People's Republic of Bangladesh

FY2017 Ex-Post Evaluation of Japanese ODA Loan Project

"Grid Substations and Associated Transmission Lines Development Project"

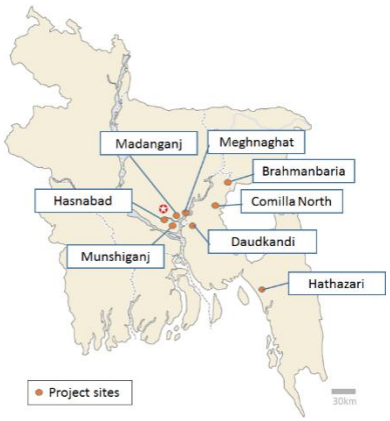
External Evaluator: Kaho Kumagai, Hideyuki Takagi, Ernst & Young ShinNihon LLC

0. Summary

The Project was implemented with the objective of stably providing high-quality electric power by constructing and expanding transmission lines and sub-stations in major cities such as Dhaka, Comilla and Chittagong and surrounding areas where rapid increase of electricity demand was expected.

The relevance of the project is high as it is consistent with the Bangladesh's development plan which places the promotion of the electric power infrastructure as an important field for the sustainable development of society and the economy, the need for development to establish a stable and reliable electric power supply, as well as Japan's ODA policy. Although the project cost was within the plan, the project period exceeded the plan due to the fact that it took time to prepare the bidding document and the delay occurred in the additional work to respond to the increase in regional power needs. Therefore, the efficiency of the project is fair. The implementation of the Project has enabled a continuous and steady supply of electric power even under the continuous increase in power demand. As an effect, the frequency of power failures and accidents has decreased, which has contributed to the enhancement of economic activity in the target area and the improvement of quality of social services such as hospitals and schools. Therefore, the effectiveness and impact of the project are high. With regard to the operation and maintenance of grid substations constructed and expanded during the Project, there were issues with securing technicians and parts in some instances. However, considering that a backup structure of the executing agency is in place and that the substations are in operation without issue, the sustainability of the transmission system overall has been secured. In light of the above, this project is evaluated to be highly satisfactory.

1. Project Description



Project Location(s)
(Subject areas: The surrounding areas of Dhaka, Comilla and Chittagong)

Photo 1. Transformers and transmission facilities (Meghnaghat 132/33 kV substation)

1.1 Background

In Bangladesh, electricity demand was growing at an annualized rate of about 8% as of 2006 with peak electricity demand of approximately 4,000MW, but the generation capacity of approximately 3,600MW could not satisfy demand. Thus the gap between supply and demand was adjusted for using routine planned power outages. The gap between electricity supply and demand was expected to widen further due to the planned decommissioning of power plants in operation at the time due to dilapidation. Electricity shortages were especially critical in major cities such as Dhaka, Comilla and Chittagong and surrounding areas, which caused frequent power outages and dangerously low voltage. These issues posed a major obstacle to the economic activities of small to medium sized enterprises in particular, who do not have access to private power generators; therefore, a reliable and quality supply of electricity was required as the foundation for economic development. In the *Bangladesh Power Sector Development Plan and Strategy* (January 2004), the Government of Bangladesh stated three goals in its long-term vision for the energy sector: (a) to guarantee a supply of power which makes it possible for everyone to use electricity by the year 2020, (b) to supply high-quality and highly reliable electrical power, and (c) to supply electrical power at a reasonable price.

Under these circumstances, the "Grid substations and associated transmission lines development project" (hereinafter referred to as "the Project") was implemented in major cities and surrounding areas where rapid growth of electricity demand was expected. The Project provided assistance with the construction and expansion of substations and transmission lines by Power Grid Company of Bangladesh Limited (hereinafter referred to as "PGCB"), which is in charge of electricity transmission.

1.2 Project Outline

The objective of this project is to improve stability and reliability of electric power supply by constructing and expanding transmission lines and sub-stations in major cities and surrounding areas where rapid increases in demand was expected, thereby contributing to the growth of the economy and society of Bangladesh.

Loan Approved Amount/ Disbursed Amount	4,642 million yen / 4,183 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	June 2006 / June 2006
Terms and Conditions	Interest Rate 0.01% Repayment Period 40 years (Grace Period 10 years) Conditions for Procurement General untied
Borrower / Executing Agency	Government of the People's Republic of Bangladesh (GOB) / Power Grid Company of Bangladesh Ltd. (PGCB)
Project Completion	October 2013
Main Contractor(s)	・ KEC International Ltd. (India) ・ Hyosung Corporation (South Korea) ・ M/S Jiangsu Etern (China) / China National Electric Wire & Cable Export Corp. (China) ・ Energypac Engineering Ltd. (Bangladesh) / ABB Ltd. (India) (JV)
Main Consultant(s)	―
Related Studies (Feasibility Studies, etc.)	・ Feasibility study (PGCB, 2004)
Related Projects	JICA (Technical Cooperation Project): ・ Strengthening Management and Performance Standards in Power Sector of Bangladesh through Promotion of TQM (2006 – 2009) JICA (ODA Loan Projects): ・ National Power Transmission Network Development Project (February 2013) ・ Dhaka-Chittagong Main Power Grid Strengthening Project (December 2015) World Bank:

	・ Power Sector Development Technical Assistance Project (2004 – 2014) Asian Development Bank (ADB): ・ Bangladesh Power Development Program (2003 – 2012)

2. Outline of the Evaluation Study

2.1 External Evaluator

Kaho Kumagai, Hideyuki Takagi, Ernst & Young ShinNihon LLC

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: November 2017 – November 2018

Third-Country Meeting: February 18 – 21 and May 6 – 9, 2018

Duration of the Field Study: February 27 – April 5 and June 27, 2018 (The field study was carried out by a local consultant.)

2.3 Constraints during the Evaluation Study

Based on instructions from the JICA Evaluation Department, the evaluator did not enter Bangladesh for security reasons and a local consultant carried out the entire process of the field study under the direction of the evaluator. The evaluator and the local consultant had a preliminary meeting in the third country (Thailand) before the field study to share information on the evaluation policy of the project and the method of the field study. In the meeting, in order for the local consultant to accurately understand and be able to collect information necessary for the analysis in accordance with 5 evaluation criteria, the evaluator explained the details of materials including a questionnaire to the executing agency and an information collection checklist to be used in the site survey. This process ensured the completeness of the collection of information and the quality of information collection used in analysis.

3. Results of the Evaluation (Overall Rating: A[1])

3.1 Relevance (Rating: ③[2])

3.1.1 Consistency with the Development Plan of Bangladesh

Poverty Reduction Plan (2005), a national development plan of Bangladesh at the time of appraisal of the Project, regarded infrastructure as important in poverty reduction, economic growth and social development, as it directly affects socioeconomic consequences. Increasing

[1] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

[2] ③: High, ②: Fair, ①: Low

access to electricity was stated as an issue given that about 1/3 (22% in rural areas) of the population had access to electricity as of 2005[3].

Policy Statement on Power Sector Reforms (2000), one of the sector development plans at the time of the appraisal of the Project, stated three goals in the long-term vision for the electric power sector: to ensure universal access to electricity by 2020, to ensure a high-quality and reliable electric power supply, and to provide electricity at reasonable rates[4]. In addition, the *Bangladesh Power Sector Development Plan and Strategy* (2004) stated plans to construct/strengthen new power sources about 5,000MW by 2012 and about 11,000MW by 2020, power transmission lines of about 10,000km in total, 230kV/132kV substations of about 17.5 thousand MVA, and 132/33 kV substations of 12 thousand MVA by 2020.

The 7th Five-Year Plan 2016 – 2020 (2015) [5], a national development plan at the time of the ex-post evaluation, states that an efficient and inexpensive electric power infrastructure needed to be established in order to maintain the growth of Bangladesh's international competitiveness. It plans to add following new substations within the planning period: approximately 11.8 thousand MVA of 400/230kV substations, 18.3 thousand MVA of 230kV/132kV substations, and approximately 17.3 thousand MVA of 132/33kV substations[6].

Furthermore, the *Power System Master Plan 2016* (2016), a sector development plan at the time of the ex-post evaluation, also states the necessity of building a high-quality electricity network to support long-term economic development[7].

As stated above, both national development plans and sector development plans of Bangladesh have positioned the increase and improvement in quality of electric power supply as the basis for economic development, both at the time of appraisal and at the time of ex-post evaluation of the Project. The Project supports these plans and is consistent with the development policy of Bangladesh.

3.1.2 Consistency with the Development Needs of Bangladesh

At the time of appraisal of the Project, electricity demand was rapidly increasing in Bangladesh at 300-400 MW per year (annual increase of about 8%) due to economic growth; therefore, capital investment was required to respond to the increase in demand in each department of electricity: generation, transmission, and distribution. Regarding the power

[3] Source: *Bangladesh Unlocking the Potential National Strategy for Accelerated Poverty Reduction*, General Economics Division Planning Commission, Government of People's Republic of Bangladesh, 2005
[4] Source: Materials provided by JICA
[5] The five-year development plan was replaced by a poverty reduction plan between 2002 and 2010. It then restarted from 2011.
[6] Source: *Seventh Five Year Plan FY2016-FY2020*, General Economics Division Planning Commission, Government of People's Republic of Bangladesh
[7] Source: Power Division, Ministry of Power, Energy and Mineral Resources, Government of People's Republic of Bangladesh, September 2016

transmission department, it was required to extend the transmission lines about 5,000km, increase the substation of 230kV/132kV about 8,000 MVA and 132kV/33kV about 5,000 MVA by 2012. The supply and demand of electric power was tight especially in major cities such as Dhaka, Comilla and Chittagong and surrounding areas where industrial concentration has progressed. In the project target area as of 2006, load cutoff of about 80 MW was implemented at the peak hours. Electricity issues including frequent power outages and low voltages affected mainly small and medium enterprises that cannot use private generators, posing a major obstacle to economic activity[8].

The capacity of the power generation facilities and the power demand in Bangladesh continue to increase even after completion of this project (see table 1). The nationwide capacity as of 2013 was surpassed by the peak demand as of 2017, in just four years. Considering that electricity demand will grow further in Bangladesh, which continues to grow economically, demand may exceed supply over the next few years unless investment is made for electric power infrastructure. Electricity demand in major cities including Dhaka, Comilla and Chittagong was also increasing at the time of ex-post evaluation; therefore, it is necessary to continue developing electric power facilities with a view to the future, in order to keep supplying electric power stably to such major cities which lead the economic growth of the country. Based on these observations, it is confirmed that there are needs for improvement of the electricity transmission network carried out by the Project.

Table 1. Capacity and peak demand of electricity nationwide and in major cities

Area	Item	2013	2014	2015	2016	2017
Nationwide	Total capacity (MW)	9,151	10,416	11,532	12,365	13,846
	Actual peak demand (MW)	7,482	8,488	8,124	9,286	9,507
	Peak demand / Total capacity (%)	82	81	70	75	69
Dhaka	Total capacity (MW)	3,894	3,407	3,575	4,322	4,644
	Actual peak demand (MW)	2,604	2,834	3,113	3,438	3,842
	Peak demand / Total capacity (%)	67	83	87	80	83
Comilla	Total capacity (MW)	1,341	1,332	1,732	2,192	2,465
	Actual peak demand (MW)	767	564	723	907	963
	Peak demand / Total capacity (%)	57	42	42	41	39
Chittagong	Total capacity (MW)	1,207	1,283	1,405	1,408	1,641
	Actual peak demand (MW)	687	743	925	1,079	1,155
	Peak demand / Total capacity (%)	57	58	66	77	70

Source: Materials provided by PGCB

[8] Source: Materials provided by JICA

3.1.3 Consistency with Japan's ODA Policy

At the time of appraisal of the Project, support for the electric power sector was positioned as a priority sector for "establishment of infrastructure for sustainable growth" in the *Medium-Term Strategy for Overseas Economic Cooperation Operations* (April 2005)[9]. In addition, in t*he Country Assistance Strategy for Bangladesh* (May 2006), electric power was positioned as a priority sector for support: a policy was stated to support and promote sector reform by providing loans in collaboration with other donors[10]. Furthermore, the *Country Assistance Program for Bangladesh* (May 2006) listed the development of infrastructure including electric power as a priority target and sector for economic growth, as it is important to the investment environment and has a direct effect on poverty reduction. The Project was aimed at the development of the economy and society by establishing transmission and distribution facilities in various parts of Bangladesh and supplying stable electric power, which was consistent with Japan's aid policy at the time of appraisal.

This project is sufficiently consistent with the development plan and development needs of Bangladesh, as well as Japan's ODA policy. Therefore its relevance is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

3.2.1.1 Construction and procurement of machinery

Table 2 shows the planned and actual output of the Project. Outputs were constructed and expanded as planned, except for the increase in number and scale of the facilities to be built at the substations in Brahmanbaria and Comilla North substation due to the increase in regional power needs.

Table 2. Plan and actual of the main outputs

Item	Plan	Actual
Construction of new substations and transmission lines	Daudkandi: 132/33kV substation including 2X50/75MVA, 3-phase transformers and all other necessary equipment and materials	As planned
	Brahmanbaria: 132/33kV substation including 2X25/41MVA, 3-phase transformers and all other necessary equipment and materials	Modification of the facility from 2X25/41MVA to 3X25/41MVA, 3-phase transformers and all other necessary equipment and materials
	Munshiganj: 132/33kV substation including 2X50/75MVA, 3-phase transformers and all other necessary equipment and materials	As planned

[9] Source: Materials provided by JICA
[10] Source: Materials provided by JICA

	Meghnaghat: 132/33kV substation including 2X50/75MVA, 3-phase transformers and all other necessary equipment and materials	As planned
	Transmission lines for the above substations (Approximately 80km of total extension 132kV double circuit transmission lines)	As planned
Extension of facilities in existing substations (transformers and other equipment)	Comilla North substation: Installation of new 3X75MVA 230/132kV single phase transformers along with necessary equipment for bay extension	2X50/75MVA 132/33kV 3-phase transformers along with necessary equipment for bay extension, in addition to the originally planned facilities
	Hasnabad substation: Replacement of existing transformer by the new 3X66/100MVA 132/33kV 3-phase transformers along with necessary equipment for bay extension	As planned
	Hathazari substation: Installation of new 1X150MVA 230/132kV 3-phase transformers along with necessary equipment for bay extension	As planned
	Madanganj: Installation of two 132kV line bays with necessary equipment for bay extension	As planned

Source: Materials provided by JICA and PGCB

Details and the reason for modifications in outputs

Taking into consideration the fact that an increase in power needs exceeding the demand forecast in the advance feasibility study, the following additions in facilities were carried out.

(Additions to the newly constructed Brahmanbaria substation)

Modification: Addition of a 25/41MVA transformer[11]

Reason: The establishment of Brahmanbaria substation was planned in 2003. With the passage of time, however, demand growth as of 2011 exceeded the demand forecast at the time of its planning. As it was predicted that further load interruption would occur, PGCB conducted a survey on the addition of a 25/41MVA transformer, which is necessary as power supply increases. Following the concurrence of JICA on the modification on February 12, 2012, additional extension was implemented. The additional 25/41MVA transformer was connected with a 70MW power station (Quick Rental Power Plant: QRPP[12]) installed adjacent to the new substation, to compensate for the power demand in the Brahmanbaria area.

[11] Source: Materials provided by JICA

[12] The Bangladesh government allows construction of rather expensive private rental power plants in order to meet urgent electricity demand. Source: Ministry of Power, Energy and Mineral Resources of Bangladesh (Quoted from the survey report on actual condition of BOP in Bangladesh (December 2012), Japan External Trade Organization (JETRO))

(Additions to Comilla North substation)

Modification: Upgrading from two 25/41MVA transformers to two 50/75MVA transformers[13]

Reason: Comilla North substation is located in the same area as Brahmanbaria. Due to the rapid demand growth in the region, in 2012, the Comilla North substation was experiencing overload situation. It was predicted that further load interruption would occur unless the transformer capacity was increased. Therefore, PGCB conducted a survey on replacing existing two 25/41MVA transformers with two 50/75MVA transformers. Following the concurrence of JICA on April 4, 2012, additional expansion was implemented.

3.2.1.2 Consulting Services

At the time of appraisal, PGCB was planning to use consulting services only for the construction of Munshiganj substation, where construction was necessary to deal with the special topography (it was necessary to lay overhead transmission line across the Daleshwari river). However, by the time the project was implemented, PGCB had implemented a number of constructions under similar conditions through other projects (ADB projects) and had accumulated sufficient know-how. For this reason, PGCB changed its decision and did not use consulting services for the construction[14].

Cancellation of the consulting services for the construction of Munshiganj substation did not affect the project period, and no additional costs were incurred as all the tasks were carried out by PGCB staff instead[15]. Furthermore, facilities are being operated with no problems at the time of ex-post evaluation. Because technical consulting was not necessary at the project execution stage, the change in their decision is considered appropriate.

On the other hand, not hiring a procurement support consultant caused delay in project completion as the executing agency was not familiar with the bidding procedure based on JICA's procurement guidelines for ODA loan projects. The risk of delay could have been lowered by receiving consultants' support on the procedural aspects of bidding. Therefore, measures should have been taken to prevent the delay in the Project by using consulting services even if only partially. (Refer to "3.2.2.2 Project period" and "Lessons learned")

3.2.2 Project Inputs

3.2.2.1 Project Cost

The actual project cost was within the plan (99% of the plan). The total project cost was planned to be 7,234 million yen (yen loan portion was 4,642 million yen), but the actual cost was 7,128 million yen (yen loan portion was 4,183 million yen). Although additions

[13] Source: Materials provided by JICA
[14] Source: Interview with PGCB
[15] Source: Answer to the questionnaire for PGCB

were made at two substations, the actual project cost was reduced due to the exchange rate fluctuations[16], cancellation of consulting services, and no utilization of resources for contingencies and price escalation[17].

3.2.2.2 Project Period

The original project period at appraisal was from June 2006 to June 2009, 37 months in total[18]. However, as mentioned in "Output", additional work was carried out at the substations in Brahmanbaria and Comilla North, for the purpose of responding to the increase in power needs. For this reason, the additional 19 months for this change was included in the comparison of planned and actual project period. As a result, the actual project period of 97 months from June 2006 to June 2014, significantly exceeding the plan of 56 months (173% compared to the plan).

The breakdown of the 41-month period of delay is as follows: 28 months for the construction of original scope, 2 months from the completion of the original scope construction to the start of the additional construction, 5 months for the additional constructions, and 6 months from the completion of additional work to the commencement of operation of the facilities. As described below, delay in the project period also occurred due to factors other than construction, during the process from bidding preparation to conclusion of contract in the original scope work, and when switching from temporary connection with a power station in additional work.

[Preparation for bidding - conclusion of contract with contractor]

Compared to the 3 months planned period (from July 2006 to September 2006), the actual period was 10 months (October 2006 - July 2007) for the preparations for bidding documents related to the construction and expansion of each substation and related facilities of this project. The bidding then began in December 2007, five months later.[19] The reason why the delay in the preparation of bidding documents occurred was that although PGCB decided that procurement support consultants were unnecessary at the commencement of the Project given their experience in preparing bidding documents for the ADB projects, it took more time than expected to finalize the content of the bidding documents as PGCB was unfamiliar with preparing documents based on JICA's procurement guidelines for ODA loan projects.

[16] 1 Bangladesh Taka (BDT) = 1.64 yen at the time of appraisal, and BDT 1 = 1.31 yen at the completion of the project; therefore, the yen strengthened about 20% against BDT.
[17] Source: Answer to the questionnaire for PGCB
[18] The project period was set to be from the Loan Agreement signing date (starting point) up to the commencement of operation (completion) of new facilities.
[19] Source: Materials provided by JICA

After preparing the bidding documents, a long period of time (more than 10 months) was also required to conclude the contract. The longest construction lot took 27 months from preparation of the bidding documents until the contract became effective[20].

[Delay in the additional work]

It was decided through formal procedures that in Brahmanbaria and Comilla North substations, additional work for electric facilities would be done in addition to the original work while the original work of development and expansion was completed. At Brahmanbaria substation, a method of temporary connection to QRPP, a 70MW power station, via a circuit breaker had been adopted until the completion of the 25/41MVA transformer. Although it was necessary to temporarily shut down QRPP when switching to connection via the 25/41MVA transformer after completion of the additional work and trial operation, it overlapped with the irrigation season which requires more power than usual. For the convenience of beneficiaries receiving electricity from QRPP, it was decided to wait for trial operation until May 23 of the same year when the irrigation period would end[21]. As a result, the trial operation which was originally scheduled on January 5, 2013 was delayed until May 23 of the same year.

As for the additional work at Comilla North substation, the date of trial operation was scheduled to be July 10, 2013; however, the actual date was December 6, 2013[22]. The delay was caused by the process of changing of L/C (letter of credit) issuing bank[23].

3.2.3 Results of Calculations for Internal Rates of Return (Reference only)

Since internal rates of return of the Project were not calculated at appraisal, recalculations were not made at the ex-post evaluation.

Although the project cost was within the plan, the project period exceeded the plan. Therefore, the efficiency of the project is fair.

[20] In the construction of lot No. 3, bidding document was prepared in October 2007, then re-bidding was done in May 2008. After the conclusion of contract in December 2009, it became effective through the concurrence of JICA in January 2010 (Source: Materials provided by PGCB).
[21] Source: Interview with PGCB
[22] Materials provided by JICA
[23] Source: Interview with PGCB

3.3 Effectiveness and Impacts[24] (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

The operation and effect indicators set at the time of appraisal were "capacity utilization," "load shedding" and "voltage drop (%)." The baselines and targets of the indicators are shown in Table 3.

Table 3. Operation and effect indicators set at the time of appraisal

Indicator	2005	2012 (3 years after completion)
	Baseline	Target
Availability Factor (%)[Note 1]	88.14% (Average)	Below 100%
Load shedding (MW)[Note 2]	78MW (Total)	0MW
Voltage drop (%)[Note 3]	81% (Average)	Within +/-10% from 100% rated voltage

Source: Materials provided by JICA

Note 1: This indicator uses the average value of existing substations subject to the project. The Availability Factor of the new substation adopts the operation rate of the substation that supplies electricity to the area.

Note 2: Load shedding means stopping the supply from a substation in order to protect equipment in the event that demand occurs beyond the supply capacity of the transmission/substation equipment of the substation.

Note 3: Voltage is more stable as the fluctuation range of ± is smaller with respect to the standard value (indicated by 100%)[25]. The voltage drop rate compares the lowest voltage, which is expressed as a ratio (%) of the voltage dropped at the maximum against the standard value. The baseline value of the Project was set as the voltage drop rate at the time of appraisal at the site where the substations are to be newly established, and the target value was set as the range of voltage fluctuation at the new substations (± fluctuation range to 100%).

(1) Availability Factor

The availability factor of substations is required not to exceed 100%. At the time of appraisal, it was expected that the capacity utilization rate would exceed 100% in a few years without the Project. Then, an actual excess was observed. However, it has been maintained at 100% or less since completion of the Project, showing that the target has been achieved.

[24] Sub-rating for Effectiveness is to be put with consideration of Impacts.

[25] Supplemental note: Voltage always fluctuates slightly, and when the fluctuation range exceeds a certain percentage, adverse effects such as deactivation occur on the electricity equipment at factory and electric appliances at home. Therefore, it is necessary to control the voltage so that the voltage drop rate falls within a certain range.

Table 4. Annual changes in availability factor of each facility

(Unit: %)

Year / Facility	2005 **Baseline**	2006	2007	2008	2009	2010	2011	2012	2013	Completion 2014	2015	2016	3 years after completion 2017 **Actual**
Construction of new substations and transmission lines													
Daudkandi	80	86	92	100	31	34	37	41	48	46	39	70	80
Brahmanbaria	85	91	99	107	75	80	88	95	51	65	67	88	88
Munshiganj	76	82	89	96	58	63	69	76	48	65	76	83	88
Meghnaghat	94	118	129	140	48	52	56	61	46	56	36	44	49
Extension of facilities in existing substations													
Comilla North	104	112	121	131	71	76	82	98	54	32	44	93	84
Hasnabad	82	89	96	104	56	61	65	71	48	56	56	58	69
Hathazari	96	104	112	121	71	78	87	96	72	72	79	75	73
Average	**88**	**97**	**105**	**114**	**59**	**63**	**69**	**77**	**52**	**56**	**57**	**73**	**76**

Source: Answer to the questionnaire and data provided by PGCB

(2) Load shedding

The load shedding in the project area remains at a low level following the completion of the Project and it has been on a downward trend, while it drastically increased once after the appraisal. The decrease rate of load shedding is only 35% in comparison of the actual amount at the time of ex-post evaluation (2017) with those of the baseline. However, in comparison with the peak of 348MV in 2010, there has been a major decrease of 85% so far. Although it has not reached the target of 0MW, the project is considered to have contributed to a substantial improvement in load shedding.

Table 5. Annual changes in load shedding of each facility

(Unit: MW)

Year / Facility	2005 **Baseline**	2006	2007	2008	2009	2010	2011	2012	2013	Completion 2014	2015	2016	3 years after completion 2017 **Actual**
Construction of new substations and transmission lines													
Daudkandi	8	9	10	11	12	14	13	10	10	12	14	12	13
Brahmanbaria	14	15	16	19	25	30	26	22	20	19	8	5	0
Munshiganj	30	33	35	38	45	52	48	38	38	33	11	9	7
Meghnaghat	18	19	20	27	33	38	34	27	27	24	10	11	14
Extension of facilities in existing substations													
Comilla North	8	25	43	63	76	87	80	63	62	55	18	15	10
Hasnabad	0	0	0	6	8	9	9	8	7	5	0	0	0
Hathazari	0	17	50	85	102	118	108	85	84	75	25	20	7
Total	**78**	**118**	**174**	**249**	**301**	**348**	**318**	**253**	**248**	**223**	**86**	**72**	**51**

Source: Answer to the questionnaire and data provided by PGCB

(3) Voltage drop

The actual voltage drop rate at the time of ex-post evaluation (2017) achieved the target rate of within -10% of the standard value.

Table 6. Annual changes in voltage drop of each facility

(Unit: %)

Year / Facility	2005 Baseline	2006	2007	2008	2009	2010	2011	2012	2013	2014 (Completion)	2015	2016	2017 (3 years after completion) Actual
Construction of new substations and transmission lines													
Daudkandi	84	84	85	86	97	96	95	94	96	97	96	97	98
Brahmanbaria	84	85	84	85	103	102	101	100	98	99	98	98	98
Munshiganj	77	79	80	80	81	89	94	97	98	97	98	98	98
Meghnaghat	79	84	82	86	97	96	95	94	97	98	98	98	98
Average	**81**	**83**	**83**	**84**	**95**	**96**	**96**	**96**	**97**	**98**	**98**	**98**	**98**

Source: Answer to the questionnaire and data provided by PGCB

3.3.1.2 Qualitative Effects (Other Effects)

The qualitative survey was conducted in all of the target areas of the construction of new substations and transmission lines (Daudkandi, Brahmanbaria, Munshiganj, Meghnaghat) and surrounding areas, and in the two places of the extension of facilities in existing substations (Comilla North and Madanganj). The subjects of the survey were PGCB personnel in charge of the operation, large-scale customers (SMEs, hotels, hospitals, schools, state power distribution companies etc.), chambers of commerce and other economic organizations. The key informant interview (KII) method was used for the survey[26]. Interview items were set regarding the stability of electric power service as a qualitative effect (stabilization of voltage, reduction of power failure time, etc.), and the accompanying economic and social impact for the purpose of investigating the difference between before and after the Project.

(1) Stable supply of electric power

In response to the questions concerning stabilization of electric power supply, the executing agency and all of the KII respondents replied that the number of the electrical equipment failure has decreased since the project implementation. For example, according to the owner of a rice mill factory in Madanganj, damage to the machine motor due to unstable voltage has

[26] The target of KII was a beneficiary that fulfilled the characteristics of each area subject to the Project and was a small business that was easily susceptible to load shedding. Specific subjects include 2 timber factories in Munshiganj, 1 hospital and 1 school in Meghnaghat, 1 confectionary shop and 1 clothing shop in Comilla North, 1 hospital and 1 general store that sells household electric appliances, etc. in Daudkandi, 1 office of a bus company and 1 restaurant in Brahmanbaria, 1 lumber trading company and one rice mill in Madanganj.

not occurred after the Project whereas it frequently occurred before the Project. Therefore, the implementation of the Project is considered to have contributed to the stabilization of electricity supply.

(2) Frequency of blackouts

Load shedding causes blackouts and electrical equipment failure. Through the development of new power transmission facilities, the reliability of the power system has been improved as load shedding has reduced as described in the quantitative effect above. According to the timber factory manager of Munshiganj, one of the respondents to the KII survey, the instantaneous interruption (momentary power failure) before the project was 5-6 times a day (total 1 to 2 hours), whereas there is almost none at the time of the ex-post evaluation. The implementation of the Project is considered to have contributed to the stabilization of electricity supply, as decreases in power outage and instantaneous interruptions have been observed after the Project.

(3) Customer satisfaction

According to the answers to the questionnaire to PGCB, complaints are decreasing as load shedding has decreased and the voltage problem has also improved after project implementation. In addition, no complaints about power service were heard in the KII. Therefore, the Project is considered to have contributed to improvement of customer satisfaction.

As described above, the data of the project area and the qualitative information obtained through the field survey confirm that the planned project effects have been achieved.

3.3.2 Impacts

3.3.2.1 Intended Impacts

(1) Economic effects

The answers to the questions on the economic effects in the KII were as shown in Table 7. The answers in the KII indicate that the number of factories and commercial facilities, etc. entering the beneficiary area is rapidly increasing due to stable supply of electric power. Respondents also experienced a rise in land prices due to these effects. Examples of the economic effects reported include increase in sales due to improvement in productivity of factory equipment and increase in sales at a bus company which uses an online reservation system, both due to stable operation of electricity equipment by stable supply of electric power.

Table 7. List of answers to KII regarding economic effects

Category	Economic effects	Attributable respondent(s)
Development of the entire region	We have felt the effects of the rapid increase in investment in the area as new commercial facilities, schools, hospitals, etc. are newly established.	All of the respondents
	As electricity is supplied in a stable manner, the number of entrants to the beneficiary area has increased, and land prices have increased three to five times.	Factory, hospital, school, clothing store, restaurant
Effects related to business management	Since the supply of electric power has become stable, business hours can be extended, which has led to improved sales. For example: Ÿ Prior to the project, it was able to operate effectively for only 5 hours due to unstable power supply, but it has been able to operate for 8 hours after the project. (A factory in Munshiganj) Ÿ After the project, rice mills can be operated overnight. As a result, the amount of rice that can be shipped to merchants has increased by 65% compared to the previous years. (A rice-milling plant in Madanganj)	General store, restaurant, factory, clothing store
	The respondent purchased new timber processing equipment as electricity was supplied in a stable manner, which led to an increase in its production volume. As a result, sales increased by 60% compared with before the project.	Factory
	Because it is able to operate the online reservation system stably after the project, the bus company acquires twice as many customers as before (400 people a day). Power stabilization has contributed to improve sales.	Bus company
	Electricity fees paid have increased, but the increase in revenue due to the stable supply of electricity is larger. For this reason, the respondent has experienced economic benefit.	Factory
	A large-sized in-house generator became unnecessary. It became possible to change it to a small one or not to use it.	Hospital, clothing company, restaurants
	Before the project, it was impossible to preserve merchandise (confectionery), but since the refrigerator works steadily after the project, it became possible to store the goods. As an effect, food loss has decreased by 35 to 45% compared with before project implementation, and sales have increased by 150%.	Confectionery shop
	Timber processing equipment can be operated stably now. Due to the increase in production volume, monthly sales have increased by 25 to 40% compared to before the project.	Timber trading company

The respondents to the KII recognize that while electricity expenditures have increased in comparison with that at the time of appraisal due to increase in tariffs and the volume of use of electricity, the effect of increased revenue from the stable supply of electric power outweighed these expenses. Therefore, beneficiaries are considered to have benefitted

economically from the Project.

(2) Improvement of social services

The steady supply of electric power has led to improvements in services at hospitals, factories and commercial facilities, as the disruption of work due to unstable electricity has been reduced. The KII respondents have also experienced improved quality of life such as the increase in streetlights and the stable consumption of electricity at home.

The effect of power stabilization is not limited to electric equipment. In the answers to the KII to the school, it was mentioned that increasing electricity supply amount facilitated learning at school because it enabled the school to stay well-lit and students to study even at home.

In terms of safety, it was also reported in the KII that security has been improved due to cities becoming better lit at night, or police investigation became more efficient due to an increase in the number of surveillance cameras installed.

Table 8. List of answers to KII regarding social services

Category	Social effects	Attributable respondents
Effects on the services of hospitals	Ÿ Prior to the project, surgery could only be performed on one operating table, but now it is possible to perform surgery simultaneously on three operating tables. (A hospital in Daudkandi) Ÿ Before the project, there were five to six instantaneous interruptions a day; this caused frequent interruption of medical examination when using machines, with only about 60% of an examination being completed. Such interruption has not occurred after the project implementation. (A hospital in Meghnaghat) Ÿ Prior to the project, not very much electric equipment had been introduced. At present, the hospital has introduced CT scan and ultrasound diagnostic equipment; therefore, the range of medical services the hospital can offer has increased. (A hospital in Daudkandi)	Hospital
Effects on general consumers	The sales of electrical appliances such as household appliances and pumps have increased by 20 to 25% compared with before project implementation. (A general store in Daudkandi)	General store
Effects on schools	Ÿ Keeping the classroom well-lit makes it easier for students to study at school. Students can also study at home. Ÿ In classes using projectors, interruption of classes due to instantaneous power interruption occurred before the project, and they could not follow the schedule. Currently such classes can proceed without problems.	School
Effects on security	The city became well-lit and safe due to the increase in street lights etc. It has enabled people to walk at night. For example: The effects of an increase in the number of installed surveillance cameras have been felt. (A factory in Munshiganj)	Factory, restaurants, bus company

(3) Contribution to economic development (Reference only)

The GDP growth rate of Bangladesh as a whole is shown in figure 1, which is alternative information as a reference as GDP growth rate in the direct beneficiary area of the Project could not be obtained. The GDP growth rate since the 2015 fiscal year, when the Project was completed, has continued to rise by more than 7%, and has been at a high level in recent years. Not only PGCB, but Bangladesh Power Development Board, Dhaka Power Distribution Company, and Electricity Generation Company of Bangladesh have implemented projects related to power generation, transmission and distribution. The realization of stable supply of electric power by these projects is considered to have contributed to the economic development of the whole country.

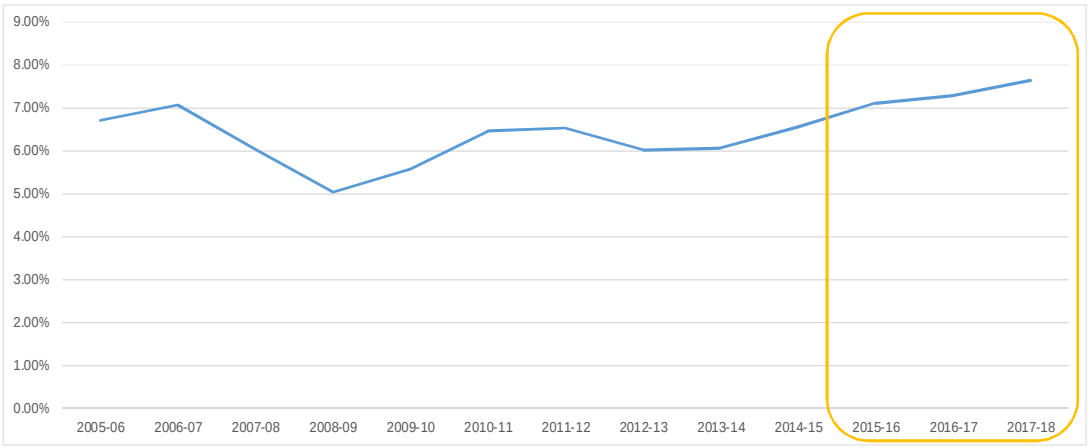


Figure 1. Annual changes in real GDP growth rate in Bangladesh

Source: Bangladesh Bureau of Statistics

Note: Bangladesh's fiscal year is from July to the end of June in the next year.

Other than the Project, facilities development including the establishment and renewal of power grid and substations etc. of PGCB has been carried out sequentially with the funds of other donors and as self-financed projects. Therefore, the above impact is recognized as a composite effect of these facilities development projects.

Table 9. A list of PGCB's projects with the funds of other donors or GOB, which were completed from the completion of this project until the time of ex-post evaluation

	Facility improvement project [Note 1]	Year of completion (Fiscal year)	Financing [Note 2]
1	Haripur 412 MW combined cycle power plant and associated substation (PGCB Part)	2013/2014	JICA, GOB
2	Meghnaghat – Aminbazar 400 kV transmission line project (Phase 1)	2013/2014	ADB, GOB
3	Grid inter connection between Bangladesh (Bheramara) and India (Baharampur)	2013/2014	ADB, GOB
4	Construction of new substation and expansion of substation including transmission line facility	2013/2014	ADB, JICA (this project), GOB
5	Transmission efficiency improvement through reactive power compensation at grid substation and re-enforcement of Goalpara substation	2013/2014	KfW (German Government-owned Development Bank), GOB
6	Aminbazar – Old Airport 230 kV transmission line and associated substations	2014/2015	ADB, GOB
7	Siddhirganj – Maniknagar 230 kV transmission line project	2014/2015	WB, GOB
8	Tripura (India) – Comilla (Bangladesh) Grid Interconnection Project	2015/2016	GOB
9	Bibiyana – Kaliakoir 400 kV and Fenchunganj – Bibiyana 230 kV transmission line	2016/2017	EDCF (Korean Economic Development Cooperation Fund), GOB

Source: Annual reports of PGCB

Note 1: These are included in PGCB's annual development program, and many use the funds of donors or Bangladesh government. Besides these projects, many facility improvements have been done using PGCB's own funds.

Note 2: The description of PGCB's own fund expenditures is omitted.

3.3.2.2 Other Positive and Negative Impacts

(1) Impact on the Natural Environment

According to the executing agency, environmental mitigation measures and environmental monitoring plan formulated under Initial Environmental Examination (IEE) were partially implemented[27]. It was confirmed by the executing agency and the KII that the construction was adequately managed in terms of the environment. Environmental influences on air, noise and vibration seemed to have occurred to some extent during construction, although no complaints were received. Regarding measures to prevent pollution, it was confirmed through site inspections that no negative impact on the environment occurred, as pollution was

[27] In this ex-post evaluation, the environmental monitoring report could not obtained although it was requested to the executing agency. For this reason, it was regarded that the environmental monitoring plan was partly implemented, referring to the response of the executing agency. Meanwhile, since there were no complaints heard around the target facilities, it was recognized that there was no particular negative environmental impact by the Project implementation.

prevented by using water spray. Also, the Project is considered to have been managed appropriately as there were no complaints about negative impact on the environment according to the information from KII respondents. Therefore, the implementation of the Project is judged to have had no negative impacts on the natural environment.

(2) Resettlement and Land acquisitions

Land acquisition was conducted according to the government regulation (The Acquisition of Waste Land Act, 1950). The site was 8 acres in size, and land acquisition was done from 23 landowners. There was no relocation of residents and/or livestock as the site was not used for those purposes. It was confirmed with the executing agency and through the KII that no complaints occurred due to the land acquisitions.

The implementation of the Project has enabled continuous and steady supply of electric power even under the continuous increase in power demand. As an effect, the frequency of power failures and accidents has decreased. In the hospitals, factories, and commercial facilities in the beneficiary area, stable operation and extension of working hours without concern for voltage interruption has been realized. The Project contributes to improve the quality of medical services and industrial services in the beneficiary area as well. These improvements contribute to the social and economic development of the country.

Given the above, this project has largely achieved its objectives and therefore the effectiveness and impacts of the project are high.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional / Organizational Aspect of Operation and Maintenance

The number of personnel at the new substations at the time of ex-post evaluation was confirmed through the site inspections and with PGCB headquarters (see Table 10). Basically, there was no major change in the number of personnel at the time of appraisal and ex-post evaluation. However, it was observed that the number of engineers at Munshiganj, Daudkandi and Brahmanbaria was insufficient. Engineers who actually work in the substation are staff below the level of field workers (Foreman), and junior engineers and engineers are in the position of supervisors. In view of this point, the insufficient number of staff below foreman is assessed to be a problem at the substations where the number of technicians is insufficient. According to PGCB, the insufficient number of technicians is a factor causing insufficient daily maintenance. On the other hand, there is a practice in place at each substation: if a situation arises that cannot be dealt with by the personnel in the substation, a junior engineer

(or someone who fulfills that role in absence of a junior engineer) contacts the executive engineer responsible for the Grid Maintenance Division (GMD), the maintenance department of power transmission in the regional jurisdiction, and GMD then dispatches necessary engineers to the substation[28]. Based on these facts, PGCB considers there to be no major problems due to lack of personnel. This systematic backup works 24 hours a day, 365 days a year. For this reason, a mechanism for maintaining sustainability is considered to have been established as an entire system.

According to the Human Resources Department of PGCB, new personnel with technical skills are scheduled to be placed at the substations with insufficient number of technicians. It was also mentioned that there is a plan to provide training for the new personnel. (Refer to the recommendation for "Formulation of human resources recruitment and capability building plan based on accurate information management on substation technical staff")

Table 10. The number of personnel at the new substations at the time of ex-post evaluation

Substation	Reply from PGCB headquarters	Reply during site inspections *The number of staff (Foreman or below) except for Munshiganj
Brahmanbaria substation	7 people in total: ・ Engineer 1 ・ Junior engineer 4 ・ Foreman 0 ・ Electric engineer/overhead wire engineer 1 ・ Technical assistant 1	4 people in total: ・ Foreman 1 ・ Electric engineer/overhead wire engineer 1 ・ Technical assistant 2
Daudkandi substation	9 people in total: ・ Engineer 1 ・ Junior engineer 4 ・ Foreman 0 ・ Electric engineer/overhead wire engineer 1+2 ・ Technical assistant 1	6 people in total: ・ Foreman 2 ・ Electric engineer/overhead wire engineer 3 ・ Technical assistant 1
Meghnaghat substation	9 people in total: ・ Engineer 1 (Newly hired) ・ Junior engineer 6 ・ Foreman 0 ・ Electric engineer/overhead wire engineer 0 ・ Technical assistant 2	The number of staff is sufficient (There was no response on the detail of the number of staff)
Munshiganj substation	6 people in total: ・ Engineer 0 (a junior engineers takes the responsibility as an engineer) ・ Junior engineer 5 ・ Foreman 0	7 people in total: ・ Engineer 1 (on leave) ・ Junior engineer 5 ・ Foreman 0

[28] As for the frequency of dispatch from GMD, it is irregular as it is performed on as-necessary basis. The dispatched engineer addresses equipment problems in which failure has occurred by checking the operation state of each part, testing the operation, replacing parts with problems and filling lubricating oil, etc.

	・ Electric engineer/overhead wire engineer 0 ・ Technical assistant 1	・ Electric engineer/overhead wire engineer 0 ・ Technical assistant 1

Source: Interview with PGCB, site inspection

3.4.2 Technical Aspect of Operation and Maintenance

At the time of appraisal, PGCB was implementing projects for the development of transmission lines without problems supported by ADB etc. without hiring consultants. It was also maintaining facilities appropriately[29]. At the time of the ex-post evaluation, all the staff at the substations are required to attend 72 hours of training per year in order to maintain their technical capabilities. In the operation and maintenance training for technical staff (Technical Officers), 5 days of training courses are provided to learn about equipment maintenance and safe operation, equipment monitoring, trouble and coping methods, disaster response methods etc. In addition, JICA has provided technical cooperation on total quality control (TQM) to the power sector of the country since 1999. It also implemented a technical cooperation project "Strengthening Management and Performance Standards in Power Sector of Bangladesh through Promotion of TQM" from 2006 to 2009, simultaneously with the implementation of the Project. In these projects, introduction of TQM, improvement of maintenance management technique, establishment of quality control (QC) circle, training of QC trainers, etc. were carried out. According to PGCB, TQM has contributed to enhancing the technical capability of operation and maintenance.

The operation and maintenance manual of each equipment have been distributed to and utilized by the engineers and staff. In addition, a service manual has been prepared by PGCB which includes the method of disassembling and assembling of facilities, cleaning and inspection etc. of each equipment. Safety manuals are also included in the service manual of PGCB. These manuals have been utilized mainly by junior engineers and foreman, and are stored together with maintenance records[30].

Currently, there are limited persons with skills to respond to the problems occurring at substations. However, technical upgrades are considered to be underway as all the staff must receive periodic training and the manuals have been utilized in the operation. (See the recommendation concerning "Implementation of training to secure long-term sustainability")

3.4.3 Financial Aspect of Operation and Maintenance

From the time of appraisal[31] to the time of ex-post evaluation, PGCB has maintained sound financial condition in general as well as positive operating results for the past five years (See

[29] Source: Materials provided by JICA
[30] Source: Answer to the questionnaire for PGCB, interview with PGCB
[31] Source: Materials provided by JICA

Table 11 below). Financial expenses (such as long-term borrowing interests) are growing because PGCB is actively investing capital in facilities such as transmission lines as mentioned above in the "Impact" section. As an effect, although it recorded a deficit in 2013/2014, PGCB has maintained steady operating results following a significant increase in revenue from transmission fees from 2015/2016. The annual changes in its financial ratios over the past five years (See Table 12 below) also show stable financial conditions: capital expenditures have been carried out with sufficient consideration of financial stability, as certain margin has been maintained in repaying the principal and interest. The financial figures also indicate that PGCB maintains a certain level of repair and maintenance costs, substantiating the answer to interviews during site inspections that there have been no problems in particular regarding the budget for repair and maintenance expenses. From the above analysis, there is considered to be no problem in the financial aspects of operation and maintenance.

Table 11. Annual changes in PGCB's revenue and expenditure and surplus for past 5 years

(Unit: Million BDT)

Item	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017
Revenue (Transmission fees)	7,870	8,671	9,378	12,722	14,368
% of change from previous year	*10%*	*10%*	*8%*	*36%*	*13%*
Cost of revenue (Transmission costs)	4,718	6,145	6,903	7,228	8,034
% of change from previous year	*9%*	*30%*	*12%*	*5%*	*11%*
(Repair and maintenance cost)	*(234)*	*(217)*	*(327)*	*(326)*	*(329)*
Profit from revenue	3,151	2,526	2,474	5,493	6,334
% of change from previous year	*12%*	*-20%*	*-2%*	*122%*	*15%*
General & admin. expenses	254	341	347	542	620
Operating profit	2,897	2,184	2,126	4,950	5,713
Non-operating income & expenses (financial exp. etc.)	-781	-1,585	-2,198	-2,545	-2,694
Income before tax	2,015	570	-71	2,291	2,876
Income after tax [Note]	1,010	-29	416	1,226	1,995
Surplus	5,774	4,613	4,567	5,180	6,380

Source: Annual reports of PGCB (fiscal year is from July to the end of June in the next year)

Note: In 2014-2015, income after tax is larger than income before tax due to the adjustment for deferred tax effects.

Table 12. Annual changes in PGCB's financial ratios for past 5 years

Financial ratio	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017
Debt-servicing capability					
1. Current ratio	1.55	0.81	2.58	3.10	2.78
2. Debt equity ratio	2.49	2.69	2.59	2.57	2.49
3. Debt service coverage ratio	1.90	1.11	1.14	2.26	2.56
Financial stability					
4. Equity ratio	0.27	0.25	0.26	0.26	0.26
Profitability					
5. Sales profit ratio (%)	40	29	26	43	44
6. Operating profit ratio (%)	37	25	23	39	40
7. Rate of return on assets (ROA) (%)	0.9	0.0	0.3	0.9	1.3
8. Rate of return on equity (ROE) (%)	3.4	-0.1	1.3	3.5	4.8
Other					
9. Receivables turnover period (days)	59	60	61	71	69

Source: Calculated by the evaluator based on the figures in PGCB's annual reports (the figures of 3. "Debt service coverage ratio" is transferred from the annual report)

3.4.4 Status of Operation and Maintenance

The substations newly established by the Project operate without problem at the time of ex-post evaluation. According to the response to the questionnaire to PGCB, all the new substations are in good condition. Meanwhile, as stated in "Organizational aspect of operation and maintenance" described above, there is room for improvement as there is insufficient daily maintenance at each substation because of a lack of field technicians below foreman. Maintenance is performed once a year, and if there is a problem, parts replacement is carried out each time.

PGCB uses a method of parts replacement in which each substation obtains necessary parts each time from the central repository. In the central repository, there is always inventory to prevent the occurrence of missing items, by ordering spare parts from the manufacturer beforehand. During the site inspection, it was observed that there were some damages to equipment such as electric circuit breaker etc. in Comilla North, Daudkandi, Meghnaghat, and insufficient stock of spare parts in Munshiganj, Meghnaghat and Daudkandi. However, in the practice of replacing spare parts, each substation obtains necessary parts from the central repository as soon as possible, according to the explanation of substation staff. Equipment, helmets, gloves and other equipment for repair and maintenance are sufficiently secured at each substation. Based on the results of site inspection, the shortage of spare parts occurring at each substation is considered to have been duly addressed.

No major problems have been observed in the institutional, technical, financial aspects and

current status of the operation and maintenance system. Therefore, the sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The Project was implemented with the objective of stably providing high-quality electric power by constructing and expanding transmission lines and sub-stations in major cities such as Dhaka, Comilla and Chittagong and surrounding areas where rapid increase of electricity demand was expected. The relevance of the project is high as it is consistent with the country's development plan which places the promotion of the electric power infrastructure as an important field for the sustainable development of society and the economy, the need for development to establish a stable and reliable electric power supply, as well as Japan's ODA policy. Although the project cost was within the plan, the project period exceeded the plan due to the fact that it took time to prepare the bidding document and the delay occurred in the additional work to respond to the increase in regional power needs. Therefore, the efficiency of the project is fair. The implementation of the Project has enabled a continuous and steady supply of electric power even under the continuous increase in power demand. As an effect, the frequency of power failures and accidents has decreased, which has contributed to the enhancement of economic activity in the target area and the improvement of quality of social services such as hospitals and schools. Therefore, the effectiveness and impacts of the project are high. With regard to the operation and maintenance of grid substations constructed and expanded during the Project, there were issues with securing technicians and parts in some instances. However, considering that a backup structure of the executing agency is in place and that the substations are in operation without issue, the sustainability of the transmission system overall has been secured. In light of the above, this project is evaluated to be highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

<u>Formulation of human resources recruitment and capability building plan based on accurate information management related to substation technical staff</u>

It was observed during the site inspection that there is a practice of dispatching necessary engineers from GMD to the substation without sufficient number of skilled-technicians. Therefore, it was confirmed that a mechanism for maintaining the sustainability has been established as an entire system. However, it was observed in this evaluation study that there is a difference in the grasp of the number of technical staff members located at each substation between the headquarters and substations concerned. Therefore, it seems that there is room for

improvement in management of information as a prerequisite for formulating a recruitment/capability building plan. It is recommended that the executing agency accurately grasp and manage the information of the current status of technical staff such as their position and capability level before the planning for recruitment and contents of training etc. and putting them into implementation.

Implementation of training to secure long-term sustainability

From a long-term perspective, it is necessary for an organization to maintain technical capacity even when experienced engineers retire. For this reason, it is important to incorporate training of young people into the plan, and to increase the number of employees who have acquired daily maintenance and troubleshooting skills. The training of high level technicians cannot be achieved by training alone, but requires daily experience. For this reason, it is recommended to develop a mechanism to promote practical training for technical staff, so that those who accumulate such experiences for working as a foreman, the highest technical worker.

4.3 Lessons Learned

Appointment of a procurement support consultant

The implementation period of the Project ran considerably longer compared to the plan. One of the reasons for the delay was that the executing agency was unfamiliar with the preparation of the bidding documents based on JICA's procurement guidelines for ODA loan projects. For this reason, it took more time than expected until the contents of the bidding document were finalized, through a series of discussions between the JICA and the Bangladesh side. In order to prevent this situation beforehand, it should have confirmed the degree of proficiency of the executing agency regarding the bidding procedure of ODA loan project at the time of appraisal.

If a procurement support consultant had been appointed, PGCB would have been able to save time on considering the bidding procedure which ultimately took a long time, and JICA would have been able to manage the schedule more easily as well. In future project implementations, it is desirable to examine a way to reduce the risk of delay at the bidding stage including an appointment of a procurement support consultant who supports the bidding process through the stage of implementation of the bidding, if the executing agency is unfamiliar with the bidding procedure for ODA loan projects. Or, it is also recommended that JICA consider conducting concentrated procurement management seminars in advance if the executing agency decide not to appoint a procurement support consultant.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs		
Construction of new substations and transmission lines	Ÿ Daudkandi: 132/33kV substation Ÿ Brahmanbaria: 132/33kV substation Ÿ Meghnaghat: 132/33kV substation Ÿ Munshiganj: 132/33kV substation	Ÿ As planned Ÿ Adding a 25/41MVA transformer Ÿ As planned Ÿ As planned
Extension of facilities in existing substations (transformers and other equipment)	Ÿ Comilla North substation: Installation of new transformers along with necessary equipment Ÿ Hasnabad substation: Replacement of existing transformer along with necessary equipment Ÿ Hathazari substation: Installation of new transformers along with necessary equipment Ÿ Madanganj: Installation of two line bays with necessary equipment for bay extension	Ÿ Upgrading transformers from the existing 25/41MVA to 50/75MVA in addition to the originally planned facilities Ÿ As planned Ÿ As planned Ÿ As planned
2. Project Period	June 2006 – June 2009 (37 months)	June 2006 – June 2014 (97 months)
3. Project Cost Amount Paid in Foreign Currency Amount Paid in Local Currency Total ODA Loan Portion Exchange Rate	 4,642 million yen 2,592 million yen (1,970 million Bangladesh Taka) 7,234 million yen 4,642 million yen 1 Bangladesh Taka = 1.31509 yen (As of February 2005)	 4,183 million yen 2,944 million yen (2,102 million Bangladesh Taka) 7,128 million yen 4,183 million yen 1 Bangladesh Taka = 1.4002 yen (Average between June 2006 and June 2014)
4. Final Disbursement	October 2013	