All members	
				20:30	Ar. Bangkok		
2	2/13	Tue.	Dacca	10:30	Lv. Bangkok	"	
				13:30	Ar. Dacca Japanese Embassy		
3	2/14	Wed.	"	9:00	Ministry of Finance, Depart- ment of Resources	"	"
				10:00	Ministry of Power, Water Resources & Flood Control		
4	2/15	Thu.	"	9:00	BPDB	BPDB staff	Meeting on definite line and survey schedule
5	2/16	Fri.	"	9:00	BPDB	All members	Gathering of data and in- formation in various fields
6	2/17	Sat.	"	9:00	BPDB	All members	"
				15:00	Internal Meeting		
7	2/18	Sun.	"	10:00	Internal Meet- ing	"	"
8	2/19	Mon.	Faridpur	7:00	Group A Departure Dacca	Group A & counterparts	Field survey in Faridpur
			Dacca	9:00	BPDB	Group B	Preliminary aerial survey along route
9	2/20	Tue.	Faridpur	8:00	Survey in Faridpur Madaripur area	Group A	
			Dacca			Group B	Secondary aerial survey along route

No.	Date	Day	Place	Time	Activity	Participant	Contents
10	2/21	Wed.	Barisal	7:30	Barisal area	Group A	Inspection of Substation
			Bheramara		Bheramara area	Group B	Inspection of transmission line and substation
11	2/22	Thu.	Faridpur	7:30	Trip to Jessore	Group A & counterparts	Inspection of planned site
			"		"	Trip to Barisal	Group B & counterparts
12	2/23	Fri.	Khulna	8:00	In the city	Group A & counterparts	"
			Barisal	9:00	"	Group B & counterparts	"
13	2/24	Sat.	Bheramara	8:00	Ishurdi	Group A & counterparts	Inspection of Bheramara
			Barisal	8:30	Barisal	Group B & counterparts	Inspection of Power Plant
14	2/25	Sun.			Ishurdi	Group A & counterparts	Trip
			Dacca	9:00	Barisal	Group B & counterparts	Trip
15	2/26	Mon.	"	9:00	Internal Meeting	All members of survey team	Report on the survey results obtained in various fields. Exchange of views
16	2/27	Tue.		8:30	BPDB	Group A	Report on the survey results obtained in various fields. Exchange of views
			Dacca	8:30	BPDB	Group B	"
17	2/28	Wed.	"	8:30	BPDB	Group A	"
			"	8:30	BPDB	Group B	"
18	3/1	Thu.		7:00	Jessore	Group A	Visit to concerned facilities in Khulna
			Khulna	"	"	Group B	"

No.	Date	Day	Place	Time	Activity	Participant	Contents
19	3/2	Fri.	Bheramara	7:00	Bheramara	Group A & counterparts	Inspection of Bheramara and Jessore
			Faridpur	"	Faridpur	Group B & counterparts	Trip
20	3/3	Sat.	Ishurdi	10:00	Ishurdi	Group A & counterparts	Trip
			Dacca	15:00	Faridpur	Group B & counterparts	Route investigation
21	3/4	Sun.	Dacca	10:00	Internal Meeting	All members	Report on results obtained in various fields. Exchange of views
22	3/5	Mon.	"	8:00	Meeting	Group A	Discussion on details
				8:00	BPDB BWDB	Group B	Discussion on data gathering
23	3/6	Tue.	"	8:00	BPDB	Group A	Questions and Answers
				8:00	BPDB IWTA	Group B	- Investigation of civil construction machinery - PDB data request - Inland freight survey
24	3/7	Wed.	"	8:00	BPDB	Group A	Detailed arrangements
				8:00	BPDB & others	Group B	Arrangements with local boring companies. Data request. Investigation of cargo handling capacities

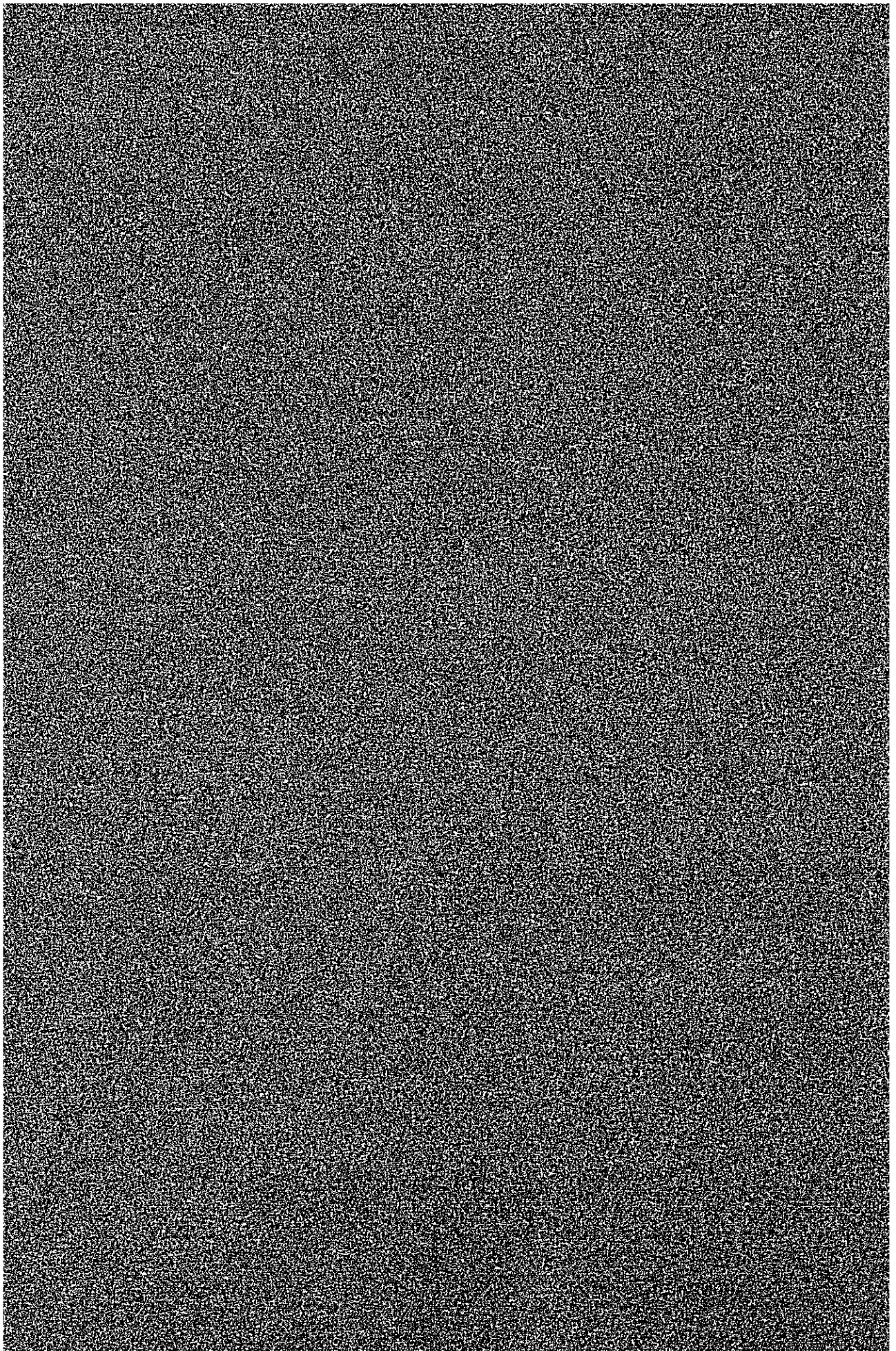
No.	Date	Day	Place	Time	Activity	Participant	Contents
25	3/8	Thu.	Dacca	8:00	BPDB	Group A	Numerical data for financial analysis
				8:00	BPDB & others	Group B	Investigation regarding local construction companies
26	3/9	Fri.	"	9:00	BPDB meeting	Group A	Arrangement
				9:00	Geographical Institute	Group B	Request for data from local survey company
27	3/10	Sat.	"	9:00	BPDB	Group A	Survey of power distribution equipment
				9:00	BPDB, Ministry of Power, Water, Resources & Flood Control	Group B	Arrangements for authorization of aerial photography
28	3/11	Sun.	Dacca	9:00	BPDB	Group A	Investigation of irrigation plan
			Chittagong	8:00	Chittagong	Yamada, Asakawa, Ohto, Ogura, Araki	Investigation of local survey capacity port facilities and customs & import duty
29	3/12	Mon.	Datta	9:00	BPDB	Group A	Survey for financial analysis
			Chittagong	8:00	City	Yamada, Asakawa, Ohto, Ogura, Araki	Price of cement, sand, round bar. Visit to steel mill
30	3/13	Tue.	Dacca	9:00	Internal meeting	All members	Internal Report meeting
31	3/14	Wed.	Dacca	9:00	Internal meeting	All members	Report of results obtained by Groups A & B, arrangements for future activities

No.	Date	Day	Place	Time	Activity	Participant	Contents
32	3/15	Thu.	Dacca	9:00	Internal meeting	All members	Report of results obtained by Groups A & B, arrangements for future activities Arrangement referring to preparation of Interim Report Draft
33	3/16	Fri.	Dacca	9:00	"	"	" Translation into English
34	3/17	Sat.	Dacca	9:00	"	"	Interim Report Translation into English
35	3/18	Sun.	Dacca	9:00	"	"	"
36	3/19	Mon.	Dacca	8:30	BPDB	Group A Mr. Murtafa Group B Mr. Kabir	Explanation of the current work status referring to Interim Report
37	3/20	Tue.	Dacca	9:00	BPDB	Group A Mr. Murtafa Group B Mr. Ali	Global Arrangements Arrangements to obtain photographs and maps of route
38	3/21	Wed.	Dacca	9:00 8:00	BPDB BPDB	"	Interim Report Request for maps from the Geographical Institute
39	3/22	Thu.	Dacca	9:00 9:00	BPDB Ministry of Power, Water Resources & Flood Control	Group A Group B Mr. Ali	Courtesy visits to various concerned persons Obtained maps and photographs, courtesy visit

No.	Date	Day	Place	Time	Activity	Participant	Contents
40	3/23	Fri.	Bangkok				Preparation for return to Japan PM Return to Japan

CHAPTER 2

CONCLUSIONS



CHAPTER 2 CONCLUSIONS

Based on this study our conclusions are as follows:

(1) Components of the Plan

- Construction of a single circuit transmission line (132kV, ACSR, 477MCM, 230km) on double circuit tower.
- Installation of an outgoing transmission bay and modification of an existing outgoing transmission bay at the existing Bheramara Substation on double circuit tower.
- Construction of Faridpur substation (with a 10/13MVA transformer).
- Construction of Madaripur substation (with a 10/13MVA transformer) and erection of new 33kV distribution line which connects, new substation and the existing one.
- Installation of an outgoing transmission bay at Barisal substation.

(2) Power demand forecast figures for the western grid area, assuming an annual increase rate of 16% up to 1990 and thereafter 11% up to 1995, are as follows.

Power Demand Forecast

Unit : MW

<u>Year</u>	<u>1979</u>	<u>1980</u>	<u>1983</u>	<u>1986</u>	<u>1989</u>	<u>1992</u>	<u>1995</u>
Total Western Grid	110.0	127.6	199.2	268.0	483.5	693.5	948.5
Rajbari	1.7	2.0	3.0	4.9	7.6	11.0	15.0
Faridpur	2.0	2.4	3.8	5.9	9.2	13.1	17.9
Madaripur	1.1	1.3	2.0	3.2	4.9	7.0	9.6

(3) In view of the power flow analysis made for the proposed project (132kV west grid), the following measures are recommended.

- Successive installation of capacitor at power stations and substations as countermeasures for voltage dropping after 1990.
- Duplicating of the transmission lines of this project in 1993. For the purpose of above, this project consists of single circuit on double circuit transmission towers.
- Installation of two (2) power generating facilities (100MVA x 2) in the Khulna area or any other suitable place between 1992 and 1995.

Further detailed studies concerning power demand and other related subjects should be conducted when implementation of each of the above plans becomes necessary.

(4) The proposed transmission line should be along the Bheramara-Rajbari-Faridpur-Barisal route paralleling roads and, partially, railroads. There are four (4) crossings over the rivers. These crossings, however, involves no difficulties in construction (the greatest, Gorai River, is 420m wide).

(5) As to foundations for the transmission towers, two(2) types (spread foundations 80%, pile foundations 20%) have been selected, using boring data and classifying the total area into five (5) blocks.

(6) Four (4) types of vertical formation lattice steel tower have been selected. The total number of towers is 705, and the total weight is 4,767 tons.

(7) Construction period, including preparatory work, is as follows:

- Starting time for preparatory work: January, 1980
- Starting time for construction work: October, 1981
- Commissioning of substations:
 - (Bheramara and Faridpur) July, 1983
 - (Madripur and Barisal) July, 1985
- Commissioning of all construction: July, 1985

Because the region is flooded during the rainy seasons and constructing time is limited to dry seasons (December to May), four (4) dry seasons (1981-1985) are required for completing this project.

(8) Estimate of investment costs is as follows:

Estimate of Investment Costs

Item	Foreign Currency		Local Currency TK (1,000)	Total TK (1,000)
	¥ (1,000)	TK (1,000)		
Construction Cost of Transmission lines	1,922,616	144,557	156,781	301,338
Construction Cost of Substations	894,298	67,241	30,857	98,098
Land Purchase and Compensation for Right-of-Way	-	-	3,070	3,070
Construction of Building	-	-	9,720	9,720
Route survey	-	-	2,721	2,721
(1) Direct Costs	2,816,914	211,798	203,135	414,933
(2) Indirect Costs	622,231	46,784	67,643	114,427
(1)+(2) Total	3,439,145	258,582	270,778	529,360
Interest during Construction	-	-	33,703	33,703
Gross Investment	3,439,145	258,582	304,481	563,063

Condition of Estimation

- Import duty: 20% of CIF
- Landing and warehouse charge: 3% of CIF
- Inland transportation: 7% of CIF
- Field establishment: 2% of local portion of direct cost
- Over head cost: 5% of local portion of direct cost

- Physical contingencies: 10% of direct cost
- Price contingencies: 9% of domestic portion of direct cost from 1982/83 onwards.
- Interest during construction: 5% of total foreign currency costs
- Foreign exchange rate: 1TK = ¥13.3

(N.B.) 1981/82 price is used as base.

(9) In view of the comparative economic analysis of this project and an alternative project for local thermal power stations, using a discount rate of 15% and the present values as of 1980/81 for thirty years from 1980/81 up to 2009/2010, this project is found to be advantageous.

This project (Transmission lines): $751,820 \times 10^3$ TK

The alternative project (Local thermal power stations): $986,467 \times 10^3$ TK

(10) With this project, the domestic, industrial agricultural consumer profits will amount to nearly one hundred million TK by one year 1995 as calculated on current electricity rate.

(11) With this project, it is expected that the Faridpur paddy irrigation program will be promoted and an increase in the production of paddy amounting to 150 thousand tons (approx.) will be possible. As a consequence, job opportunities for about 250 thousand people a year may be available.

As discussed above, this project will not only contribute to the stable supply of power, but will be technically feasible and have economic advantages over the alternative project. It is directly profitable to local society and indirectly beneficial to an increase in paddy production. The project therefore is recommended as highly feasible.

Reference: Based on the BPDB's manual for project evaluation, the B/C Ratio are calculate as shown in Annex X.

Financial analysis

B/C Ratio discount rate 15%: 0.198/1.0

Economic analysis

B/C Ratio discount rate 15%: 0.231/1.0

Further, the B/C ratio with a discount rate of 4% are calculated as shown below.

Financial: 0.667/1.0

Economic: 0.771/1.0

(12) The survey team recommends that the BPDB takes account the following matters:

- Necessary land acquisition for the transmission line and substations, as well as preparatory work for detailed design e.g. surveying, boring, etc. should be completed by May, 1981.
- Boring should be done for every five (5) towers on the average.
- Locally procured supplies should be arranged in advance.
- "Non stop stringing method" should be adopted for protection of the wire and satisfactory scheduling.

