Ministry of Power, Energy and Mineral Resources
The People's Republic of Bangladesh

THE STUDY
ON
GAS SCADA SYSTEM REHABILITATION AND EXPANSION PROJECT
FOR
GAS TRANSMISSION COMPANY LIMITED (GTCL)
IN
THE PEOPLE'S REPUBLIC OF BANGLADESH

FINAL REPORT

VOLUME 1

MARCH 2011

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS CO., LTD.

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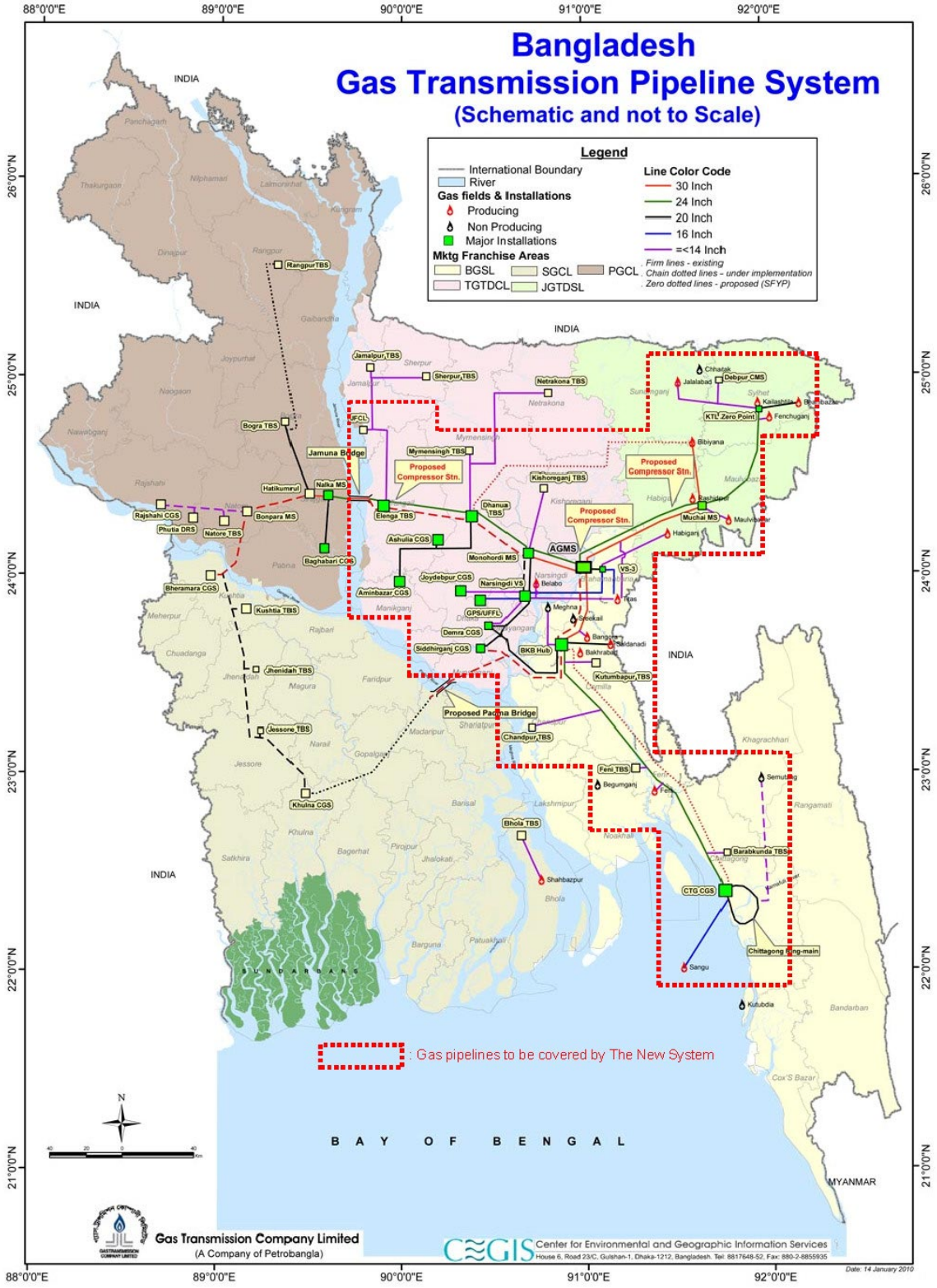


Project Location Map

The Study on the Gas SCADA System Rehabilitation and Expansion Project for Gas Transmission Company Limited (GTCL)

SUMMARY

1 INTRODUCTION

In January 2010, JICA dispatched a team of experts to preliminarily examine the requirements for rehabilitation and expansion of the existing natural gas SCADA-Communication system operated by GTCL (the Existing System). As a result of its examination, JICA has engaged this team to further study in detail the requirements for rehabilitation and expansion of the Existing System, including the selection of an optimum communication backbone system containing media such as microwaves, fibre optic cable networks, GPRS, etc., and to formulate a detailed future investment plan for the New System.

2 OVERVIEW OF THE STUDY

2-1 Current Status and Issues

The Existing System was installed under DFID (Department for International Development, UK Government) assistance between 1996-2003 for the efficient operation and monitoring of the gas supply in the country. However, malfunctions currently occur due to the following serious issues.

(1) Since the installation and subsequent operation of the Existing System, many new gas fields started gas production and delivery to the GTCL pipelines and new gas offtake points were developed. However, as no expansion of the system was done by GTCL, all newly developed gas sites have remained outside the coverage of the Existing System.
After the operation & maintenance support service period, the Existing System was not maintained properly, and has become old and dilapidated.

(2) The TGTDCL microwave analog communication system, which was used as the backbone of the Bramaputra Basin pipeline from Monohordi to Elenga and Tarakandi, has become old and is not used anymore.

(3) The pipeline operations application software used to support leak detection, load balancing and scheduling for the Existing System hasn't functioned since its installation in 2003, because the Existing System could not cover all the related sites and collect the required data on the GTCL pipelines.

(4) The Existing System was designed 15 years ago, and is approaching the final stage of its lifetime. The equipment/parts used for the system have become one generation older than the latest type, and the following reasons make the procurement of spare parts

more difficult year by year and seriously affect maintenance work.

1) The recent SCADA system has evolved so that by applying internet technology, it can correspond to a computer network such as LAN or WAN, instead of the telemetry communication system which has become outdated.
2) Granger Telecommunication System Ltd., who supplied the existing communication equipment, has gone bankrupt. Therefore, the procurement of spare units/parts is impossible and support for repairing the system is not available. Also, procurement of a compatible product from other companies is not easy.

2-2 Necessity of the Project

As mentioned in the previous sections, despite the significant expansion/extension of the gas pipeline network, the Existing System has not been properly maintained or improved since its installation and subsequent operation. Meanwhile, a rapid increase in gas demand and supply in Bangladesh has been forecasted and many further expansion/extension projects for gas pipelines are under implementation or being planned. In addition, the following problems shall be solved:

- Insufficient gas supply volume against increasing gas demand.
- Gas transmission capability from the northeast to the southwest in the country.

Considering these situations, an integrated SCADA communication system shall be built up urgently to realize an effective and sustainable gas supply for the whole country.

2-3 Selection of SCADA Communication Backbone

(1) Preliminary Study of Applicable Networks

In order to select the optimum communication media for the SCADA backbone of the New System, the following applicable networks were studied preliminarily.

(a) Existing Microwave Network

(b) Provider's Network

- Bangladesh Telecommunications Company Limited (BTCL)
- Bangladesh Railway (BR)
- Power Grid Company of Bangladesh (PGCB)
- Grameen Phone (GP)

As a result of the preliminary study on the state of the services available from these providers, BTCL and GP were recommended for further studies.

(2) Characteristic Comparison of Applicable Networks

Further, seven network configurations were studied regarding characteristics of "Cost",

"Transmission Quality", "Maintainability" and "Expandability". The results of the characteristic comparison are summarized in Table 2-9.

Table 2-9 Characteristic Comparison

Cases	Provider	Cost	Trans-mission Quality	Maintain-ability	Expand-ability	Recommend-able Order
Case 1: MW		High	Good	Good	Good	2
Case 2-1: MW + PN (Last 1 Mile: Wireless)	GP	High	Good	Good	Good	2
Case 2-2a: MW + PN (Last 1 Mile: Wireless)	BTCL	High	Good	Good	Good	
Case 2-2b: MW + PN (Last 1 Mile: FOC)		High	Good	Good	Good	
Case 3-1: PN (Last 1 Mile: Wireless)	GP	Rather High	Good	Almost Free	Excellent	1
Case 3-2a: PN (Last 1 Mile: Wireless)	BTCL	Lowest	Good	Almost Free	Excellent	
Case 3-2b: PN (Last 1 Mile: FOC)		Rather High	Good	Good	Good	

(3) Recommendation and Selection of SCADA Communication Backbone System

In consideration of all respects mentioned above, the Study Team recommended Case 3-2a, BTCL's network with a wireless link between GTCL's radio stations and BTCL's access points, for the communication media of the SCADA backbone system. GTCL also expressed their preference for Case 3-2a after presentation of these studies by the Study Team at the end of the site surveys in Bangladesh.

3 CONTENTS OF THE PROJECT

3-1 Basic Concept of the Project

The purpose of the Project is to improve and expand the Existing System in the GTCL gas transmission pipeline network, thereby building up an integrated SCADA-Communication system (the New System) as a component of the establishment of a stable gas supply system and secure efficient and effective gas distribution to the whole country.

3-2 Outline Design

3-2-1 Design Policy

(1) The scope of the Project will be as follows:

1) To build up an integrated SCADA communication system in the GTCL gas transmission pipeline network by:

(a) Improving the system and instruments of existing sites covered by the Existing System.
(b) Expanding the system into existing sites not yet covered by the Existing System.
(c) Expanding the system into upcoming sites such as those under construction or being planned.
(d) Enabling connections to other SCADA systems operated by IOCs or installed by other donors.

2) To assist GTCL with the establishment of a sustainable Operation and Maintenance (O & M) system by:
(a) Training on skills and expertise for GTCL related personnel for smooth commencement of the New System and its sustainable O & M
(b) Preparing the manual and schedule for O & M.

(2) The New System will be designed in accordance with basically the same operational philosophy for pipelines as the one currently being used for the Existing System.

(3) The New System shall meet the following functional requirements:
1) To support the centralized control and operation of the pipelines covered by the Project.
2) To support management of the country's gas resources and security of supply to consumers.
3) To improve the safety of operation of the pipelines covered by the Project.
4) To enhance the skills and expertise of GTCL personnel.
5) To support the future expansion of the pipeline network.

(4) All main components of the Existing System, such as servers, workstations, RTUs, communication equipment, etc., except field instruments, are to be replaced with new one. The existing field instruments, including field cabling, junction boxes, and power supply cabling to RTU will be reused.

(5) Existing associated facilities, such as communication towers, equipment rooms and foundations/sunshades for field equipment, are still in usable condition. Therefore, these existing facilities will be refurbished if necessary, and used for the New System.

3-2-2 Basic Plan

As a result of studies and discussions with GTCL for the rehabilitation and expansion of the Existing System, the basic design requirements and major equipment for the New System has been designed as follows. Figure 3.1 shows the schematic system outline.

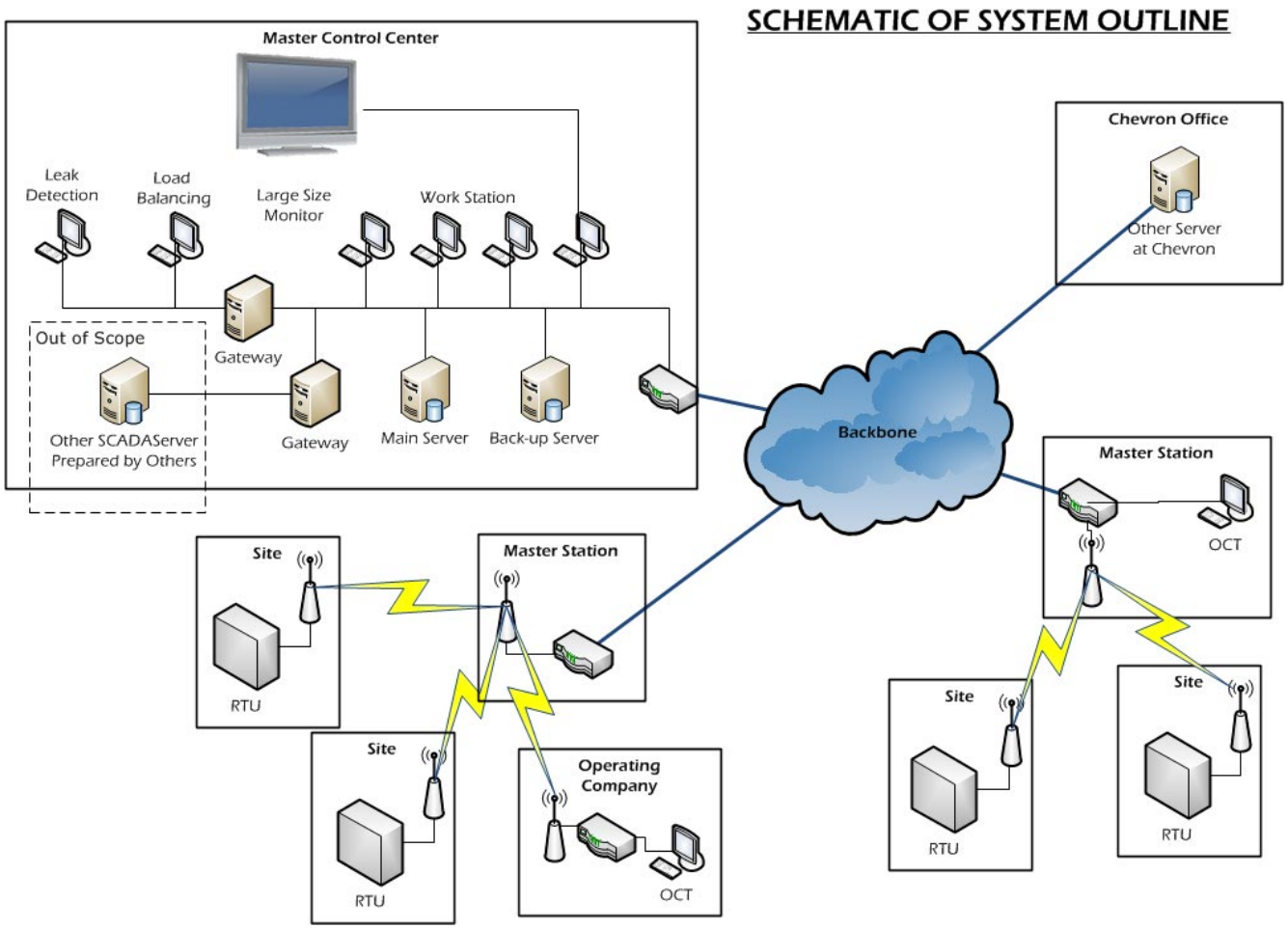


Figure 3-1 Schematic System Outline

(1) SCADA System

The SCADA system will be designed to meet the following functional requirements:

(a) Event and alarm reporting
(b) Operational monitoring
(c) Data collection and storage
(d) Operational control
(e) Interchangeable data with other systems such as Chevron's SCADA system and additional SCADA servers provided by others in the future. For this purpose, the New SCADA System will have an Ethernet interface.
(f) Disclosure of operation data to nine (9) operating companies
(g) System management capability including system security, access control and system time adjustment.
(h) Pipeline operation application software for "Leak Detection" and "Load Balancing and Scheduling".

(2) Communication System

The communication system shall be composed of the following network, links and other sub-systems:

(a) Provider's Network (BTCL's network is supposed)
(b) Wireless Link between Master Telemetry Station (MTS) and Access Points (AP)
(c) Telemetry Radio Link
(d) IP PBX
(e) Network Monitoring System

3-2-3 Implementation Plan

(1) Consulting Services

For smooth implementation of the Project, a Consultant will be employed by GTCL. The consulting services consist of the following works:

(a) Assistance for the EPC Contract Tendering
(b) Assistance for the EPC Contract Management

In executing the services, the Consultant shall follow the relevant procedures of the GOB and JICA. The Consultant shall assist GTCL in all aspects of services including the correspondence and necessary measures for the schedule, planning, design, operation and services required for execution of the Project.

(2) Implementation Schedule

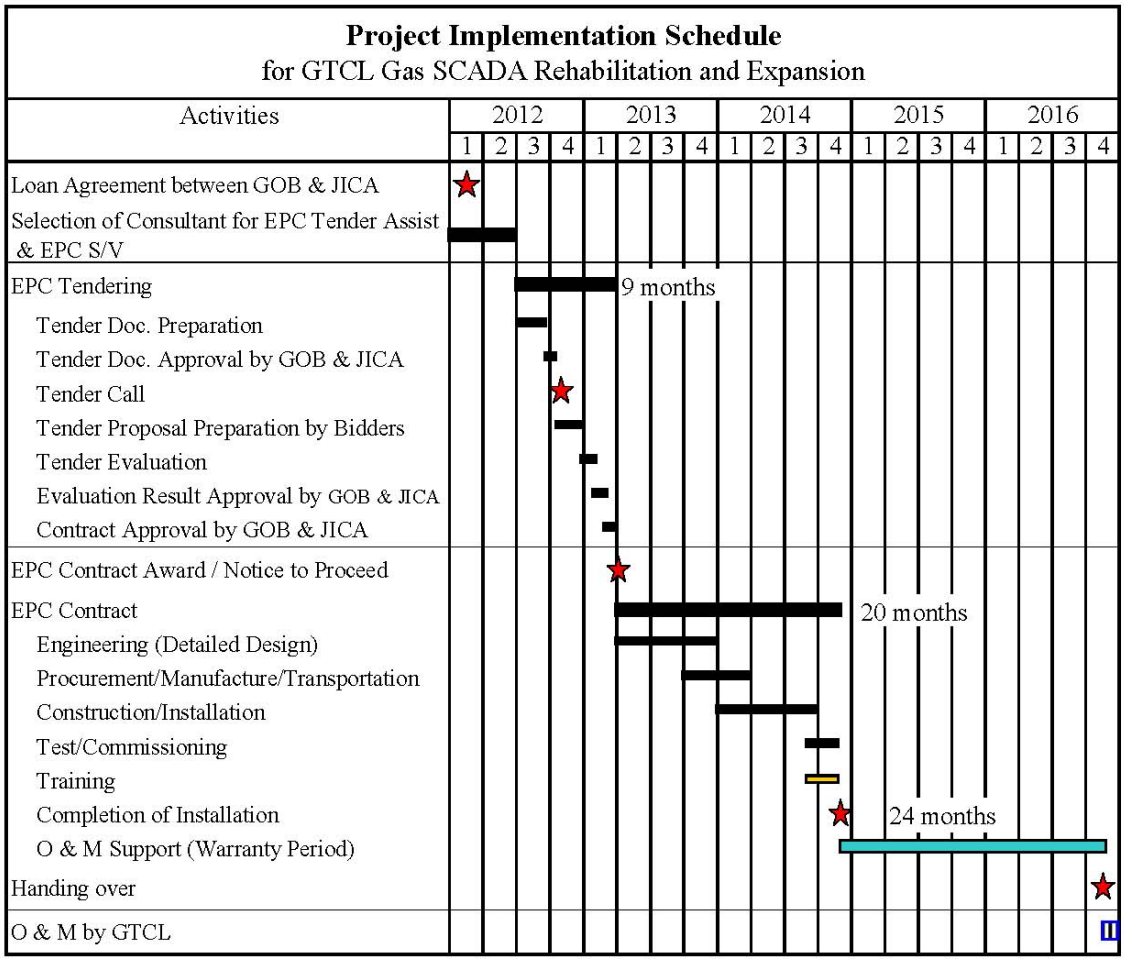
Based on the following assumptions, an implementation schedule for the Project has been prepared and is shown in Table 3-3.

(a) The Project will be financed from the proceeds of a JICA Loan.

- JICA guidelines shall be used for the employment of consultant(s) and the procurement of goods and services under the Loan.
- Review and/or concurrence procedures required by JICA shall be taken.
- The Loan Agreement will be made between GOB and GOJ in January 2012.

(b) All necessary approvals from GTCL and review and/or concurrence procedures by JICA will be applied for in a timely manner and obtained without any delay.

Table 3-3 Project Implementation Schedule



(3) Undertakings by Bangladesh

GTCL shall be responsible to undertake the following items for smooth implementation of the Project.

1) Responsibilities of GTCL

(a) Necessary land-use permissions shall been obtained by GTCL so that the Contractor can start their work without any delay.

(b) The communication system lease contract between GTCL and BTCL shall

be made prior to the start of the equipment installation work.

2) Works by GTCL

i) Prior to the tendering of the EPC Contract

The following information shall be provided by GTCL as a part of the tender document for the EPC Contract:

(a) Detailed information, such as the type and exact location of whole intake and offtake points, valve stations, metering stations, etc., on GTCL and other related gas pipeline networks

(b) Layout and P&ID drawings of sites to be covered by the New System.

ii) Prior to the commencement of the EPC Contract

(a) Thermo-wells additionally required for the New System shall be installed by GTCL.

(b) The soundness of all transmitters, limit switches and/or supply power including related cables and junction boxes at existing RTU sites and other related sites shall be checked and repaired/replaced by GTCL as necessary.

(c) For the detection of a gas leakage from the pipelines covered by the Project, the precise measurement of gas flow at whole intake and offtake points is indispensable. Therefore, the current situation of the relevant points with respect to the gas flow measuring capability shall be checked and necessary measures shall be taken by GTCL.

3-4 Project Operation and Maintenance Plan

(1) In consideration of the current status and problems with the O & M for the Existing System, various measures shall be examined in GTCL and carried out to establish a secure O & M system.

(2) For smooth commencement of the O & M of the New System, training for related staff on the installation, operation management and maintenance of the system is required and shall start as early as possible prior to the completion of the system installation. Also, during the liability period, training for related staff by the Contractor on an OJT basis will be necessary to enable effective repair and maintenance of the system.

(3) To cope with the additional coverage of New RTU sites for the future expanded pipeline, connections with the other SCADA systems, etc., the modification/maintenance works for the software of SCADA system will be required. Therefore, GTCL is recommended to study the necessity of a long-term maintenance support contract with the supplier of the New System or another service provider.

3-5 Project Cost Estimation

The Project cost has been estimated as shown in Table 3-6 below.

(x 1000)

Table 3-6 Project Cost

		Foreign currency	Local currency portion		Total
		YEN	BTK	Equivalent YEN	YEN
I	Engineering, procurement & construction	1,838,100	151,200	187,300	2,025,400
1	Equipment (SCADA, Communication)	1,595,200	23,300	28,800	1,624,000
2	Associated Facilities	36,700	25,000	31,000	67,700
3	EPC management	61,700	88,900	110,200	171,900
4	EPC O/H, profit, etc.	56,900	3,400	4,200	61,100
	Sub Total	1,750,500	140,600	174,200	1,924,700
5	Price escalation (14.2% for Local portion)	100	3,400	4,200	4,300
6	Physical contingency (5%)	87,500	7,200	8,900	96,400
II	Consultant service	140,000	11,600	14,400	154,400
III	Operation and maintenance support	100,800	12,000	14,900	115,700
	Total (I + II + III)	2,078,900	174,800	216,600	2,295,500
IV	Administration expenses		92,490	114,700	114,700
V	Tax and duty		665,887	825,700	825,700
1	Import Tax		325,484	403,600	403,600
2	VAT		340,403	422,100	422,100
	Grand Total	2,078,900	933,177	1,157,000	3,235,900

4 EVALUATION AND RECOMMENDATION

Since the Project is a rehabilitation and expansion project for the Existing System that is a part of the GTCL gas transmission pipeline network, it is rather difficult to estimate the quantitative effects of the Project. For example, the Existing System's revenue cannot be separated from GTCL's total revenue, and similarly, the revenue from the New System cannot be determined. Therefore, the justification for Project implementation has been evaluated as follows.

In the "Bangladesh Gas Sector Master Plan and Strategy", which was prepared by Wood Mackenzie Limited in January 2006, the system loss for the gas sector in Bangladesh was described as below:

i) The total Unaccounted for Gas (UFG) of the gas distribution sector in fiscal year 2004-05 was at 77 mmcfd (28 bcf: about 6% of total production each year), which equates to US$39 million per annum.

ii) A figure close to 2% is viewed as being caused by technical losses, and at least 4% of the total 6% is due to non-technical reasons, largely theft.

iii) A System Loss Reduction Plan (SLRP) is under implementation.

Although system loss is believed to have been decreasing since then through the implementation of SLRP, no consolidated data of the system loss other than the aforementioned data is available. Once the New System is installed and operating effectively, the SLRP is expected to be further enhanced and system loss would be further reduced. In other words, without an integrated and well-operated SCADA system, achievement of the SLRP may not be possible.

Further, comparing the Project cost of US$26.5million (YEN2.3billion) with the annual system loss equivalent to US$39 million, contribution of the Project to system loss reduction and efficient and effective gas distribution would justify implementation of the Project.

As a result of the above examination, it is recommended that the Project be implemented on an urgent basis.

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VOLUME 1: MAIN REPORT

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Abbreviations & Definitions

Abbreviations

ACC	:	Auxiliary Control Center
ADB	:	Asian Development Bank
BGFCL	:	Bangladesh Gas Field Co., Ltd.
BGSL	:	Bakhrabad Gas System Ltd.
CGS	:	City Gate Station
CMS	:	Customer Metering Station
DRS	:	District Regulating Station
FAT	:	Factory Acceptance Test
FF	:	Fertilizer Factory
GPRS	:	General packet radio service
GTCL	:	Gas Transmission Co., Ltd.
IOC	:	International Oil Company
JICA	:	Japan International Cooperation Agency
JGTDSL	:	Jalalabad Gas Transmission & Distribution System Ltd.
LAN	:	Local Area Network
MCC	:	Main Control Center
MS	:	Metering Station
OCT	:	Operation Company Terminal
PS	:	Power Station
RMS	:	Regulating & Metering Station
RTU	:	Remote Terminal Unit
SAT	:	Site Acceptance Test
SCADA	:	Supervisory Control and Data Acquisition
SGFL	:	Sylhet Gas Field Ltd.
TBS	:	Town Bordering Station
TGTDCL	:	Titas Gas Transmission & Distribution Co., Ltd.
UPS	:	Uninterruptible Power Supply
VS	:	Valve Station
WAN	:	Wide Area Network
WB	:	World Bank

Definitions

Access Point	:	Provider's network station where Master Telemetry Station of The New System shall be linked with.
Additional Site	:	Existing site which is currently not covered by The Existing System but shall be covered by The New System.
Employer	:	GTCL
Future Site	:	Upcoming site which is planned to be added into The New System after the completion of the Project.
Master Telemetry Station	:	The radio station which communicate with its associated New RTU(s) and Control Center as relay station.
Original Site	:	Existing site which has been covered by The Existing System, and shall be covered by The New System.
Project	:	Detail design, procurement, construction, installation, commissioning and training for the rehabilitation and expansion of The Existing System.
Site	:	Place where gas pipeline related facilities are or will be situated.
Study	:	All activities by experts selected by JICA to examine the requirement for the rehabilitation and expansion of The Existing System and to formulate a detailed future investment plan for the efficient gas transmission inclusive of training for transfer of technical know-how.
The Existing System	:	Existing SCADA and Telecommunication System which had been previously established and shall be rehabilitated in the Project.
The New System	:	New SCADA and Communication System which shall be established in the Project.

1 INTRODUCTION

1-1 Background of the Study

The existing natural gas SCADA-Communication system operated by GTCL (the Existing System) was installed between 1996-2003 for efficient operation and monitoring of the gas supply in Bangladesh. Since the installation and subsequent operation of the Existing System, there has been a significant expansion/extension of the gas pipeline network. Consequently, the Existing System has been unable to cover the entire gas pipeline grid. In addition, the Existing System has become old and replacement spare parts have been mostly unavailable resulting in frequent malfunctions. In January 2010, JICA dispatched a team of experts to preliminarily examine the requirements for rehabilitation and expansion of the Existing System. As a result of its examination, JICA has engaged this team to further study in detail the requirements for rehabilitation and expansion of the Existing System, including the selection of an optimum communication backbone system including media such as microwaves, fibre optic cable networks, GPRS, etc., and to formulate a detailed future investment plan for the New System.

1-2 Objective of the Study

The objective of this study is to examine the requirements for rehabilitation and expansion of the Existing System and to formulate a detailed future investment plan for an efficient gas SCADA-Communication system that will contribute to a sustainable natural gas supply. In addition, training for counterpart personnel related to the Study will be conducted.

1-3 Study Area

The Study covers all the areas of Bangladesh to be under the coverage of the New System.

1-4 Milestones of the Study

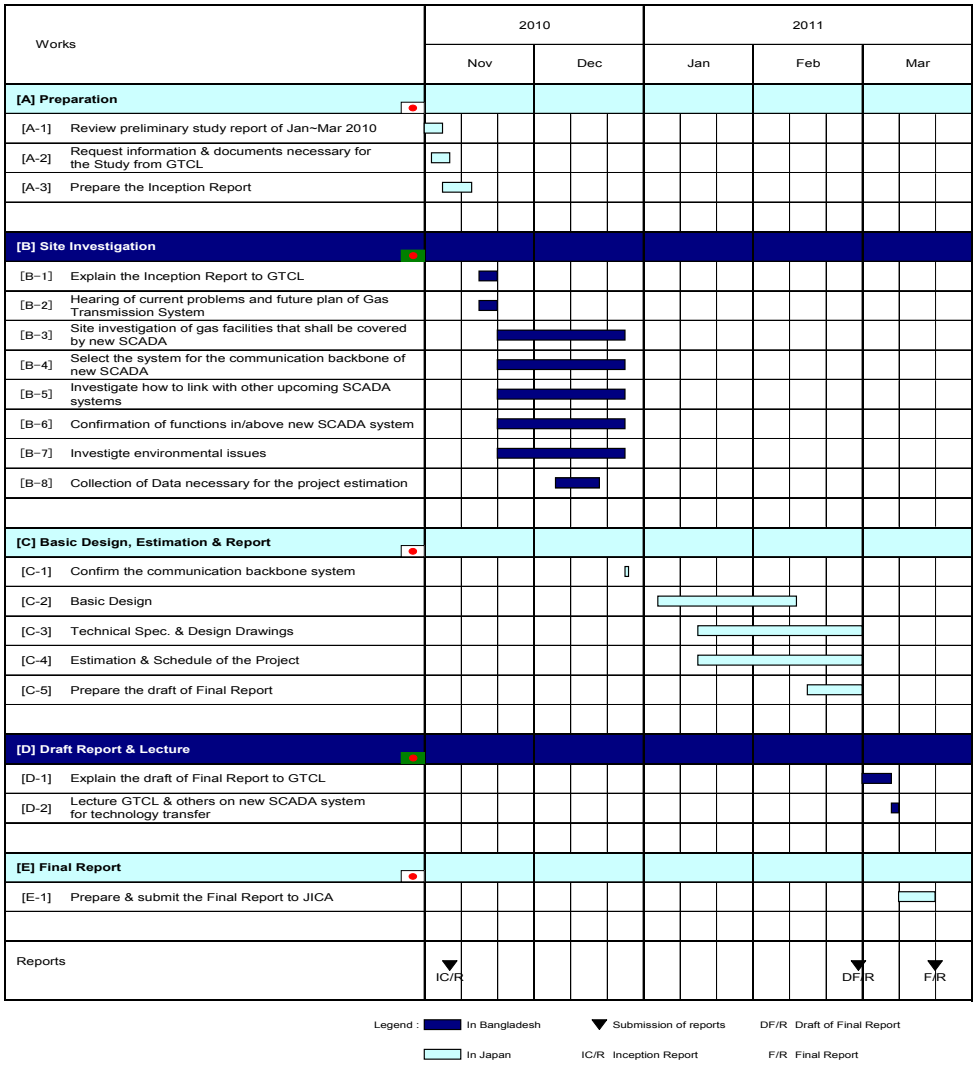
The Study commenced with the presentation of an Inception Report in November 2010 followed by the submission of a Draft Final Report in early March 2011, for presentation to the Bangladesh side.

Half a month was allocated for the review and comments of the Report by the

Bangladesh side, prior to finalizing and submitting the Final Report to JICA in late March 2011. Table1-1 shows the major tasks schedule showing the milestones for report submissions.

Table 1-1 Schedule of the Major Tasks

Figure 3.3.1 Schedule of the Study



All efforts were undertaken to complete the Study successfully to ensure the viability of the project for possible implementation through loan arrangements and preparation of the corresponding plans and Basic Design works.

The document “Site Information & Scope of Work”, which summarizes the site name, code number, coordinates, and the type and scope of work for each Site of the Project, is incorporated in the separate volume of “Draft Technical Specification” as a result of the site investigation.

2 OVERVIEW OF THE STUDY

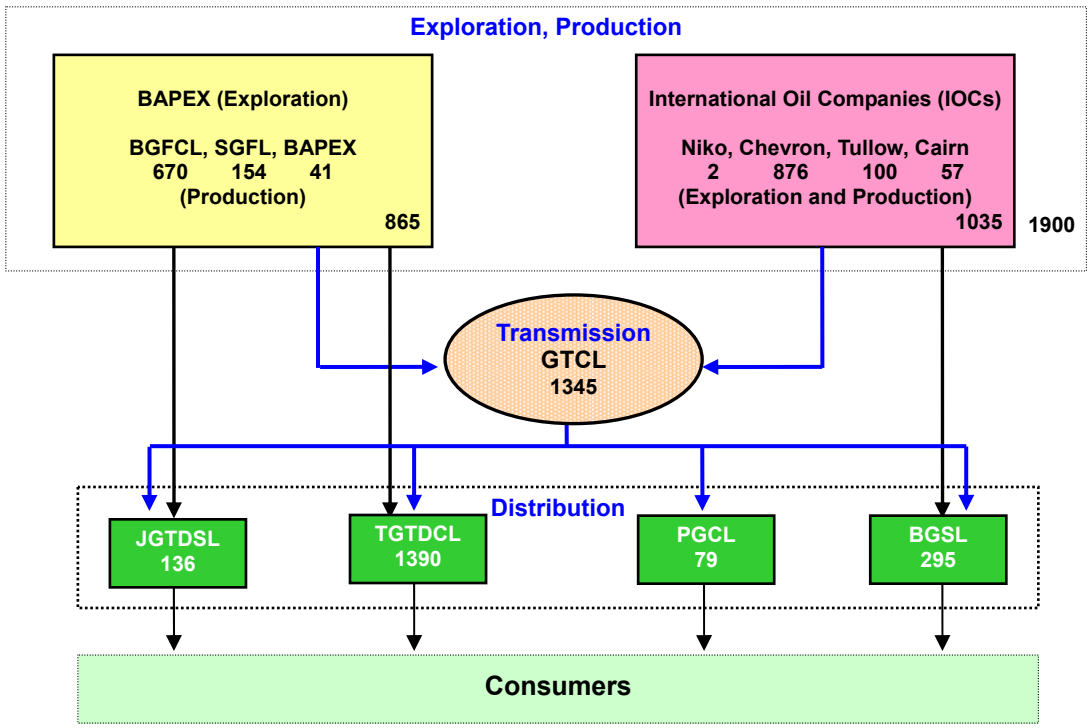
2-1 Status and Issues

2-1-1 Organizational structure of the gas sector

The gas sector in Bangladesh is under the Ministry of Power, Energy & Mineral Resources, and is organized into four distinct segments with individual companies responsible for exploration, production, transmission and distribution as shown in Figure 2-1.

The exploration and production sector is comprised of International Oil Companies (IOCs) and state owned companies. Meanwhile, the transmission and distribution sector is completely state owned via a number of Petrobangla subsidiaries that are regulated by the Bangladesh Energy Regulatory Commission (BERC).

The gas sector has recorded significant growth in the last several years. Presently, the use of natural gas in Bangladesh accounts for approximately 75% of all energy consumption in the country with 40-50% of the natural gas being consumed in the power sector.



(All figures in mmscfd)

Figure 2-1 Gas Industry Structure

2-1-2 Gas Transmission Company Ltd. (GTCL)

The natural gas transmission function in Bangladesh is carried out by the Gas Transmission Company Ltd. (GTCL), which was established in 1994 as one of Petrobangla subsidiaries and is the counterpart agency to JICA for the Project. GTCL currently operates approximately 930 km of high-pressure transmission pipelines (20/24/30 inch diameters). Its daily gas transmission is about 70% of the total daily gas production in the country (1400 mmscf/1900 mmscf). All major power stations, fertilizer plants and the four gas distribution companies are supplied with gas from the GTCL pipelines.

2-1-3 Existing SCADA-Communication System

The Existing System was installed under DFID (Department for International Development, UK Government) assistance between 1996-2003 for the efficient operation and monitoring of the gas supply in the country. However, malfunctions currently occur due to the following serious issues.

(1) Since the installation and subsequent operation of the Existing System, there has been significant growth of the gas sector. Many new gas fields started gas production and delivery to the GTCL pipelines and new gas offtake points were developed. However, as no expansion of the system was done by GTCL, all newly developed gas sites have remained outside the coverage of the Existing System.

GTCL could not obtain sufficient maintenance support from the previous Contractor after the operation & maintenance support service period. Thus, the Existing System was not maintained properly, and has become old and dilapidated.

(2) The TGTDCL microwave analog communication system, which was used as the backbone of the Bramaputra Basin pipeline from Monohordi to Elenga and Tarakandi, has become old and is not used anymore.

(3) The pipeline operations application software to support leak detection, load balancing and scheduling, was designed as the upper function of the SCADA system in the basic design for the Existing System. However, it hasn't functioned since its installation in 2003, because the Existing System could not cover all the related sites and collect the required data on the GTCL pipelines.

(4) The Existing System was designed in 1995 (15 years ago), and is approaching the final stage of its lifetime. The equipment/parts used for the system have become one generation older than the latest type, and the following reasons make the procurement of spare parts more difficult year by year and seriously affect the maintenance work.

1) The recent SCADA system has evolved so that by applying internet technology, it can correspond to a computer network such as LAN or WAN.

2) Granger Telecommunication System Ltd., who supplied the existing communication equipment, has gone bankrupt. Therefore, the procurement of spare units/parts is impossible and support for repairing the system is not available. Also, procurement of a compatible product from other companies is not easy.

2-2 Development Plan

2-2-1 Gas Sector Master Plan and Strategy

The report, "Bangladesh Gas Sector Master Plan and Strategy", was prepared for Petrobangla and World Bank by Wood Mackenzie Limited in January 2006, and officially approved by the Government of Bangladesh. The data and schedule contained have been reviewed and revised as necessary, and the development plans in the gas sector are being carried out almost in accordance with the report.

In the report, the vision to 2025 has been defined as follows:

"Enabling the Gas Sector to facilitate the requisite economic growth in Bangladesh, required to meet the PRSP (Poverty Reduction Strategy Plan) and MDG (Millennium Development Goal) targets committed to by the Government, through transformation into an economically efficiently operating Sector to bring the maximum benefit to the population of Bangladesh."

It is determined that the gas sector strategy to achieve the above vision is built around two central pillars, which are Pricing Reform and Institutional Reform.

Further, the time bound priorities for each segment of the gas sector, from exploration to distribution, have been set out as the roadmap for implementation of the gas sector master plan. The priorities for the transmission sector are as follows:

i) Urgent Priorities:
- Initiate a three phase pigging program
- Compressor Operation and Maintenance training

ii) Near-term Priorities:
- Install planned compression project (Muchai, Ashuganj West/South, Bakhrabad gas field)
- Install Pipeline Project (Dhanua-Savar)
- Establish on-going pigging program

iii) Medium-term Priorities:
- Looping between Muchai and Ashuganj
- Looping from Monohordi to Dhanua and Elanga)

In the above report, the gas system loss is mentioned as follows:

i) The total Unaccounted for Gas (UFG) of the gas distribution sector in fiscal year 2004-05 was at 28 bcf (77 mmcfd: about 6% of total production each year), which equates to US$39 million per annum.

ii) A figure close to 2% is viewed as being caused by technical losses, and at least 4% of the total 6% is due to non-technical reasons, largely theft.

iii) A System Loss Reduction Plan (SLRP) is under implementation.

As for the system loss in gas sector, the following data is also found in the "Bangladesh Gas Sector (Issues, options and the Way Forward)" published by ADB in 2007.

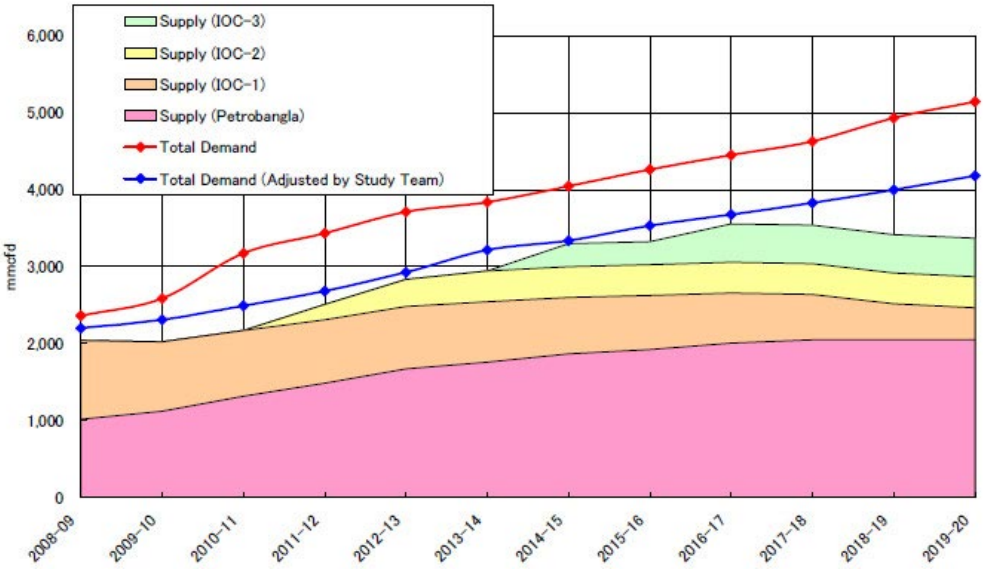
Table 2-1 System Loss in Gas Sector (in bcf)

Year	TGTDCL	BGSL	JGTDSL	PGCL	Total
1999-2000	19.1	2.1	0.00	0.0	21.20
2000-2001	21.3	1.8	0.01	0.0	23.22
2001-2002	22.1	3.3	0.20	0.0	25.60
2002-2003	18.1	0.8	0.04	0.0	18.94
2003-2004	23.0	0.9	0.00	0.0	23.90

This system loss is due primarily to the non-bulk sectors composed of industrial, commercial, domestic and seasonal category of customers which consume about 31% of total gas. So this is not a consolidated data of whole gas sector.

2-2-2 Gas Supply and Demand

The "Gas Demand Forecast", "Gas Supply Forecast", "Gas Production Forecast", and "Gas Remaining Reserve" in Bangladesh are shown as follows.



Source: JICA Report (Original from Petrobangla)

Figure 2-2 Gas Demand and Supply Forecast

Table 2-2 Gas Production and Remaining Reserve

Company		Recoverable (P1＋P2)	Cumulative Production (June 2008)	Remaining Reserve (P1＋P2)	Production (2008-2009)	Remaining Reserve (P1＋P2) (2020)
Petrobangla	BGFCL	1,0876.0	5374.1	5,501.9	4,726.0	775.9
	SGFL	3,476.0	914.8	2,561.2	1,799.0	762.2
	BAPEX	1,015.0	105.3	909.7	1,220.0	-310.3
IOC-1	CHEVRON	3,687.0	732.9	2,954.1	2,966.0	-11.9
	CAIRN	500.0	439.7	60.3	40.0	20.3
	TULLOW	305.0	47.3	257.8	274.0	-16.2
	NIKO	603.0	86.6	516.4	75.0	441.4
IOC-2	Block-5,7,10	0	0	0	621.0	0
	Block-16	0	0	0	329.0	0
	Block-17,18	0	0	0	274.0	0
IOC-3		0	0	0	949.0	0
Total		20462.0	7700.7	12761.4	13273.0	1661.4

Source: JICA Report (Original from Petrobangla)

Table 2-3 Gas Supply Forecast (mmcfd)

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

Source: JICA Report (Original from Petrobangla)

Table 2-4 Gas Demand Forecast (mmcfd)

Company	Category	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
BGSL	Power	138.3	148.3	183.3	218.3	218.3	218.3	218.3	218.3	218.3	218.3	218.3	218.3
	Captive	29.6	32.0	34.5	37.3	40.3	43.5	47.0	50.7	54.8	59.2	63.9	69.0
	Fertilizer	120.0	120.	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0
	Non-Bulk	122.7	132.5	143.1	154.6	166.9	180.3	194.7	210.3	227.1	245.3	264.9	286.1
	Sub-total	410.6	432.8	480.9	530.2	545.5	562.1	580.0	599.3	620.2	642.8	667.1	693.4
JGTDSL	Power	136.7	166.7	241.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7	205.7
	Captive	5.8	6.2.	6.7	6.9	7.0	7.2	7.4	7.6	7.8	8.0	8.3	8.5
	Fertilizer	15.0	15.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
	Non-Bulk	33.5	36.2	39.1	42.2	45.6	49.2	53.2	57.4	62.0	67.0	72.3	78.1
	Sub-total	191.0	224.1	312.5	279.8	283.8	287.1	291.3	295.7	300.5	305.7	311.3	317.3
PGCL	Power	85.0	85.0	200.0	200.0	200.0	200.0	200.0	200.0	20.0.0	200.0	200.0	200.0
	Captive	4.0	4.8	5.8	6.9	8.3	10.0	11.9	14.3	17.2	20.6	24.8	29.7
	Fertilizer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	70.0	70.0	70.0	70.0	70.0
	Non-Bulk	11.2	13.2	15.8	19.0	22.8	27.4	32.9	39.4	47.3	56.8	68.1	81.7
	Sub-total	100.0	103.0	221.6	225.9	231.1	237.4	244.8	323.7	34.5	347.4	362.9	381.4
TGTDCL	Power	757.0	863.0	982.0	1147.0	1162.0	1179.0	1270.0	1288.0	1331.0	1356.0	1493.0	1523.0
	Captive	198.1	213.9	231.0	249.5	269.5	291.0	314.3	339.5	366.6	395.9	427.6	461.8
	Fertilizer	155.0	155.0	155.0	155.0	155.0	155.0	155.0	155,0	155.0	155.0	155.0	155.0
	Non-Bulk	551.4	595.6	643.2	694.7	750.2	810.3	875.1	945.1	1020.7	1102.3	1190.5	1285.8
	Sub-total	100.0	103.0	221.6	225.9	231.1	237.4	244.8	323.7	334.5	347.4	362.9	381.4
SGCL	Power	0.0	0.0	135.0	135.0	298.0	298.0	298.0	298.0	298.0	298.0	298.0	298.0
	Captive	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Fertilizer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Non-Bulk	0.0	0.0	14.0	15.1	16.3	17.6	19.1	20.6	22.2	24.0	25.9	28.0
	Sub-total	0.0	0.0	149.0	150.1	314.3	315.6	317.1	318.6	320.2	322.0	323.9	326.0
Total Demand		2362.1	2587.4	3157.2	3432.2	3710.9	3837.5	4047.6	4264.9	4448.7	4627.1	4931.3	5143.7

Source: JICA Report (Originally from Petrobangla)

2-2-3 Gas Pipeline Construction Project

Table 2-5 and Table 2-6 show the "List of Projects under Construction" and "List of Projects under Planning" under GTCL.

Table 2-5 List of Projects Under Construction

SI No.	Project Name	Length (km)	Dia (inch)	Financed by	Expected Completion Time
1	Bonpara-Rajshahi Gas Transmission Pipeline (45 mmcfd)	53	12	ADB	Jun-2011 (ADB: Jun-2012)
2	2(two) Compressor Stations at Elenga and Ashuganj(Partial) (under re-tender)	-	-	ADB New Loan	Dec-2013
3	Monohardi – Dhanua – Elenga – East Bank of Jamuna Bridge Gas Transmission Pipeline (300 - 750 mmcfd)	103	30	ADB	Jun-2011 (ADB: Jun-2012)
4	West Bank of Jamuna Bridge – Nalka, Hatikumrul – Isshordi - Bheramara Gas Transmission Pipelin (400 mmcfd)	101	30	ADB	Dec-2012 (ADB: Dec-2012)
5	Bheramara - Khulna Gas Transmission Pipeline (mmcfd)	165	20	ADB	Dec-2012 (ADB: Jun-2012)
6	Bakhrabad – Siddhirganji Gas Transmission Pipeline (mmcfd)	60	30	WB	Dec-2012
7	Titas Gas Field – AB Interconnection Pipeline	8	24		
8	Ashuganj – Bakhrabad Pipeline	61	30	ADB New Loan	Jun-2013

Source: from GTCL on March 05, 2011

Table 2-6 List of Projects Under Being Planned

SI No.	Project Name	Length (km)	Dia (inch)	Financed by	Expected Completion Time
P-1	Langalbandh – Mawa Pipeline	40	30	-	No Schedule
P-2	Padma Bridge Pipeline (with approach road)	20	30	-	No Schedule
P-3	Bakhrabad – Feni Pipeline	91	30	-	No Schedule
P-4	Bibiyana Dhanua Pipeline	190	24/30	-	Dec-2012
P-5	Zajira – Khulna Pipeline	110	30	-	No Schedule
P-6	Bogra – Rangpur Pipeline	100	20	-	No Schedule
P-7	Installation of Custody Transfer meter				No Schedule
P-8	Rehabilitation and upgrading of SCADA				No Schedule
P-9	Human Resource Development				No Schedule
P-10	Maheshkhali – Anowara Pipeline	90	30		Dec-2012

Source: GTCL Web Site on March 05, 2011

2-3 Necessity of the Project

As mentioned in the previous sections, despite the significant expansion/extension of the gas pipeline network, the existing gas SCADA-Communication system has not been properly repaired or improved since its installation and subsequent operation. Consequently, it is malfunctioning.

Meanwhile, a rapid increase of the gas demand and supply in Bangladesh is forecasted as shown in Figure 2.2, and many further expansion/extension projects of gas pipeline are under implementation or being planned. In addition, the following problems shall be solved:

- Insufficient gas supply volume against increasing gas demand.
- Gas transmission capability from the northeast to the southwest in the country.

Considering the above situation, an integrated SCADA-Communication system shall be built up urgently to realize the effective and sustainable gas supply for the whole country.

2-4 Selection of SCADA Communication Backbone

2-4-1 Basic Principles for the Selection

In order to select the optimum communication media for SCADA backbone of the New System, the following principles are taken into consideration:

(1) High transmission quality is required.
(2) Transmission quality should not be decreased by the natural environment, communication congestion phenomenon, etc.
(3) The backbone system should have a redundant system.
(4) Cost for the operation and maintenance of the backbone system should be economical.
(5) GTCL should be able to operate/maintain new backbone system without any major changes in the current organization for operation & maintenance.
(6) The backbone system should be expandable for upcoming additional sites to be monitored.

2-4-2 Preliminary Study of Applicable Networks

Considering the above principles, the following applicable networks were studied:

(1) Microwave Network

The existing microwave network can be rehabilitated by replacing the existing outdated and faulty radio equipment including auxiliary power units such as batteries and generators. The existing microwave network currently uses a 1.5 GHz band, which the Bangladesh Telecommunication Regulatory Commission (BTRC) has requested to be changed into a 2.0 GHz band. However, instead of a 2.0 GHz band, a 6.0~7.0 GHz band is recommended due to the risk of interference with other services and the abundant availability of equipment on the global market. So, GTCL needs to obtain approval for the use of a 6.0~7.0 GHz band from BTRC prior to Project implementation.

(2) Provider's Network

The provider's network consists of a fibre optic cable network and/or microwave network. It can be leased from telecommunication service providers and used for the SCADA backbone system. The Study Team was informed that the following service providers are available and accessible in Bangladesh:

- Bangladesh Telecommunications Company Limited (BTCL)
- Bangladesh Railway (BR)
- Power Grid Company of Bangladesh (PGCB)
- Grameen Phone (GP)

The state of the services available from these providers was studied, and the results are shown in Table 2-7 below.

Table 2-7

Operator's Circumstances	Conclusion
Bangladesh Telecommunications Company Limited (BTCL) ▪ BTCL has nationwide telephone and Internet services through their network. ▪ Either FOC or wireless links can be established from BTCL's access points to GTCL's radio stations. Initial cost to establish such links shall be born by GTCL. ▪ FOC laying for the link between BTCL's access points and GTCL's radio stations shall be difficult and costly because cable routes shall have to pass through congested roads in town. ▪ In case GTCL lays FOC for this link, GTCL shall have to take responsibility for the regular maintenance as well as unexpected cable obstacles.	Further examination required for adoption in the Project.
Bangladesh Railway (BR) ▪ BR leased out their FOC network to GP and does not intend to lease their facilities to GTCL.	It cannot be used.
Power Grid Company of Bangladesh (PGCB) ▪ PGCB has Fibre Optic Cable Network (FOCN) along their power transmission lines. ▪ Access points to their FOCN shall be at OLT (Optical fibre Line Terminal) in their substations or at OLT mounted on field towers where their fibre optic cables are connected. ▪ Numbers of access points (substations) are much less than GPs' and BTCLs' and some access points are distant from GTCL's radio stations. ▪ PGCB could not provide information on field access points at towers. Further, most of the towers are located in paddy fields or wetland without proper access roads. Consequently, FOC laying route shall be mostly under paddy fields or wetlands with a high risk of unexpected cable cuts. ▪ PGCB has no experience of leasing their FOCN and shall not take responsibility for maintenance.	PGCB's FOCN is not recommended.
Grameen Phone (GP) ▪ GP has nationwide mobile phone and Internet services through their network. ▪ GP can provide wireless links from their access points to GTCL's radio stations. GP will not charge for the initial cost to establish this link and will charge only a leasing fee. ▪ GP has similar experience for this type of network system lease. ▪ Initial cost is less than other cases but the leasing fee shall be high.	Further examination required for adoption in the Project.

As a result of the above studies, BTCL and GP are recommendable service providers.

2-4-3 Case Study of Applicable Networks

As a result of the preliminary study, the following three (3) network configurations are considered for further studies in detail:

(1) Case 1: Microwave Network
(2) Case 2: Combination of Microwave Network and Provider's Network
(3) Case 3: Provider's Network

The details of each case are described below.

(1) Case 1: Microwave Network (see Figure 2-4)

The backbone network shall be formed by installing a new microwave network in place of the existing microwave network that is currently faulty. It is assumed that GTCL shall obtain the approval for use of a 6.0~7.0 GHz band from BTRC prior to Project implementation.

In this case:

- A total of 20 microwave links shall be newly established between 21 existing radio stations with towers including MCC/ACC. New microwave radio equipment (capacity in each link is E1) shall be installed in place of existing faulty equipment at these radio stations.

Figure 2.3 shows the components of the new equipment to be installed at each radio station.

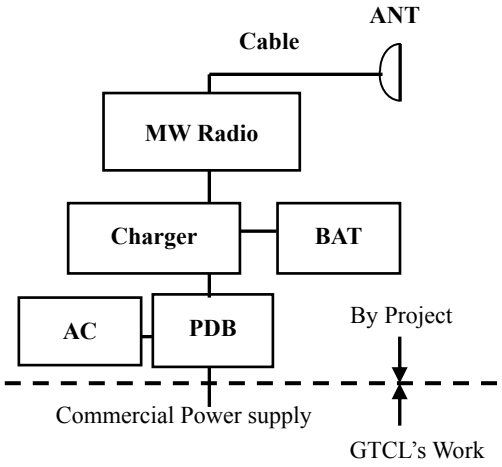
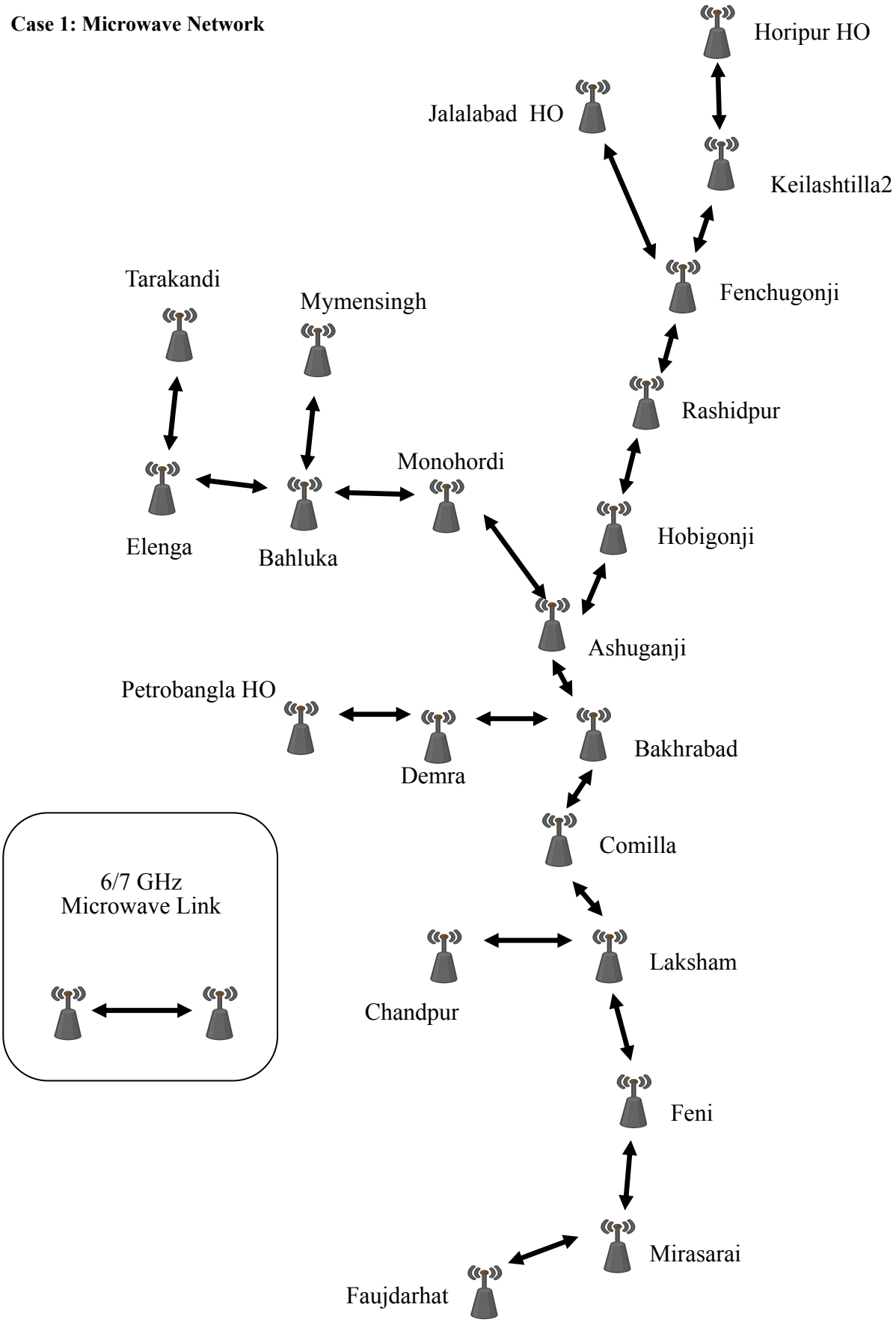


Fig. 2-3 Microwave Radio Station

Figure 2-4

Case 1: Microwave Network



(2) Case 2: Combination of Microwave Network and Provider's Network (see Figure 2-5)

The backbone network shall be formed by the combination of a new microwave network and a provider's network. The provider's network shall be applied at existing radio stations at the northwest part of the gas grid where transmission capacity is rather small, and the new microwave network shall be established at the other part of the gas grid in place of the existing faulty microwave network in an identical manner to Case 1.

In this case:

- A total of 16 microwave links shall be newly established between 17 existing radio stations with towers including MCC/ACC. New radio equipment (capacity in each link is E1) shall be installed in place of existing faulty equipment at these radio stations.
- A total of 4 existing radio stations shall be equipped with new equipment and linked to the service provider's nearest access points by fibre optic cable or wireless radio.

GP's network can be connected only by wireless radio while BTCL's network allows both wireless and FOC links; therefore, Case 2 is divided into sub-cases as below:

- Case 2-1: Microwave Network & GP's network linked by wireless radio (using non-licensed 2.4 GHz or 5.2 GHz band)
- Case 2-2a: Microwave Network & BTCL's network linked by wireless radio (using non-licensed 2.4 GHz or 5.2 GHz band)
- Case 2.3b: Microwave Network & BTCL's network linked by FOC

(3) Case 3: Provider's Network (see Figure 2-6)

The backbone network shall be formed by a provider's network with a system (E1 capacity) lease from either BTCL or GP.

In this case:

- A total of 20 existing radio stations shall be equipped with new equipment and linked to the service provider's nearest access points by fibre optic cable or wireless radio.

GP's network can be connected only by wireless radio while BTCL's network allows both wireless and FOC links; therefore, Case 3 is divided into sub-cases as below:

- Case 3-1: GP's network linked by wireless radio (using non-licensed 2.4 GHz or 5.2 GHz band)
- Case 3-2a: BTCL's network linked by wireless radio (using non-licensed 2.4 GHz or 5.2 GHz band)
- Case 3-2b: BTCL's network linked by FOC

Figure 2-5

Case 2: Microwave Network & Provider's Network

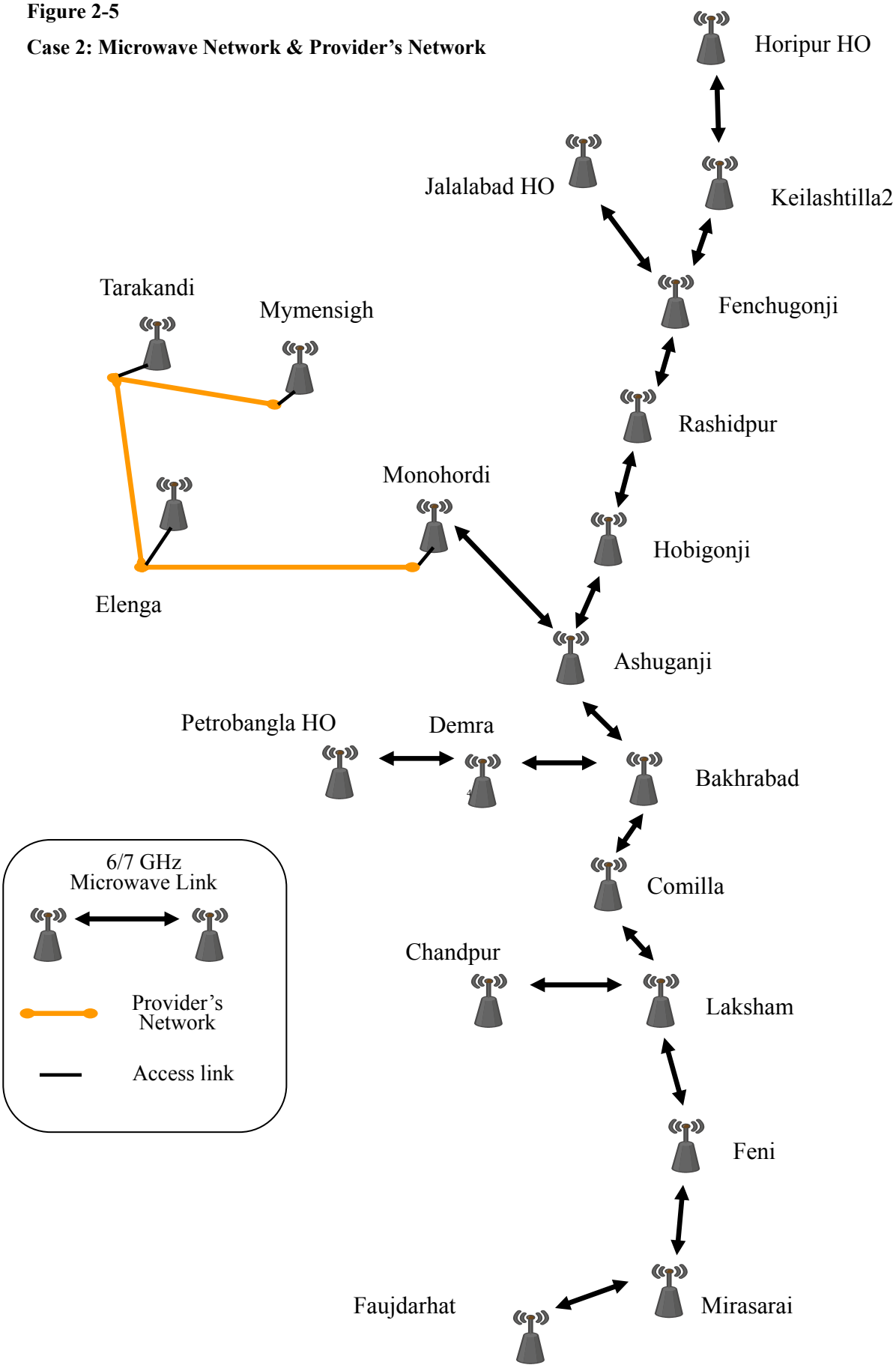


Figure 2-6

Case 3: Provider's Network

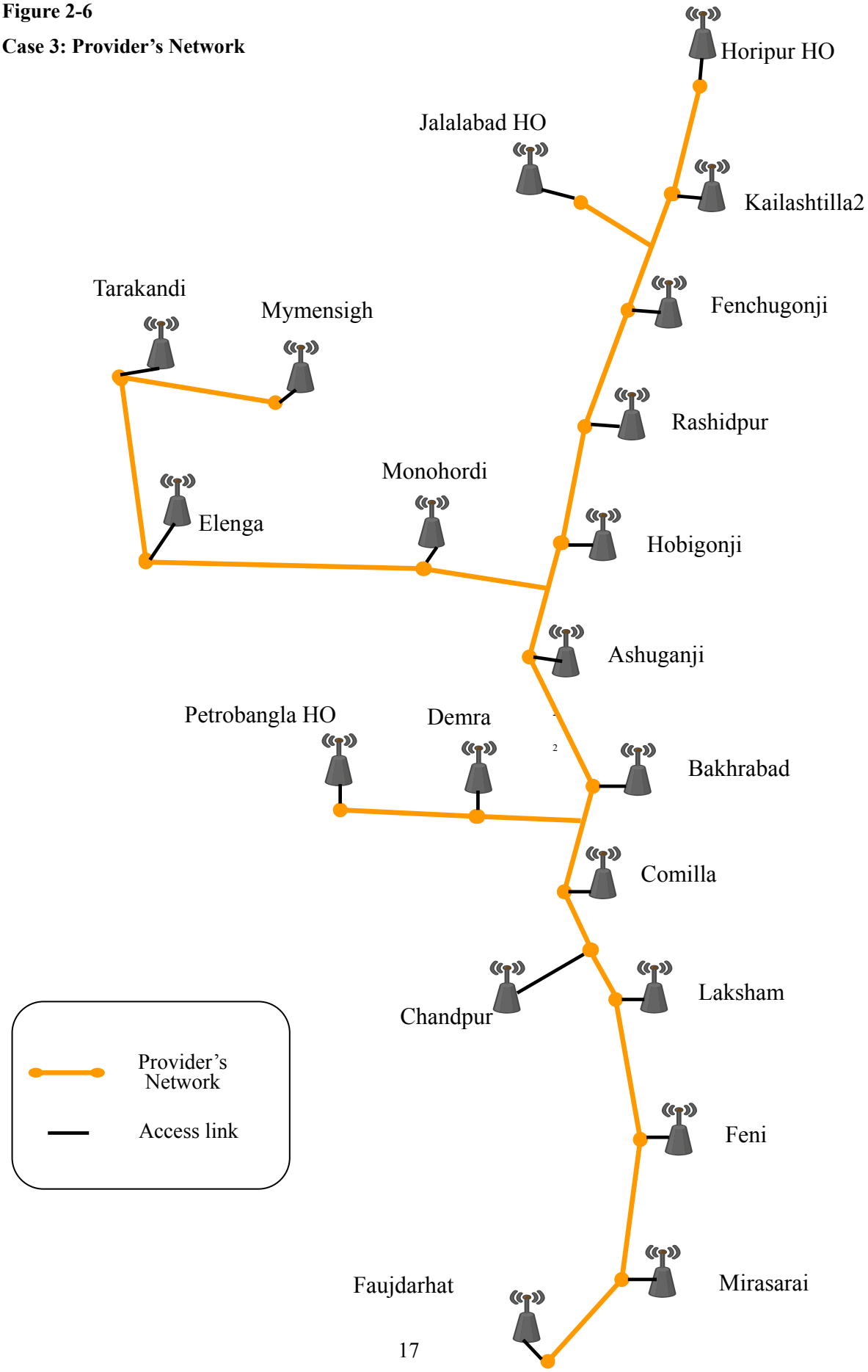


Figure 2-7, 2-8, 2-9 shows division of works between GTCL and Providers for Case 2 & 3.

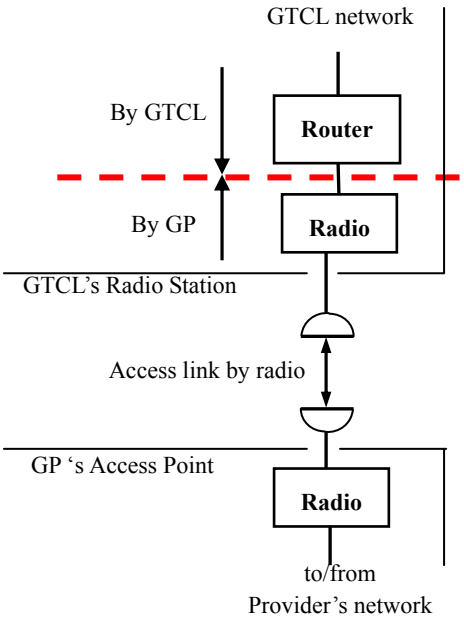


Fig.2-7. Division of Work with GP

For Case 2-1 & 3-1

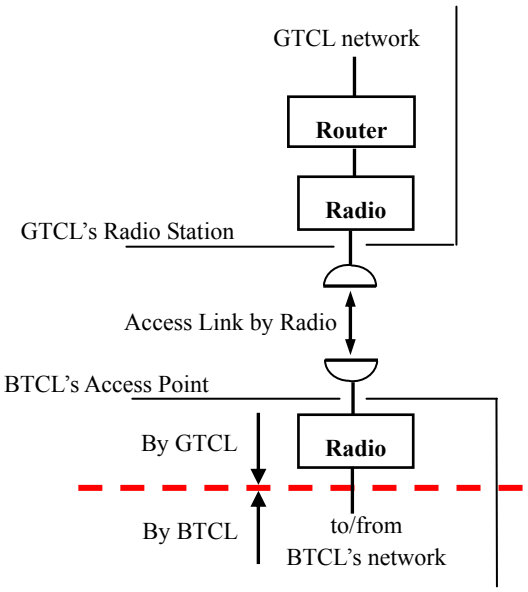


Fig. 2-8. Division of Works with BTCL

For Case 2-2a & 3-2a

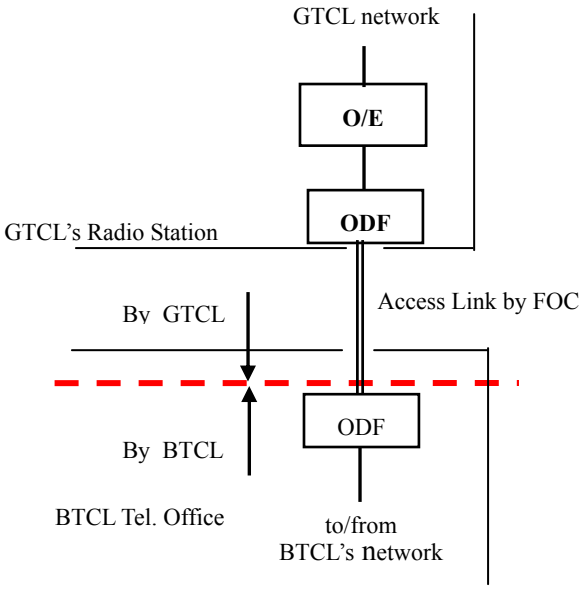


Fig. 2-9. Division of Works with BTCL

For Case 2-2b & 3-3b

2-4-4 Cost Comparison of Applicable Networks

(1) The initial investment cost and running costs, such as lease charges and maintenance for each case, are estimated for comparison purposes.

(2) Conditions & Assumptions of Estimation

1) Time period for running cost is set at 15 years for comparison purposes.
2) Initial investment cost for the microwave network of Case 1 & 2 is predominantly composed of supply and installation of new microwave backbone equipment.
3) Initial investment cost for the provider's network of Cases 2 & 3 is predominately composed of supply and installation of equipment for wireless radio or FOC facilities to link with the provider's network.
4) Lease charge is estimated based on:
   - Provider's price regulations available on their web pages
   - Distance between MCC/ACC and each Master telemetry station
   - Distance between GTCL's radio stations and provider's access points.
5) License fee for the use of microwave frequency bandwidth to be paid to BTRC is considered as the leasing charge for the microwave network.
6) Equipment and maintenance costs, including consumable materials, are estimated by the following assumptions:
   - First 5 years: 1% of initial investment cost
   - Next 5 years: 2% of initial investment cost
   - Last 5 years: 5% of initial investment cost

(3) Cost Comparison

1) Initial Investment Cost

   The initial cost for the provider's network is cheaper than the initial cost for the microwave network because both providers already own, operate and maintain their networks. Among the providers, GP is the cheapest in initial cost because they will provide the link between their access point and GTCL's radio station at their cost.

2) Lease Charge

   Contrary to the initial investment cost, the lease charge of the microwave network (payment to BTRC) is the cheapest and GP's lease charge is the highest.

3) Maintenance Cost

   The maintenance cost is proportional to the initial investment cost as mentioned above.

   Cost comparison of each case integrating the above factors resulted in Table 2-8 below.

Table 2-8 Cost Comparison

(x 1,000 TK)

Cases	Provider	Initial Investment Cost			MW/FOC Lease Charge			Equipment Maintenance Cost				Total (for 15 years)
		Mirowave	Last 1 Mile	Sub Total	Payment to	Yearly Charge	Sub Total (for 15 ys)	1-5 ys (1%)	5-10 ys (2%)	10-15 ys (5%)	Sub Total (for 15 ys)	
Case 1: MW		304,100		304,100	BTRC	1,400	21,000	15,205	30,410	76,025	121,640	447,000
Case 2-1: MW + PN (Last 1 Mile: Wireless)	GP	266,000	(by GP)	266,000	BTRC+GP	2,876	43,140	13,300	26,600	66,500	106,400	416,000
Case 2-2a: MW + PN (Last 1 Mile: Wireless)	BTCL	271,600	← Included	271,600	BTRC+BTCL	1,724	25,860	13,580	27,160	67,900	108,640	406,000
Case 2-2b: MW + PN (Last 1 Mile: FOC)		269,900	20,400	290,300	BTRC+BTCL	1,724	25,860	13,495	26,990	67,475	107,960	424,000
Case 3-1: PN (Last 1 Mile: Wireless)	GP	76,000	(by GP)	76,000	GP	13,752	206,280	3,800	7,600	19,000	30,400	313,000
Case 3-2a: PN (Last 1 Mile: Wireless)	BTCL	86,700	← Included	86,700	BTCL	2,760	41,400	4,335	8,670	21,675	34,680	163,000
Case 3-2b: PN (Last 1 Mile: FOC)		75,700	119,800	195,500	BTCL	2,760	41,400	3,785	7,570	18,925	30,280	267,000

2-4-5 Characteristic Comparison of Applicable Networks

(1) Cost

Refer to section 2.4.4 above.

(2) Transmission Quality

There is no remarkable difference among each case.

(3) Maintainability

GTCL will be able to operate and maintain every case by their current operation & maintenance organization after necessary training for the new system. However, the adoption of a provider's network shall naturally result in fewer operation and maintenance works for GTCL because a major part of the backbone network shall be operated and maintained by service providers.

(4) Expandability

The transmission capacity shall be able to be expanded without any problem in every case. However, the provider's network is more flexible for future expansion to any location because the service provider's access points are spread all over the country.

These comparisons are summarized in Table 2-9 below.

Table 2-9 Characteristic Comparison

Cases	Provider	Cost	Trans-mission Quality	Maintain-ability	Expand-ability	Recommend-able Order
Case 1: MW		High	Good	Good	Good	2
Case 2-1: MW + PN (Last 1 Mile: Wireless)	GP	High	Good	Good	Good	2
Case 2-2a: MW + PN (Last 1 Mile: Wireless)	BTCL	High	Good	Good	Good	
Case 2-2b: MW + PN (Last 1 Mile: FOC)		High	Good	Good	Good	
Case 3-1: PN (Last 1 Mile: Wireless)	GP	Rather High	Good	Almost Free	Excellent	1
Case 3-2a: PN (Last 1 Mile: Wireless)	BTCL	Lowest	Good	Almost Free	Excellent	
Case 3-2b: PN (Last 1 Mile: FOC)		Rather High	Good	Good	Good	

2-4-6 Recommendation and Selection of SCADA Communication Backbone System

In consideration of all respects mentioned above, the Study Team recommended Case 3-2a, BTCL's network with wireless link between GTCL's radio stations and BTCL's access points, for the communication media of the SCADA backbone system. Further, GTCL also expressed their preference to Case 3-2a after presentation of these studies by the Study Team at the end of the site surveys in Bangladesh, and issued a letter as shown in Figure 2-10 below.

JICA-033-2011
"জ্বালানী নিরাপত্তা সর্বোচ্চ অগ্রাধিকার"

গ্যাস ট্রান্সমিশন কোম্পানী লিমিটেড (জিটিসিএল)
(পেট্রোবাংলার একটি কোম্পানী)
GAS TRANSMISSION COMPANY LTD. (GTCL)
(A Company of Petrobangla)

Ref: GTCL/OPERATION/SCADA/ 216 Date: 9 -01-2011

REGISTERED
10 JAN 2011
JICA BANGLADESH

Mr Shinichi Iwamoto
Team Leader of JICA Study team
JICA Bangladesh Office
Uday Tower 7th floor, 57 & 57/A
Gulshan Avenue (South), Circle, Dhaka-1212

Subject: Selection of Communication Backbone for SCADA system under SCADA Rehabilitation and Expansion Project.

Dear Mr. Iwamoto,

With reference to the above, we would like to thank you for your extensive study on communication backbone for GTCL's SCADA system particularly the microwave option and lease line based backbone from BTCL, PGCB and GP. After reviewing your preliminary report it is found that the implementation cost of Case3-2a: (BTCL backbone+ last mile wireless) is the lowest and its maintainability is almost free. On the other hand, implementation cost of Case1: (GTCL own microwave backbone) is the highest. So on the basis of JST findings we have decided to select the Case3-2a (BTCL backbone + last mile wireless) as communication backbone for our SCADA system.

With best regards

Yours sincerely

9/1/11

(Md. Aminur Rahman)
Managing Director

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Figure 2-10

3 CONTENTS OF THE PROJECT

3-1 Basic Concept of the Project

3-1-1 Purpose of the Project

In the report "Bangladesh Gas Sector Master Plan and Strategy", the vision to 2025 has been defined as follows:

"Enabling the Gas Sector to facilitate the requisite economic growth in Bangladesh, required to meet the PRSP (Poverty Reduction Strategy Plan) and MDG (Millennium Development Goal) targets committed to by the Government, through transformation into an economically efficiently operating Sector to bring the maximum benefit to the population of Bangladesh."

In addition, a strong gas demand of 5,600 mmscfd by 2025, approximately 3 times the present demand, is forecasted in the same report. Therefore, in order to realize the above vision, a stable gas supply system, which can meet the increasing gas demand and contribute to sustainable economic growth in Bangladesh, shall be established and maintained properly.

The purpose of the Project is to improve and expand the existing gas SCADA system (the Existing System) in the GTCL gas transmission pipeline network, thereby building up an integrated SCADA-Communication system (the New System) as a component of the establishment of a stable gas supply system and secure efficient and effective gas distribution to the whole country.

3-1-2 Outline of the Project

(1) Output

1) Design, installation and commissioning of a New System, which meets International Standards and satisfies agreed user requirements. The New System shall be implemented on a turnkey basis by an Engineering, Procurement and Construction Contract (EPC Contract).
2) Personnel will be trained and able to operate, maintain, interpret information and make minor adjustments to the New System.
3) In-house capability for New System maintenance and minor modifications.

(2) Activities

The Project will be carried out in the following sequence:

1) Selection of a Consultant to assist with the tender for EPC Contract and supervise the Contractor's work

2) Selection of EPC Contractor
3) Build-up of the New System
   (a) Rehabilitation and expansion of the Existing System so that it can monitor and operate the gas supply on the entire gas pipeline grid efficiently
   (b) Interface with other SCADA systems operated by IOCs or installed by other donors.
4) Training to enhance the skills and expertise of GTCL related personnel
   (a) Training during the installation period (3 months)
   (b) Training during the Operation and Maintenance (O&M) period (12 months)
5) Establishment of an O&M system
   (a) Formulate manual and plan for O&M
   (b) Establish organization for O&M

(3) Inputs

1) Consultants
   (a) Tender assistance for selecting Contractor
   (b) Supervision of design, procurement, installation and commissioning works of Contractor
2) EPC Contractor
   (a) Design, procurement, construction/installation and commissioning of the New System
   (b) Training to enhance the skills and expertise of GTCL related personnel
3) Asset and personnel for O&M
   (a) Assignment of qualified personnel to be trained
   (b) Asset provision for sustainable maintenance and operation of the New System

3-2 Outline Design

3-2-1 Design Policy

(1) Scope of the Project

The scope of the Project will be as follows:

1) To build up an integrated SCADA-Communication system (the New System) in the GTCL gas transmission pipeline network by:
   (a) Improving the system and instruments of existing sites that are already covered by the Existing System.
   (b) Expanding the system into existing sites that are not yet covered by the Existing System.
   (c) Expanding the system into upcoming sites such as those under construction or being planned.
   (d) Enabling connections to other SCADA systems operated by IOCs or installed by other donors.
2) To assist GTCL with the establishment of a sustainable O&M system by:
   (a) Training on skills and expertise for GTCL related personnel for smooth commencement of the New System and its sustainable O&M
   (b) Preparing the manual and schedule for O&M.

(2) Pipeline Operational Philosophy

Based on the following pipeline operational philosophy, the New System shall be designed.

1) GTCL will receive requests or nominations from distribution companies for the supply of gas at designated Sites on a periodical basis.
2) GTCL will also establish the levels of gas to be provided into the pipelines covered by the Project, by production companies on a regular basis.
3) GTCL will plan for the transmission of the gas through the pipelines covered by the Project in accordance with the demand as put forward by distribution companies under their contract with the production companies.
4) GTCL will be responsible for the O&M of the pipelines and plants forming the National Gas Grid and for planning such activities in accordance with the contracts established between the Operating Companies and IOCs or other utilities.
5) GTCL will affect the control of Ashuganj Metering Station and/or Ashuganj compressor station to control the flow of gas from the N-S Pipeline and R-A pipeline into the Ashuganj-Elenga, A-B Pipelines, B-B and VS3 pipelines.
6) It has been agreed that, whilst the ownership of the outlet valves from gas fields lies

with the respective gas field, their operation will be controlled by the gas field operator under direction from GTCL. This will prevent unnecessary and potentially dangerous conflict within the gas field plant operation.

7) Except where the ownership of the site lies with GTCL, inlet and outlet valves to Gas Metering and Regulating (M&R) Stations and bulk consumers will be operated by the distribution and marketing Operating Companies under direction from GTCL.
8) The GTCL will provide figures for the quantity of gas flowing into and out of the pipelines covered by the Project to Petrobangla and the other Operating Companies to support billing and payment for gas and other financial systems such as periodic accounts or planning.

(3) Sites to be Covered

In order to build up the integrated SCADA-Communication system, the Project covers several classifications of sites as follows:

Table 3-1

Site	Number
Control Centre (MCC, ACC)	2
Master Telemetry Station	20
Existing RTU to be replaced	58
New RTU to be supplied & installed	23
New RTU to be supplied for future site	7
Operation Company Terminal	7

The general locations of sites are presented in Appendix-1 Site Location Map. Also, the detailed classification of each site to be included within the Project is indicated in Appendix-2 Site List.

(4) System Architecture

The New System shall consist of a SCADA system and a communication s system to support their operations including but not limited to the following:

1) Monitoring of gas parameters at specified sites.
2) Control of gas flow either remotely or through instructions to third parties via written, verbal or electronically communicated means.
3) Planning the strategic use of gas in accordance with the agreed production and consumption contracts.
4) Fault identification and diagnosis on the pipeline network covered by the Project and within the system itself.

5) Maintenance scheduling.
6) Field crew dispatch.
7) Transfer of reports within the Petrobangla group of companies.

(5) Functional Requirements for the New System

The New System shall meet the following functional requirements:

1) To support the centralized control and operation of the pipelines covered by the Project.
2) To support management of the country's gas resources and security of supply to consumers.
3) To improve the safety of operation of the pipelines covered by the Project.
4) To enhance the skills and expertise of GTCL personnel.
5) To support the future expansion of the pipeline network.

(6) Communication Backbone

As described in Sub-section 2-4 in this report, the communications service provided by Bangladesh Telecommunications Company Limited (BTCL) will be used (leased) as the communication backbone of the New System.

(7) Replacement and Reuse of Equipment Used for the Existing System

After surveying the existing sites, various discussions were had between the JICA Study Team and GTCL, and it was confirmed that all main components of the Existing System such as servers, workstations, RTUs, communication equipment, etc., except field instruments, are to be replaced with new one. The existing field instruments, including field cabling, junction boxes, and power supply cabling to RTU will be reused.

(8) Equipment for the New System

1) Field-proven and robust equipment

While there is no policy requiring the equipment of the New SCADA and the New Communication System to be designed using state of the art technology, the equipment should have a proven track record in this field and should be able to withstand the toughest environmental conditions of Bangladesh.

2) Expandability for future extension

The New System will support scalable architecture for future expansion.

In terms of spare capacity, the equipment provided under the Project will retain 25% of the installed capacity as spare capacity for future requirements.

3) Low power consumption

Employing low power consumption equipment for the New System, which can downsize the back up battery, will reduce the initial installation cost and save on

operation costs.

4) Easy O&M
All equipment shall be designed for easy operation, maintenance and management.

5) Support IP/Ethernet interface
The New System shall support an IP/Ethernet interface to reduce initial installation cost and maintenance costs.

6) Environmental requirements
Equipment shall operate in a wide variety of different locations and shall therefore be subjected to different environmental conditions.
The equipment installed outdoors shall not be dependant upon the availability of heating, ventilation and air conditioning systems and shall function in all respects without degradation of facilities or accuracy over the specified temperature and humidity ranges.

7) Backup electrical system
In order to maintain the continuous operation of the New System, a stable/uninterruptible electric power supply to related equipment is essential. A backup battery for RTU and UPS (Uninterruptible Power Supply) for MCC & ACC shall be newly equipped in the Project to supply electrical power in the event of power failure.

(9) Utilization of Existing Associated Facilities
During site investigation, it was found that existing associated facilities, such as a communication tower, equipment room and foundation/sunshade for field equipment, are still in usable condition. Therefore, these existing facilities shall be refurbished if necessary, and used for the New SCADA and Communication System.

3-2-2 Basic Plan

As a result of studies and discussions with GTCL for the rehabilitation and expansion of the Existing System, the basic design requirements and major equipment for the New System has been designed as follows. The Figure 3.1 shows the schematic system outline.

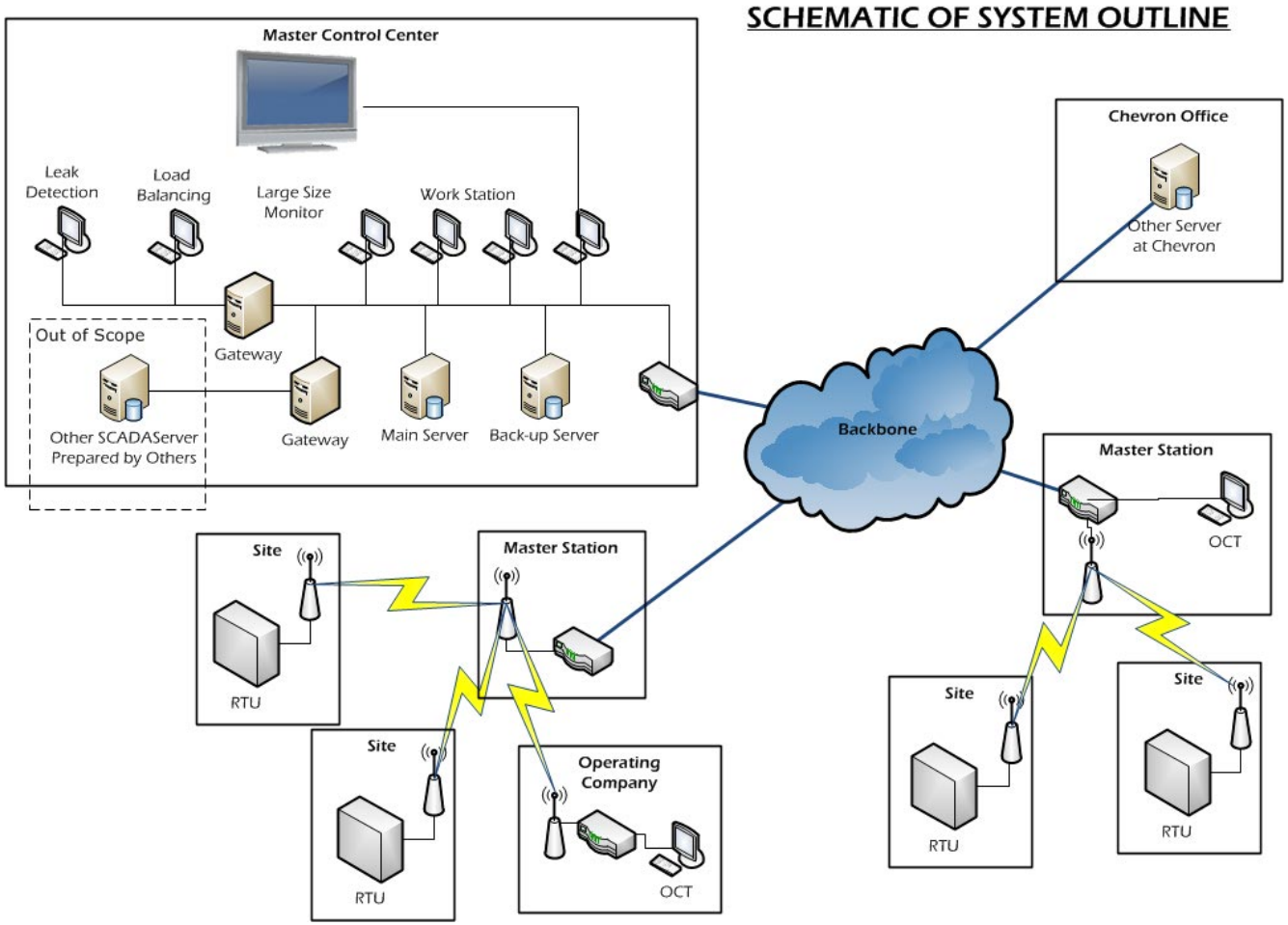


Figure 3-1 Schematic System Outline

(1) SCADA System

1) MCC and ACC

The SCADA System will be designed to meet the following functional requirements:

(a) Event and alarm reporting
(b) Operational monitoring
(c) Data collection and storage
(d) Operational control
(e) Interchangeable data with other systems such as Chevron's SCADA system and other SCADA servers provided by others in the future. For this purpose, the New SCADA System will have an Ethernet interface.
(f) Disclosure of operation data to nine (9) operating companies
(g) System management capability including system security and access control, system time adjustment.
(h) Pipeline operation application software for "Leak detection" and "Load Balancing and Scheduling".

Both MCC and ACC will be provided with following equipment as a minimum:

(a) SCADA Server : 2 (one for main and one for backup)
(b) HMI work station : 4 (one work station will be used as engineering work station)
(c) Color printer : 1
(d) Monochrome printer : 1
(e) Large screen monitor (bigger than 50 inches) : 1

The software for servers of the New SCADA System provided at MCC and ACC will be designed based on OLE (Object, Linking & Embedding) for Process Control (OPC) servers and Open Database Connectivity (ODPC).

By using the above software, the SCADA Server will be able to communicate with SCADA systems supplied by other projects.

An OPC Server is a software application that acts as an API (Application Programming Interface) or protocol converter. An OPC Server will connect to a device such as a PLC, DCS, RTU, or a data source such as a database or user interface, and translate the data into a standard-based OPC format.

2) Operating Company Terminal (OCT)

Operation data that are monitored at the MCC can be monitored at the site of the following operating companies:

Code	Site
20-CML-100T	Comilla Head Office
10-ASH-204T	BGFCL Head Office
10-HOR-300T	Horipur Head Office
30-PBG-500T	TITAS Head Office
10-JAL-600T	Jalalabad Head Office
30-PBG-700T	Petrobangla Head Office
20-FAU-701T	Sanghu Onshore Process Plant
20-FAU-702T	KGDCL Head Office
30-PBG-701T	Chevron Head Offive

To monitor the operation data the following equipment will be provided at the operation company at a minimum:

(a) HMI : 1
(b) Color printer : 1
(c) UPS for the above equipment : 1
(30-minute power supply during power failure)

3) GTCL New Head Office

The following equipment will be designed for the new head office under planning

(a) HMI workstation : 2
(b) Engineering workstation : 1

4) RTU

Major components of the New RTU are its own processor, memory, communication processor, I/O module, power supply module, TCP/IP ports, slave telemeter radio and a 24-hour backup battery.

(a) New RTU for Original Site

All Existing RTUs that are currently installed at the Original Sites will be replaced with New RTUs. At the Original Sites, the complete RTU set, including the battery, will be replaced with New RTUs. However, other related existing equipment/facilities, such as the junction box, the primary power supply for RTU (single phase AC 230), and field instruments are to be reused.

(b) New RTU for Additional Site

Currently no RTU is installed at the Additional Site. A New RTU, junction box, primary power supply for RTU and instruments including cabling will be installed at the Additional Site.

(c) New RTU for Future Sites

GTCL is now planning to construct seven (7) sites for transmission of natural gas. These planned sites may not be finished by the completion of this Project. Therefore, the New RTUs will be designed based on respective site requirements and supplied to GTCL.

The New RTUs will be installed by GTCL after completion of the Future Sites.

(d) New RTU with Display Monitor

The New RTUs installed at the following sites will be equipped with display monitors to indicate process data of the respective sites:

Site Code	Name of Site
10-ASH-400	Ashuganj
20-BKB-101	Kutombopur
20-FAU-100	Faujdarhat
20-MIR-401	Barakubundu TBS
30-PBG-401	CGS Aminbazar (out)
30-PBG-402	CGS Ashulia (out)
40-ELE-500	Elenga
40-MHD-500	Monohordi

(e) New RTUs Without Slave Radio Telemeter

Most of the New RTUs are to be provided with a slave radio telemeter; however, where the New RTUs are co-located with Master Telemetry Station, no slave radio telemeter is required. The signal from/to the RTU will be transferred via Local Area Network (LAN).

The applicable sites are as follows:

Site Code	Name of Site
10-ASH-400	Ashuganj
10-HOB-200	Hobigonj Gas Field
10-RAS-300	Rashidpur Gas Field
10-FCH-600	Fenchugonj 90 MW PS
10-KAI-400	Kailashtilla GTCL Compound
10-HOR-300	Horipur Gas Field
20-BKB-100	Bakhrabad

20-FEN-100	Feni TBS
20-FAU-100	Faujdarhat
30-DMR-100	Demra CGS
40-MHD-500	Monohordi
40-ELE-500	Elenga
40-TRK-500	Tarakandi (JFCL RMS)

5) Junction Box for the Additional Site

A junction box (J.B) will be provided on an instrument stand installed at the site. Cables from field instruments will be connected to the junction box. All connections to the field instruments will be made on terminal blocks in the J.B. The type of enclosure used for the J.B will be intrinsically safe because the J.B will be installed at the gas field.

6) Instrumentation

Instrumentation will be installed for all the Additional Sites and for some of the Existing Sites that have extended streams with no instrumentation.

The applicable sites and the type and quantity of the instrumentation are shown in the Appendix-1 RTU list.

The type of instrumentation will be:

- Pressure Transmitter (PT)
- Temperature Transmitter (TT)
- Differential Transmitter (PdT)
- Limit switch for valve status monitoring

7) Expandability

The SCADA system will be designed to support a scalable architecture for future expansions and shall have an expansion capability upto 200 RTUs without installing additional servers or software. In addition, the SCADA system allows communications with a wide variety of control devices utilizing off the shelf driver packages.

8) Data Polling

Polling interval will be 15 minutes per all RTU scanning as a minimum interval.

(2) Communication System

The communication System will be composed of the following network, links and other sub-systems:

i) Provider's Network (BTCL's network is supposed)
ii) Wireless Link between Master Telemetry Station (MTS) and Access Points (AP)
iii) Telemetry Radio Link
iv) IP PBX
v) Network Monitoring System

The requirements for the equipment to establish these networks, links and other sub-systems are described below.

1) Provider's Network

In accordance with Chapter 2-4, the provider's network shall be leased and used for the main trunk line of the SCADA backbone. The structure and requirements for the provider's network shall be as follows.

i) An E1 circuit (minimum 2 Mb/s) between each MTS and MCC/ACC shall be adopted, and 4 E1 circuits between MCC and ACC are required.
ii) The network structure between each MTS and MCC/ACC shall be a radial connection to minimize the influence from local link interruption on the entire system. The configuration of the network is shown in Figure 3-2.

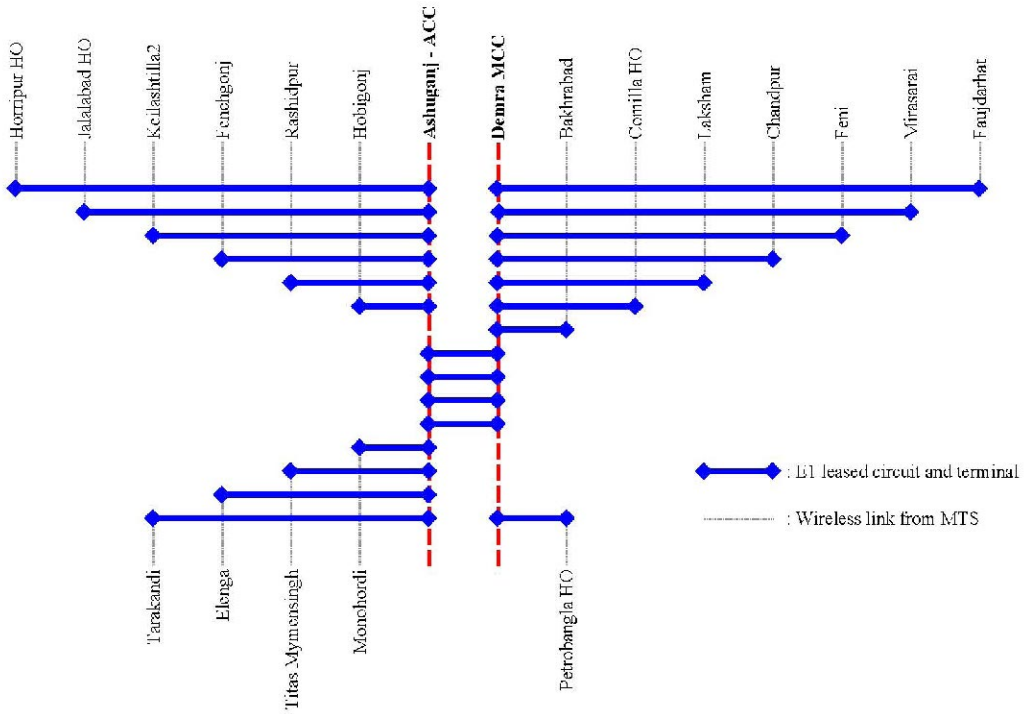


Figure 3-2

2) Wireless Link Between MTS and AP

i) IP radio equipment

IP radio equipment shall be used to establish a wireless link between MTS and the provider's AP as well as for the link between MTS and OCT located apart from MTS. It will be also used to form a part of the SCADA backbone. The principal requirements for IP radio equipment shall be as follows:

a) Frequency band: 2.4 or 5.2GHz non-licensed band
b) 1+1 standby protection for both end equipment
c) Transmission capacity: 11 Mb/s minimum
d) Radio equipment shall have security measures such as encryption of the signal since a non-licensed frequency band shall be used.
e) The antenna shall be suitably selected to receive power that may vary according to the link distance.

ii) Networking Equipment

Since the signal format of provider's network shall be E1, a signal converter (IP/Ethernet ←→ E1) shall be installed at each AP. Plural leased E1 lines shall be connected to the SCADA network at AP for MCC/ACC. Therefore the signal converters installed at AP for MCC/ACC shall have ports corresponding to the numbers of leased E1 lines.

Typical connection diagrams for a wireless link between MTS and AP are shown in Figure 3-3 below.

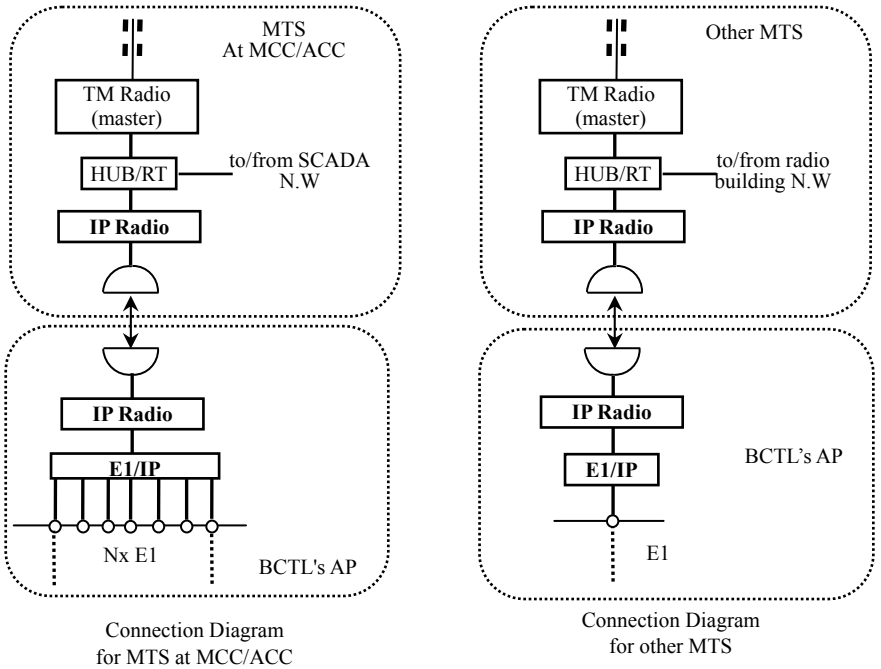


Figure 3-3

3) Telemetry Radio Link between MTS and New RTU

New telemetry radio equipment shall be used to establish the wireless link between MTS and the New RTU. The principal requirements for new telemetry radio equipment shall be as follows:

(a) Frequency band : 382-392MHz
(b) Protection : 1+1 standby for master telemetry equipment
: No standby for slave telemetry equipment
(c) Interface : IP/Ethernet
(d) Output Power : To be decided after radio path calculation
(e) Antenna type : Omni-directional or Corner reflector
: Directional antenna
(f) Antenna height : To be decided after radio path calculation

The structure of a Telemetry Radio Link is shown in Figure 3-4 below.

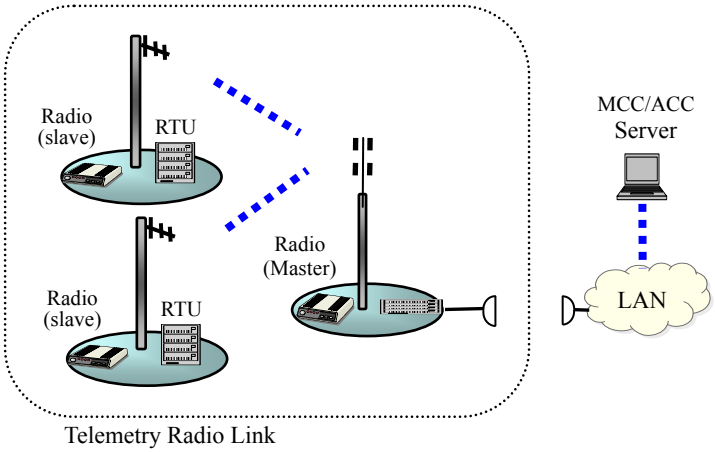


Figure 3-4

4) IP PBX

A New IP PBX system shall be applied over the network to provide a direct internal liaison. It is recommended that the New IP PBX be installed at ACC, because MCC shall be moved into GTCL's new head office which is currently being planned and will be constructed in the future.

Requirements for the IP PBX system shall be as follows:

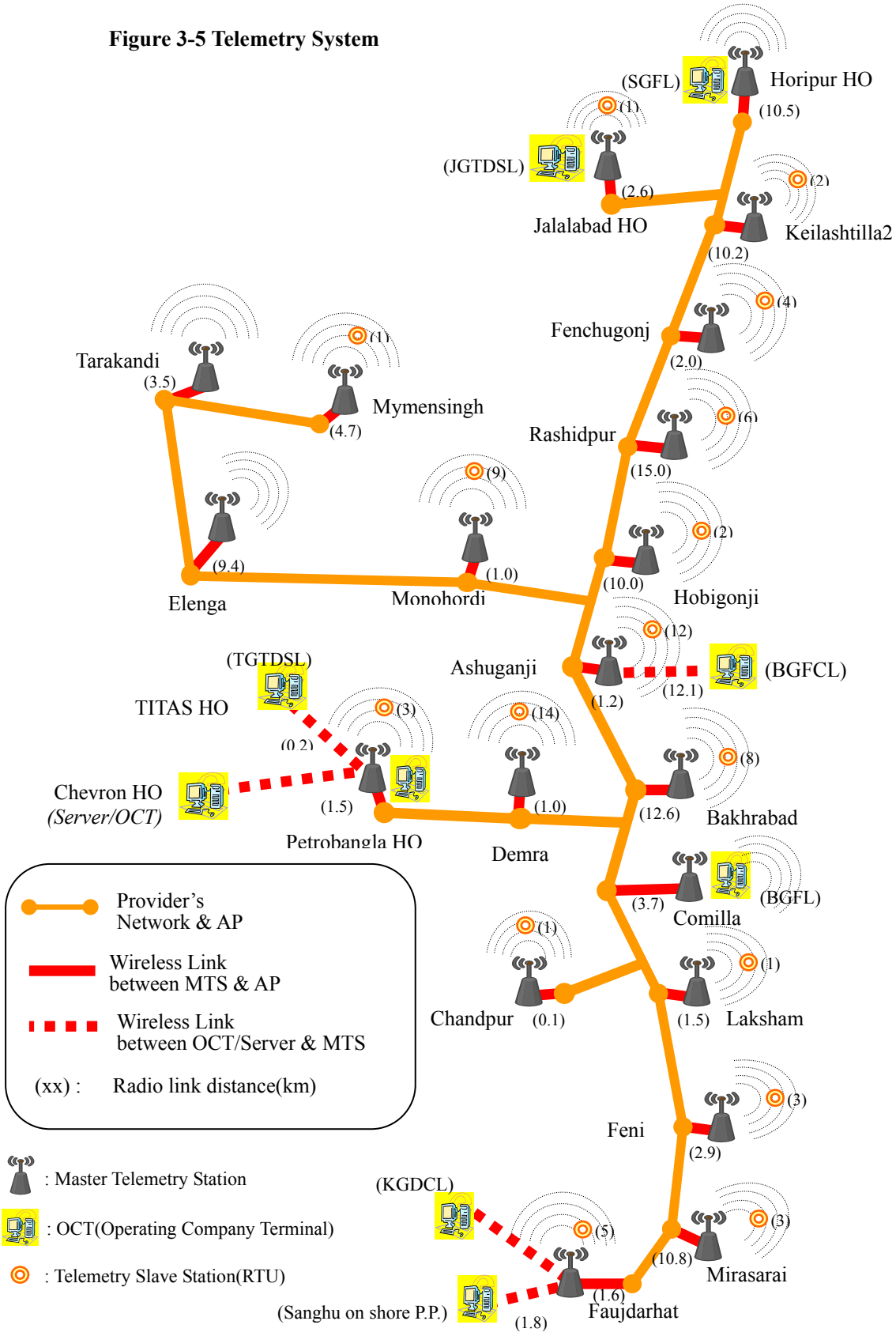
(a) Trunk line provision : PBX to PBX through digital line
(b) Connection to PSTN : 6 lines (analogue or digital line)
(c) Extension lines : Max. 200 lines
(d) Operation over VoIP extension line

5) Networking Monitoring System (NMS)

An NMS shall be installed at MCC and ACC for the maintenance purposes. It shall monitor the conditions of equipment connected with the SCADA backbone network. The NMS shall be composed of an NMS server, NMS software and monitoring equipment.

A diagram of the entire communication system mentioned above is shown in Figure 3-5.

Figure 3-5 Telemetry System



(3) Associated Facilities with Electrical Services

1) Associated Facilities

(a) System Management Room

The existing system management rooms at both MCC and ACC shall be refurbished and used for the installation of the new SCADA equipment.

(b) Equipment Room

Existing equipment rooms such as radio equipment rooms and battery rooms shall be refurbished and used for the installation of new communication equipment at each Telemetry Master Station.

(c) Foundation and Sunshade for Field Equipment

i) The existing foundation and sunshade for the Existing RTU at Original Sites shall be refurbished if necessary, and used for the installation of the New RTU.

ii) The existing foundation and sunshade for the existing Instrument Stand at Original Sites shall be refurbished if necessary for continuous use.

iii) New foundations and sunshades for New RTUs and new Instrument Stands shall be suitably designed and constructed according to the requirements at Original/Additional Sites.

2) Electrical Services

(a) Power supply

i) MCC and ACC

The following new UPS will be planed at MCC and ACC respectively to provide backup power supply in the event of a failure of the incoming AC power.

- 15kVA with 8 hours back up for System Equipment
- 15kVA with 4 hours back up for emergency lighting

ii) RTUs

- Power supply to the New RTUs at the Original Site where AC power exists

  At present, the Existing RTUs are connected to an AC power feeder (Single Phase 230 V), which is connected to the existing distribution board in a building. The New RTUs will be connected to this existing feeder.

- Power supply to the New RTUs at the Original Site where AC power is not available

  Currently, there is no AC power supply at the smaller Original Site and solar panels have been installed to feed electric power to the Existing RTU. The existing solar panels, cabling from the solar panels to the New RTU, and the solar controller will be replaced with new one. The solar controller will be equipped with all of the necessary protection and charging equipment

- Power supply to the New RTUs at the Additional Site where AC power exists

  One Molded Case Circuit Breaker (MCB) Box will be installed adjacent to the existing distribution panel (DP) which is installed in a building at the Additional Site. Cabling from the existing DP to the MCB Box, and from the MCB Box to the New RTU will be installed.

- Power supply to the New RTUs at the Additional Site where AC power is not available

  Solar panels will be installed on the roof of the RTU shed. A solar controller and cabling from the solar panel to the New RTU will be installed. The solar controller will be equipped with all of the necessary protection and charging equipment.

(b) Equipment

i) Battery for backup

- Battery backup for RTU

  The New RTU has battery backup and the batteries will be sized depending on the power consumption of the individual RTUs. With an output voltage of DC 24 V, the batteries have the capacity to supply emergency power for a period of 24 hours in case of AC failure.

- Battery backup for Communication System

  A battery backup system will be provided at the Master Telemetry Station and the batteries will be sized based on the power consumption of all related communication system equipment. With an output voltage of DC 48 V, the batteries have the capacity to supply emergency power for a period of 48 hours in case of main AC power failure.

ii) Uninterruptible Power Supply (UPS)

The UPS will be able to supply stabilized, transient free AC power in case of main AC power failure. The output will be single phase, 50 Hz, 230V, and the UPS will be comprised of the following major apparatus:

- Battery charger
- Static convertor
- Static by-pass switch
- Batteries

iii) Emergency Generator

A standby diesel generator that is dedicated to the communication system will be installed at the following telemeter base stations:

- Monohordi
- Elenga
- Mirasarai
- Feni
- Laksham
- Chandpur

The generator will have a manual start/stop, 3 phase 4 wire, 400/230 V and an output capacity of 15 kVA.

iv) Portable Type Generator for maintenance

A portable generator will be provided for maintenance of the battery for the RTUs located where AC power is not available. The generator will be a single phase 230 V and the output capacity will be 1 kVA.

7 sets of generators will be provided and will be kept at the Master Telemetry Station.

3-2-3 Implementation Plan

3-2-3-1 Implementation Policy

1) Local transporters

The Project will cover many Sites throughout Bangladesh. The inland transportation route is still not well developed; therefore, the employment of a local transportation firm, who is familiar with the actual situation, is recommended in order to achieve smooth and effective transportation of the equipment and material.

2) Installation works

Local installation firms do not have sufficient experience in installing the equipment of the SCADA system or the communication system for the Project. The employment of an internationally recognized firm will be required.

3-2-3-2 Implementation Conditions

1) Equipment for the Future Sites

The equipment for the Future Sites (7) will be installed by GTCL after completion of the Project and shall only be delivered to places designated by GTCL.

2) Planning of the implementation schedule

Bangladesh has three seasons, winter (between November and February, which is dry and cool), the pre-monsoon season (between March and May, which exhibits increasing temperatures and rainfall with periodic thunderstorms), and the monsoon season (from June to October, which is hot and humid and in which more than 80% of the annual rainfall occurs). Accordingly, the implementation schedule shall be prepared considering the above climate conditions.

3) Safety measures

The Contractor shall adhere strictly to the requirements of the safe working practices of the Employer, details of which will be provided in writing to the Employer and the Engineer at the time of requisition.

The Contractor shall ensure that procedures for the control of health and safety are in place during the execution of the works.

3-2-3-3 Scope of Works

For the implementation of the Project, the responsibility between the Contractor and GTCL (Employer) will be demarcated as defined in Table 3-2.

Table 3-2 Scope of Works

No.	Description of Works	Contractor	GTCL
1.	Land acquisition excluding the temporary construction space		X
2.	To clear, level and reclaim the site, if required	X	
3.	To construct temporary gates and fences in and around the site if required To provide all necessary temporary material, equipment and buildings such as office, warehouse and storage for the implementation of the Project To provide the installation/construction space as necessary	X	
4.	Any addition, deletion, removal, change, restoration, or the like, required for the Project, to any part of existing buildings, structures, foundations, utility services, mechanical and electrical facilities including but not limited to the following:		
	- Removal/restoration of doors or enlargement of openings for carrying new systems and associated equipment into their final locations	X	
	- Provision/restoration/finishing of openings for equipment installation	X	
	- Provision/extension of cable ducts and trays with covers, if required	X	
	- Cleaning and refurbishment of related rooms and buildings	X	
	- To provide the power supply with its cabling for the new RTU and equipment/systems	X	
	- To provide additionally required thermo-wells		X
	- To check and repair/replace transmitters, limit switches and/or supply power at existing RTU sites and other related sites		X
	- To check the relevant points situation with respect to the gas flow measuring capability		X
	- To provide the desks, chairs, benches and other furniture required for installation of new equipment/systems		X
5.	Removal/demolishing of any equipment or material that becomes unnecessary due to the implementation of the Project	X	
7.	Service/lease agreement with the BTCL		X
8.	Procurement (including packing, shipping, transportation, loading/unloading) of materials, equipment and systems	X	
9.	Installation/construction of materials, equipment and systems, and all related tests and inspections required Adjustment/calibration and testing of the test equipment required	X	
10.	Recommendation/supply of spare parts for the equipment and systems	X	
11.	VAT and Import Tax for the Project	X	

3-2-3-4 Consulting Services

(1) Objectives of Consulting Services

The Objectives of Consulting Services are:

(a) Smooth implementation of the tender to select an EPC Contractor for the Project

(b) Smooth implementation of the EPC Contract for the Project.

(2) Scope of Services

In executing the Services, the Consultant shall follow the relevant procedures of the GOB and JICA. The Consultant shall assist GTCL in all aspects of services including the correspondence and necessary measures for the schedule, planning, design, operation and services required for execution of the Project. The scope of the consulting services consists of the following works:

1) EPC Contract Tendering Assistance Stage

(a) Assist the preparation of tender documents

(b) Assist the tendering arrangements

(c) Assist the evaluation and assessment of the submitted tenders

(d) Assist the contract negotiations with the selected tender

2) EPC Contract Management Assistance Stage

(a) Setting-out of the works for construction

(b) Preparation of updated implementation and financial schedules periodically

(c) Coordination of periodic meetings including safety meetings

(d) Review of the Contractor's drawing and documents

(e) Quantity and quality control of the construction works

(f) Monitoring and control of construction progress and schedule

(g) Inspection and measurements of progress of payments for the works

(h) Preparing required reports and certificates

- Construction progress reports and monitoring reports
- Project completion report

(i) Settling of disputes or differences

(j) Periodical monitoring and inspection for defects during the liability period

3-2-3-5 Quality Control Plan

To achieve the required level of quality assurance, the Contractor shall produce and work to a achieve a functional and documented Quality Management System formulated to satisfy the requirements of ISO 9001 and covering all aspects of the work required under the Contract.

(1) Quality Plan

A Project Quality Plan will be submitted for the Employer's approval. The Plan shall encompass all elements of the extent of supply and shall include, but not be limited to, the design, production, installation and commissioning of both hardware and software.

(2) Quality Audits

The Employer and the Engineer may at any stage of the Contract verify the correct application of the Contractor's quality system by the application of Quality Audits e.g. during build and upon completion of the manufacture of major items of equipment and upon completion of major integration builds of software.

(3) Quality Records

In order to be able to verify control over the quality of all works during design and manufacture, the Contractor shall maintain quality records covering all items of design, equipment or software.

(4) Designs

1) All designs shall be reviewed, verified and validated by the Contractor and/or Sub-contractors.
2) Designs are subject to review by the Engineer to check the design against specifications and what has been agreed on. Provision of quality and safety plans must be made by the Contractor for such activities.

3-2-3-6 Procurement Plan

(1) Procurement Sources

The main materials/equipment/systems procured for this project are categorized as follows:

i) SCADA System
ii) Communication System
iii) Locally available products/materials such as cement, aggregates, reinforcing bars and lumber for installation and temporary works.

For the above listed materials/equipment/systems, as the equipment/systems itemized in

i) to ii) are not available in Bangladesh, these will be procured from overseas markets. The materials itemized in iii) will be economically procured in Bangladesh.

Accordingly, for the procurement of the SCADA System and the Communication System, due considerations, including an economic comparison study, shall be made on the reliability of equipment/systems, manufacturing period, and the convenience of GTCL concerning repair/maintenance service.

In addition, for the procurement of the computer system and its peripherals like printers, monitors, etc., it is essential that the suppliers have a local agent or can offer service in Bangladesh, in consideration of easy after-care service and maintenance and easy supply of spare/replacement parts.

(2) Spare Parts

During the warranty period, the Contractor shall provide all spare parts and consumables required for the support of the System appropriate to maintaining the specified ava1iability. These spare parts shall be stored on the Employer's premises, and at the end of the Contract period, all spare parts that have been used shall be replaced.

(3) Procurement Plan

In accordance with the specifications, the Contractor shall design, manufacture, paint, test in the factory, pack, transport and install, perform site tests and then hand-over materials/equipment/systems to GTCL. Furthermore, the Contractor shall consult with the relevant authorities and prepare documents necessary for obtaining permission such as for transportation, installation and temporary power for the installation work, when necessary. The Contractor shall conduct a site investigation to confirm the actual conditions of all Sites prior to preparation of the detailed design and installation plan.

3-2-3-7 Implementation Schedule

As a result of site surveys and subsequent studies, an implementation schedule for the Project has been prepared on a basis of following assumptions and is shown in Table 3-3.

i) The implementation of the Project will be financed from the proceeds of JICA Loan.
   - Therefore, the JICA guidelines shall be used for the employment of consultant(s) and the procurement of goods and services under the Loan.
   - And, review and/or concurrence procedures required by JICA shall be taken.
   - The Loan Agreement will be made between GOB and GOJ in January 2012.

ii) All necessary approvals from GTCL and review and/or concurrence procedures by JICA will be applied in a timely manner and obtained without any delay.

It is estimated that the implementation of the Project shall extend over three years from

2012 to 2014 excluding the warranty period, and yearly major activities are broken down as follows:

2012: 1) Selection of consultant for EPC tender assistance & EPC S/V
2) Tender document preparation and its approval by GOB & JICA
3) Tender proposal submission by Bidders

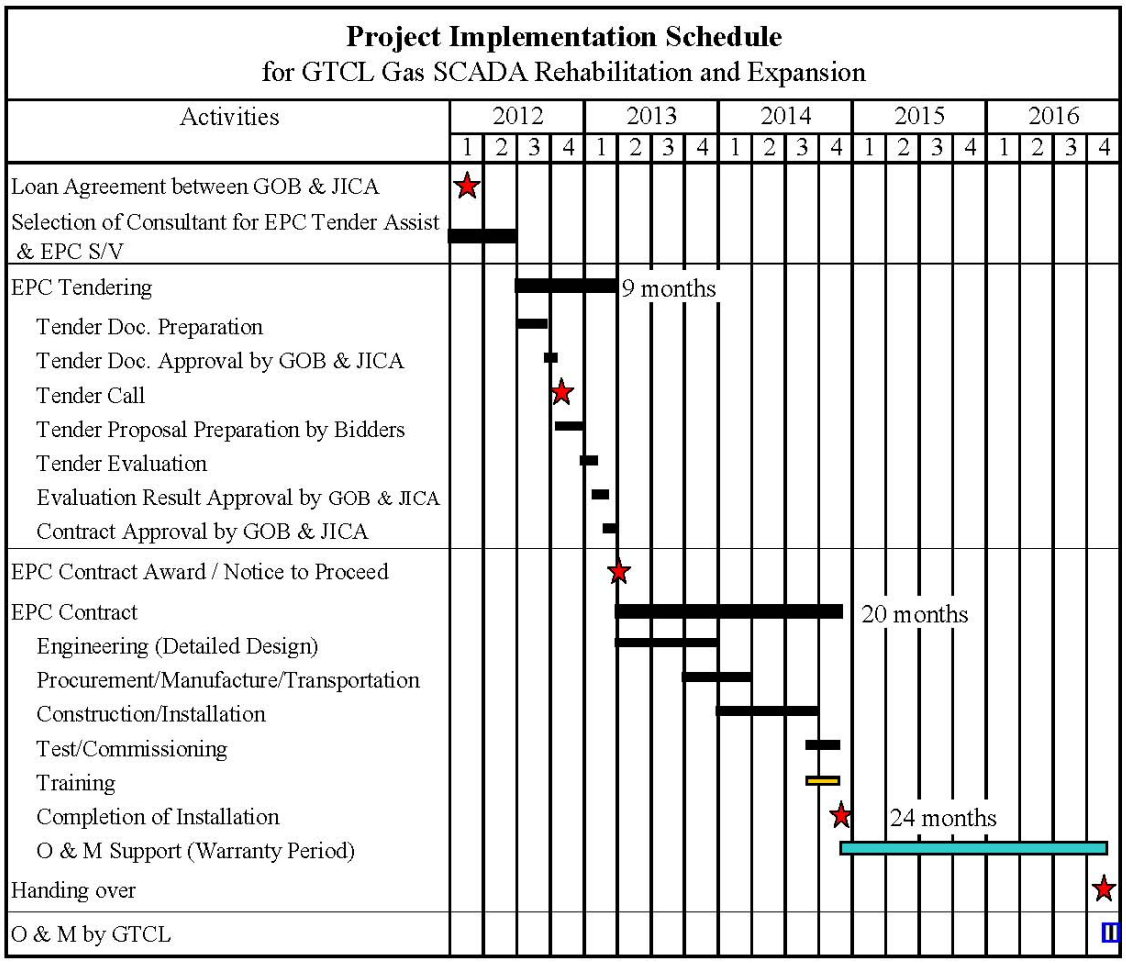
2013: 1) Tender proposal evaluation and EPC Contract award
2) Engineering (detailed design)
3) Procurement of equipment

2014: 1) Equipment construction & installation
2) Test & commissioning
3) Training

2015: Warranty Period / O&M Support

2016: Handing over

Table 3-3 Project Implementation Schedule



3-3 Undertakings by Bangladesh

For smooth implementation of the Project, GTCL shall be responsible to undertake the following items as mentioned in Sub Clause 3-2-4-3 of the "Scope of Works".

(1) Responsibilities by GTCL

1) Procedures for lands

In this Project, procured equipment and materials will be installed at the Sites owned by GTCL or other companies who belong to the gas sector and have gas business with GTCL. Therefore, necessary land-use permissions shall been obtained by GTCL so that the Contractor can start their work without any delay.

2) Communication system lease contract between GTCL and BTCL

GTCL has decided to select the communication system provided by BTCL as the communication backbone for the GTCL SCADA system. Accordingly, the lease contract between GTCL and BTCL shall be made prior to the start of the equipment installation work.

(2) Works by GTCL

1) Thermo-wells additionally required for the New System shall be installed by GTCL prior to the issuance of "Notice To Proceed".
2) The soundness of all transmitters, limit switches and/or supply power including related cables and junction boxes at existing RTU sites and other related sites shall be checked and repaired/replaced by GTCL as necessary prior to the issuance of "Notice To Proceed".
3) For the detection of a gas leakage from the pipelines covered by the Project, the precise measurement of gas flow at whole intake and offtake points shall be indispensable. Therefore, the current situation of the relevant points with respect to the gas flow measuring capability shall be checked by GTCL and necessary countermeasures shall be taken prior to the commencement of the Project.
4) The following information shall be provided by GTCL as a part of the tender document for the EPC Contract:
   (a) Detailed information, such as the type and exact location of whole intake and offtake points, valve stations, metering stations, etc., on GTCL and other related gas pipeline networks
   (b) Layout and P&ID drawings of sites to be covered by the New System.

3-4 Project Operation and Maintenance Plan

After the completion of the Project, the O&M for the New System will be planned and conducted by the SCADA/Telecom Team of the GTCL Operation Division in cooperation with the Regional Operation Team as shown in Figure 3-6 below.

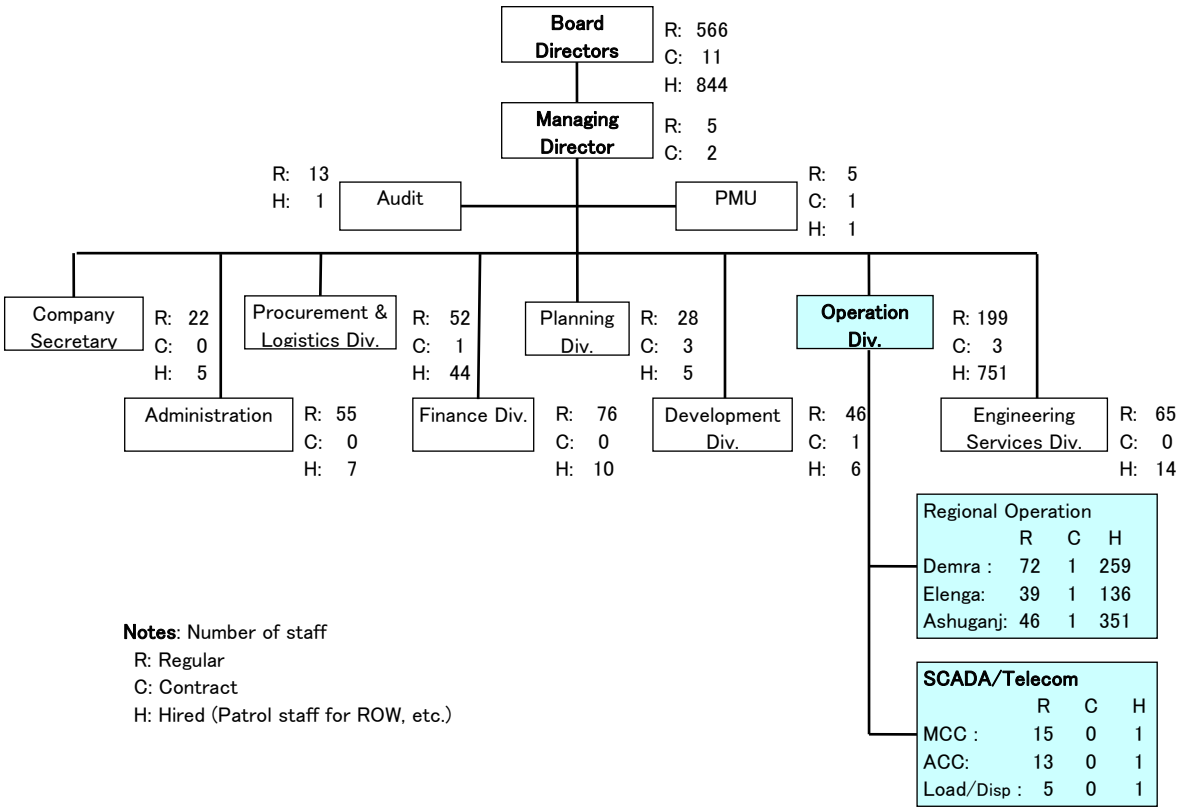


Figure 3-6 GTCL Organization Chart (in 2006)

(1) Establishment of Operation and Maintenance System

In consideration of the current status and problems with the O&M for the Existing System, the following measures shall be examined in GTCL and carried out to establish a secure O&M system.

1) Study on O&M manual to be submitted by the Contractor
2) Formulation of O&M schedule (plan) defining the following, and the necessity of support outsourcing for these items shall be examined.
   (a) Routine operation procedure
   (b) Routine maintenance schedule (for the system lifetime)
   (c) Emergency support

(d) Manning schedule
(e) Spare parts procurement and storing schedule
(f) Education and training for staff

3) Formulation of the O&M organization
4) Implementation of O&M in accordance with the schedule of Item-2 above
5) Review of the schedule of Item-2 above if necessary

(2) Education and training

For smooth commencement of the O&M of the New System, the training for the related staff on the installation, operation management and maintenance of the System shall be required to start as early as possible prior to the completion of the System installation. Also, after the completion of the System installation (during the liability period), the training for the related staff by the Contractor on an OJT basis will be necessary to enable effective repair and maintenance of the hardware as well as the software of the System. Details of the required training are mentioned in the technical specifications.

(3) Maintenance support contract

To cope with the additional coverage of New RTU sites for the pipeline to be expanded, connections with the other SCADA systems, etc., the modification/maintenance works for the software of SCADA system will be required in the future. Therefore, GTCL is recommended to study the necessity of a long-term maintenance support contract with the supplier of the New System or another service provider.

3-5 Project Cost Estimation

3.5.1 Conditions and Assumptions

The cost estimate has been worked out under the following conditions and assumptions.

Construction:

(1) The EPC work is to start from early 2013 and complete in the year 2014.

(2) The EPC work will be conducted to meet the proposed implementation schedule.

(3) Annual workable days are assumed to be 275 days deducting Friday, National holiday and suspended days due to rainfall.

(4) Required utilities for the Project and its development scheme are tabulated as follows:

Table 3-4

Engineering, Procurement and Construction Cost		
No.	Cost Item	Development Scheme
1	SCADA system	1) MCC and ACC 2) Operating Company Terminal (OCT) 3) RTU 4) Junction Box for the Additional Site 5) Instrumentation
2	Communication system	1) Backbone consists of provider's network and IP radio link. 2) Telemetry radio link 3) IP PBX system 4) Network monitoring system
3	Associated Facilities	1) Public power supply, Battery for backup and emergency generator 2) Building and Civil Work /01. Radio Building finishing touch up works /02. MCC/ACC Int.finishing touch up works /03. Mirasarai Radio Building construction works (as a maximum cost of defect repair) /04. RTU/Instrument Stand Foundation and Sunshade works

Costing:

(5) An international competitive bid is assumed.

(6) Cost Composition

The project cost and construction cost were reviewed under the following arrangement of cost components.

Table 3-5 Project Cost Component

No.	Project Cost Item
I	Engineering, procurement and construction
I-1	Equipment (SCADA, Communication)
I-2	Associated facilities
I-3	EPC management
I-4	EPC O/H, profit, etc.
I-5	Price escalation
I-6	Physical contingency
II	Consultant services
III	O&M support
IV	Administration expenses
V	Tax and duty

(7) Price level of the cost estimate is December 2010.

(8) Exchange Rates applying US$ 1.0 = JPY 86.6 = BTK69.78 BTK 1.0=JPY1.24

(9) Price Escalation Rate for Local Portion is 14.2% based on Inflation, average consumer prices International Monetary Fund, World Economic Outlook Database, October 2010

(10) Physical Contingency Rate is 5 %.

(11) Procedure of Project Cost Estimation

1) Estimate of Base Cost
2) Estimated Base Cost x Price Escalation Rate
3) ((1)+(2))x Physical Contingency Rate
4) Total Cost = (I) + (2) + (3)

Note: Price escalation and physical contingency of consulting services shall be included in the cost of consulting service. Tax and Administration cost shall be calculated according to (13) below.

(12) Administration cost is, in principle, 5% of the total project cost.

(13) Taxes and duties is determined as follows:

1) VAT

15% of all Project cost including those classified in non-eligible portion.

2) Import tax

In principle, 30% of cost for imported material and equipment.

3.5.2 Project Cost

The Project cost has been estimated as shown in Table 3-6 below.

(x 1000)

Table 3-6 Project Cost

		Foreign currency	Local currency portion		Total
		YEN	BTK	Equivalent YEN	YEN
Ⅰ	Engineering, procurement & construction	1,838,100	151,200	187,300	2,025,400
1	Equipment (SCADA, Communication)	1,595,200	23,300	28,800	1,624,000
2	Associated Facilities	36,700	25,000	31,000	67,700
3	EPC management	61,700	88,900	110,200	171,900
4	EPC O/H, profit, etc.	56,900	3,400	4,200	61,100
	Sub Total	1,750,500	140,600	174,200	1,924,700
5	Price escalation (14.2% for Local portion)	100	3,400	4,200	4,300
6	Physical contingency (5%)	87,500	7,200	8,900	96,400
Ⅱ	Consultant service	140,000	11,600	14,400	154,400
Ⅲ	Operation and maintenance support	100,800	12,000	14,900	115,700
	Total (Ⅰ + Ⅱ + Ⅲ)	2,078,900	174,800	216,600	2,295,500
Ⅳ	Administration expenses		92,490	114,700	114,700
Ⅴ	Tax and duty		665,887	825,700	825,700
1	Import Tax		325,484	403,600	403,600
2	VAT		340,403	422,100	422,100
	Grand Total	2,078,900	933,177	1,157,000	3,235,900

3-6 Other Relevant Issues

3-6-1 Communication System Lease Contract

Prior to the agreement between GTCL and BTCL on the communication lease services, it is recommended that the technical and commercial issues mentioned below be confirmed and finalized by both parties in order to make each party's responsibility clear and thereby diminish related disputes.

(1) The distance between GTCL's Master Telemetry Station (MTS) and BTCL's Access Point shall be confirmed because the distance is the base figure for calculating the lease fee.

(2) Any special discount terms shall be confirmed to determine an appropriate lease fee.

(3) Locations and spaces to install equipment, including antennas, shall be reserved in the BTCL's access points. Also, power feeding points and methods, and the payment system for power to be consumed by equipment shall be finalized.

(4) Demarcation points of obligation between GTCL and BTCL shall be confirmed so that they shall be the same as those stipulated in the technical specifications of this Project.

(5) Concerning the system:

1) E1 interface to be provided by BTCL shall be as stipulated in the technical specifications (e.g. ITU-T V.35 Serial, X21 Serial, RJ45, etc.).
2) The network and/or system to be provided by the Project should be protected against malicious and inadvertent attacks and should have high reliability, integrity and scalability. Network security (ITU-T X.805) available in the service menu of BTCL shall be confirmed and be of the same type as the one stipulated in the technical specifications of the Project.
3) BTCL's redundancy configuration or route (hard loop), which will be used to transfer the GTCL's data in case the original route has any failure in its network, shall be confirmed.
4) Whether or not BTCL can accept it, if GTCL has assigned IP address himself.

(6) Commencement of Lease System

The detailed procedure to commence the leased BTCL's network/system should be confirmed with BTCL. Also, data and/or information showing the condition/status of the leased network/system should be informed to GTCL. Acceptance tests for equipment and systems provided by the Project shall be carried out by the contractor under the supervision of GTCL's engineers following the rules stipulated in the technical specifications.

(7) Operation and Maintenance

1) The service level agreement should be confirmed and checked whether it is acceptable to GTCL if BTCL has specifications such as those listed below:
   - Line availability ratio
   - Average transmission delay time (processing delay, propagation delay, queuing delay)
   - Average failure recovery time
   - Delivery delay of services
2) Monitoring level and process of the equipment and the system/network operation, i.e., these should be confirmed and checked with BTCL.
   - Resources Management
   - Performance Management
   - Fault Management
3) Correspondence procedures, initial actions, escalation flow, etc. when any failures arise on the system/network shall be confirmed.
4) Disconnection process of the system/network for analysing the causes of failure shall be confirmed. Also, the required time for disconnection shall be confirmed.
5) Duration of dispatch engineer(s)/technician(s) into the site(s) for recovery of the failure. Also, whether or not BTCL can provide services for dispatching personnel into a site 24 hours/day and 365 days/year.
6) Maintenance meetings to be periodically (ex. once per month) held by both GTCL and BTCL should be required, with BTCL reporting on the status of failure/recovery, traffic data, etc. made within the past month of the meeting.

4 PROJECT EVALUATION

4-1 Project Effect

The following table shows the specific effects (results) expected to be achieved by the implementation of the Project for its objectives.

Table 4-1 Project Effects

Current status and problems	Measures to be taken in the Project	Direct effects	Indirect effects
The Existing System has malfunctioned because of the low maintenance capability due to the lack of maintenance support by the previous Contractor, the unavailability of spare parts, etc.	The software and hardware of existing sites already covered by the Existing System will be improved and the system function will be rehabilitated.	The New System, which will enable GTCL to monitor and control all related sites under the gas pipeline network covered by the Project, will be constructed.	A stable and efficient gas supply to the whole country will be realized. Thereby, it will contribute to sustainable economic growth in Bangladesh.
Despite a significant expansion/extension of the gas pipeline network since the installation of the Existing System, many of the newly developed facilities have remained outside the coverage of the Existing System.	The New System will be expanded to the existing sites not covered under the Existing System	The New System, which will enable GTCL to monitor and control all related sites under gas pipeline network covered by the Project, will be constructed.	A stable and efficient gas supply to the whole country will be realized. Thereby, it will contribute to sustainable economic growth in Bangladesh.
New SCADA systems are planned for the GTCL gas pipeline projects supported by other donors. IOCs are operating their own SCADA systems.	In order to monitor the process data of sites under other SCADA systems, interfaces between the server of this system and the servers of other systems will be provided.	The New System, which will enable GTCL to monitor and control all related sites under gas pipeline network covered by the Project, will be constructed.	A stable and efficient gas supply to the whole country will be realized. Thereby, it will contribute to sustainable economic growth in Bangladesh.
GTCL organizational structure for O&M seems to be not sufficiently established.	• Preparation of O&M Manual • Formulation of O&M Schedule for daily operation and short & long term maintenance • Establishment of O&M organization, which can realize the O&M Schedule above	The New System will be operated and maintained sustainably by a new GTCL O&M organization.	A stable and efficient gas supply to the whole country will be realized. Thereby, it will contribute to sustainable economic growth in Bangladesh.
The skills and expertise of GTCL related personnel seem to be not sufficient.	Training to enhance the skills and expertise of GTCL related personnel. • During the installation period (3 months) • During O&M support period (24 months)	Personnel's skills and expertise will be improved to operate, maintain, interpret information and make minor adjustments to the New System.	A stable and efficient gas supply to the whole country will be realized. Thereby, it will contribute to sustainable economic growth in Bangladesh.

4-2 Evaluation and Recommendation

It is rather difficult to estimate the quantitative effects of the Project since the Project is a rehabilitation and expansion project for the Existing System that is a part of the GTCL gas transmission pipeline network. For example, the Existing System's revenue cannot be separated from GTCL's total revenue, and similarly, the revenue from the New System cannot be determined. Therefore, the justification for Project implementation has been evaluated as follows.

As described in Sub-section 2-2-1, system loss in the Bangladesh gas sector was 28 bcf (77 mmcfd) in fiscal year 2004-05, which is equivalent to US$39 million per annum. Although system loss is believed to have been decreasing since then through the implementation of the System Loss Reduction Plan (SLRP), no consolidated data of the system loss other than the aforementioned data is available. Once the New System is installed and operating effectively, the SLRP is expected to be further enhanced and system loss would be further reduced. In other words, without an integrated and well-operated SCADA system, achievement of the SLRP may not be possible.

Further, comparing the Project cost of US$26.5million (YEN2.3billion) with the annual system loss equivalent to US$39 million, contribution of the Project to system loss reduction and efficient and effective gas distribution would justify implementation of the Project.

As a result of the above examination, it is recommended that the Project be implemented on an urgent basis.

FINAL REPORT

APPENDICES

Appendix-1 Site Location Map

90° E
91° E
92° E
25° N
24° N
23° N
22° N
SHERPUR
JAMALPUR
NETROKONA
SUNAMGANJ
SYLHET
HORIPUR
Horipur H/O
Kailashtilla 2
Jalalabad H/O
TARAKANDI
Tarakandi
MYMENSHINGH
TITAS Mymensing
Fenchugonj
FENCHUGANJ
MAULAVI BAZAR
KISHOREGANJ
HABIGANJ
ELENGA
Elenga
TANGAIL
Rashidpur
Monohordi
Hobigonj
Ashuganj
GAZIPUR
NARSINGDI
BRAHMANBARIA
MANIKGANJ
Demra
DHAKA
Petrobangla H/O
FARIDPUR
NARAYANGANJ
MUNSHIGANJ
Bakhrabad
COMILLA
Comilla H/O
SHARIATPUR
CHANDPUR
MADARIPUR
Chadpur
LAKSHAM
Laksham
KHAGRACHARI
GOPALGANJ
LAKSHMIPUR
FENI
Feni
NOAKHALI
MIRASARAI
Mirasarai
BAGERHAT
BARISAL
BHOLA
JHALAKATI
PIROJPUR
RANGAMATI
PATUAKHALI
CHITTAGONG
Faujdarhat
BARGUNA
BANDARBAN
PROVIDER'S NETWORK
0
50
100 km

LEGENDS:

: MASTER TELEMETRY STATION (M/S)
: RTU
: COVERAGE OF M/S
: INTERNATIONAL BOUNDARY
: MAJOR CITIES
: ROADS

Appendix-2 Site List

Site List

Area	Covered by	New Code	Old Code	SITE	Operator	Site Category	Site Status	Coordinates		RTU Link	Solor
								Latitude	Longtitude		
North-East Leg [Ashuganj - Horipur H/O]		10-ASH-400M	400	Ashuganj New Radio	GTCL	MTS	Original	N 24° 01′ 48.60″	E 90° 59′ 52.40″		
	Ashuganj	10-ASH-400C	400	ACC at Ashuganj	GTCL	CC	Original	colocated with 10-ASH-400M			
		10-ASH-201	205	Titas Gas Filed 1	BGFCL	GF	Original	N 23° 59′ 49.20″	E 91° 06′ 41.90″		
		10-ASH-202	206	Titas Gas Filed 3	BGFCL	GF	Original	N 24° 00′ 55.70″	E 91° 07′ 20.40″		
		10-ASH-203	N400-4	TITAS Location 7	BGFCL	GF	future	N 23° 56′ 54.40″	E 91° 06′ 48.90″		
		10-ASH-204T	205	BGFCL Head Office	BGFCL	OCT	Additional	N 23° 58′ 59.10″	E 91° 06′ 00.00″		
		10-ASH-400	400	Ashuganj	GTCL	GMS	Original	colocated with 10-ASH-400M		cable	
		10-ASH-401	409	VS R	GTCL	VS	Original	N 24° 02′ 22.20″	E 91° 10′ 01.90″		○
		10-ASH-402	410	VS T	GTCL	VS	Original	N 24° 02′ 55.70″	E 91° 06′ 55.70″		
		10-ASH-403	417	VS 1 A-B	GTCL	VS	Original	N 23° 58′ 13.60″	E 91° 02′ 55.80″		○
		10-ASH-404	N400-X	VS Chandura R-A Line	GTCL	VS	Additional	N 24° 02′ 24.80″	E 91° 13′ 58.10″		○
		10-ASH-501	500	Ashganj PS	TGTDCL	PS	Original	N 24° 02′ 28.60″	E 91° 00′ 40.00″		
		10-ASH-502	502	Ashganj FF	TGTDCL	FF	Original	N 24° 01′ 28.50″	E 90° 59′ 27.20″		
		10-ASH-503	514	TITAS VS3	TGTDCL	VS	Original	N 24° 02′ 11.80″	E 91° 00′ 25.70″		
		10-ASH-504	516	Daulatkandi VS0	TGTDCL	VS	Original	N 24° 01′ 18.70″	E 90° 57′ 08.60″		○
		10-ASH-505	N400-2	MS Ghatura	TGTDCL	MS	Additional	N 23° 59′ 50.30″	E 91° 06′ 29.70″		
		10-HOB-200M	203	Hobigonj Gas Field	BGFCL	MTS	Original	N 24° 14′ 00.00″	E 91° 22′ 38.80″		
	Hobigonj	10-HOB-200	203	Hobigonj Gas Field	BGFCL	GF	Original	colocated with 10 HOB-200M		cable	
		10-HOB-401	416	VS P	GTCL	VS	Original	N 24° 13′ 51.00″	E 91° 22′ 30.60″		○
		10-HOB-501	513	Hobigonj TITAS DRS	TGTDCL	DRS	Original	N 24° 14′ 03.60″	E 91° 22′ 23.40″		
		10-RAS-300M	302	Rashidpur Gas Field	SGFL	MTS	Original	N 24° 18′ 43.20″	E 91° 36′ 26.30″		
	Rashidpur	10-RAS-300	302	Rashidpur Gas Field	SGFL	GF	Original	colocated with 10 RAS-300M		cable	
		10-RAS-401	403	VS L	GTCL	VS	Original	N 24° 17′ 42.20″	E 91° 36′ 42.30″		
		10-RAS-402	412	VS H	GTCL	VS	Original	N 24° 29′ 58.70″	E 91° 44′ 32.10″		○
		10-RAS-403	414	VS K	GTCL	VS	Original	N 24° 22′ 19.60″	E 91° 44′ 10.90″		○
		10-RAS-404	415	VS M	GTCL	VS	Original	N 24° 16′ 09.00″	E 91° 30′ 09.60″		○
		10-RAS-405	N302-3	Rashipdur/Muchai Compressor Station	GTCL	CS	future	N 24° 17′ 42.90″	E 91° 35′ 09.00″		
		10-RAS-406	N302-X	VS Chunarughat R-A Line	GTCL	VS	Additional	N 24° 15′ 37.60″	E 91° 28′ 58.80″		○
		10-FCH-600M	604	Fenchugonj Radio	JGTDSL	MTS	Original	N 24° 41′ 16.90″	E 91° 55′ 16.50″		
	Fenchugonj	10-FCH-401	406	VS E	GTCL	VS	Original	N 24° 41′ 24.00″	E 91° 55′ 13.20″		○
		10-FCH-402	413	VS D	GTCL	VS	Original	N 24° 41′ 40.80″	E 91° 55′ 12.60″		○
		10-FCH-600	604	Fenchugonj 90MW PS	JGTDSL	PS	Original	colocated with 10 FCH-600M		cable	
		10-FCH-601	602	Fenchugonj NGF	JGTDSL	FF	Original	N 24° 39′ 39.00″	E 91° 56′ 13.80″		
		10-FCH-701	N604-1	Fenchugonj Gas Field	BAPEX	GF	Additional	N 24° 36′ 58.20″	E 91° 57′ 09.20″		
		10-JAL-600M	608	Jalalabad Head Office	JGTDSL	MTS	Original	N 24° 53′ 00.80″	E 91° 53′ 04.90″		
	Jalalabad HO	10-JAL-600T	608	Jalalabad Head Office	JGTDSL	OCT	Original	colocated with 10-JAL-600M			
		10-JAL-601	N608-X	Devpur DRS	JGTDSL	DRS	Additional	N 24° 54′ 13.80″	E 91° 55′ 15.70″		
		10-KAI-400M	405	Kailashtilla 2 Radio	GTCL	MTS	Original	N 24° 51′ 58.90″	E 92° 01′ 44.00″		
	Kailashtilla2	10-KAI-301	303	Benibazar Gas Field	SGFL	GF	Original	N 24° 47′ 42.80″	E 92° 09′ 58.90″		
		10-KAI-400	405	Kailashtilla GTCL Compound	GTCL	GMS	Original	colocated with 10-KAI-400M		cable	
		10-KAI-601	600	Kailashtilla DRS	JGTDSL	DRS	Original	N 24° 51′ 16.80″	E 92° 00′ 48.00″		
		10-HOR-300M	306	Horipur Head Office	SGFL	MTS	Original	N 24° 58′ 04.30″	E 92° 01′ 41.80″		
	Horipur HO	10-HOR-300T	306	Horipur Head Office	SGFL	OCT	Original	colocated with 10-HOR-300M			
		10-HOR-300	300	Horipur Gas Field	SGFL	GF	Original	colocated with 10-HOR-301M		cable	
South-East Leg [Bakhrabad - Faujdarhat]		20-BKB-100M	120	Bakhrabad Radio	BGSL	MTS	Original	N 23° 38′ 04.20″	E 90° 52′ 24.70″		
	Bakhrabad	20-BKB-100	120	Bakhrabad	BGSL	GF	Original	colocated with 20-BKB-100M		cable	
		20-BKB-101	100	Kutombopur	BGSL	TBS	Original	N 23° 30′ 11.50″	E 90° 54′ 42.80″		
		20-BKB-102	128	VS3 BKB-Demra	BGSL	VS	Original	N 23° 31′ 48.40″	E 90° 43′ 01.40″		○
		20-BKB-201	200	Meghna Gas Field	BGFCL	GF	Original	N 23° 50′ 16.30″	E 90° 47′ 18.10″		
		20-BKB-401	418	VS2 A-B	GTCL	VS	Original	N 23° 45′ 34.70″	E 90° 59′ 44.30″		○
		20-BKB-501	N120-2	TBS Gazaria	TGTDCL	TBS	Additional	N 23° 34′ 32.20″	E 90° 38′ 32.90″		○
		20-BKB-701	703	Salda Nadi Gas Field	BAPEX	GF	Original	N 23° 40′ 31.00″	E 91° 10′ 15.40″		
		20-BKB-702	N120-1	Bangura Gas Field	Tullow	GF	Additional	N 23° 42′ 38.60″	E 90° 58′ 59.30″		
		20-BKB-703	N120-5	Srikail Gas Field	BAPEX	GF	future	N 23° 45′ 14.60″	E 90° 58′ 13.40″		
		20-CML-100M	114	Comilla Head Office	BGSL	MTS	Original	N 23° 26′ 53.20″	E 91° 12′ 49.50″		
	Comilla HO	20-CML-100T	114	Comilla Head Office	BGSL	OCT	Original	colocated with 20-CML-100M			
		20-LAK-100M	115	Laksham Radio	BGSL	MTS	Original	N 23° 15′ 04.50″	E 91° 07′ 20.60″		
	Laksham	20-LAK-101	101	Laksham TBS	BGSL	TBS	Original	N 23° 16′ 18.60″	E 91° 07′ 21.80″		
		20-CHA-100M	116	Chandpur	BGSL	MTS	Original	N 23° 14′ 02.80″	E 90° 41′ 00.60″		
	Chandpur	20-CHA-101	112	Chandpur TBS	BGSL	TBS	Original	N 23° 14′ 22.90″	E 90° 40′ 55.60″		
		20-FEN-100M	102	Feni	BGSL	MTS	Original	N 23° 01′ 02.00″	E 91° 22′ 10.50″		
	Feni	20-FEN-100	102	Feni TBS	BGSL	TBS	Original	colocated with 20-FEN-100M		cable	
		20-FEN-701	N102-1	Feni Gas Field	NIKO	GF	Additional	N 22° 56′ 29.30″	E 91° 24′ 08.00″		
		20-FEN-702	N102-2	Sundalpur Gas Field	BAPEX	GF	future	N 22° 51′ 28.40″	E 91° 14′ 39.00″		
		20-FEN-703	N102-3	Begumgonj Gas Field	BAPEX	GF	future	N 22° 59′ 17.00″	E 91° 10′ 03.00″		
		20-MIR-100M	118	Mirasarai	BGSL	MTS	Original	N 22° 42′ 15.80″	E 91° 36′ 46.60″		
	Mirasarai	20-MIR-101	103	Mitachara	BGSL	TBS	Original	N 22° 48′ 16.20″	E 91° 33′ 20.60″		
		20-MIR-401	N118-X	Barakubundu TBS	GTCL	TBS	Additional	N 22° 34′ 58.00″	E 91° 39′ 58.20″		
		20-MIR-701	N118-1	Semutang Gas Field	BAPEX	GF	future	N 22° 49′ 59.30″	E 91° 46′ 01.20″		
		20-FAU-100M	105	Faujdarhat	BGSL	MTS	Original	N 22° 23′ 00.00″	E 91° 46′ 07.00″		
	Faujdarhad	20-FAU-100	105	Faujdarhat	BGSL	CGS	Original	colocated with 20-FAU-100M		cable	
		20-FAU-101	122	CUFL	BGSL	FF	Original	N 22° 13′ 22.30″	E 91° 49′ 48.30″		
		20-FAU-102	123	KAFCO	BGSL	FF	Original	N 22° 13′ 51.00″	E 91° 49′ 37.20″		
		20-FAU-103	124	Sikalbaha	BGSL	PS	Original	N 22° 19′ 26.80″	E 91° 51′ 59.10″		
		20-FAU-104	125	Raujan PS	BGSL	PS	Original	N 22° 27′ 32.00″	E 91° 58′ 32.40″		
		20-FAU-701	706	Sanghu Onshore Process Plant	CAIRN	GF	Original	N 22° 23′ 44.80″	E 91° 45′ 10.10″		
		20-FAU-701T	706	Sanghu Onshore Process Plant	CAIRN	OCT	Original	colocated with 20-FAU-701T			
		20-FAU-702T	-	KGDCL Head Office	KGDCL	OCT	Additional	Not available, but in Chittagong City			
Around Demra & Dhaka		30-DMR-100M	109	Demra	BGSL	MTS	Original	N 23° 42′ 40.10″	E 90° 30′ 25.20″		
	Demra	30-DMR-401C	401	MCC at Demra	GTCL	CC	Original	colocated with 30-DMR-100M			
		30-DMR-100	109	Demra CGS	BGSL	CGS	Original	colocated with 30-DMR-101M		cable	
		30-DMR-101	107	Sonargaon	BGSL	TBS	Original	N 23° 38′ 23.20″	E 90° 36′ 08.10″		
		30-DMR-102	108	Dewanbagh	BGSL	TBS	Original	N 23° 41′ 33.90″	E 90° 32′ 31.20″		
		30-DMR-103	126	VS7 BKB-Demra	BGSL	VS	Original	N 23° 42′ 38.60″	E 90° 31′ 27.20″		○
		30-DMR-104	127	VS5 BKB-Demra	BGSL	VS	Original	N 23° 36′ 01.80″	E 90° 36′ 52.70″		○
		30-DMR-501	N109-1	Siddirganj 210 MW PS	TGTDCL	PS	Additional	N 23° 40′ 55.10″	E 90° 31′ 16.20″		
		30-DMR-502	N109-10	Horipur IPP 350 MW PS	TGTDCL	PS	future	N 23° 41′ 05.50″	E 90° 31′ 46.90″		
		30-DMR-503	N109-2	Horipur IPP 360 MW PS	TGTDCL	PS	Additional	N 23° 40′ 44.80″	E 90° 32′ 05.60″		
		30-DMR-504	N109-3	Horipur SBU 100MW	TGTDCL	PS	Additional	N 23° 41′ 04.10″	E 90° 31′ 54.10″		
		30-DMR-505	N109-4	VS 14 Madhabdi	TGTDCL	VS	Additional	N 23° 51′ 23.00″	E 90° 39′ 20.40″		
		30-DMR-506	N109-5	VS 15 Tarabo	TGTDCL	VS	Additional	N 23° 43′ 03.90″	E 90° 30′ 26.90″		
		30-DMR-507	N109-6	VS Dighibarabo	TGTDCL	VS	Additional	N 23° 43′ 25.70″	E 90° 31′ 00.90″		○
		30-DMR-508	N109-7	VS Horipur	TGTDCL	VS	Additional	N 23° 41′ 11.60″	E 90° 32′ 10.30″		
		30-DMR-509	N120-3	VS Meghnaghat	TGTDCL	VS	Additional	N 23° 36′ 49.20″	E 90° 36′ 19.60″		
		30-DMR-510	N120-4	Meghnaghat IPP 450 MW PS	TGTDCL	PS	Additional	N 23° 36′ 47.60″	E 90° 36′ 02.20″		
		30-DMR-701	N302-1	Moulavibazar Gas Field	Chevron	GF	Original	N/A		serv.	
		30-DMR-702	N302-2	Bibiyana Gas Field	Chevron	GF	Original	N/A		serv.	
		30-DMR-703	N405-1	Jalalabad Gas Field	Chevron	GF	Original	N/A		serv.	
		30-PBG-700M	702	Petrobangla Head Office	Petrobangla	MTS	Original	N 23° 44′ 59.30″	E 90° 23′ 50.30″		
	Petrobangla HO	30-PBG-401	N702-2	CGS Aminbazar (out)	GTCL	CGS	Additional	N 23° 47′ 18.80″	E 90° 19′ 04.60″		
		30-PBG-402	N702-3	CGS Ashulia (out)	GTCL	CGS	Additional	N 23° 53′ 13.70″	E 90° 19′ 48.90″		
		30-PBG-500T	509	TITAS Head Office	TGTDCL	OCT	Original	N 23° 45′ 02.30″	E 90° 23′ 37.00″		
		30-PBG-501	N702-1	Tongi 80 MW P.S. (out)	TGTDCL	PS	Additional	N 23° 53′ 47.40″	E 90° 24′ 41.50″		
		30-PBG-700T	702	Petrobangla Head Office	Petrobangla	OCT	Original	colocated with 30-PBG-700M			
		30-PBG-701T	-	Chevron Head Office	Chevron	OCT	Additional	Not available, but in Gulshan, Dhaka			
North-West Leg [Monohordi - Tarakandi]		40-MHD-500M	510	Monohordi	TGTDCL	MTS	Original	N 24° 07′ 55.00″	E 90° 42′ 09.00″		
	Monohordi	40-MHD-201	201	Narsingdi Gas Field	BGFCL	GF	Original	N 24° 01′ 23.20″	E 90° 49′ 00.50″		
		40-MHD-500	510	Monohordi	TGTDCL	GMS	Original	colocated with 40-MHD-500M		cable	
		40-MHD-501	503	GUFF/PUFF	TGTDCL	FF	Original	N 23° 59′ 11.00″	E 90° 38′ 28.60″		
		40-MHD-502	504	Ghorasal PS	TGTDCL	PS	Original	N 23° 58′ 50.50″	E 90° 38′ 40.40″		
		40-MHD-503	505	Joydevpur CGS	TGTDCL	CGS	Original	N 24° 00′ 31.80″	E 90° 24′ 55.80″		
		40-MHD-504	515	Poladi VS3	TGTDCL	VS	Original	N 24° 12′ 49.20″	E 90° 32′ 00.00″		○
		40-MHD-505	517	Uzilab VS1	TGTDCL	VS	Original	N 24° 04′ 26.40″	E 90° 49′ 34.00″		○
		40-MHD-506	518	Khirti VS2	TGTDCL	VS	Original	N 24° 09′ 06.90″	E 90° 40′ 50.30″		○
		40-MHD-507	519	Dhanua VS4	TGTDCL	VS	Original	N 24° 14′ 39.70″	E 90° 24′ 11.10″		○
		40-MHD-508	N510-2	VS-12 Narsingdi	TGTDCL	VS	Additional	N 23° 55′ 56.20″	E 90° 42′ 06.60″		
		40-ELE-500M	508	Elenga	TGTDCL	MTS	Original	N 24° 20′ 18.50″	E 89° 55′ 34.20″		
	Elenga	40-ELE-500	508	Elenga	TGTDCL	GMS	Original	colocated with 40-ELE-500M		cable	
		40-MYM-500M	NMW1	TITAS Mymensing Office	TGTDCL	MTS	Original	N 24° 43′ 17.60″	E 90° 24′ 37.60″		
	Titas Mymensingh	40-MYM-501	NMW1-1	RPCL PS Mymensing	TGTDCL	PS	Additional	N 24° 45′ 47.90″	E 90° 25′ 06.40″		
		40-TRK-500M	511	Tarakandi	TGTDCL	MTS	Original	N 24° 41′ 03.50″	E 89° 49′ 42.20″		
	Tarakandi	40-TRK-500	511	Tarakandi (JFCL RMS)	TGTDCL	DRS	Original	colocated with 40-TRK-500M		cable	

Appendix-3 RTU List

RTU LIST

Equip.
RTU: Replacement of existing RTU
New RTU: New RTU to be prepared

Status
exist: the site is existing
future: the site will be developed

Elec. Power
AC240V: AC 240V will be supplied
SP exist: Existing Solar Panel will be re-uesd.
SP new: New Solar Panel to be prepared

Display Panel
Yes: Display panel to be mounted on the RTU

New Instruments
PT: Pressure Transmitter
TT: Temperature Transmitter w/ RTD
PdT: Pressure Differential Transmitter

CODE	OLD CODE	SITE	Equip.	Status	Master Station	Elec. Power	Display Panel	NEW INSTRUMENTS				
								PT	TT	PdT	Limit Switch	JB
10-ASH-201	205	Titas Gas Filed 1	RTU	exist	10-ASH-400M	AC240V		1	1	2		1
10-ASH-202	206	Titas Gas Filed 3	RTU	exist	10-ASH-400M	AC240V		1	1	2		1
10-ASH-203	N400-4	TITAS Location 7	New RTU	future	10-ASH-400M	AC240V						
10-ASH-400	400	Ashuganj	RTU	exist	10-ASH-400M	AC240V	Yes	1			1	1
10-ASH-401	409	VS R	RTU	exist	10-ASH-400M	SP exist.						
10-ASH-402	410	VS T	RTU	exist	10-ASH-400M	AC240V						
10-ASH-403	417	VS 1 A-B	RTU	exist	10-ASH-400M	SP exist.						
10-ASH-404	N400-X	VS Chandura R-A Line	New RTU	exist	10-ASH-400M	SP new		1			1	1
10-ASH-501	500	Ashganj PS	RTU	exist	10-ASH-400M	AC240V						
10-ASH-502	502	Ashganj FF	RTU	exist	10-ASH-400M	AC240V		2	2	2		1
10-ASH-503	514	TITAS VS3	RTU	exist	10-ASH-400M	AC240V						
10-ASH-504	516	Daulatkandi VS0	RTU	exist	10-ASH-400M	SP exist.		1			1	1
10-ASH-505	N400-2	MS Ghatura	New RTU	exist	10-ASH-400M	AC240V		4	4	8		2
10-FCH-401	406	VS E	RTU	exist	10-FCH-600M	SP exist.						
10-FCH-402	413	VS D	RTU	exist	10-FCH-600M	SP exist.						
10-FCH-600	604	Fenchugonj 90MW PS	RTU	exist	10-FCH-600M	AC240V		1	1	2		1
10-FCH-601	602	Fenchugonj NGF	RTU	exist	10-FCH-600M	AC240V						
10-FCH-701	N604-1	Fenchugonj Gas Field	New RTU	exist	10-FCH-600M	AC240V		2	2	4		1
10-HOB-200	203	Hobigonj Gas Field	RTU	exist	10-HOB-200M	AC240V						
10-HOB-401	416	VS P	RTU	exist	10-HOB-200M	SP exist.						
10-HOB-501	513	Hobigonj TITAS DRS	RTU	exist	10-HOB-200M	AC240V		2	2	4		1
10-HOR-300	300	Horipur Gas Field	RTU	exist	10-HOR-300M	AC240V						
10-JAL-601	N608-X	Devpur DRS	New RTU	exist	10-JAL-600M	AC240V		2	2	4		1
10-KAI-301	303	Benibazar Gas Field	RTU	exist	10-KAI-400M	AC240V		1	1	2		1
10-KAI-400	405	Kailashtilla GTCL Compound	RTU	exist	10-KAI-400M	AC240V		3	3	6		2
10-KAI-601	600	Kailashtilla DRS	RTU	exist	10-KAI-400M	AC240V						
10-RAS-300	302	Rashidpur Gas Field	RTU	exist	10-RAS-300M	AC240V						
10-RAS-401	403	VS L	RTU	exist	10-RAS-300M	AC240V						
10-RAS-402	412	VS H	RTU	exist	10-RAS-300M	SP exist.						
10-RAS-403	414	VS K	RTU	exist	10-RAS-300M	SP exist.						
10-RAS-404	415	VS M	RTU	exist	10-RAS-300M	SP exist.						
10-RAS-405	N302-3	Rashipdur/Muchai Compressor Station	New RTU	future	10-RAS-300M	AC240V						
10-RAS-406	N302-X	VS Chunarughat R-A Line	New RTU	exist	10-RAS-300M	SP new		1			1	1
20-BKB-100	120	Bakhrabad	RTU	exist	20-BKB-100M	AC240V		1			1	1
20-BKB-101	100	Kutombopur	RTU	exist	20-BKB-100M	AC240V	Yes					
20-BKB-102	128	VS3 BKB-Demra	RTU	exist	20-BKB-100M	SP exist.						
20-BKB-201	200	Meghna Gas Field	RTU	exist	20-BKB-100M	AC240V						
20-BKB-401	418	VS2 A-B	RTU	exist	20-BKB-100M	SP exist.						
20-BKB-501	N120-2	TBS Gazaria	New RTU	exist	20-BKB-100M	SP new		2	2			1
20-BKB-701	703	Salda Nadi Gas Field	RTU	exist	20-BKB-100M	AC240V						
20-BKB-702	N120-1	Bangura Gas Field	New RTU	exist	20-BKB-100M	AC240V						
20-BKB-703	N120-5	Srikail Gas Field	New RTU	future	20-BKB-100M	AC240V						
20-CHA-101	112	Chandpur TBS	RTU	exist	20-CHA-100M	AC240V		2	2	4		1
20-FAU-100	105	Faujdarhat	RTU	exist	20-FAU-100M	AC240V	Yes					
20-FAU-101	122	CUFL	RTU	exist	20-FAU-100M	AC240V						
20-FAU-102	123	KAFCO	RTU	exist	20-FAU-100M	AC240V						
20-FAU-103	124	Sikalbaha	RTU	exist	20-FAU-100M	AC240V						
20-FAU-104	125	Raujan PS	RTU	exist	20-FAU-100M	AC240V						
20-FAU-701	706	Sanghu Onshore Process Plant	RTU	exist	20-FAU-100M	AC240V						
20-FEN-100	102	Feni TBS	RTU	exist	20-FEN-100M	AC240V						
20-FEN-701	N102-1	Feni Gas Field	New RTU	exist	20-FEN-100M	AC240V		1	1	2		1
20-FEN-702	N102-2	Sundalpur Gas Field	New RTU	future	20-FEN-100M	AC240V						
20-FEN-703	N102-3	Begumgonj Gas Field	New RTU	future	20-FEN-100M	AC240V						
20-LAK-101	101	Laksham TBS	RTU	exist	20-LAK-100M	AC240V						
20-MIR-101	103	Mitachara	RTU	exist	20-MIR-100M	AC240V		1	1			1
20-MIR-401	N118-X	Barakubundu TBS	New RTU	exist	20-MIR-100M	AC240V	Yes					
20-MIR-701	N118-1	Semutang Gas Field	New RTU	future	20-MIR-100M	AC240V						
30-DMR-100	109	Demra CGS	RTU	exist	30-DMR-100M	AC240V						
30-DMR-101	107	Sonargaon	RTU	exist	30-DMR-100M	AC240V						
30-DMR-102	108	Dewanbagh	RTU	exist	30-DMR-100M	AC240V						
30-DMR-103	126	VS7 BKB-Demra	RTU	exist	30-DMR-100M	SP exist.						
30-DMR-104	127	VS5 BKB-Demra	RTU	exist	30-DMR-100M	SP exist.						
30-DMR-501	N109-1	Siddirganj PS	New RTU	exist	30-DMR-100M	AC240V		4	4	8		2
30-DMR-502	N109-10	Horipur IPP 350 MW PS	New RTU	future	30-DMR-100M	AC240V						
30-DMR-503	N109-2	Horipur IPP 360 MW PS	New RTU	exist	30-DMR-100M	AC240V		1	1	2		1
30-DMR-504	N109-3	Horipur SBU 100MW & NEPC 110MW	New RTU	exist	30-DMR-100M	AC240V		3	3	4		2
30-DMR-505	N109-4	VS 14 Madhabdi	New RTU	exist	30-DMR-100M	AC240V		1			1	1
30-DMR-506	N109-5	VS 15 Tarabo	New RTU	exist	30-DMR-100M	AC240V		1			1	1
30-DMR-507	N109-6	VS Dighibarabo	New RTU	exist	30-DMR-100M	SP new		1			1	1
30-DMR-508	N109-7	VS Horipur	New RTU	exist	30-DMR-100M	AC240V		1			1	1
30-DMR-509	N120-3	VS Meghnaghat	New RTU	exist	30-DMR-100M	AC240V		1			1	1
30-DMR-510	N120-4	Meghnaghat IPP 450 MW PS	New RTU	exist	30-DMR-100M	AC240V		1	1	2		1
30-PBG-401	N702-2	CGS Aminbazar (out)	New RTU	exist	30-PBG-700M	AC240V	Yes	3	3	6		2
30-PBG-402	N702-3	CGS Ashulia (out)	New RTU	exist	30-PBG-700M	AC240V	Yes	2	2	4		1
30-PBG-501	N702-1	Tongi 80 MW P.S. (out)	New RTU	exist	30-PBG-700M	AC240V		1	1			1
40-ELE-500	508	Elenga	RTU	exist	40-ELE-500M	AC240V	Yes	1	1	2		1
40-MHD-201	201	Narsingdi Gas Field	RTU	exist	40-MHD-500M	AC240V						
40-MHD-500	510	Monohordi	RTU	exist	40-MHD-500M	AC240V	Yes	1	1	2		1
40-MHD-501	503	GUFF/PUFF	RTU	exist	40-MHD-500M	AC240V		4	4			1
40-MHD-502	504	Ghorasal PS	RTU	exist	40-MHD-500M	AC240V						
40-MHD-503	505	Joydevpur CGS	RTU	exist	40-MHD-500M	AC240V		8	8	2		2
40-MHD-504	515	Poladi VS3	RTU	exist	40-MHD-500M	SP exist.						
40-MHD-505	517	Uzilab VS1	RTU	exist	40-MHD-500M	SP exist.		1			1	1
40-MHD-506	518	Khirti VS2	RTU	exist	40-MHD-500M	SP exist.						
40-MHD-507	519	Dhanua VS4	RTU	exist	40-MHD-500M	SP exist.						
40-MHD-508	N510-2	VS-12 Narsingdi	New RTU	exist	40-MHD-500M	AC240V		2				1
40-MYM-501	NMW1-1	RPCL PS Mymensing	New RTU	exist	40-MYM-500M	AC240V		1	1	2		1
40-TRK-500	511	Tarakandi (JFCL RMS)	RTU	exist	40-TRK-500M	AC240V		1	1	2		1
Total Instruments								69	56	78	11	45

Total of RT Total RTU Number:	88
AC240V Site:	67
Existing Solar Panel Site:	17
New Solar Panel Site:	4
Display Panel:	8

Appendix-4 Breakdown of Cost Estimation

Summary

1USD= 86.6 Yen、1BTK= 1.24 Yen (x1,000)

	Description	Foreign Portion	Local Portion		Total
			BTK	YEN Equivalent	
		YEN	BTK	YEN	YEN
Ⅰ	Engineering, Procurement and Construction	1,838,100	151,200	187,300	2,025,400
1	Equipment(SCADA,Communication)	1,595,200	23,300	28,800	1,624,000
2	Associated Facilities	36,700	25,000	31,000	67,700
3	EPC management Expense	61,700	88,900	110,200	171,900
4	EPC O/H, Profit,etc.	56,900	3,400	4,200	61,100
	Sub-total	1,750,500	140,600	174,200	1,924,700
5	Price escalation	100	3,400	4,200	4,300
6	Physical contingency	87,500	7,200	8,900	96,400
Ⅱ	Consultants Service	140,000	11,600	14,400	154,400
Ⅲ	O/M Support	100,800	12,000	14,900	115,700
	Total (Ⅰ+Ⅱ+Ⅲ)	2,078,900	174,800	216,600	2,295,500
Ⅳ	Administration expenses		92,490	114,700	114,700
Ⅴ	Tax and duty		665,887	825,700	825,700
1	Import Tax		325,484	403,600	403,600
2	VAT		340,403	422,100	422,100
	Grand Total	2,078,900	933,177	1,157,000	3,235,900

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-1	Equipment Cost				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
E-1	Equipment Cost									1,257,532,628	1,257,532,628	
E-1.1	Equipment Cost	SCADA Syetem								863,869,728	863,869,728	
E-1.1.1	Monitoring System									465,239,438	465,239,438	
E-1.1.2	Equipment of Instruments									87,514,850	87,514,850	
E-1.1.3	RTU									311,115,440	311,115,440	
E-1.2	Equipment Cost	Communication Syetem								327,066,900	327,066,900	
E-1.2.1	IP Radio Eq.									85,569,000	85,569,000	
E-1.2.2	Telemetry Radio Equipment									61,902,000	61,902,000	
E-1.2.3	IP PBX									17,748,000	17,748,000	
E-1.2.4	Network Equipment									102,231,900	102,231,900	
E-1.2.5	Power Supply Equipment									59,616,000	59,616,000	
E-1.3	Spare parts									66,596,000	66,596,000	
E-2	Installation Works					23,282,731				323,875,717	352,746,303	
E-2.1	Installation Works					6,501,946				141,875,189	149,937,602	
E-2.2	Site Acceptance Test					7,671,216				97,606,512	107,118,820	
E-2.3	Commisionning & start-up					7,671,216				65,858,512	75,370,820	
E-2.4	Operation Training Cost					1,438,353				18,535,504	20,319,062	
E-3	Transportation							53,150		9,143,325	13,746,133	
	Transportation charge for SCADA							35,789		5,379,249	8,478,599	
	Transportation charge for TELEMETRY							17,361		3,764,076	5,267,534	
						23,282,731		53,150		1,590,551,670	1,624,025,064	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I -1	Equipment Cost				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
E-1	Equipment Cost	SCADA Syetem										
E-1.1	Equipment Cost											
E-1.1.1	Monitoring System									465,239,438	465,239,438	
E-1.1.1.1	Monitoring system1 (MCC)											
/1	SCADA Sever		set	2.0					77,392,741	154,785,483	154,785,483	
/2	HMI Work Station		set	4.0					1,082,290	4,329,160	4,329,160	
/3	Color printer		set	1.0					768,285	768,285	768,285	
/4	Monochrome Printer		set	1.0					703,381	703,381	703,381	
/5	Large Screen Monitor		set	1.0					745,500	745,500	745,500	
/6	Uninterruptible Power Systems	15kVA 8h	set	1.0					18,000,000	18,000,000	18,000,000	
/7	Uninterruptible Power Systems	15kVA 4h	set	1.0					12,000,000	12,000,000	12,000,000	
E-1.1.1.2	Monitoring System2 (ACC)											
/1	SCADA Sever		set	2.0					77,392,741	154,785,483	154,785,483	
/2	HMI Work Station		set	4.0					1,082,290	4,329,160	4,329,160	
/3	Color printer		set	1.0					768,285	768,285	768,285	
/4	Monochrome Printer		set	1.0					703,381	703,381	703,381	
/5	Large Screen Monitor		set	1.0					745,500	745,500	745,500	
/6	Uninterruptible Power Systems	15kVA 8h	set	1.0					18,000,000	18,000,000	18,000,000	
/7	Uninterruptible Power Systems	15kVA 4h	set	1.0					12,000,000	12,000,000	12,000,000	
E-1.1.1.3	Monitoring3 (OCT)											
/1	HMI Work Station		set	9.0					7,561,806	68,056,255	68,056,255	
/2	Color printer		set	9.0					768,285	6,914,565	6,914,565	
/3	UPS		set	9.0					845,000	7,605,000	7,605,000	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-1	Equipment Cost				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
E-1.1.2	Equipment of Instruments									87,514,850	87,514,850	
E-1.1.2.1	Pressure Transmitter		set	86.0					322,300	27,717,800	27,717,800	
E-1.1.2.2	Temperature Transmitter		set	73.0					164,010	11,972,730	11,972,730	
E-1.1.2.3	Differential Transmitter		set	102.0					363,000	37,026,000	37,026,000	
E-1.1.2.4	Limit Switch valve status monitoring		set	11.0					39,000	429,000	429,000	
E-1.1.2.5	Jointbox		set	46.0					225,420	10,369,320	10,369,320	
E-1.1.3	RTU									311,115,440	311,115,440	
E-1.1.3.1	RTU (New installation)		set	23.0					3,424,130	78,754,990	78,754,990	
E-1.1.3.2	RTU (Remove and installation)		set	58.0					3,424,130	198,599,540	198,599,540	
E-1.1.3.3	RTU (Material sapply		set	7.0					3,424,130	23,968,910	23,968,910	
E-1.1.3.4	Solar Panel	8pcs/RTU x 17RTU	set	136.0					72,000	9,792,000	9,792,000	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-1	Equipment Cost				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
E-1.2	Equipment Cost	Communication Syetem								327,066,900	327,066,900	
E-1.2.1	IP Radio Eq.									85,569,000	85,569,000	
/1	5.0GHz band IP radio & installation materials (BTCL A.P)		set	40.0					853,000	34,120,000	34,120,000	
/2	5.0GHz band IP radio & installation materials		set	58.0						22,239,000	44,370,000	
/3	Antenna & mounting hardware		set	142.0						3,831,000	3,834,000	
/4	Coaxial cable with connector & Arrestor		set	100.0						714,000	1,520,000	
/5	Accessories & Spares		set	1.0						11,725,000	1,725,000	
E-1.2.2	Telemetry Radio Equipment									61,902,000	61,902,000	
/1	Telemetry Radio(Master) & installation materials		set	20.0					945,000	18,900,000	18,900,000	
/2	Omnidirectional antenna & mounting hardware		set	20.0					406,800	8,136,000	8,136,000	
/3	Coaxial cable with connector		set	20.0					123,300	2,466,000	2,466,000	
/4	Accessories & Spares		set	2.0					945,000	1,890,000	1,890,000	
/5	Telemetry Radio(Slave) & installation materials		set	75.0					274,500	20,587,500	20,587,500	
/6	Yagi antenna & mounting hardware		set	75.0					45,000	3,375,000	3,375,000	
/7	D/D converter(24/13.6V, 5A)		set	75.0					18,000	1,350,000	1,350,000	
/8	Coaxial cable with connector		set	75.0					44,100	3,307,500	3,307,500	
/9	Accessories & Spares		set	2.0					945,000	1,890,000	1,890,000	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
Ⅰ-1	Equipment Cost				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
E-1.2.3	IP PBX									17,748,000	17,748,000	
/1	IP PBX(6 PSTN, Max. 100 Ext. lines) & installation materials		set	1.0						17,748,000	17,748,000	
/2	Ext. line telephone set		set	61.0								
/3	Accessories & Spares		LS	1.0								
E-1.2.4	Network Equipment									102,231,900	102,231,900	
/1	IP/E1 converter (BTCL A.P)		set	18.0					842,400	15,163,200	15,163,200	
/2	Router (for dual root of IP Radio)		set	58.0					630,000	36,540,000	36,540,000	
/3	HUB 16P		set	2.0					1,240,200	2,480,400	2,480,400	
/4	HUB 8P		set	21.0						10,705,500	10,705,500	
/5	Router (with NxE1 interface)		set	2.0						13,614,300	13,614,300	
/6	Fire Wall		set	1.0					1,177,200	1,177,200	1,177,200	
/7	LAN materiasl (cable or others)		set	25.0					72,000	1,800,000	1,800,000	
/8	Network monitoring software		set	2.0					3,294,900	6,589,800	6,589,800	
/9	Server for NW monitoring		set	2.0					1,440,000	2,880,000	2,880,000	
/10	Accessories & Spares		set	1.0					11,281,500	11,281,500	11,281,500	
E-1.2.5	Power Supply Equipment									59,616,000	59,616,000	
/1	Battery (48V, 200AH, long life) & mounting rack		set	18.0					1,440,000	25,920,000	25,920,000	
/2	Charger Rectifier(20A, 48V)		set	18.0					1,872,000	33,696,000	33,696,000	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
Ⅰ-1	Equipment Cost				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
E-1.3	Spare parts									66,596,000	66,596,000	
E-1-3.1	Spare Parts		LS	1.0					33,298,000	33,298,000	33,298,000	
E-1-3.2	Start-Up and Commissioning Spare Parts		LS	1.0					16,649,000	16,649,000	16,649,000	
E-1-3.3	2years Spare parts		LS	1.0					16,649,000	16,649,000	16,649,000	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-1	Equipment Cost				UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
E-2	Installation Works					23,282,731				323,875,717	352,746,303	
E-2.1	Installation Works					6,501,946				141,875,189	149,937,602	
E-2.1.1	Installation Works of Monitoring system equipment					58,573					72,630	
E-2.1.1.1	Monitoring System 1 (MCC)		set	2.0	14,643	29,286					36,315	
E-2.1.1.2	Monitoring System 2 (ACC)		set	2.0	14,643	29,286					36,315	
E-2.1.1.3	Monitoring System 3 (OCT)		set									
E-2.1.2	Installation Works of Instruments					318,710					395,201	
E-2.1.2.1	Pressure Transmitter		set	71.0	1,480	105,053					130,266	
E-2.1.2.2	Temperature Transmitter		set	58.0	1,480	85,818					106,414	
E-2.1.2.3	Differential Transmitter		set	82.0	1,480	121,329					150,448	
E-2.1.2.4	Limit Switch valve status monitoring		set	11.0	592	6,510					8,073	
E-2.1.3	Installation Works RTU facility					1,831,605					2,271,190	
E-2.1.3.1	Installation RTU (VHF LINK)		set	23.0	14,643	336,793					417,623	
E-2.1.3.2	Installation RTU(Remove & Installation) (VHF LINK)		set	58.0	11,129	645,508					800,430	
E-2.1.3.3	Installation RTU(Remove & Installation) (CABLE LINK)		set	58.0	14,643	849,304					1,053,137	
E-2.1.4	Installation Work of Communication Facility		set	88.0					85,991,000	85,991,000	87,116,854	
	Installation work		LS	1.00					85,991,000	85,991,000	85,991,000	
	Exsinting Backup Battery removed works		set	18.00	4,227	76,094					94,356	
	Backup Battery installation		set	18.00	14,091	253,647					314,522	
	Exsinting Antenna removed works		set	42.00	13,767	578,206					716,975	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-1	Equipment Cost				UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
E-2.1.5	Cabling Works (Instrument-Junction Box-RTU-Antenna)					3,385,111.44				55,884,189	60,081,727	
/1	Primary Power Supply Cabling between MCB Panel and RTU					342,583.57				4,307,981	4,732,785	
	Cabling	CVMAZV 3C-2.5sq	m	920.0	46.72	42,982.40			4,216	3,878,298	3,931,596	
	Installation MCB Box		set	23.0	591.85	13,612.55			8,308	191,082	207,961	
	Underground line marker		m	920.0	6.23	5,731.60			259	238,602	245,709	
	Excavation by manual		m3	441.6	120.00	52,992.00					65,710	
	Backfill by manual	by excavated soil	m3	220.8	120.00	26,496.00					32,855	
	Backfill by manual	by backfill sand	m3	220.8	909.28	200,769.02					248,954	
/2	Cabling Works between RTU and Junction box					1,169,334.14				43,413,950	44,863,924	
	Cabling	10P-1.5sq	m	1,400.0	58.87	82,418.00			9,502	13,302,911	13,405,110	
		20P-1.5sq	m	600.0	98.12	58,872.00			17,582	10,549,347	10,622,348	
		10P-1.5sq	m	850.0	58.87	50,039.50			9,502	8,076,768	8,138,817	
	Installation Junction box		set	46.0	1,515.44	69,710.24			225,420	10,369,320	10,455,761	
	Hard-drawn stranded copper conductor		m	2,000.0	143.29	286,580.00			298	596,904	952,263	
	Underground line marker		m	2,000.0	6.23	12,460.00			259	518,700	534,150	
	Excavation by manual		m3	960.0	120.00	115,200.00					142,848	
	Backfill by manual	by excavated soil	m3	480.0	120.00	57,600.00					71,424	
	Backfill by manual	by backfill sand	m3	480.0	909.28	436,454.40					541,203	

I.	Engineering, Procurement and Construction				LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	
Ⅰ-1	Equipment Cost	SPECIFICATION	UNIT	QUANTITY	UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	REFERANCE NO
/3	Cabling Works between Junction box and Instruments					1,510,248.55				6,847,081	8,719,789	
	Cabling Works	1P-1.5sq	m	865.0	18.22	15,760.30			5,772	4,992,387	5,011,930	
		2ｐ-1.5sq	m	325.0	720.49	234,159.25			5,707	1,854,694	2,145,051	
	Raceway		m	1,190.0	1,059.10	1,260,329.00					1,562,808	
/4	Cabling Works between RTU and Antenna					362,945.18				168,578	618,630	
	Underground conduct pipe	埋設用FEP30	m	650.0	221.05	143,682.50					178,166	
	Cabling	Lan Cable CAT5	m	650.0	26.47	17,205.50					21,335	
	Underground line marker		m	650.0	6.23	4,049.50			259	168,578	173,599	
	Excavation by manual		m3	312.0	120.00	37,440.00					46,426	
	Backfill by manual	by excavated soil	m3	156.0	120.00	18,720.00					23,213	
	Backfill by manual	by backfill sand	m3	156.0	909.28	141,847.68					175,891	
/5	Generator (1.5KVA)		set	7.0					163,800	1,146,600	1,146,600	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
Ⅰ-1	Equipment Cost				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
E-2.2	Site Acceptance Test		LS	1.00		7,671,216				97,606,512	107,118,820	
	SCADA system		Per/d	720.00					100,000	72,000,000	72,000,000	
	Telemetry system		Per/d	240.00					100,000	24,000,000	24,000,000	
	Air Tickt for Enginner		LS	6.00					267,752	1,606,512	1,606,512	
	Hotel Charge for Enginner		day	960.00	7,991	7,671,216						
E-2.3	Commisionning & start-up		LS			7,671,216				65,858,512	75,370,820	
	SCADA system		Per/d	360.00					100,000	36,000,000	36,000,000	
	Telemetry system		Per/d							28,252,000	28,252,000	
	Air Tickt for Enginner		LS	6.00					267,752	1,606,512	1,606,512	
	Hotel Charge for Enginner		day	960.00	7,991	7,671,216					9,512,308	
E-2.4	Operation Training Cost			1.00		1,438,353.00				18,535,504	20,319,062	
	Engineer fee		Per/d	180.00					100,000	18,000,000	18,000,000	
	Air Tickt for Enginner		LS	2.00					267,752	535,504	535,504	
	Hotel Charge for Enginner		day	180.00	7,990.85	1,438,353.00					1,783,558	
E-3	Transportation							53,150.21		9,143,325	13,746,133	
E-3.1	Transportation charge for SCADA		LS	1.0				35,789.26		5,379,249	8,478,599	
E-3.2	Transportation charge for TELEMETRY		LS	1.0				17,360.94		3,764,076	5,267,534	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-1	Equipment Cost				UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
E-3.1	Transportation charge for SCADA											
1	Packing Charge											
	Case Packing		F/T	311.13								
	Crate Packing		F/T									
2	Loading Charge											
	Custom Clearance Charge	For 1 B-L	LS	1.00					5,900	5,900	5,900	
	Loading Charge	20 feet Container	F/T						5,500			
		40 feet Container	F/T	311.13					4,000	1,244,528	1,244,528	
	Documentation fee		LS	1.00					20,000	20,000	20,000	
	Export application fee		LS	1.00					30,000	30,000	30,000	
3	Ocean Freight											
	Ocean Fright											
		20 feet Container	Con				1,385.00					
		40 feet Container	Con	8.00			1,945.00	15,560.00			1,347,496	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-1	Equipment Cost				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
4	Local Port Portion											
	Custom Clearance											
		20' feet Container	Con				168.75					
		40' feet Container	Con	8.00			249.75	1,998.00			173,027	
	Delivery Charge at Port	20' feet Container	Con				47.25					
		40' feet Container	Con	8.00			81.00	648.00			56,117	
	Handling Charge at Port	Per B/L	Ship	1.00			675.00	675.00			58,455	
	Storage Charge											
	First 5 days are free	20' 3days(5-7day)	day				8.10					
		2days(9-10day)	day				16.20					
		20days(after 10days)	day				28.35					
		40' 3days(5-7day)	day	24.00			16.20	388.80			33,670	
		2days(9-10day)	day	16.00			32.40	518.40			44,893	
		20days(after 10days)	day	160.00			37.80	6,048.00			523,757	
	Delivery to Dhaka											
		20'	Con				298.89					
		40'	Con	8.00			578.34	4,626.72			400,674	
	Discharge fee at Yard											
		20'	Con				108.49					
		40'	Con	8.00			209.92	1,679.33			145,430	
	Delivery to each Site		t	74.00			32.40	2,397.60			207,632	
	Loading at Dhaka Yard		t	74.0			8.44	624.71			54,100	
	Unloading at Site		t	74.0			8.44	624.71			54,100	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-1	Equipment Cost				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
5	Insurance fee											
		I=C&P*1.1r/(1-1.1r)		0.00373						4,078,821	4,078,821	
		r=0.373%										
		C&P=FOB+Ocean Freight + Inland transportation										
		990,028,355										
	FOB	986,518,495										
	Ocean Freight	2,647,924										
	Inland Transportation	861,936										
	SCADA Equiopment Trannsportation Chrage							35,789.26		5,379,249	8,478,599	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-1	Equipment Cost				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
E-3.2	Transportation charge for TELEMETRY											
1	Packing Charge											
	Case Packing		F/T	148.61					11,500	1,709,053	1,709,053	
	Crate Packing		F/T									
2	Loading Charge											
	Custom Clearance Charge	For 1 B-L	LS	1.00					5,900	5,900	5,900	
	Loading Charge	20 feet Container	F/T	28.61					5,500	157,373	157,373	
		40 feet Container	F/T	120.00					4,000	480,000	480,000	
	Documentation fee		LS	1.00					20,000	20,000	20,000	
	Export application fee		LS	1.00					30,000	30,000	30,000	
3	Ocean Freight											
	Ocean Fright											
		20 feet Container	Con	1.00			1,385.00	1,385.00			119,941	
		40 feet Container	Con	3.00			1,945.00	5,835.00			505,311	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-1	Equipment Cost				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
4	Local Port Portion											
	Custom Clearance											
		20' feet Container	Con	1.00			168.75	168.75			14,614	
		40' feet Container	Con	3.00			249.75	749.25			64,885	
	Delivery Charge at Port	20' feet Container	Con	1.00			47.25	47.25			4,092	
		40' feet Container	Con	3.00			81.00	243.00			21,044	
	Handling Charge at Port	Per B/L	Ship	1.00			675.00	675.00			58,455	
	Storage Charge											
	First 5 days are free	20' 3days(5-7day)	day	3.00			8.10	24.30			2,104	
		2days(9-10day)	day	2.00			16.20	32.40			2,806	
		20days(after 10days)	day	20.00			28.35	567.00			49,102	
		40' 3days(5-7day)	day	9.00			16.20	145.80			12,626	
		2days(9-10day)	day	6.00			32.40	194.40			16,835	
		20days(after 10days)	day	60.00			37.80	2,268.00			196,409	
	Delivery to Dhaka											
		20'	Con	1.00			298.89	298.89			25,884	
		40'	Con	3.00			578.34	1,735.02			150,253	
	Discharge fee at Yard											
		20'	Con	1.00			108.49	108.49			9,395	
		40'	Con	3.00			209.92	629.75			54,536	
	Delivery to each Site		t	45.73			32.40	1,481.58			128,305	
	Loading at Dhaka Yard		t	45.73			8.44	386.03			33,431	
	Unloading at Site		t	45.73			8.44	386.03			33,431	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-1	Equipment Cost				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
5	Insurance fee											
		I=C&P*1.1r/(1-1.1r)		0.00373						1,361,750	1,361,750	
		r=0.373%										
		C&P=FOB+Ocean Freight + Inland transportation										
		¥330,529,713										
	FOB	¥327,066,900										
	Ocean Freight	¥3,027,578										
	Inland Transportation	¥435,235										
	Telemetry Equipment Transportation Charge							17,360.94		3,764,076	5,267,534	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
I-2-1	Direct Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
I-2-1	Radio Building・MCC/ACC Painting Works・MIRASARAI Radio building Construction・RTU /Instrument Stand Foundation & Sunshede Works											
			L.S	1.0		24,954,258.51		5,181.09		36,253,893.63	67,645,856	
2-1.1	Radio Building Painting Work s		L.S	1.0		456,456.75					566,006	
2-1.2	MCC/ACC Iterior Painting Work s		L.S	1.0		62,677.79					77,720	
2-1.3	MIRASARAI Dadio Building Construction Works		L.S	1.0		2,818,387.19					3,494,800	
2-1.4	RTU/Instrument stand Foundation and Sunshed works		L.S	1.0		11,275,443.37					13,981,550	
2-1.5	Radio Building Electric works		L.S	1.0		4,037,172.05				32,886,509	37,892,602	
2-1.6	Radio Building Plumbing, Air Conditioning works		L.S	1.0		2,419,374.64					3,000,025	
2-1.7	Transportation Works for Building works		L.S	1.0				5,181.09		951,514	1,400,196	
I-2-2	Indirect Cost											
I-2-2.1	General Temporary Works		L.S	1.0		3,884,746.74				2,415,871	7,232,955	

I	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
I-2-1	Direct Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
1.1	Radio Building Painting Works					456,456.75					566,006	
	Interior skrting AEP painting works		m	573.36	14.32	8,207.65					10,177	
	Interior wall AEP painting works		m2	1,862.55	105.00	195,567.96					242,504	
	Ceiling AEP painting works		m2	508.31	154.94	78,756.85					97,658	
	Exterior wall painting works		m2	928.55	177.17	164,511.91					203,995	
	Wooden joiner painting works		m2	18.35	180.98	3,321.71					4,119	
	Steel joiner painting works		m2	8.69	124.76	1,084.66					1,345	
	Interior cleaning works		m2	100.00	50.06	5,006.00					6,207	

I	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
I-2-1	Direct Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
1.2	MCC/ACC Iterior Painting Work s					62,677.79					77,720	
	MCC/ACC											
	Interior skrting AEP painting works		m	164.72	14.32	2,357.97					2,924	
	Interior wall AEP painting works		m2	524.52	105.00	55,075.02					68,293	
	Wooden joiner painting works		m2	28.98	180.98	5,244.80					6,504	

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
Ⅰ-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
Ⅰ-2-1	Direct Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
1.3	MIRASARAI Dadio Building Construction Works		L.S			2,818,387.19					3,494,800	
(1)	Direct Temporary works		L.S	1.0		63,556.56					78,810	
(2)	Foundation works		L.S	1.0		84,827.78					105,186	
(3)	Earth works		L.S	1.0		22,192.97					27,519	
(4)	Skeleton works		L.S	1.0		845,247.42					1,048,107	
(5)	Finishing works		L.S	1.0		1,802,562.46					2,235,177	
	(5)-1. Masonry works		L.S	1.0		231,282.71					286,791	
	(5)-2. Waterproof works		L.S	1.0		318,551.03					395,003	
	(5)-3. Stone works		L.S	1.0		23,520.44					29,165	
	(5)-4. Tile works		L.S	1.0		9,701.40					12,030	
	(5)-5. Plaster works		L.S	1.0		117,738.53					145,996	
	(5)-6. Roofing works		L.S	1.0		20,618.22					25,567	
	(5)-7. Metal works		L.S	1.0		129,302.88					160,336	
	(5)-8. Wooden joiner works		L.S	1.0		474,859.21					588,825	
	(5)-9. Steel joiner works		L.S	1.0		118,125.00					146,475	
	(5)-10. Glazing works		L.S	1.0		1,566.34					1,942	
	(5)-11. Painting works		L.S	1.0		48,426.08					60,048	
	(5)-12. Micelaniace works		L.S	1.0		308,870.61					383,000	

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
Ⅰ-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
Ⅰ-2-1	Direct Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
(1)	Direct Temporary works		L.S			63,556.56					78,810	
	Batter Board		m2	51.29	76.50	3,923.69					4,865	
	Marking		m2	51.29	41.85	2,146.49					2,662	
	Temporally scaffolding for foundation work		m2	51.29	225.27	11,554.10					14,327	
	Temporally scaffolding exterior wall		m2	133.88	250.99	33,601.15					41,665	
	Temporally scaffolding inside Skelton work		m2	51.29	80.13	4,109.87					5,096	
	Temporally scaffolding interior finishing work		m2	51.29	160.29	8,221.27					10,194	
(2)	Foundation works		L.S			84,827.78					105,186	
	Clash stone laying work	Under the Foundation	m3	8.67	5,171.25	44,846.37					55,610	
	Clash stone laying work	Under ground slab	m3	7.46	5,171.25	38,584.64					47,845	
	Damp-proof sheet laying	Under ground slab	m2	49.74	28.08	1,396.77					1,732	
(3)	Earth works		L.S			22,192.97					27,519	
	Excavation by manual		m3	102.9	120.00	12,345.35					15,308	
	Backfill by manual		m3	72.1	120.00	8,653.80					10,731	
	Banking by manual	By excavated soil	m3	9.9	120.00	1,193.82					1,480	

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
Ⅰ-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
Ⅰ-2-1	Direct Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
(4)	Skeleton works		L.S			845,247.42					1,048,107	
	《Concrete work》											
	Blinding concrete mixing	fc=15N/mm2 t=50mm	m3	2.89	5,684.13	16,431.40					20,375	
	Placing blinding concrete		m3	2.89	173.55	501.69					622	
	FC-21N/mm2 concrete mixing	foundation	m3	19.20	6,684.56	128,342.72					159,145	
	Placing concrete (foundation)	foundation	m3	19.20	433.87	8,330.25					10,330	
	FC-21N/mm2 concrete mixing	ground slab	m3	10.34	6,684.56	69,121.69					85,711	
	Placing concrete (ground slab)	ground slab	m3	10.34	166.87	1,725.52					2,140	
	FC-21N/mm2 concrete mixing	upper Skelton	m3	16.88	6,684.56	112,867.12					139,955	
	Placing concrete (upper Skelton)	upper Skelton	m3	16.88	287.03	4,846.35					6,009	
	Common form		m2	142.00	1,136.45	161,375.90					200,106	
	Fabrication for small size re-bar		t	2.65	69,739.00	184,543.34					228,834	
	Installation for small size re-bar		t	2.65	3,819.40	10,106.90					12,533	
	Fabrication for large size re-bar		t	2.09	68,804.50	143,917.68					178,458	
	Installation for large size re-bar		t	2.09	1,499.68	3,136.87					3,890	

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
Ⅰ-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
Ⅰ-2-1	Direct Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
(5)	Finishing works		L.S	1.00		1,802,562.46					2,235,177	
	(5)-1. Mason work		L.S			231,282.71					286,791	
	Brick laying for exterior wall	Exterior wall t-200	m2	79.78	2,796.10	223,081.60					276,621	
	Brick laying for interior wall	partition wall t-100	m2	5.84	1,403.70	8,201.12					10,169	
	(5)-2. Waterproof works		L.S	1.00		318,551.03					395,003	
	Asphalt roofing sheet build up waterproof (on floor)		m2	62.81	4,203.22	263,983.23					327,339	
	Asphalt roofing sheet build up waterproof (on wall)		m2	5.15	4,197.24	21,594.80					26,778	
	Angle stopper		m	34.3	332.81	11,415.38					14,155	
	Caulking surround joiner		m	46.0	93.60	4,305.60					5,339	
	Caulking on exterior wall		m	76.9	214.95	16,529.66					20,497	
	Internal Conner mortar for waterproof (on floor)		m	34.3	21.06	722.36					896	
	(5)-3. Stone works		L.S	1.00		23,520.44					29,165	
	Terrazzo block installation on floor		m2	15.2	1,230.00	18,697.54					23,185	
	Terrazzo block installation on skirting		m	20.2	239.35	4,822.90					5,980	
	(5)-4. Tile works		L.S	1.0		9,701.40					12,030	
	Tiling on floor		m2	2.5	1,130.00	2,779.80					3,447	
	Tiling on wall		m2	6.7	1,030.00	6,921.60					8,583	

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
Ⅰ-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
Ⅰ-2-1	Direct Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
	(5)-5. Plaster works		L.S			117,738.53					145,996	
	《Floor》											
	Mortar steel trowel on floor		m2	35.83	281.84	10,096.92					12,520	
	Mortar bedding for floor tile		m2	2.46	300.00	738.00					915	
	Mortal steel trowel on stair case		m2	3.44	518.39	1,784.56					2,213	
	《Skirting》											
	Mortar skirting H-100		m	31.10	107.15	3,332.37					4,132	
	Mortar skirting H-300		m	33.50	161.18	5,399.53					6,695	
	《Wall》											
	Mortar steel trowel on exterior wall		m2	96.66	295.00	28,515.44					35,359	
	Mortar steel trowel on interior wall		m2	134.06	343.64	46,067.52					57,124	
	Mortar bedding for wall tile		m2	6.72	186.77	1,255.09					1,556	
	《Others》											
	Grouting mortar surround exterior joiner		m	3.60	222.33	800.39					992	
	Grouting mortar surround interior joiner		m	18.20	147.31	2,681.04					3,324	
	Mortar topping exterior wall		m	34.3	229.29	7,864.65					9,752	
	Repairing ceiling concrete surface		m2	11.8	12.01	141.87					176	
	Mortar finishing window shell		m	6.60	147.98	976.67					1,211	
	Mortar finishing exterior glove		m	76.9	105.13	8,084.50					10,025	
	(5)-6. Roofing works		L.S			20,618.22					25,567	
	Roof draing(100φ)	For asphalt proof	pce	2.0	3,782.91	7,565.82					9,382	
	Down-spout	PVC-100φ	m	6.0	2,175.40	13,052.40					16,185	
	(5)-7. Metal works		L.S			129,302.88					160,336	
	Grille for window		m2	9.3	13,933.50	129,302.88					160,336	

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
Ⅰ-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
Ⅰ-2-1	Direct Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
	(5)-8. Wooden joiner works		L.S			474,859.21					588,825	
	Wooden door D-1	1.0 x 2.1	set	4.0	42,137.69	168,550.76					209,003	
	Wooden door D-2	0.8 x 2.1	set	1.00	37,710.19	37,710.19					46,761	
	Wooden window W-1	1.0 x 1.0	set	6.0	38,956.11	233,736.66					289,833	
	Wooden window W-2	0.6 x 0.6	set	1.0	34,861.60	34,861.60					43,228	
	(5)-9. Steel joiner works		L.S			118,125.00					146,475	
	Light weight roll shutter	1.8m x 2.1	set	1.0	118,125.00	118,125.00					146,475	Local unit P-96
	(5)-10. Glazing works		L.S			1,566.34					1,942	
	Float glass t-5mm		m	6.36	246.28	1,566.34					1,942	
	(5)-11. Painting works		L.S			48,426.08					60,048	
	Exterior wall AEP painting		m2	96.7	177.17	17,125.70					21,236	
	Ceiling AEP painting		m2	47.1	154.94	7,297.09					9,048	
	Interior wall AEP painting		m2	134.1	105.00	14,076.04					17,454	
	Wooden joiner painting		m2	23.2	180.98	4,195.84					5,203	
	Steel joiner painting		m2	8.7	124.76	1,084.66					1,345	
	Interior skirting AEP painting		m	31.1	14.32	445.20					552	
	Dustproof painting		m2	35.8	117.28	4,201.56					5,210	

I	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
I-2-1	Direct Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
	(5)-12. Micelaniace works		L.S			308,870.61					383,000	
	Septic tank/Soak well/Drainage											
	Excavation by manual		m3	47.7	120.00	5,724.68					7,099	
	Backfill by manual		m3	27.7	120.00	3,322.76					4,120	
	Clash stone laying work	foundation	m3	6.02	5,171.25	31,136.10					38,609	
	FC-21N/mm2 concrete mixing	foundation	m3	6.91	6,684.56	46,159.23					57,237	
	Placing concrete (foundation)	foundation	m3	6.91	433.87	2,996.02					3,715	
	Common form		m2	15.76	1,136.45	17,910.45					22,209	
	Fabrication for small size re-bar		t	0.28	69,739.00	19,215.19					23,827	
	Installation for small size re-bar		t	0.28	3,819.40	1,052.36					1,305	
	Brick laying for exterior wall	Exterior wall t-200	m2	44.29	2,796.10	123,844.86					153,568	
	Mortar steel trowel on floor		m2	14.52	281.84	4,092.32					5,074	
	Mortar steel trowel on exterior wall		m2	51.84	295.00	15,292.80					18,963	
	Manhole cover 450φ		pce	2.00	19,061.93	38,123.86					47,274	

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
Ⅰ-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
Ⅰ-2-1	Direct Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
1.4	RTU/Instrument stand Foundation and Sunshed works					11,275,443.37					13,981,550	
(1)	Direct Temporary Works		L.S	1.0		41,547.95					51,519	
(2)	Foundation works		L.S	1.0		371,026.85					460,073	
(3)	Earth works		L.S	1.0		84,629.64					104,941	
(4)	Skeleton works		L.S	1.0		10,310,897.61					12,785,513	
(5)	Finishing works		L.S	1.0		467,341.32					579,503	
	(5)-1. Plaster works		L.S	1.0		21,527.00					26,693	
	(5)-2. Roofing works		L.S	1.0		445,814.33					552,810	

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
Ⅰ-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
Ⅰ-2-1	Direct Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
(1)	Direct Temporary Works		L.S			41,547.95					51,519	
	Batter Board		m2	351.1	76.50	26,856.09					33,302	
	Marking		m2	351.1	41.85	14,691.86					18,218	
(2)	Foundation works		L.S			371,026.85					460,073	
	Clash stone laying works	Under the Foundation	m3	38.3	5,171.25	198,219.18					245,792	
	Clash stone laying works	Under ground slab	m3	33.4	5,171.25	172,807.66					214,281	
(3)	Earth works		L.S			84,629.64					104,941	
	Excavation by manual		m3	408.0	120.00	48,962.88					60,714	
	Backfill by manual		m3	264.5	120.00	31,740.96					39,359	
	Banking by manual	By excavated soil	m3	32.7	120.00	3,925.80					4,868	
(4)	Skeleton works		L.S			10,310,897.61					12,785,513	
	《Concrete work》											
	Blinding concrete mixing	fc=15N/mm2 t=50mm	m3	12.8	5,684.13	72,626.13					90,056	
	Placing blinding concrete		m3	12.8	173.55	2,217.45					2,750	
	FC-21N/mm2 concrete mixing	foundation	m3	210.8	6,684.56	1,409,045.09					1,747,216	
	Placing concrete (foundation)	foundation	m3	210.8	433.87	91,455.89					113,405	
	Common form		m2	1,166.5	1,136.45	1,325,703.02					1,643,872	
	Installation for anchor bolt		pce	404.0	237.20	95,828.80					118,828	
	Fabrication for small size re-bar		t	13.4	69,739.00	937,531.36					1,162,539	
	Installation for small size re-bar		t	13.4	3,819.40	51,345.84					63,669	
	Fabrication for large size re-bar		t	11.7	68,804.50	805,322.27					998,600	
	Installation for large size re-bar		t	11.7	1,499.68	17,553.00					21,766	
	Steel fabrication on shop		t	23.0	142,000.00	3,272,506.03					4,057,907	
	Mortar finish under steel Column		pce	202.0	200.05	40,410.10					50,109	
	Steel structure erection		t	23.0	15,000.00	345,687.26					428,652	
	Hot deep Galvanized steel		t	23.0	80,000.00	1,843,665.37					2,286,145	

I	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
I-2-1	Direct Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
(5)	Finishing works		L.S			467,341.32					579,503	
	(5)-1. Plaster works		L.S			21,527.00					26,693	
	Steel trowel concrete floor		m2	351.06	61.32	21,527.00					26,693	
	(5)-2. Roofing works		L.S			445,814.33					552,810	
	Galvanizedsteel corrugated sheet roofing		m2	426.47	645.00	275,069.93					341,087	
	Galvanizedsteel corrugated sheet wall		m2	264.72	645.00	170,744.40					211,723	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
I-2-1	Direct Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
2-1.5	Radio Building Electric works					4,037,172.05				32,886,509.02	37,892,602	
2-1.5.1	MIRASARAI Radio Building Construction Electric Works		L.S	1.0		3,151,905.92				999,000	4,907,363	
2-1.5.2	Replacement of Generator at Radio Building		L.S	1.0		286,073.76				19,332,000	19,686,731	
2-1.5.3	Monopole and foundation for telemetry antenna		L.S	1.0		599,192.37				12,555,509	13,298,508	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
I-2-1	Direct Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
2-1.5.1	MIRASARAI Radio Building Construction Electric Works		L.S	1.00		3,151,905.92				999,000	4,907,363	
1.5.1.1	Power supply line works		L.S	1.00		393,267.44				999,000	1,486,652	
1.5.1.2	Lighting fixture and out let works		L.S	1.00		2,758,638.48					3,420,712	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
I-2-1	Direct Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
1.5.1.1	Power supply line works		L.S			393,267.44				999,000	1,486,652	
	Conduit pipe	Under ground VE28	m	15.00	340.34	5,105.10					6,330	
	Cable	CV 25sqmm-4C+E	m	15.00	2,513.22	37,698.30					46,746	
	Cable	IV10mm	m	15.00	193.24	2,898.60					3,594	
	Main income panel		set	1.00	347,565.44	347,565.44					430,981	
	Change-over switch panel		set	1.00					999,000	999,000	999,000	
1.5.1.2	Lighting fixture and out let works		L.S			2,758,638.48					3,420,712	
	Conduit pipe	Under ground VE20	m	128.4	236.88	30,415.39					37,715	
	Cable	CV 3.5sqmm-1c	m	276.6	139.98	38,711.47					48,002	
	Cable	IV2.0mm	m	128.0	58.00	7,424.00					9,206	
	Switch	1P15Ax2	pce	7.0	795.65	5,569.55					6,906	
	Out let	2P15Ax2	pce	8.0	2,226.55	17,812.40					22,087	
	Lighting fixture	Ceiling mounted Fluorescence lighting fixture	set	8.0	18,325.97	146,607.76					181,794	
	Lighting fixture	Incandescent lump 60W	set	3.0	1,566.07	4,698.21					5,826	
	Lighting fixture	Mercury vapour lamp 400w	pce	26.0	95,468.37	2,482,177.62					3,077,900	
	Flush-mounted box	100x100	pce	26.0	970.08	25,222.08					31,275	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
I-2-1	Direct Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
2-1.5.2	Replacement of Generator at Radio Building		L.S			286,073.76				19,332,000.00	19,686,731	
	Generator installation	15KVA	set	6.00	47,678.96	286,073.76			2,223,000	13,338,000	13,692,731	
	Change-over switch panel		set	6.00					999,000	5,994,000	5,994,000	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
I-2-1	Direct Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
2-1.5.3	Monopole and foundation for telemetry antenna		L.S			599,192.37				12,555,509.02	13,298,508	
1.5.3.1	Panzer mast foundation works											
	Excavation by manual		m3	558.17	120.00	66,980.46					83,056	
	Backfill by manual		m3	544.7	120.00	65,362.33					81,049	
	Footing concrete	FC-21N/mm2 concrete mixing	m3	6.37	6,684.56	42,580.65					52,800	
	Form for footing concrete	Common form	m2	19.5	1,136.45	22,160.78					27,479	
1.5.3.2	Panzer mast installation works											
	Panzer mast installation works											
	Panzer mast 8.0m installation		set	1.0	2,122.09	2,122.09			88,452.00	88,452	91,083	
	Panzer mast 10.0m installation		set	3.00	2,612.70	7,838.10			119,620.80	358,862	368,582	
	Panzer mast 15.0m installation		set	7.0	4,843.82	33,906.74			280,519.20	1,963,634	2,005,679	
	Panzer mast 20.0m installation		set	12.00	5,309.12	63,709.44			437,205.60	5,246,467	5,325,467	
	Supply panzer mast material											
	Panzer mast 10.0m		set	1.0					115,020.00	115,020	115,020	
	Panzer mast 15.0m		set	1.00					269,730.00	269,730	269,730	
	Panzer mast 20.0m		set	5.0					420,390.00	2,101,950	2,101,950	
1.5.3.3	Lightning protection system for panzer mast											
	Air terminal		set	23.0	4,127.37	94,929.51			35,939.70	826,613	944,326	
	Copper wire	35sq	m	613.00	143.29	87,836.77			298.45	182,951	291,869	
	Test grounding terminal box		pce	23.0	389.37	8,955.51			21,481.20	494,068	505,172	
	Grounding electrode		set	230.00	447.00	102,810.00			1,946.16	447,617	575,101	
	Materilal supply											
	Air terminal		set	7.0					35,939.70	251,578	251,578	
	Copper wire		m	195.0					298.45	58,198	58,198	
	Test grounding terminal box		pce	7.00					21,481.20	150,368	150,368	
	Grounding electrode		set	70.0					1,946.16	136,231	136,231	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
I-2-1	Direct Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
2-1.6	MIRASARAI Dadio Building Construction Works					551,476.66		0.00		0.00	683,831	
(1)	Water supply and drainage system											
	Water supply pipe	HIVP20A (under ground)	m	1.50	359.37	539.06					668	
		HIVO20A (toilet)	m	4.00	549.39	2,197.56					2,725	
		HIVP15A (toilet)	m	7.50	509.44	3,820.80					4,738	
	Faucet	15A	pce	2.00	1,711.61	3,423.22					4,245	
	Plumbing fixture	Wash basin	pce	1.00	26,839.71	26,839.71					33,281	
	Plumbing fixture	Water close	pce	1.00	22,300.54	22,300.54					27,653	
	Drain pipe	PVC100A (under ground)	m	3.00	1,529.46	4,588.38					5,690	
	Drain pipe	PVC50A (under ground)	m	5.00	601.82	3,009.10					3,731	
	Drain fitting	Drain strainer fitting 50A	pce	1.00	4,779.95	4,779.95					5,927	
	Gate valve	Gate valve (15φ)	pce	1.00	2,171.09	2,171.09					2,692	
	Gate valve	Gate valve (20φ)	pce	2.00	2,190.56	4,381.12					5,433	
	FRP water tank 1.0*1.0*1.0	1.0m3	pce	1.00	418,017.89	418,017.89					518,342	
	Ventilator 500φ on wall		pce	2.00	27,704.12	55,408.24					68,706	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
I-2-1	Direct Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
2	Replacement of A/C					1,867,897.98					2,316,193	
	Wall type air-conditionar	(12000kcal/h)	set	18.00	103,533.82	1,863,608.76					2,310,875	
	Remove exsisted air-conditonar		set	18.00	238.29	4,289.22					5,319	
	Total					2,419,374.64		0.00		0.00	3,000,025	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		EURO PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
I-2-1	Direct Construction Cost				(BDT)	(BDT)	US$	US$	(€)	(€)	Yen	Yen	Yen	
	Building Material													
1	Packing Charge													
	Case Packing		F/T	13.02							15,060	196,044	196,043	
	Crate Packing		F/T	26.84							15,060	404,200	404,200	
2	Loading Charge													
	Custom Clearance Charge	For 1 B-L	LS	1.00							5,900	5,900	5,900	
	Loading Charge	40 feet Container	F/T	39.86							4,000	159,427	159,427	
	Documentation fee		LS	1.00							20,000	20,000	20,000	
	Export application fee		LS	1.00							30,000	30,000	30,000	
3	Ocean Freight													
	Ocean Fright													
		40 feet Container	pce	1.00			1,945.00	1,945.00					168,437	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		EURO PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
I-2-1	Direct Construction Cost				BDT	BDT	US$	US$	(€)	(€)	Yen	Yen	Yen	
4	Local Port Portion													
	Custom Clearance													
		20' feet Container	Con				168.75							
		40' feet Container	Con	1.00			249.75	249.75					21,628	
	Delivery Charge at Port	20' feet Container	Con				47.25							
		40' feet Container	Con	1.00			81.00	81.00					7,014	
	Handling Charge at Port	Per B/L	Ship	1.00			675.00	675.00					58,455	
	Storage Charge													
	First 5 days are free	20' 3days(5-7day)	day				8.10							
		2days(9-10day)	day				16.20							
		20days(after 10days	day				28.35							
		40' 3days(5-7day)	day	3.00			16.20	48.60					4,208	
		2days(9-10day)	day	2.00			32.40	64.80					5,611	
		20days(after 10days	day	20.00			37.80	756.00					65,469	
	Delivery to Dhaka													
		20'	Con				298.89							
		40'	Con	1.00			578.34	578.34					50,084	
	Discharge fee at Yard													
		20'	Con				108.49							
		40'	Con	1.00			209.92	209.92					18,178	
	Delivery to each Site		t	11.62			32.40	376.49					32,603	
	Loading at Dhaka Yard		t	11.62			8.44	98.10					8,495	
	Unloading at Site		t	11.62			8.44	98.10					8,495	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		EURO PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
I-2-1	Direct Construction Cost				BDT	BDT	US$	US$	(€)	(€)	Yen	Yen	Yen	
5	Insurance fee													
		I=C&P*1.1r/(1-1.1r)		0.00373								135,943		
		r=0.373%												
		C&P=FOB+Ocean Freight + Inland transportation												
		¥32,782,102												
	FOB	¥31,732,626												
	Ocean Freight	¥984,007												
	Inland Transportation	¥65,469												
	Total Amount							5,181.09				951,514	1,400,196	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
I-2-2	Indirect Construction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
	General Temporary Works		L.S	1.00		3,884,746.74				2,422,557.09	7,239,642.00	
(1)	Amount of Ratio from direct cost		L.S	1.00		0.00				2,422,557.09	2,422,557.00	
(2)	Preparation works		L.S	1.00		0.00					0.00	
(3)	Temporary building cost		L.S	1.00		0.00					0.00	
(4)	Temporary facilities cost		L.S	1.00		0.00					0.00	
(5)	Safety & Security works		L.S	1.00		3,069,831.16					3,806,590.00	
(6)	Fuel & Power cost		L.S	1.00		490,024.30					607,630.00	
(7)	Outdoor cleaning cost		L.S	1.00		0.00					0.00	
(8)	Construction facility cost		L.S	1.00		324,891.28					402,865.00	
(9)	Transportation cost		L.S	1.00		0.00					0.00	
(10)	others		L.S	1.00		0.00					0.00	

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
I-2-2	Indirect Cocstruction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
(1)	Amount of Ratio from direct cost		L.S	1.00		0.00				2,422,557	2,422,557.0	
	General Temporary works for Building works											
	$Kr=4.83 \times P^{-0.0168}$	Kr:	Ratio of General temporary works								4.01	
		P:	Direct Cost (1000 Yen)					Direct cost			60,412.9	
	Amount of general temporary works			Direct cost x ratio					60,412,895.02	4.01	2,422,557.1	
								Building works			18,120,074.0	
								Plumbing works			7,907,387.0	
								Other works			32,985,238.0	
								Transportation			1,400,196.0	
										2,422,557.1		

I.	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERANCE NO
I-2	Associated Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
I-2-2	Indirect Cocstruction Cost				BDT	BDT	US$	US$	Yen	Yen	Yen	
(2)	Preparation works		L.S	1.00		0					0.0	
(3)	Temporary building cost		L.S	1.0		0.00					0.0	
(3)－1	Temporary facilities cost		L.S	1.0		0.00					0.0	
(4)	Temporary facilities cost		L.S	1.00		0.00					0.0	
(5)	Safety & Security works		L.S	1.0		2,782,150.36					3,806,590.00	
	Guardman	(1person x 3sift x 5month)	M	15.0	96,000.00	1,440,000.00						
(6)	Fuel & Power cost		L.S	1.00		202,343.50					607,630.00	
	Generator 35KVA		L.S	1.00	202,343.50	202,343.50						
	Fuel	0.170L/KW-hx33.0 x 8hx25dx5m	L	5,610.0	51.28	287,680.80						
(7)	Outdoor cleaning cost		L.S	1.00		0.00					0.0	
(8)	Construction facility cost		L.S	1.00		324,891					402,865.00	
	Concrete Mixer	0.3m3	set	2.00	101,525.00	203,050.00					251,782.00	
	Fuel	0.495L/KW-hx4.8.0 x 8hx25dx5m	L	2,376.0	51.28	121,841.28					151,083.00	
(9)	Transportation cost		L.S									
(10)	others		L.S									

Ⅰ-3 EPC management

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
3	EPC management				UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅰ-3(5)	EPC management Cost											
(1)	Temporary Site Facilities		LS	1	68,276,929	68,276,929	0	0	6,672,000	6,672,000	91,335,392	
(2)	Shop inspection		LS	1	0	0	0	0	162,840	162,840	162,840	
(3)	Pre-shipment review		LS	1	0	0	0	0	162,840	162,840	162,840	
(4)	Inspection before shipping		LS	1	0	0	0	0	187,680	187,680	187,680	
(5)	EPC management Cost		LS	1	20,640,580	20,640,580	0	0	54,485,690	54,485,690	80,080,009	
	Total					88,917,509		0		61,671,050	171,928,761	

Ⅰ-3 EPC management

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
3	EPC management				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
	Temporary Site Facilities				BDT	BDT	US$	US$	Yen	Yen	Yen	
Ⅰ-3(5)	Temporary Site Facilities											analysis sheetNo.
/1	Local Site Facilities		LS	1.0		20,139,840					24,973,402	
/2	Office Facilities		LS	1.0		16,520,496				6,672,000	27,157,415	
/3	Vehicles		LS	1.0		31,616,593					39,204,576	
	Total					68,276,929				6,672,000	91,335,392	

Temporary Site Facilities

Ⅰ-3 Temporary Site Facilities

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
3	Temporary Site Facilities				UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅰ-3 (1)	Temporary Site Facilities											analysis sheetNo.
/1	Local Site Facilities		day	2,240.0	8,991	20,139,840					24,973,402	
	4personsx2weeksx2timesx20places											
	Hotel rate	7,991										
	Daily allowance	1,000										
	total	8,991										
	Total					20,139,840					24,973,402	

Ⅰ-1 Temporary Site Facilities

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
1	Temporary Site Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
Ⅰ-1 (1)	Temporary Site Facilities											analysis sheetNo.
/2	Office Facilities	Demra and Ashuganj										
/2－1	Office (3LDK)	12monthsx2places	months	24.0	136,986	3,287,664					4,076,703	
/2－2	Furniture for Office	2*12monthsx2places	LS	2.0	500,000	1,000,000					1,240,000	
/2－3	Computer Equipments											
a	PC with UPS	1x2Places	set	2.0					340,000	680,000	680,000	
b	Laptop PC	2x2Places	set	4.0					220,000	880,000	880,000	
c	A3/A4 Color printer/Scanner/C	1x2Places	set	2.0					2,000,000	4,000,000	4,000,000	
d	Comsumables(Paper, ink .etc)		LS	1.0						1,112,000	1,112,000	
e	Connections Fees(Broadband Int	12monthsx2	months	24.0	35,000	840,000					1,041,600	
/2－4	Inspection Equipments		LS	1.0	1,000,000	1,000,000						
/2－5	Utility Charges(electricty,Fuel and Water)		months	72	30,000	2,160,000					2,678,400	
/2－6	Accommodations(3LDK)	2*12monthsx2places	months	48.0	136,986	6,575,328					8,153,407	
/2－7	Furniture for Accommodation		LS	2.0	500,000	1,000,000					1,240,000	
/2－8	Office Boy	(1+2)x12x2	m/m	72	9,132	657,504					815,305	
	Total					16,520,496				6,672,000	25,917,415	

Ⅰ-1 Temporary Site Facilities

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
1	Temporary Site Facilities				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
Ⅰ-1 (1)	Temporary Site Facilities											analysis sheetNo.
/3	Vehicles											
a	Vehicles											
a-1	Saloon Car		set	1.0	3,995,425	3,995,425					4,954,327	
a-2	Land cruiser		set	4.0	6,048,387	24,193,548					30,000,000	
b	Fuel expense											
b-1	Saloon Car	1x12	months	12.0	24,735	296,820					368,057	
b-2	Land cruiser	4*12	months	48.0	44,962	2,158,176					2,676,138	
	Saloon Car	112kWx0.047l/kWx3.43hx57.08TK/lx24days										
		24735										
	Land cruiser	203kWx0.047l/kWx3.44hx57.08TK/lx24days										
		44962										
c	Automobile insuranc											
c-1	Saloon Car	1x12	months	12.0	5,708	68,496					84,935	
c-2	Land cruiser	4*12	months	48.0	4,566	219,168					271,768	
d	Driver	(1+4)x12	m/m	60	11,416	684,960					849,350	
	Total					31,616,593					39,204,576	

Ⅰ-3 EPC management

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
3	EPC management				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
Ⅰ-3 (2)	Shop Inspection											
/1	Inspector	class3	m/m	0.18					778,000	140,040	140,040	
/2	Daily Allowance	class3	day	6.00					3,800	22,800	22,800	
	Total									162,840	162,840	

Ⅰ-3 EPC management

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
3	EPC management				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
Ⅰ-3(3)	Pre-shipment review											
/1	Inspector		m/m	0.18					778,000	140,040	140,040	
/2	Daily allowance		day	6.00					3,800	22,800	22,800	
	Total									162,840	162,840	

Ⅰ-3 EPC management

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
3	EPC management				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
Ⅰ-3(4)	Inspection before shipping											
/1	Inspector		m/m	0.18					778,000	140,040	140,040	
/2	Cost of travel		time	6.00					4,140	24,840	24,840	
/3	Daily allowance		day	6.00					3,800	22,800	22,800	
	Total									187,680	187,680	

Ⅰ-3 EPC management

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
3	EPC management				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
Ⅰ-3(5)	EPC management Cost											analysis sheetNo.
/1	Direct Personal Cost		LS	1.0						36,254,800	36,254,800	PSV1
/2	Cost of Local Staff		LS	1.0		9,417,820					11,678,097	PSV2
/3	cost of travel, daily allowance and lodging expense		LS	1.0		2,739,720				15,587,868	18,985,121	PSV3
/4	Welfare expense		LS	1.0						369,550	369,550	PSV4
/5	Stationery cost [expense]		LS	1.0						1,164,822	1,164,822	PSV5
/6	Communication cost [expense]		LS	1.0						526,239	526,239	PSV6
/7	Traveling expenses		LS	1.0		8,483,040					10,518,970	PSV7
/8	Social expenses		LS	1.0						582,411	582,411	PSV8
/9	Others		LS	1.0								PSV9
	Total					20,640,580				54,485,690	80,080,009	

Schedule of EPC management

Item	3	2012 Apr ～ Dec	2013 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	2014 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	2015 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	Remarks
Design and installation work						
Detail design	-3 (5)		0			
Procurement ,manufacturing, inspection and transportation						
Installation work						
Design of Foundation						
Preparation and Civil Works						
Commissioning						
Start-up training						
Inspection and Hand Over						
O & M (2year)						

Personnel assignment		M/M Local	M/M Inland	M/M total	trip
Engineer(SCADA)	class 3	14.00	4.00	18.00	3
Engineer(Telecom)	class 3	13.00	4.00	17.00	3
Inspector(SCADA)	class 3	5.00	0.30	5.30	1
Inspector(Telecom)	class 3	6.00	0.30	6.30	2
		38.00	8.60	46.60	9
local Staff					
Assistant engineer	10 yrs. exp.	20.00			
Assistant engineer	10 yrs. exp.	20.00			
Assistant engineer 4Person (SCADA)	10 yrs. exp.	36.00			
Assistant engineer 2Person (Communication)	10 yrs. exp.	14.00			
Office administrator		20.00			
Driver					
Driver for 4WD		20.00			
Driver for 4WD		20.00			
Driver for 4WD 4person		36.00			
Driver for 4WD 2person		14.00			
Vehicle					
4WD		20.00			
4WD		20.00			
4WD 4cars		36.00			
4WD 2cars	3	14.00			

EPCM-6
(Schdule of EPC Management

Ⅰ-3 EPC management

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
3	EPC management				UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅰ-3(5)	EPC management Cost											
/1	Direct Personal Cost											
a	Local Work		m/m	38.0					778,000	29,564,000	29,564,000	
b	Internal Work		m/m	8.6					778,000	6,690,800	6,690,800	
	Total									36,254,800	36,254,800	

Ⅰ-3 EPC management

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
3	EPC management				UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅰ-3 (5)	EPC management Cost											
/2	Cost of Local Staff											
a	Assistant engineer	10 yrs. exp.	m/m	40.0	85,616	3,424,640					4,246,554	
b	Assistant engineer 4Person (SCADA)	10 yrs. exp.	m/m	36.0	85,616	3,082,176					3,821,898	
c	Assistant engineer 2Person (Communication)	10 yrs. exp.	m/m	14.0	85,616	1,198,624					1,486,294	
d	Office administrator		m/m	20.0	34,247	684,940					849,326	
e	Driver for 4WD		m/m	40.0	11,416	456,640					566,234	
f	Driver for 4WD 4person		m/m	36.0	11,416	410,976					509,610	
g	Driver for 4WD 2person		m/m	14.0	11,416	159,824					198,182	
	Total					9,417,820					11,678,097	

Ⅰ-3 EPC management

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
3	EPC management				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
Ⅰ-3 (5)	EPC management Cost											
/3	cost of travel, daily allowance and lodging expense											
3-1	Cost of travel											
	Economy class		trip	9.0					272,852	2,455,668	2,455,668	Tokyo-Hong Kong-Dhaka
	Economy class	¥267,752										Tokyo-Hong Kong-Dhaka
	Farelocal transport	¥5,100										one way 2550(tokyo～nippori～narita)
	total	¥272,852										
												analysis sheetNo.
3-2	Daily allowance		LS	1.0						7,459,800	7,459,800	.PSV3-1
3-3	Lodging expense		LS	1.0		2,739,720				5,672,400	9,069,653	PSV3-2
	Total					2,739,720				15,587,868	18,985,121	

Ⅰ-3 EPC management

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
3	EPC management				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
Ⅰ-3 (5)	EPC management Cost											
/3-2	Daily allowance											
	Engineer(SCADA)		m/m	14.00								
	Engineer(Telecom)		m/m	13.00								
	Inspector(SCADA)		m/m	5.00								
	Inspector(Telecom)		m/m	6.00								
a	Daily allowance for Class3	1day-30day	day	210.00					3,800	798,000	798,000	
b	Daily allowance for Class3	31day～60day	day	150.00					3,420	513,000	513,000	
c	Daily allowance for Class3	over61day	day	180.00					3,040	547,200	547,200	
d	Daily allowance		month	20.00					280,080	5,601,600	5,601,600	
	Total									7,459,800	7,459,800	

Ⅰ-3 EPC management

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
3	EPC management				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
Ⅰ-3 (5)	EPC management Cost											
/3-2	Lodging expense											
	Engineer(SCADA)		m/m	14.0								
	Engineer(Telecom)		m/m	13.0								
	Inspector(SCADA)		m/m	5.0								
	Inspector(Telecom)		m/m	6.0								
a	Lodging expense of Class 3	1day-30day	day	210.0					11,600	2,436,000	2,436,000	
b	Lodging expense of Class 3	31day～60day	day	150.0					10,440	1,566,000	1,566,000	
c	Lodging expense of Class 3	over61day	day	180.0					9,280	1,670,400	1,670,400	
d	Accommodation	2X300/30	month	20.0	136,986	2,739,720					3,397,253	
	Total					2,739,720				5,672,400	9,069,653	

Ⅰ-3 EPC management

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
3	EPC management				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
Ⅰ-3 (5)	EPC management Cost											
/4	Welfare expense		LS	1.0						369,550	369,550	A×B÷100
	A: Direct Personal Cost(L Work)	29,564,000										
	B: ratio	1.25%										
	'=12750×A-1+0.82											
	Total									369,550	369,550	

Ⅰ-3 EPC management

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
3	EPC management				UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅰ-3 (5)	EPC management Cost											
/5	Stationery cost [expense]		LS	1.0						1,164,822	1,164,822	A×B÷100
	A: Direct Personal Cost(L Work)	29,564,000										
	B: ratio	3.94%										
	B=30134×A-1+2.92											
	Total									1,164,822	1,164,822	

Ⅰ-3 EPC management

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
3	EPC management				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
Ⅰ-3 (5)	EPC management Cost											
/6	Communication cost [expense]		LS	1.0						526,239	526,239	A×B÷100
	A: Direct Personal Cost(L Work)	29,564,000										
	B: ratio	1.78%										
	B=21199XA-1+1.076											
	Total									526,239	526,239	

Ⅰ-3 EPC management

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
3	EPC management				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
Ⅰ-3 (5)	EPC management Cost											
/7	Transportation cost											
a	Vehicle											
a-1	4WD		month	40.0	74,746	2,989,840					3,707,402	
a-2	4WD		month	36.0	76,546	2,755,656					3,417,013	
a-3	4WD		month	14.0	76,546	1,071,644					1,328,839	
b	Fuel expense											
b-1	4WD		month	40.0	13,944	557,760					691,622	
b-2	4WD		month	36.0	13,944	501,984					622,460	
b-3	4WD		month	14.0	13,944	195,216					242,068	
c	Automobile insuranc											
c-1	4WD		month	40.0	4,566	182,640					226,474	
c-2	4WD		month	36.0	4,566	164,376					203,826	
c-3	4WD		month	14.0	4,566	63,924					79,266	
	Total					8,483,040					10,518,970	

Ⅰ-3 EPC management

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅰ	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
3	EPC management				UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅰ-3 (5)	EPC management Cost											
/8	Social expenses		LS	1.0						582,411	582,411	A×B÷100
	A: Direct Personal Cost(L Work)	¥29,564,000										
	B: ratio	1.97%										
	B＝28244XA-1+1.017											
	Total									582,411	582,411	

I-3 EPC management

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

I	Engineering, Procurement and Construction	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
3	EPC management				UNIT	AMOUNT	UNIT	AMOUNT	UNIT	AMOUNT	TOTAL	
					BDT	BDT	US$	US$	Yen	Yen	Yen	
I-3 (5)	EPC management Cost											
/9	Others											
	Total											

Ⅱ- Consultant Services

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅱ	Consultant Services	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
					UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅱ	Consultant Services											analysis sheetNo.
(1)	Design for execution		LS	1	2,644,137	2,644,137			53,850,661	53,850,661	57,129,391	DD
(2)	Execution management		LS	1	8,958,040	8,958,040			86,226,766	86,226,766	97,334,736	CSV
	Total					11,602,177				140,077,427	154,464,126	

Time schedule of Cosultants Service (Design)

Personnel assignment	2012									2013					2014			2015			M/M		
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	～	Dec	Jan	～	Dec	Jan	～	Dec	Local	Inland	total
Engineer Class 2					75		45		60		30										7.00	0.00	7.00
(SCADA) Class 2					75	12			30												3.90	0.00	3.90
(Telecom) Class 3					75	12			30												3.90	0.00	3.90
Incidental facilities/Estimate Class 3					75	12			45												4.40	0.00	4.40
total																					19.20	0.00	19.20
Local Staff																							
Office administrator																					9.00		
Driver for sedan																					9.00		
Driver for 4WD																					9.00		
Vehicle																							
Sedan																					9.00		
4WD																					9.00		
total																							

Ⅱ- Consultant Services

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅱ	Consultant Services	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
					UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅱ	Consultant Services											analysis sheet No.
(1)	Design for execution											DD
/1	(1)Direct Personal Cost		LS	1						16,463,600	16,463,600	DD1
/2	(2)Direct expense											
a	Interpreter		LS	1								DD2
b	Cost of Local Staff		LS	1		513,711					637,002	DD3
c	Cost of travel		LS	1						4,859,821	4,859,821	DD4
d	Daily allowance		LS	1						2,292,150	2,292,150	DD5
e	Lodging expense		LS	1						6,923,550	6,923,550	DD6
f	Transportation cost		LS	1		2,130,426					2,641,728	DD7
g	Report writing		LS	1						262,500	262,500	DD8
h	Others		LS	1								DD9
	Sub-total					2,644,137				14,338,021	17,616,751	
/3	(3)Expense											
a	Miscellaneous expense		LS	1						16,463,600	16,463,600	(1)×100%
b	Miscellaneous expense(Techn		LS	1						6,585,440	6,585,440	{(1)+Miscellaneous expense}×20%
	Sub-total									23,049,040	23,049,040	
	Total					2,644,137				53,850,661	57,129,391	

Ⅱ- Consultant Services

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅱ	Consultant Services	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
					UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅱ	Consultant Services											
(1)	Design for execution											
/1	Direct Personal Cost											
/1-1	Local Work											
a	Engineer	Class 2	m/m	7.0					918,000	6,426,000	6,426,000	
b	(SCADA)	Class 2	m/m	3.9					918,000	3,580,200	3,580,200	
c	(Telecom)	Class 3	m/m	3.9					778,000	3,034,200	3,034,200	
d	ncidental facilities/Estimat	Class 3	m/m	4.4					778,000	3,423,200	3,423,200	
/1-2	Inland Work											
a	Engineer	Class 2	m/m						918,000			
b	(SCADA)	Class 2	m/m						918,000			
c	(Telecom)	Class 3	m/m						778,000			
d	ncidental facilities/Estimat	Class 3	m/m						778,000			
	Total									16,463,600	16,463,600	

Ⅱ- Consultant Services

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅱ	Consultant Services	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION UNIT BDT	LOCAL PORTION AMOUNT BDT	US$ PORTION UNIT US$	US$ PORTION AMOUNT US$	YEN PORTION UNIT Yen	YEN PORTION AMOUNT Yen	EXCHANGE TOTAL Yen	REFERENCE No.
Ⅱ	Consultant Services											
(1)	Design for execution											
/2	Direct Expense											
a	Interpreter											
	Total											

Ⅱ- Consultant Services

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅱ	Consultant Services	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
					UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅱ	Consultant Services											
(1)	Design for execution											
/2	Direct Expense											
b	Cost of Local Staff											
b-1	Office administrator		month	9	34,247	308,223					382,197	
b-2	Driver for sedan		month	9	11,416	102,744					127,403	
b-3	Driver for 4WD		month	9	11,416	102,744					127,403	
	Total					513,711					637,002	

Ⅱ- Consultant Services

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅱ	Consultant Services	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
					UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅱ	Consultant Services											
(1)	Design for execution											
/2	Direct Expense											
c	Cost of travel											
c-1	Air fare	Business class	trip	7					460,387	3,222,709	3,222,709	NRT-hong kong-Dhakka
c-2	Air fare	Economy class	trip	6					¥272,852	1,637,112	1,637,112	NRT-hong kong-Dhakka
	Air fareBusiness class	¥455,287										NRT-hong kong-Dhakka
	Farelocal transport	¥5,100										one way 2550 (tokyo～nippori～narita)
	total	¥460,387										
	Air fareEconomy class	¥267,752										NRT-hong kong-Dhakka
	Farelocal transport	¥5,100										one way 2550 (tokyo～nippori～narita)
	total	¥272,852										
	Total									4,859,821	4,859,821	

Ⅱ- Consultant Services

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅱ	Consultant Services	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
					UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅱ	Consultant Services											
(1)	Design for execution											
/2	Direct Expense											
d	Daily allowance											
	Engineer	Class 2	months	7								
	SCADA	Class 2	months	3.9								
d-1-1	Daily allowance for Class2	1day-30day	day	192					4,500	864,000	864,000	
d-1-2	Daily allowance for Class2	31day～60day	day	105					4,050	425,250	425,250	
d-1-3	Daily allowance for Class2	over61day	day	30					3,600	108,000	108,000	
	(Telecom)	Class 3	months	3.9								
	Incidental facilities/Estim	Class 3	months	4.4								
d-2-1	Daily allowance for Class3	1day-30day	day	144					3,800	547,200	547,200	
d-2-2	Daily allowance for Class2	31day～60day	day	75					3,420	256,500	256,500	
d-2-3	Daily allowance for Class2	over61day	day	30					3,040	91,200	91,200	
	Total									2,292,150	2,292,150	

Ⅱ- Consultant Services

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅱ	Consultant Services	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
					UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅱ	Consultant Services											
(1)	Design for execution											
/2	Direct Expense											
e	Lodging expense											
	Engineer	Class 2	months	7								
	SCADA	Class 2	months	3.9								
e-1-1	lodging expense of Class2	1day-30day	day	192					13,500.0	2,592,000	2,592,000	
e-1-2	lodging expense of Class2	31day～60day	day	105					12,150.0	1,275,750	1,275,750	
e-1-3	lodging expense of Class2	over61day	day	30					10,800.0	324,000	324,000	
	(Telecom)	Class 3	months	3.9								
	Incidental facilities/Estim	Class 3	months	4.4								
e-2-1	lodging expense of Class2	1day-30day	day	144					11,600.0	1,670,400	1,670,400	
e-2-2	lodging expense of Class2	31day～60day	day	75					10,440.0	783,000	783,000	
e-2-3	lodging expense of Class2	over61day	day	30					9,280.0	278,400	278,400	
	Total									6,923,550	6,923,550	

Ⅱ- Consultant Services

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅱ	Consultant Services	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
					UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅱ	Consultant Services											
(1)	Design for execution											
/2	Direct Expense											
f	Transportation cost											
f-1	Vehicle											
f-1-1	Sedan		months	9	123,710.0	1,113,390					1,380,604	
f-1-2	4WD		months	9	73,546.0	661,914					820,773	
f-2	fuel expense											
f-2-1	Sedan		months	9	15,240.0	137,160					170,078	
f-2-2	4WD		months	9	13,944.0	125,496					155,615	
f-3	automobile insuranc											
f-3-1	Sedan		months	9	5,708.0	51,372					63,701	
f-3-2	4WD		months	9	4,566.0	41,094					50,957	
	Total					2,130,426					2,641,728	

Ⅱ- Consultant Services

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅱ	Consultant Services	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
					UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅱ	Consultant Services											
(1)	Design for execution											
/2	Direct Expense											
g	Report writing											
g-1	Bid document		copy	5					50,000	250,000	250,000	
g-2	Report of bid evaluation		copy	5					2,500	12,500	12,500	
g-3	Translation		page									
	Total									262,500	262,500	

Ⅱ- Consultant Services

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅱ	Consultant Services	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
					UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅱ	Consultant Services											
(1)	Design for execution											
/2	Direct Expense											
h	Others											
	Total											

Time Schedule of Execution management

Personnel assignment		2012			2013												2014											2015			M/M			Trip
		Apr	～	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	～	Dec	Inland	Local	total	
Resident Engineer(general)	Class2						120																			300						0.00	18.00	18.00	4
Resident Engineer(SCADA)	Class2						30					30			30			30			30				60							0.00	7.00	7.00	6
Resident Engineer(Telecom)	Class3						30					30			30			30			30				60							0.00	7.00	7.00	6
Inspector(SCADA)	Class3						3				3					3																0.30	0.00	0.30	
Inspector(Telecom)	Class3						3				3					3																0.30	0.00	0.30	
total																																0.60	32.00	32.60	16
local Staff																																			
Office administrator																																	20.00		
Assistant engineer																																	20.00		
Driver for Sedan																																	20.00		
Driver for 4WD																																			
Vehicle																																			
Sedan																																	20.00		
4WD																																	20.00		
total																																			

Ⅱ- Consultant Services

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅱ	Consultant Services	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
					UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
												analysis sheetNo.
Ⅱ	Consultant Services											
(2)	Execution management cost											CSV
/1	Direct Personal Cost		LS	1						28,862,800	28,862,800	CSV1
/2	Direct expense											
a	Cost of Local Staff		LS	1		2,853,900					3,538,836	CSV2
b	Cost of travel		LS	1						6,240,982	6,240,982	CSV3
c	Daily allowance		LS	1						5,967,900	5,967,900	CSV4
d	Lodging expense		LS	1		1,369,860				8,030,700	9,729,326	CSV5
e	Transportation cost		LS	1		4,734,280					5,870,507	CSV6
f	Inspection before shipping		LS	1						180,000	180,000	CSV7
g	Others		LS	1								CSV8
	Sub-total					8,958,040				20,419,582	31,527,552	
/3	(3)Expense											
a	Miscellaneous expense		LS	1						25,976,520	25,976,520	(1)×90%
b	Miscellaneous expense(Technical)		LS	1						10,967,864	10,967,864	{(1)+Miscellaneous Expenses}×20%
	Sub-total									36,944,384	36,944,384	
	Total					8,958,040				86,226,766	97,334,736	

Ⅱ- Consultant Services

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅱ	Consultant Services	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
					UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅱ	Consultant Services											
(2)	Execution management cost											
/1	Direct Personal Cost											
a	Local Work											
a-1	Resident Engineer(general)	Class2	m/m	18					918,000	16,524,000	16,524,000	
a-2	Resident Engineer(SCADA)	Class2	m/m	7					918,000	6,426,000	6,426,000	
a-3	Resident Engineer(Telecom)	Class3	m/m	7					778,000	5,446,000	5,446,000	
a-4	Inspector(SCADA)	Class3	m/m	0.3					778,000	233,400	233,400	
a-5	Inspector(Telecom)	Class3	m/m	0.3					778,000	233,400	233,400	
	Total									28,862,800	28,862,800	

Ⅱ- Consultant Services

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅱ	Consultant Services	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
					UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅱ	Consultant Services											
(2)	Execution management cost											
/2	Direct expense											
a	Cost of Local Staff											
a-1	Assistant engineer		m/m	20	85,616	1,712,320					2,123,277	
a-2	Office administrator		m/m	20	34,247	684,940					849,326	
a-3	Driver											
a-3-1	Sedan		month	20	11,416	228,320					283,117	
a-3-2	4WD		month	20	11,416	228,320					283,117	
	Total					2,853,900					3,538,836	

Ⅱ- Consultant Services

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅱ	Consultant Services	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
					UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅱ	Consultant Services											
(2)	Execution management cost											NRT-hong kong-Dhakka
/2	Direct expense											NRT-hong kong-Dhakka
b	Cost of travel											
b-1	Air fare	Business class	LS	10					460,387	4,603,870	4,603,870	NRT-hong kong-Dhakka
b-2	Air fare	Economy class	LS	6					272,852	1,637,112	1,637,112	NRT-hong kong-Dhakka
	Air fare Business class	¥455,287										NRT-hong kong-Dhakka
	Fare local transport	¥5,100										one way 2550 (tokyo～nippori～narita)
	total	¥460,387										
	Air fare Economy class	¥267,752										NRT-hong kong-Dhakka
	Fare local transport	¥5,100										one way 2550 (tokyo～nippori～narita)
	total	¥272,852										
	Total									6,240,982	6,240,982	

Ⅱ- Consultant Services

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅱ	Consultant Services	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
					UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅱ	Consultant Services											
(2)	Execution management cost											
/2	Direct expense											
c	Daily allowance											
	Resident Engineer(general)	Class2	month	18								
	Resident Engineer(SCADA)	Class2	month	7								
c-1	Daily allowance for Class2	1day-30day	day	240					4,500	1,080,000	1,080,000	
c-2	Daily allowance for Class2	31day～60day	day	90					4,050	364,500	364,500	
c-3	Daily allowance for Class2	over61day	day	120					3,600	432,000	432,000	
	Daily allowance		month	10					330,480	3,304,800	3,304,800	
	Resident Engineer(Telecom)	Class3	month	7								
c-4	Daily allowance for Class2	1day-30day	day	180					3,800	684,000	684,000	
c-5	Daily allowance for Class2	31day～60day	day	30					3,420	102,600	102,600	
	Total									5,967,900	5,967,900	

Ⅱ- Consultant Services

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅱ	Consultant Services	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
					UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅱ	Consultant Services											
(2)	Execution management cost											
/2	Direct expense											
d	Lodging expense											
	Resident Engineer(general)	Class2	day	540								
	Resident Engineer(SCADA)	Class2	day	210								
d-1	Lodging expense of Class2	1day-30day	day	240					13,500	3,240,000	3,240,000	
d-2	Lodging expense of Class2	31day～60day	day	90					12,150	1,093,500	1,093,500	
d-3	Lodging expense of Class2	over61day	day	120					10,800	1,296,000	1,296,000	
d-4	Accommodation		month	10	136,986	1,369,860					1,698,626	
	Resident Engineer(Telecom)	Class3	day	210								
d-5	lodging expense of Class3	1day-30day	day	180					11,600	2,088,000	2,088,000	
d-6	lodging expense of Class3	31day～60day	day	30					10,440	313,200	313,200	
	Total					1,369,860				8,030,700	9,729,326	

Ⅱ- Consultant Services

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅱ	Consultant Services	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
					UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅱ	Consultant Services											
(2)	Execution management cost											
/2	Direct expense											
e	Transportation cost											
e-1	Vehicle											
e-1-1	Sedan		month	20	123,710	2,474,200					3,068,008	
e-1-2	4WD		month	20	73,546	1,470,920					1,823,941	
e-2	fuel expense											
e-2-1	Sedan		month	20	15,240	304,800					377,952	
e-2-2	4WD		month	20	13,944	278,880					345,811	
e-3	automobile insuranc											
e-3-1	Sedan		month	20	5,708	114,160					141,558	
e-3-2	4WD		month	20	4,566	91,320					113,237	
	Total					4,734,280					5,870,507	

Ⅱ- Consultant Services

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅱ	Consultant Services	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
					UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅱ	Consultant Services											
(2)	Execution management cost											
/2	Direct expense											
f	Inspection before shipping											
f-1	Inspection before shipping	Yokohama	day	3					60,000	180,000	180,000	
	Inspection before shipping	Mumbai	day						45,000			
	Total									180,000	180,000	

Ⅱ- Consultant Services

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅱ	Consultant Services	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
					UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅱ	Consultant Services											
(2)	Execution management cost											
/2	Direct expense											
g	Other											
	Total											

Ⅲ- Operation and maintenance Support

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅲ	O/M Support	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
	O/M Support				UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅲ-	O/M Support Cost											analysis sheet
	O/M Support Cost		LS	1	11,985,768	11,985,768			100,770,976	100,770,976	115,633,328	No.OM
	Total					11,985,768				100,770,976	115,633,328	

Time Schedule of O/M Support

Personnel assignment	2012			2013			2014				2015			2016				M/M			Trip
	Apr	～	Dec	Jan	～	Dec	Jan	～	Nov	Dec	Jan	～	Dec	Jan	～	Nov	Dec	Inland	Local	total	
																		0.0	0.0	0.0	
engineer(SCADA) class3										■	■	■	■	■	■	■		0.0	24.0	24.0	4
engineer(Telecom) class3										■	■	■	■	■	■	■		0.0	24.0	24.0	4
total																		0.0	0.0	0.0	
																		0.0	48.0	48.0	8
Local Staff										■	■	■	■	■	■	■			24.0		
Office administrator										■	■	■	■	■	■	■			24.0		
Driver										■	■	■	■	■	■	■			24.0		
Vehicle																					
4WD										■	■	■	■	■	■	■			24.0	24.0	
total																					

Ⅲ- Operation and maintenance Support

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅲ	O/M Support	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
	O/M Support				UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅲ-	O/M Support Cost											analysis sheet
(1)	Direct Personal Cost		LS	1.00						37,344,000	37,344,000	OM1
(2)	Direct expense											
/1	Daily allowance		LS	1.00						13,443,840	13,443,840	OM2
/2	Lodging expense		LS	1.00		6,575,328					8,153,407	OM3
/3	Cost of travel		LS	1.00						2,182,816	2,182,816	OM4
/4	Transportation cost		LS	1.00		2,259,744					2,802,083	OM5
/5	Cost of Local Staff		LS	1.00		3,150,696					3,906,863	OM6
/6	Others											
	Sub-total					11,985,768				15,626,656	30,489,008	
											60,978,017	
(3)	Expense											
	Miscellaneous expense		LS	1.00						33,609,600	33,609,600	(1)×90%
	Miscellaneous expense(Technical)		LS	1.00						14,190,720	14,190,720	{(1)+Miscellaneous expense}×20%
	Sub-total									47,800,320	47,800,320	
	Total					11,985,768				100,770,976	115,633,328	

Ⅲ- Operation and maintenance Support

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅲ	O/M Support	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
	O/M Support				UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅲ-	O/M Support											
(1)	Direct Personal Cost											
	Local Work											
a	Engineer(SCADA)		m/m	24					778,000	18,672,000	18,672,000	
b	Engineer(Telecom)		m/m	24					778,000	18,672,000	18,672,000	
	Total									37,344,000	37,344,000	

Ⅲ- Operation and maintenance Support

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅲ	O/M Support	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
	O/M Support				UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅲ-	O/M Support											
(2)	Direct expense											
/1	Daily allowance											
	Engineer(SCADA)		m/m	24					280,080	6,721,920	6,721,920	
	Engineer(Telecom)		m/m	24					280,080	6,721,920	6,721,920	
	Total									13,443,840	13,443,840	

Ⅲ- Operation and maintenance Support

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅲ	O/M Support	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE TOTAL Yen	REFERENCE No.
	O/M Support				UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen		
Ⅲ-	O/M Support											
(2)	Direct expense											
/2	Lodging expense											
	Engineer(SCADA)		m/m	24	136,986	3,287,664					4,076,703	
	Engineer(Telecom)		m/m	24	136,986	3,287,664					4,076,703	
	Total					6,575,328					8,153,407	

Ⅲ- Operation and maintenance Support

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅲ	O/M Support	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
	O/M Support				UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅲ-	O/M Support											
(2)	Direct expense											
/3	Cost of travel											
	air fare	business class	trip									Tokyo-Hong Kong-Dha
	air fare	economy class	trip	8					272,852	2,182,816	2,182,816	Tokyo-Hong Kong-Dha
	air fare business class	¥455,287	Tokyo-Hong Kong-Dhaka									
	fare local transport	¥5,100	one way 2550 (tokyo～nippori～narita)									
	total	¥460,387										
	air fare economy class	¥267,752	Tokyo-Hong Kong-Dhaka									
	fare local transport	¥5,100	one way 2550 (tokyo～nippori～narita)									
	total	¥272,852										
	Total									2,182,816	2,182,816	

Ⅲ- Operation and maintenance Support

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅲ	O/M Support	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
	O/M Support				UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅲ-	O/M Support											
(2)	Direct expense											
/4	Transportation cost											
a	Vehicle											
	4WD		month	24	75,646	1,815,504					2,251,225	
b	fuel expense											
	4WD		month	24	13,944	334,656					414,973	
c	automobile insuranc											
	4WD		month	24	4,566	109,584					135,884	
	Total					2,259,744					2,802,083	

Ⅲ- Operation and maintenance Support

Exchang rate 1USD=86.6YEN 1BTK=1.24YEN

Ⅲ	O/M Support	SPECIFICATION	UNIT	QUANTITY	LOCAL PORTION		US$ PORTION		YEN PORTION		EXCHANGE	REFERENCE No.
	O/M Support				UNIT BDT	AMOUNT BDT	UNIT US$	AMOUNT US$	UNIT Yen	AMOUNT Yen	TOTAL Yen	
Ⅲ-	O/M Support											
(2)	Direct expense											
/5	Cost of Local Staff											
a	Assistant engineer		m/m	24	85,616	2,054,784					2,547,932	
b	Office administrator		m/m	24	34,247	821,928					1,019,191	
c	Driver											
	4WD		month	24	11,416	273,984					339,740	
	Total					3,150,696					3,906,863	

Appendix-5 Minutes of Meeting

I. Minutes of Meeting on 20 December 2010

II. Minutes of Meeting on 5-10 March 2011

I. Minutes of Meeting on 20 December 2010

Minutes of Meeting

Date: 20 December 2010
Time: 10:30~
Venue: GTCL Head Office
Participants: GTCL – Mr. Faheem/Shariful/Ashok/Momin/Nasir
JICA Study Team (JST) – Mr. Iwamoto/Oikawa/Mizushima/Kono

Subjects: Scope of Works for the Project

A: General and SCADA RTU

1. Works for GTCL New Head Office
   GTCL need OCT and PABX at GTCL new head office. However GTCL new head office may not be completed prior to the equipment installation. GTCL shall confirm what to be provided in the project on 22nd December 2010.

   P.S.
   There was no confirmation of this matter on 22nd December 2010. GTCL is requested to confirm by 15th January 2010.

2. OCT & PABX
   GTCL confirmed following:
   1) OCT & PABX are required at Petrobangla head office and GTCL new head office.
   2) OCT & Long line extension are required at following operating companies and process plant:
      - TGTDCL/SGFL/JGTDSL
      - BGFCL/SGFL
      - Sanghu onshore process plant

3. Maijdee Microwave Station
   GTCL confirmed that existing Maijdee Microwave station is no longer required and can be excluded from new SCADA system.

4. Bakhrabad Microwave Stations
   GTCL suggested to use two existing towers as they are presently used so, and allowed to use new radio room to accommodate all radio equipment. JST noted.

5. Standby Generators
   GTCL confirmed that new standby generator dedicated for telecommunication system

shall be required at following stations only.

- Monohordi
- Elenga
- Mirasarai
- Feni
- Laksham
- Chandpur

These generators can be diesel driven and capacity shall be 15kVA, and no new generators shall be required at other microwave stations.

6. Backup Batteries

JST asked why 48 hours battery system is required for radio equipment even standby generator power is available. GTCL confirmed that 48 hours battery system to radio equipment as well as 24 hours battery system to RTU are still required.

7. Display panel to RTU

GTCL requested to provide display panel to following RTUs.

- Ashuganj (SC400)
- Faujdarhat (SC105)
- Monohordi (SC510)
- Elenga (SC508)
- Kutembopur (SC100)
- CGS Ashuria
- CGS Aminbazar
- Barabkundu TBS

JST noted.

8. GTCL confirmed that new instrumentation at Ashuganj (SC400) is not required because this station shall be bypassed after the completion of Ashuganj compressor station.

Further GTCL confirmed that new RTU for Ashuganj compressor station shall monitor 10 flow meter runs from new flow computer of compressor station.
Site layout of new compressor station is under consideration. So the cable length between new flow computer and RTU is estimated as about 100m.

9. Data from Turbine Meter

GTCL suggested to JST as follows:

1) Turbine Meter is able to send dual pulse signals to operating companies and new GTCL RTU respectively.
2) Pressure transmitter can be installed to the new branch of pressure tubing.
3) Temperature signals might be separated to use dual pick up barrier.

JST shall follow these suggestions.

10. SC108 Dewangbagh

GTCL requested the provision to monitor two meter run (orifice) which shall be installed

in future. JST noted.

11. GTCL mentioned that following stations shall be upgraded in near future and new RTUs should have the provision to receive the data from new flow computers which shall be included in these upgrading projects.
    - Monohordi
    - Kutumbapur
    - Feni
    - Barabukunda
    - Dewangbagh

    Further clarification for quantities of flow meter run shall be required from GTCL.

    P.S.
    On 22nd December 2010, GTCL confirmed flow meter runs as follows:
    - *Monohordi: 2 orifices (newly installed)*
    - *Kutumbapur: 3 orifices (replacement)*
    - *Feni: 2 orifice (newly installed)*
    - *Barabukuda: 2orifices (replacement), 1 turbine (replacement)*
    - *Dewanbagh: 2 orifices (newly installed)*

12. SC502 Ashuganj Fertilizer Factory
    Same as above clause 9.

13. MS-Ghatura
    GTCL confirmed that T-branch is required for instrumentation installation.

14. TITAS Gas Field Location 7 (upcoming)
    GTCL confirmed that two flows shall be monitored.

15. SC700 Jalalabad IOC Metering Station
    GTCL confirmed that RTU SC700 can be excluded from new SCADA system, because necessary data can be collected from Chevron's server through internet.

16. SC301 Kailashtilla Gas Field 2
    GTCL confirmed that provision for pig detector and condensate tank level is not required in new SCADA system.

17. SC600 Kailashtilla DRS
    GTCL confirmed that Junction Box (SC707) can be excluded from new SCADA system.

18. SC604 Fenchuganj Power Station

GTCL confirmed that two flows to Barkatullah PS and Energy PS should be monitored by new SCADA system and monitoring item shall be as follows:

- Existing 90MW PS: 1 orifice
- New 90 MW PS: 1 orifice
- Barkatullah PS: 2 turbine meters
- Energy PS: 2 turbine meters (1 is provisional)

19. Kumargaon DRS

GTCL confirmed that this site shall not be included in new SCADA system.

20. Devpur DRS (Spur Line)

GTCL confirmed that this site should be included in new SCADA system.

21. MS-Dhanua

GTCL confirmed that:

1) This site is the upcoming station of 30" line which shall be constructed adjacent to Dhanua VS4 (SC519).
2) Process data can be received by the RTU for MS Dhanua from flow computer (2 oriffices) prepared by GTCL at the new station.
3) Cable length shall be approximately 100m for estimation purpose.

22. SC516 VS0 Titas Daulatkandi MLV & SC517 Uzilab VS1

GTCL confirmed that pressure of 30" line should be monitored by new SCADA system. Pressure meter shall be installed using pressure gauge connection at bypass line.

Further GTCL mentioned that the same method can be applied at VS-Chunarughat R-A Line and VS-Chandura R-A Line.

23. VS-12 Narsingdi

Monitoring requirements shall be confirmed by GTCL's higher management on 22nd December 2010.

P.S.

GTCL will confirm this matter by 15th January 2010.

24. SC503A & SC503B for PUFF/GUFF

GTCL confirmed that new RTU shall monitor two flows to PUFF/GUFF located in one same site. Method of data collection from turbine meters shall follow clause 9.

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25. SC112 Chandpur TBS

GTCL confirmed that Chandpur TBS shall not be excluded from new SCADA system because new power station is planned. Therefore RTU should have provision for 1 orifice and 1 turbine meter run.

26. SC706 Sanghu Onshore Process Plant

GTCL confirmed that one additional OCT at this site shall be required in new SCADA system.

27. Horipur IPP 360MW PS

GTCL confirmed that instrumentation can be installed to the new branch from existing orifice.

28. Horipur SBU 100MW PS & NEPC 110MW PS

GTCL confirmed that one new RTU can cover two power stations above because two stations are at almost same location.

29. VS-14 Madhabdi

GTCL confirmed that new RTU for this valve station can be installed at adjacent site (Madhabdi TBS) because of availability of power supply.

30. Barabkundu TBS

GTCL confirmed that new RTU shall monitor 2 existing turbine meter and shall have a provision for interface with flow computer (1 orifice) prepared by GTCL in future.

31. SC505 Joydevpur CGS

Monitoring requirements shall be confirmed by GTCL's higher management on 22nd December 2010.

P.S.

GTCL will confirm this matter by 15th January 2010.

32. Bakhrabad-Siddirgonj pipe line

New server should have the capability to receive data from the server of SCADA system for upcoming Bakhrabad-Siddirgonj pipe line project. (Other servers such as Chevron, Sangu and Western zone were already known to JST.)

33. Existing Equipment

GTCL do not want to remove existing RTUs and radio equipment because of its remaining value. This matter should be confirmed by GTCL's higher management on 22nd December

2010.

P.S.

On 22nd December 2010, GTCL confirmed that existing RTUs and radio equipment should be dismantled by EPC contractor.

34. Process data from Chevron

JST reconfirmed that collecting data from Chevron's server through internet is economical practical and recommended.

B: Communication System

1. Communication Media of SCADA backbone

   JST explained three cases listed below that are presently examined. (please see attached sketches)

   Case 1: Microwave Radio for Entire System

   Case 2: Microwave Radio for NE/SE Legs + Leased Line for NW Leg

   Case 3: Leased Line for Entire System

2. Work demarcation between GTCL and Contractor

   JST provided schematic drawing (refer to Attachement-4) and explained the work demarcation between GTCL and Contractor at the project implementation stage on the responsibility of power supply in MW Radio system.

   - GTCL agreed that Contractor shall provide PDB in MW equipment room, and GTCL provide and connect power cable to PDB and supply commercial power for the equipment.

3. Work demarcation between GTCL and Service Providers

   JST also provided schematic drawings (refer to Attachement-5) and explained that the cost estimation of each system was made on this work demarcation for comparison purpose.

   (1) Grameenphone (GP):

   GP has responsibility to connect their access radio link up to a router which is equipped by GTCL in his equipment room.

   (2) BTCL:

   GTCL has responsibility to connect between MW tower/equipment room and BTCL's access point by any media, i.e., FOC or Radio link. (The installation cost shall be provided by GTCL.) In case by FOC, GTCL install cable and connect them at ODF in BTCL telephone office. In case by radio link, GTCL install necessary radio equipment in BTCL telephone office.

   GTCL agreed above conditions.

4. GTCL requested JST to examine the use of VPN or EDGE from service providers such as GP and BTCL for following RTUs.

   (1) Tarakandi JFCL RMS SC511

   (2) RPCL Power Station at Mymensingh

   GTCL is to contact GP and BTCL on this matter to check the possibility.

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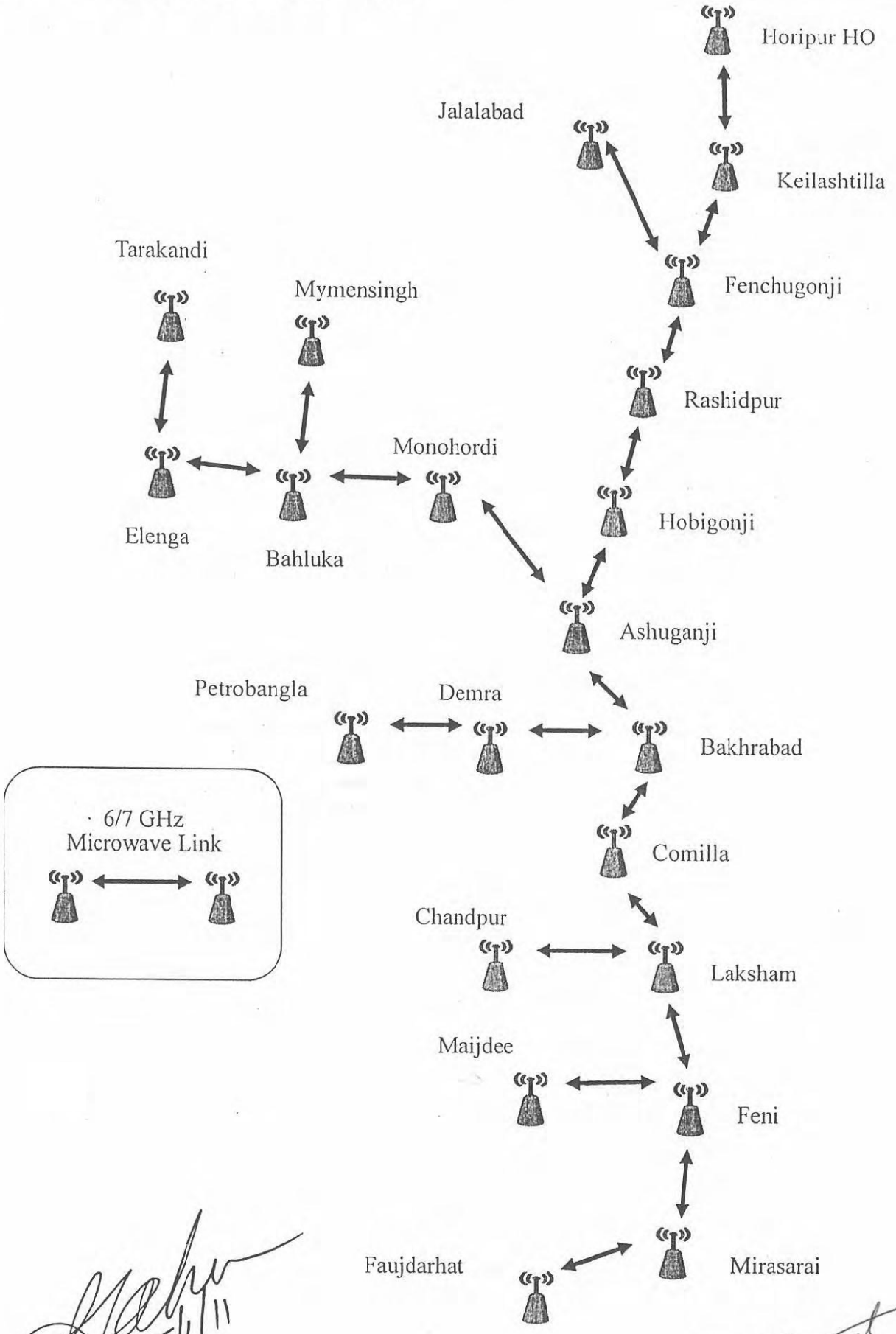
5. GTCL asked frequency range between provider's access point and GTCL's MW station.
   JST answered that according to providers, it will be 2.4 GHz or 5.8 GHz.

6. GTCL asked about auto gain control (AGC)
   JST shall confirm with Radio specialist.

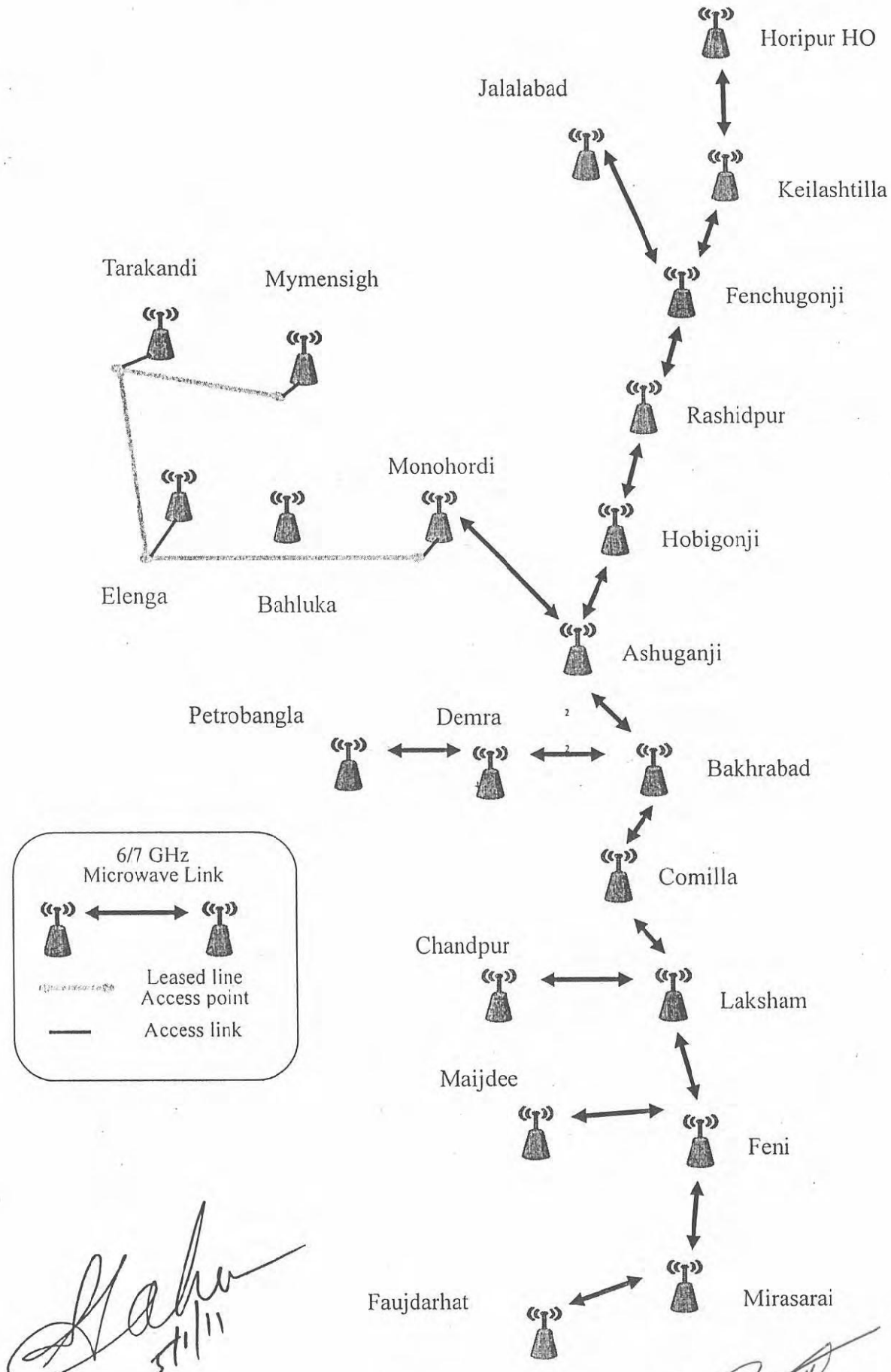
Telecom_ Attachment-1

Case 1: Using Microwave Radio



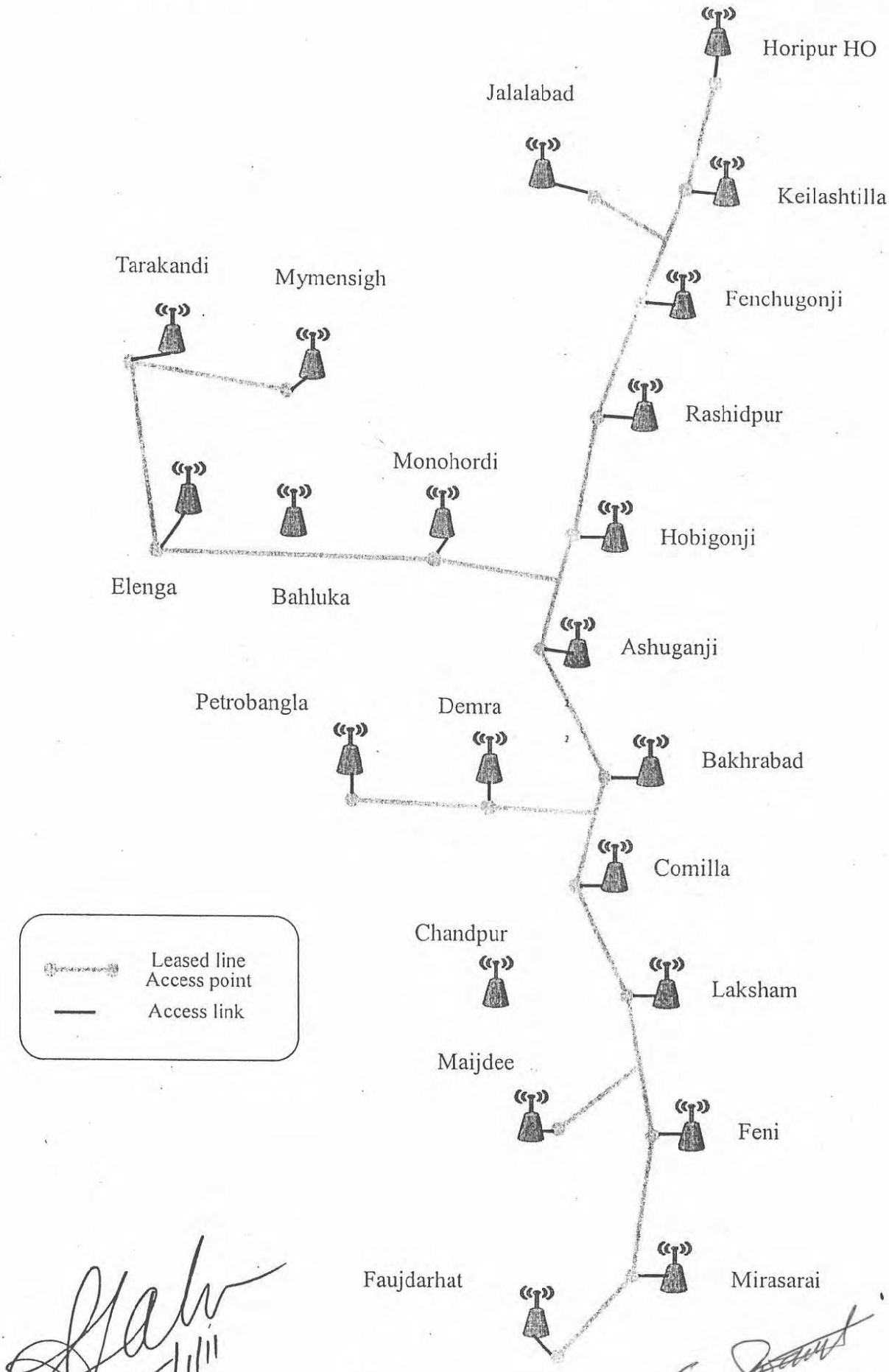
Case 2: Using Microwave + Leased Line

Telecom_ Attachment-2

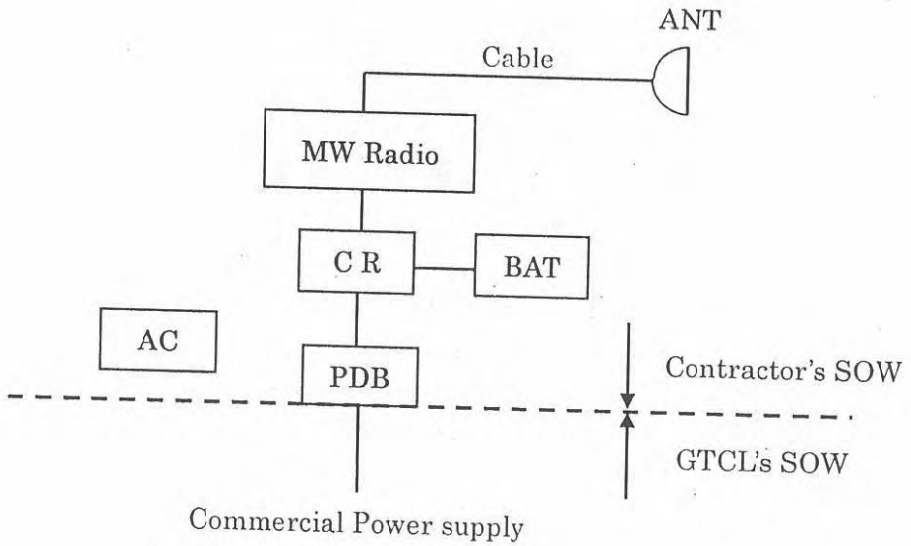


Case 3: Using Leased line

Telecom_ Attachment-3



Telecom_ Attachment-4

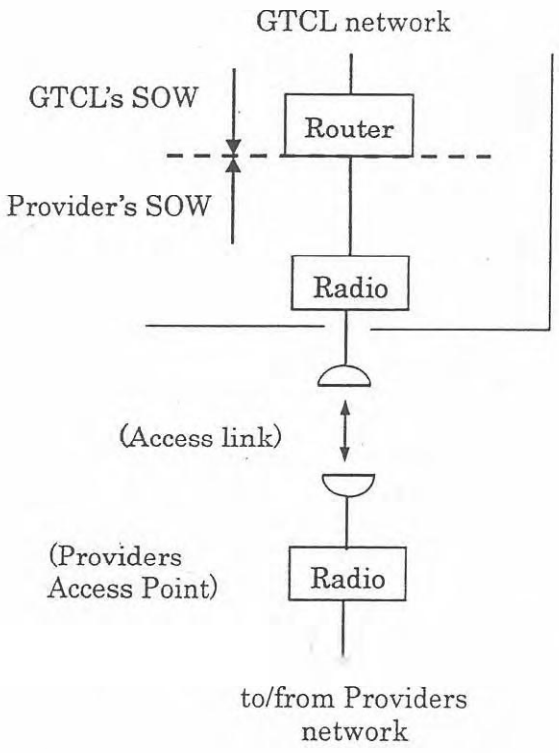


Contractor's Scope
Design, supply and install of MW Radio equipment, CR, BAT, PDB, AC, ANT and its cable laying.

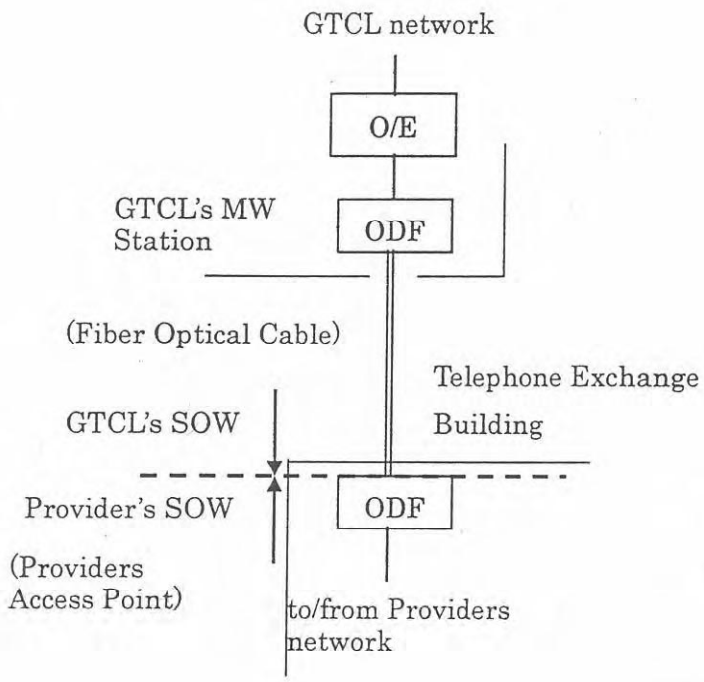
Interface Point to the Provider

Telecom_ Attachment-5

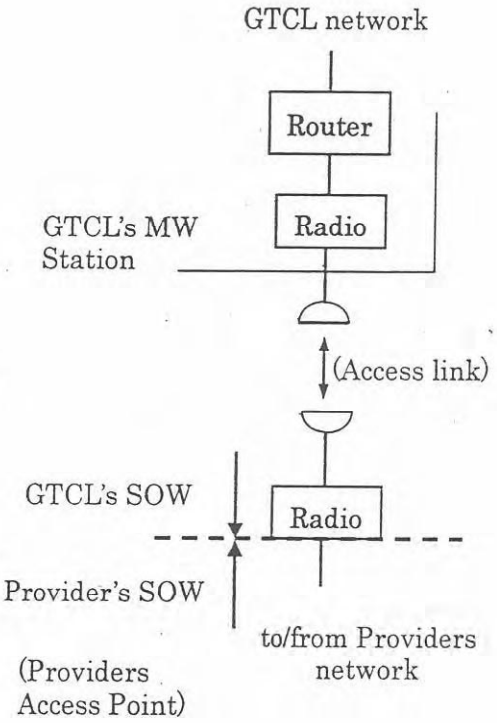
(Grameen Phone)



(BTCL)



(BTCL)



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C: Associated Facilities

JST explained the proposed scope of works for Civil Works as per following table.

Scope of Works for Civil Works

No.	Item	GTCL	EPC	Remakrs
1.	**Radio Building/Room Refurbishment**			
1)	Repair of structural & functional defect	○		Such as rainwater leakage, ground floor slab settlement and wall/slab clacks that were found in site investigations.
2)	Repair of general electrical services in radio roobuilding/room	○		Such as socket, lighting fixture, ceiling fan, etc. to be serviced in good condition.
3)	Internal finishing touch-up		○	Cleaning and paint touch-up are recommended.
4)	Replacement of air-conditioner at equipoment room		○	Most of A/C were out of order and recommended to be replaced without exception.
5)	Replacement of backup batteries		○	Existing batteries are outdated and recommended to be replaced without exception.
6)	Stand-by generator		○	Generators dedicated only to radio buildings are outdated and recommended to be replaced without exception. Generators working for entire premises are out of project scope.
2.	**Radio Tower Refurbishment**			
			△	Structural conditions of existing towers are good and only reinforcement to guyed towers by additional guys might be required.
3.	**Foundation and Shed for RTU/Junction Box**			
	Design & construction of foundation and shed for new RTU		○	
	Design & construction of foundation and shed for new junction box for instrumentation		○	
5.	**MCC/ACC Refurbishment (for Control Room, Equipment Room, Battery Room)**			
			○	Interior finishing of control room shall be refurbished.

GTCL mentioned that Item No.1-1) & 1-2) can be arranged by GTCL but it should be financially included in the Project.

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D: Other Isses Discussed

1. Preliminary cost comparison for SCADA backbone

   JST presented the preliminary cost comparison (draft) for following SCADA backbone systems. GTCL will study and reply shortly.

   - Microwave for entire system
   - Microwave + Providers' Network for North-West leg (with 3 sub-cases)
   - Providers' Network for entire system (with 3 sub-cases)

   P.S.

   GTCL will select the SCADA backbone system and inform JST of their selection by 31 December 2010.

2. As Built Information of existing towers

   JST presented the list of existing towers of which As Built information are yet to be obtained and requested GTCL to pursue. (see Appendix 1)

   GTCL requested JST to send this list by email so that GTCL can send letters to related operation companies.

3. Existing instrumentation

   It was confirmed that new instrumentation shall be supplied for the replacement of existing instrumentation in case of malfunction. Its quantity shall be 20% of existing instrumentations.

4. Site Code

   JST shall suggest renewing the site code numbering system for easy recognition of site in their proposal.

5. Piping Diagram

   JST requested piping diagram of GTCL transmission network. GTCL shall prepare by the end of January 2011.

P.S.

GTCL is to receive the formal confirmation for the use of 6GHz band from BTRC and notify JST by 31st December 2010.

P.S.

On 22nd December JST made a presentation to GTCL for following matters as per attached presentation document. (see Appendix 2)

1. *Findings of Existing Sites*
2. *Concept of New SCADA/Telecommunication System*
3. *Outline of SCADA System*
4. *Outline of Telecommunication System*
5. *Undertakings by GTCL (corrections made during presentation were shown by red characters in last page of Appendix 2)*

The minutes of meeting above verifyed by:

Date: 8 Mar. 2011

Mr. S. Faheem
Director (Operation) GTCL

(Engr. S. Faheem)
Director (Operation)
Gas Transmission Company Ltd.

Mr. Shinichi Iwamoto
Team Leader of JICA Study Team

Appendix 1

As Built Information of Existing Towers

1. Following documents were found from Demra MCC during site investigation.
   1) Structural Design & Calculation for Foundations of following towers
      - Horipur HO: 4 legs self standing tower (34m)
      - Kailashtilla: 4 legs self standing tower (50m)
      - Fenchuganj: 4 legs self standing tower (100m)
      - Rashidpur: 4 legs self standing tower (100m)
      - Ashuganj: 4 legs self standing tower (100m)

   However we still need As Built information of structural steel of these towers from GTCL.

2. As Built information of following existing towers and their foundations are still required.

   1) Towers constructed by BGFCL
      - Hobigonj GF: 3 legs self standing tower
      - Bakhrabad New: 3 legs self standing tower

   2) Towers constructed by TITAS in North-West Leg
      - Tarakandi: 3 legs self standing tower
      - Titas Mymensingh HO: 3 legs self standing tower
      - Elenga: 3 legs self standing tower
      - Bhaluka: 3 legs self standing tower
      - Monohordi 3 legs self standing tower

   3) Towers constructed by BGSL in South-East Leg
      - Faujdarhat: Guyed tower
      - Mirasarai: Guyed tower
      - Feni: Guyed tower
      - Laksham: Guyed tower
      - Comilla HO: Guyed tower
      - Bakhrabad: Guyed tower

These information shall be required prior to tender stage if microwave is selected for communication media of SCADA backbone.

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Appendix 2

ORIENTAL CONSULTANTS CO., LTD.

PRELIMINARY REPORT OF THE STUDY ON GAS SCADA SYSTEM REHABILITATION AND EXPANSION FOR GAS TRANSMISSION COMPANY LIMITED (GTCL) IN BANGLADESH

Dec. 22, 2010

Contents

ORIENTAL CONSULTANTS CO., LTD.

8/3/11

Findings on Existing Sites

ORIENTAL CONSULTANTS CO. LTD.

- ✓ Existing field instruments

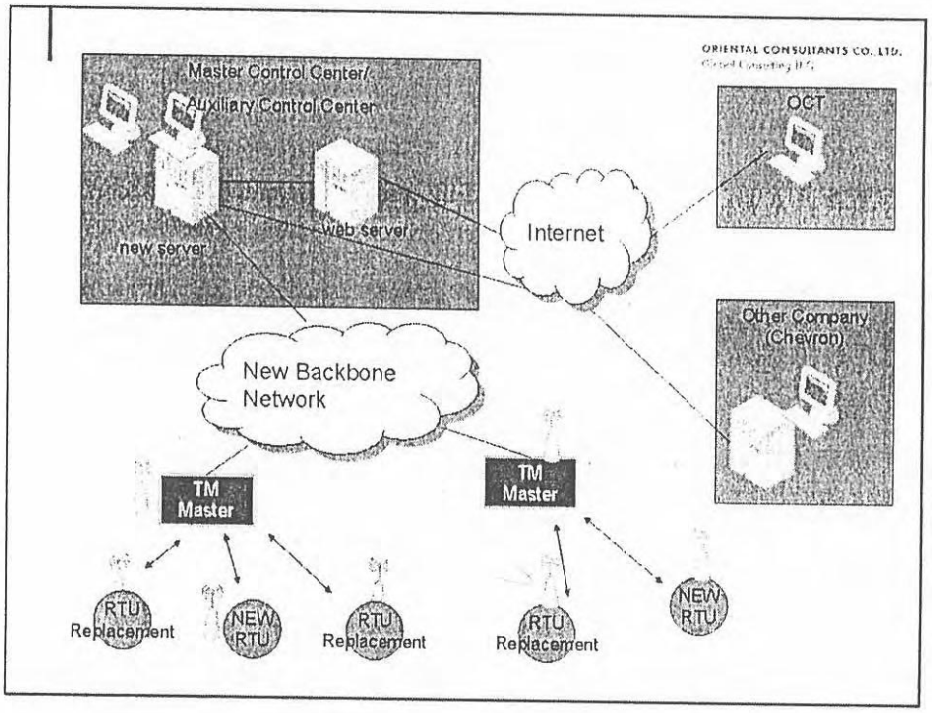
  hall be checked before project starts.

  epared before project starts.

- ✓ Power supply

  ng RTU site and radio stations shall be serviced before project starts.

- ✓ Operation and Maintenance System



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NEW SCADA SYSTEM (1/3)

ORIENTAL CONSULTANTS CO. LTD.

■ OUTLINE OF SCADA SYSTEM

- ✓ Open client/server architecture
- ✓ Windows based HMI
- ✓ OPC/ODBC compliant
- ✓ TCP/IP network communication over LAN, WAN, GPRS

NEW SCADA SYSTEM (2/3)

ORIENTAL CONSULTANTS CO. LTD.

■ FUNCTION OF SCADA SYSTEM

- ✓ Data collection & storage
- ✓ Alarming
- ✓ Reporting
- ✓ Trend display, etc
- + Leak Detection & Load Balancing

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NEW SCADA SYSTEM (3/3)

ORIENTAL CONSULTANTS CO., LTD.

■ For Leak Detection & Load Balancing

Measure all intake and off-take flow

all intake points	all off-take Points
✓ BGFCL	✓Titas
✓ SGFL	✓ BGSL
✓ Chevron	✓ JGTDSL
✓ Tullow	✓ PGCL
✓ NIKO	

NEW TELECOM. SYSTEM

ORIENTAL CONSULTANTS CO., LTD.

Selection of Optimum Communication Backbone

1. Preliminary Study on 4 FOC Network Operating Companies
2. Detailed Study on Communication Backbone
   - ① Cases of Detailed Study
   - ② Options of Detailed Study
   - ③ Cost Comparison
   - ④ Result of Comparison

S Jawad 8/3/'11

NEW TELECOM. SYSTEM

ORIENTAL CONSULTANTS CO., LTD.

Preliminary Study on FOC Network Operating Companies

Providers' Network for SCADA System Backbone - Recommended

Provider	Examination	Conclusion
1. Grameenphone (GP)	• GP has nationwide mobile phone and internet services through their network. • GP can provide wireless link from their access points to GTCL's radio stations. In this case GP will not charge for this type of initial cost and will charge only leasing fee. • GP has similar experience for this type network system lease. • Less initial cost but higher leasing fee.	Further examination required for implementation of the project
2. Bangladesh Telecommunications Company Ltd. (BTCL)	• BTCL has nationwide telephone & internet services through their network. • FOC or Wireless link can be established from BTCL's access points to GTCL's radio stations. Initial cost to establish such link shall be paid by the Project. • FOC laying between BTCL's access points and GTCL's radio stations shall be difficult and costly because cable route shall have to pass congested city. • In case GTCL lays FOC between BTCL's access points and GTCL's radio stations, GTCL shall have to take responsibility for regular maintenance as well as unexpected cable cuts.	Further examination required for implementation of the project

NEW TELECOM. SYSTEM

ORIENTAL CONSULTANTS CO., LTD.

Preliminary Study on FOC Network Operating Companies

Providers' Network for SCADA System Backbone – Not recommended

Provider	Examination	Conclusion
3. Power Grid Company of Bangladesh Ltd. (PGCB)	• PGCB has Fibre Optic Cable Network (FOCN) along their power transmission line. • Access point to their FOCN shall be at OLT (Optical fibre Line Terminal) in their substations or OLT installed at towers where FOC is jointed. • PGCB lease only dark fibre and do not provide the net work system lease. • Numbers of access points (substations) are very less than GPs' & BTCLs' and some access points are far from GTCL's radio stations. • PGCB do not provide the information of field access points at towers and cable route to most of these field access points shall be under paddy fields and wetlands with high risk of unexpected cable cuts. • PGCB has no experience of leasing out their FOCN and shall not take responsibility for maintenance.	Use of PGCB's FOCN is not recommended.
4. Bangladesh Railway (BR)	• BR leased out their FOCN to GP and not able to lease their FOCN to GTCL.	Cannot be used.

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NEW TELECOM. SYSTEM

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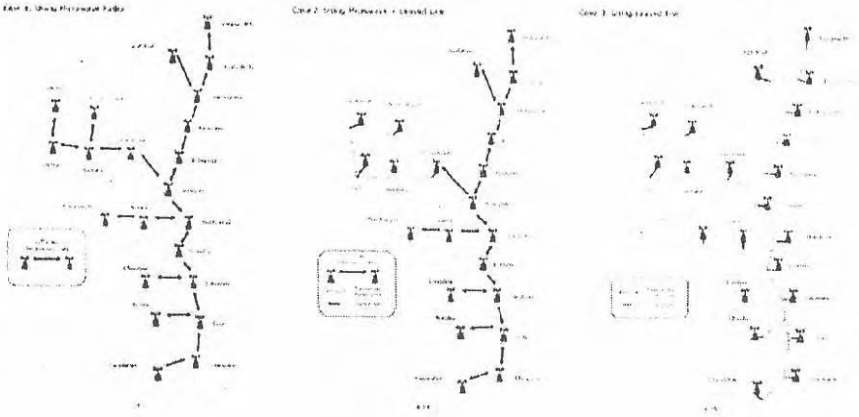
Cases of Detailed Study on Communication Backbone

Case-1 Case-2 Case-3



NEW TELECOM. SYSTEM

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Options of Detailed Study on Communication Backbone

Option	Communication Media	Provider
Case 1:	MW*	
Case 2-1:	MW + PN* (Last 1 Mile: Wireless)	GP
Case 2-2a:	MW + PN (Last 1 Mile: Wireless)	BTCL
Case 2-2b:	MW + PN (Last 1 Mile: FOC)	BTCL
Case 3-1:	PN (Last 1 Mile: Wireless)	GP
Case 3-2a:	PN (Last 1 Mile: Wireless)	BTCL
Case 3-2b:	PN (Last 1 Mile: FOC)	BTCL

Note: "MW": Micro Wave
"PN": Providers Network

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Cost Comparison on Communication Backbone System

ORIENTAL CONSULTANTS CO. LTD

(x 1,000 TK)

Option	Provider	Initial Investment Sub Total	MW/FOC Lease Charge Sub Total (for 15 ys)	Equipment Maintenance Cost Sub Total (for 15 ys)	Total (for 15 years)
Case 1: MW		304,100	21,000	121,640	447,000
Case 2-1: MW + PN (Last 1 Mile: Wireless)	GP	268,000	43,140	106,400	416,000
Case 2-2a: MW + PN (Last 1 Mile: Wireless)	BTCL	271,600	25,860	108,640	406,000
Case 2-2b: MW + PN (Last 1 Mile: FOC)	BTCL	260,300	25,860	107,960	424,000
Case 3-1: PN (Last 1 Mile: Wireless)	GP	76,000	206,280	30,400	313,000
Case 3-2a: PN (Last 1 Mile: Wireless)	BTCL	86,700	41,400	34,680	163,000
Case 3-2b: PN (Last 1 Mile: FOC)	BTCL	195,500	41,400	30,280	267,000

Assumption for Cost Comparison:

1. Initial Investment include only the cost to replace the existing communication backbone of Microwave (MW) network with the improved communication system
2. MW/FOC Lease Charge
   (1) MW license fee to be paid to BTRC: 1,400,000 TK/year
   (2) FOC Network lease charge: NW area only (GP: 123,000 TK/month, BTCL: 27,000 TK/month)
   All area (GP: 1,148,000 TK/month, BTCL: 230,000 TK/month)
3. Equipment Maintenance Cost (inc. consumable materials)
   1% of investment cost per year for first five years, 2% for next five years and 5% for last five years in total 15 years

NEW TELECOM. SYSTEM

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Result of Comparison on Communication Backbone System

Option	Provider	Cost	Trans-mission Quality	Maintain-ability	Expand-ability	Recommend-able Order
Case 1: MW		High	Good	Good	Good	2
Case 2-1: MW+ PN (Last 1 Mile: Wireless)	GP	High	Good	Good	Good	
Case 2-2a: MW + PN (Last 1 Mile: Wireless)	BTCL	High	Good	Good	Good	2
Case 2-2b: MW + PN (Last 1 Mile: FOC)	BTCL	High	Good	Good	Good	
Case 3-1: PN (Last 1 Mile: Wireless)	GP	Rather High	Good	Almost Free	Excellent	
Case 3-2a: PN (Last 1 Mile: Wireless)	BTCL	Lowest	Good	Almost Free	Excellent	1
Case 3-2b: PN (Last 1 Mile: FOC)	BTCL	Rather High	Good	Almost Free	Excellent	

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Undertakings by GTCL

1. Gas flow measuring capability at all off-take points shall be checked by January 15, 2011.
2. Necessary thermo-well shall be installed by Dec. 2011.
3. All transmitters to be checked and replaced as necessary by Dec. 2011.
4. Detailed Information (all valve stations, in-take & off-take points, exact metering locations as already required) on GTCL & other gas pipeline network shall be provided to JICA Study Team (JST) by January 31, 2011.
5. Site layout drawings of other companies shall be provided to JST by January 31, 2011.
6. Selection of Communication Backbone system shall be made by Dec. 31, 2010.

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Thank You

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II. Minutes of Meeting on 5-10 March 2011

Minutes of Meeting

Date: 2011.03.05~2011.03.10

Venue: GTCL's Head Office

Participants: GTCL .....Mr. Faheem/Shariful/Ashoke/Nasir/Momin
JST(JICA Study Team) ....Mr. Iwamoto/Oikawa/Mizushima/Kono

Sub: Draft Final Report for SCADA rehabilitation & expansion project

1. **Link with Chevron server**

   GTCL intends to establish the individual communication link between Chervon server at their Dhaka head office and GTCL's Demra MCC in order to monitor their process data at MCC prior to the Project implementation. This link will be most likely used for the New System, however, the final report shall still allow the scope and the provisional cost for the establishment of appropriate secured link between Chevron server and New server at MCC.

2. **Cost for Chevron server**

   GTCL mentioned that Chevron will modify their system to facilitate their process data to GTCL new SCADA system at their own cost.
   JST noted.

3. **Frequency band for telemetry radio link**

   GTCL mentioned that frequency band for telemetry radio link of the New System should be 382~392MHz which is instructed by BTRC.
   JST noted above.

4. **VoIP**

   GTCL mentioned that the permission is required for the use of VoIP in proposed IP PBX system, and GTCL will be responsible for the required application procedure for the permission. JST noted above.

5. **Supply of transmitter**

   JST requested GTCL to provide numbers of new transmitters to be supplied by EPC Contractor for the possible replacement of existing transmitters. GTCL confirmed that the

following transmitters should be supplied by the Project.

- PT: 15
- RTD: 15
- PdT: 20

JST noted and shall reflect it in the final report.

6. **IP-PBX**

GTCL requested to increase the numbers of extension lines at MCC/ACC from 10 to 20.

JST agreed and shall reflect it in the final report.

7. **UPS at MCC/ACC**

GTCL requested to provide the following UPS at MCC/ACC

1) 15kVA with 8 hours back up for Equipment

2) 15kVA with 4 hours back up for emergency lighting

JST agreed and shall reflect it in the final report.

8. **Redundancy of IP radio equipment**

GTCL requested 1+1 standby protection to IP radio equipment (1+1) for the wireless link between BTCL's access points and Master telemetry stations.

JST agreed and shall reflect it in the final report.

9. **Warranty and O & M support Period**

GTCL requested to increase the warranty as well as O & M support period from 1 year to 2 years.

JST agreed and shall reflect it in the final report.

10. **Output voltage of backup battery**

GTCL pointed out that Draft final report specifies the output voltage of backup battery for communication equipment as 24V which does not tally with 48V mentioned in the cost breakdown sheets.

JST replied that 48V is correct and correction shall be made accordingly.

11. **Network monitoring system**

GTCL requested to increase the number of network monitoring system from 1 (at MCC) to 2 (each 1 at MCC & ACC).

JST agreed and shall reflect it in the final report.

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12. **Necessary information for Leak Detection & Load Balancing**

GTCL mentioned that there are some off-takes with relatively very low gas flow that need not be covered by the New System. JST pointed out that it will cause the partial malfunction of Leak Detection and Load Balancing. GTCL reconfirmed that such off-takes listed below need not be covered by the New System even though the function of Leak Detection and Load Balancing is partially affected.

1) Off-take/Non Bulk: Bakhrabad-Demra Line
2) Jamalpur TBS: BB Line
3) Sherpur TBS: BB Line
4) Bhaluka TBS: BB Line
5) Netrokona TBS: BB Line
6) Kishoreganj TBS: BB Line

These off-takes will eventually be covered under separate interface metering programs by GTCL in the future when the function of Leak Detection and Load Balancing can be fully restored.

JST noted.

13. **Existing solar panel**

GTCL requested to replace all existing solar panels with new panels.

JST agreed and shall reflect in the final report.

14. **Telemetry radio equipment**

JST asked the necessity of the master telemetry radio equipment at the following stations where remote RTU does not currently exist.

- Horipur Head Office
- Elenga
- Tarakandi
- Comilla HO

GTCL replied that master telemetry radio equipment is required for future expansions at these stations.

JST noted and shall reflect in the final report.

15. **Existing Antenna for Microwave Link**

JST asked the necessity of removal of existing antennas for microwave link mounted on existing towers. GTCL replied that these antennas and feeder cables shall be removed by the Project after communication link is successfully established.

JST noted and shall reflect in the final report.

16. **Additional OCT**

GTCL mentioned that 1 (one) additional OCT is required at KGDCL's head office located in Chittagong city that can be covered by Faujdarhat master telemetry station. Also 1 (one) additional OCT is required for Chevron head office in Gulshan, Dhaka through appropriate secured link.

JST noted and shall reflect it in the final report.

17. **Cost for Microwave radio equipment**

GTCL requested JST to provide the basis of the price for microwave radio equipment given in the breakdown sheets of cost comparison sheet (table 2-7 of draft final report) for clarification purpose. JST agreed and provided the relevant information of "Basis of Unit Rates in Breakdown of Cost Estimate" on 09 March 2011.

GTCL noted.

18. **Acceptance of Draft Final Report**

After the presentation of Draft final report held on 07 March 2011 at GTCL head office and discussions mentioned above, GTCL accepts the contents of draft final report provided by JST.

The minutes of meeting above verified by:

Date: 10 Mar. 2011

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Md. Aminur Rahman
Managing Director - GTCL

Mr. Shinichi Iwamoto
Team Leader of JICA Study Team