Bangladesh

Barge-Mounted Power Plant Rehabilitation Project

Report Date: November 2002
Field Survey: September 2001

1. Project Profile and Japan's ODA Loan

Site Map: Khulna and Chittagong

Site Photo: Khulna Barge-Mounted Power Plant

1.1 Background

Khulna Barge-Mounted Power Plant (K-BMPP) and Chittagong Barge-Mounted Power Plant (C-BMPP) were constructed in June 1980 and October 1986, respectively, with funding from a Japanese ODA loan. However, operation of the two plants had been suspended frequently due to various technical faults, and, as a result, they had not realized their expected outcomes and objectives. Under the circumstances, JBIC conducted Special Assistance for Project Sustainability (SAPS) for K-BMPP and C-BMPP and recommended that the utilization and efficiency of the plants be improved by rehabilitating the facilities and upgrading operations and maintenance of the Project. Based on JBIC's recommendations, the Government of Bangladesh and the Bangladesh Power Development Board (BPDB) initiated repairs on K-BMPP and C-BMPP, but, mainly due to the lack of foreign currency reserves in Bangladesh, the recommended rehabilitation were not completed. As a result, the power supply situation turned critical.

Even though electric power demand in Bangladesh had increased 12% per annum in the 20 years before the beginning of this project, severe power shortages, caused by accidents and aging plant facilities, remained. In addition, with power supply in the western part of the country remaining low compared to the east, where natural gas was produced, improving power generation capacity and securing a stable electric power supply in the west were priority issues.

1.2 Objectives

To rehabilitate C-BMPP and K-BMPP, which were constructed with funding from a Japanese ODA loan.

1.3 Project Scope

Project scope includes:
(1) Modification, maintenance and repair of C-BMPP and K-BMPP, including hot section routine inspection and overhauling of gas generators; and
(2) Purchase of spare parts and consumables for five years consumption.

The Japanese ODA loan was to cover the foreign currency portion of the total project cost; the local currency portion was to be covered by the Government of Bangladesh (GOB).

1.4 Borrower / Executing Agency

The Government of the People's Republic of Bangladesh / Bangladesh Power Development Board

1.5 Outline of Loan Agreement

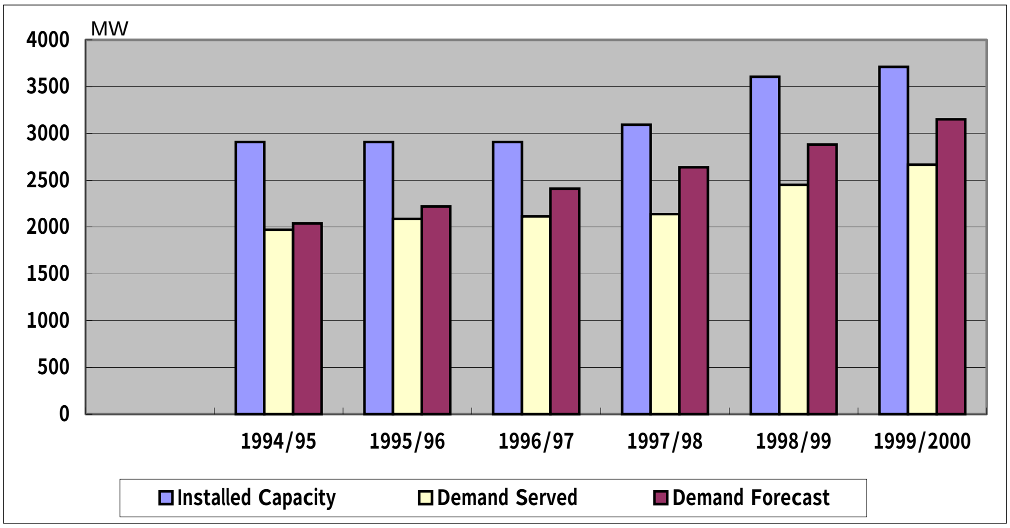
Loan Amount Loan Disbursed Amount	1,561 million yen 1,561 million yen
Exchange of Notes Loan Agreement	September 1993 September 1993
Terms and Conditions Interest Rate Repayment Period (Grace Period) Procurement	 1.0 % p.a. 30 years (10 years) General Untied
Final Disbursement Date	February 2000

2. Results and Evaluation

2.1 Relevance

At the time of project appraisal in 1991/92, the power sector was a high priority sector, having been allocated 15% of the government's public investment budget in the 4th Five Year Plan (1991-95). The main sector development goals established in the 4th Five Year Plan were as follows: (i) increase of power supply and reduction of system loss; (ii) effective utilization of natural gas for fuel; (iii) improvement of reliability and quality of power supply; and (iv) promotion of rural electrification. The project was expected to improve the operation and cost performance of K-BMPP and C-BMPP and to mitigate power shortages in Bangladesh through the rehabilitation of existing power plants. The project was also expected to contribute to the effective utilization of domestic natural gas at C-BMPP. These objectives matched the development goals for the sector.

Figure 1: Power Demand and Supply in Bangladesh



Source: BPDB

As seen in Figure 1, although installed capacity and demand served increased steadily between 1994/95 and 1999/00, a gap between power demand and generation capacity remained. In the most recent 5th Five Year Plan (1997-2002), reliable and uninterrupted power supply through maximum utilization of existing capacity is one of the main objectives.

C-BMPP was initially designed as a base load power plant, but in fact C-BMPP has been operated as a peak load power plant. In general, when sufficient generation is available, BMPPs are used for peak load to make them cost effective. The quantity of daily generation at each plant is determined as part of a load management program administered by the Load Dispatch Centre. Both C-BMPP and K-BMPP function as peak load power plants, supplying electricity in the evening for 4-7 hours every day. Therefore, it can be concluded that the the project is still relevant.

BPDB did not properly operate and maintain the project facilities, mainly because of the specific, advanced technical skills and equipment/facilities required to maintain an aero derivative machine, and because of the high cost. A way of achieving the project's goals using conventional plant facilities and equipment, with which BPDB had experience, should have been proposed. Instead, the project reproduced the constraints and difficulties identified by SAPS. The rehabilitation project (i.e. this project) did not provide a fundamental solution to the problem of BPDB's inadequate O&M capacity.

2.2 Efficiency

2.2.1 Project Scope

There were some modifications of the project scope. Inspection, repair, reconditioning and painting of the underwater hull at K-BMPP were not done because there were no dry docking facilities in Khulna. Corrective measures to overcome fuel control valve failure at K-BMPP were taken before the start of the project, so that component was deleted. Rehabilitation of the fire fighting system at K-BMPP was not done; instead, an inspection was conducted during commissioning of the plant. Meanwhile, the overhaul of additional gas generators was added to the scope at C-BMPP and K-BMPP. In addition, repair of the gas compressor, the overhaul of 2 other gas compressors and repair of the main transformer and a governor for speed control of the turbine of K-BMPP were also included in the scope. The need for these additional components was identified during the project implementation period. The rest of the rehabilitation works were conducted properly, and necessary spare parts were procured as designed in the original project scope.

2.2.2 Implementation Schedule

The original project implementation schedule was 42 months long, from January 1993 (preparation of tender documents) to June 1996 (completion of the project works). It was actually implemented over a 49-month period, from December 1993 to December 1997. The reasons for the delay were as follows: (i) Two gas generators were taken to Japan for refurbishment work at the manufacturer's factory, which was not included in the project appraisal, and (ii) additional maintenance was required when faults in the gas compressor and control system that had not been identified in the project appraisal were found during the implementation period.

2.2.3 Project Cost

The estimated project cost was 1,774 million Yen (incl. ODA loan amount: 1,561 million Yen), while the actual total project cost was 1,770 million Yen (incl. disbursed amount: 1,561 million Yen).

2.3 Effectiveness

2.3.1 Output of Power Generation

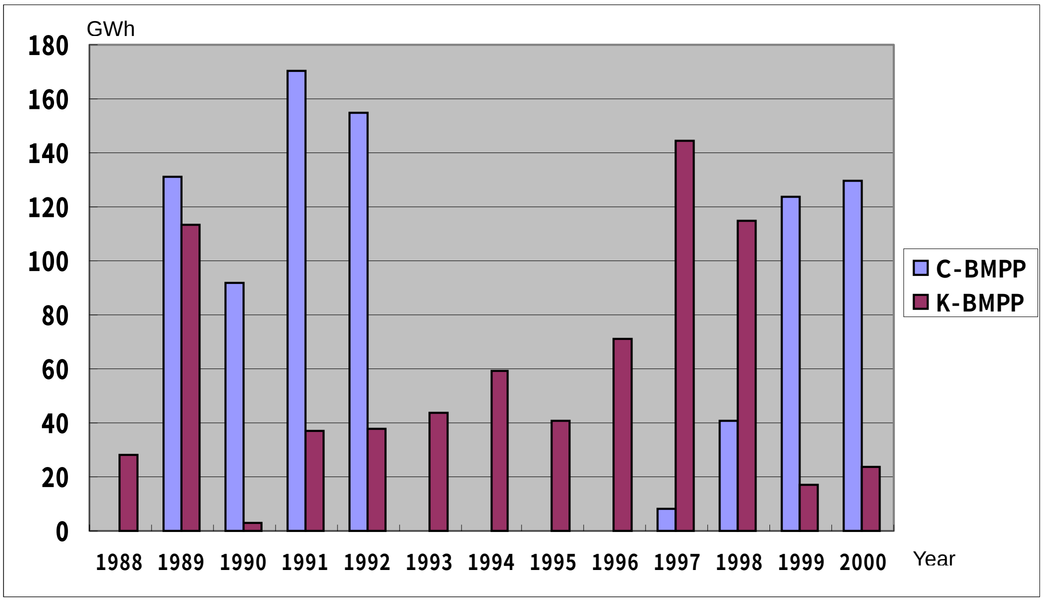
C-BMPP was installed in 1986 and has a capacity of 56MW (28MW x 2 Unit). It gradually improved its generation output again after rehabilitation in 1997. C-BMPP was initially designed as a base load power plant, but has actually served as a peak load power plant, as explained in the previous section (2.1 Relevance), providing 20-23MW load capacity per Unit vis-à-vis 28MW of installed capacity. C-BMPP's performance as a base load power plant fails to meet project goals. However, as a peak load powerplant, C-BMPP achieved the project objective to a reasonable extent in 2000.

K-BMPP was installed in 1980 with a capacity of 56MW (28MW x 2 Unit). Although the facility underwent rehabilitation in 1995, there was an accidental fire at K-BMPP Unit 1 in March 1998, and the operation of Unit 1 has been suspended ever since. According to a BPDP investigation committee report, the fire is thought to have been caused by fuel (kerosene) that had leaked through a hole in the fuel line of the high-pressure fuel pump and spread to the body of the gas generator. The fire fighting system at the power plant did not function due to the rapid spread and intensity of the fire. The plant was not insured. BPDB has not concluded its internal investigation yet, so there is no final statement regarding the fire accident. Since 1998, K-BMPP Unit 2 has been operated utilizing, alternately, a gas generator and a stand-by gas generator.

However, the generated output of Unit 2 has declined sharply since 1999. This is because it was forced to stop operations to replace the gas generator and to dredge around the facility to remove silt. In addition, there have been problems with high vibration on the low pressure side of the Unit that, despite the efforts of BPDB, have not yet been solved effectively. As a result, K-BMPP has not achieved its project objectives yet. Due to the high vibration, the maximum load of Unit 2 is limited to 20MW, compared with 28MW of installed capacity.

The appraisal outlined K-BMPP's role in providing stable power supply at peak loads in the western part of the country, where generation capacity is lower than that in the east. However, in this regard, K-BMPP's contribution has been quite limited since 1999.

Figure 2: Annual Generated Output(C-BMPP and K-BMPP)



Source: BPDB

Note: 1) From 1993-1997 there was major maintenance work at C-MBPP Unit 1 & 2.

2) From 1993-1996 there was major maintenance work at K-MBPP Unit 1, and in 1996 at Unit 2.

Table 1: Annual Generated Output(C-BMPP and K-BMPP)

(Unit: MWh)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
C-BMPP UNIT 1	N/A	123,513	29,806	104,316	57,385	0	0	0	0	6,065	6,351	68,522	64,802
C-BMPP UNIT 2	N/A	7,663	62,145	65,991	97,261	0	0	0	0	2,348	34,553	55,032	64,618
Sub-Total (C-BMPP)	N/A	131,176	91,951	170,307	154,646	0	0	0	0	8,413	40,904	123,554	129,420
K-BMPP UNIT 1	18,903	59,563	791	16,189	21,292	9,192	0	0	50,113	85,904	21,862	0	0
K-BMPP UNIT 2	9,240	54,048	1,842	20,516	16,318	34,588	58,938	40,883	20,774	58,807	92,991	17,192	23,531
Sub-Total (K-BMPP)	28,143	113,611	2,633	36,705	37,610	43,780	58,938	40,883	70,887	144,711	114,853	17,192	23,531

Source: BPBD

2.3.2 Other Operational Indicators

While the utilization factor of the two facilities varies from year to year (see Table 2, 3, 4 and 5), the average utilization since rehabilitation is 15.4% at C-BMPP (1997-2000) and 15.2% at K-BMPP (1996-2000). Generally, the average load factor of the total system in Bangladesh is about 50%[1], and power demand is concentrated in a 2-3 hour period in the evening. As power supply and system capacity are designed with peak demand in mind, the utilization factor is consistently low because they operate as a peak load electricity source. In light of this unique feature of the power system in Bangladesh, an acceptable utilization factor for the project might be around 25%[2]. The utilization factor of C-BMPP after 1999 is sufficient, but K-BMPP after 1999 needs improvement.

Table 2: Other Operational Indicators (C-BMPP Unit 1)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Utilization Factor (%)	50.4	12.2	42.5	23.4	under major maintenance work				2.5	2.6	27.9	26.4
Availability Factor (%)	56.4	18.3	50.8	29.3					3.9	3.7	33.9	33.9
Outage Rate (%)	29.1	76.7	5.4	63.9					96.1	96.1	44.4	19.6
Annual Operating Hour (hour)	4,937	1,602	4,447	2,567					342	326	2,970	2,969
Annual Stand-by Hour (hour)	1,044	867	2,529	1,210					N/A	340	3,057	4,863
Annual Planned Outage Hour (hour)	751	1,011	1,530	455					N/A	19	360	228
Forced Outage Hour (hour)	2,026	5,279	253	4,551					8,420	8,072	2,372	722

Source: BPBD

Table 3: Other Operational Indicators (C-BMPP Unit 2)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Utilization Factor (%)	3.1	25.3	26.9	39.7	under major maintenance work				1.0	14.1	22.4	26.3
Availability Factor (%)	3.4	29.7	34.5	47.6					1.4	20.9	28.4	34.3
Outage Rate (%)	96.5	61.0	43.1	50.1					98.6	63.0	58.8	10.6
Annual Operating Hour (hour)	297	2,602	3,021	4,168					123	1,827	2,484	3,007
Annual Stand-by Hour (hour)	89	1,444	2,008	9					N/A	3,589	2,437	5,240
Annual Planned Outage Hour (hour)	82	646	1,439	405					N/A	234	296	180
Forced Outage Hour (hour)	8,290	4,067	2,291	4,177					8,637	3,109	3,542	355

Source: BPBD

[1] Annual utilization factor of total system of BPDB is 47.2% in 1998/99.
[2] Assuming K-BMPP and C-BMPP are operated six hours per day, their utilization factor will be 25% (= 6hour/24hour x 100).

Table 4: Other Operational Indicators (K-BMPP Unit 1)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Utilization Factor (%)	7.7	24.3	0.3	6.6	8.7	3.7	0	0	20.4	35.0	8.9	0	0
Availability Factor (%)	20.3	44.4	0.6	11.7	18.6	7.4	0	0	28.5	58.4	14.0	0	0
Outage Rate (%)	50.2	15.6	99.3	73.6	27.9	82.3	100	100	65.7	27.1	85.6	100	100
Annual Operating Hour (hour)	1,774	3,893	56	1,028	1,631	651	0	0	2,493	5,119	1,228	0	0
Annual Stand-by Hour (hour)	5,221	4,146	256	4,866	6,523	5,076	0	0	1,520	1,742	247	0	0
Forced + Planned Outage Hour (hour)	1,789	721	8,448	2,866	630	3,033	8,760	8,760	4,771	1,899	7,285	8,760	8,760

Source: BPBD

Table 5: Other Operational Indicators (K-BMPP Unit 2)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Utilization Factor (%)	3.8	22.0	0.8	8.4	6.7	14.1	24.0	16.7	8.5	24.0	37.9	7.0	9.6
Availability Factor (%)	8.9	36.8	1.3	15.0	10.3	22.7	35.7	27.4	16.0	44.3	89.7	12.1	17.3
Outage Rate (%)	89.1	38.8	98.5	53.5	79.1	21.2	18.6	13.4	74.3	55.7	10.3	74.3	46.1
Annual Operating Hour (hour)	782	3,228	114	1,318	902	1,990	3,124	2,403	1,403	3,880	7,855	1,063	1,513
Annual Stand-by Hour (hour)	1,659	3,488	1,398	5,923	2,460	6,236	4,920	5,986	3,323	0	0	4,617	5,954
Forced + Planned Outage Hour (hour)	6,363	2,044	7,248	1,519	3,422	534	716	371	4,058	4,880	905	3,080	1,293

Source: BPDB

2.3.3 Recalculation of FIRR

At the project appraisal, FIRR was estimated to be 18.2%. The recalculation of FIRR, based on updated information, is impossible because there was a negative cash flow mainly due to the deterioration of actual generated output.

(Assumptions for FIRR)

Project life: 15 years, including project implementation.

Benefit: Increase of revenue from increased power generated by the project

Cost: (i) Project cost and (ii) fuel cost for increase power generated by the project

2.4 Impact

2.4.1 Impact on Total Power System

As shown in Table 6, although total installed capacity, generation capacity and firm capacity have increased, the shortage of power in the total power system in Bangladesh has not been alleviated. This is because power demand tends to grow as supply capacity increases, since the existing power supply capacity has not fulfilled demand. In terms of load shedding during 1987/89-2000/2001 (Table 7), the worst was 346 days (2,119 hours) in 1997/98. The situation has not improved much since: It was 283 days (1,042 hours) in 2000/01. According to BPDB's projection, generation capacity (i.e. firm capacity) is expected to accommodate increasing peak demand by 2003/2004. But it should be noted that this does not necessarily mean that the majority of the population in Bangladesh will have access to electricity, since the current electrification ratio is about 18%. Further development of the power system is needed.

The impact of the project on the total power system of Bangladesh seems to be minimal.

Table 6: Installed Capacity, Generation Capacity, Firm Capacity, Demand Forecast, Demand Served, Load Shedding and Reserved Margin

Year	Installed Capacity (MW) *1	Generation Capability (MW) *2	Firm Capacity (MW) *3	Demand Forecast (MW) *4	Demand Served (MW) *5	Load Shedding (MW) *6	Reserve Margin (%) *7
1987/88	2,146	1,859	1,393		1,317	200-10	41
1988/89	2,365	1,936	1,470		1,393	170-10	39
1989/90	2,352	1,834	1,368		1,509	180-15	22
1990/91	2,350	1,710	1,253		1,640	340-15	5
1991/92	2,398	1,724	1,243		1,672	550-25	3
1992/93	2,608	1,918	1,437		1,823	480-20	5
1993/94	2,608	1,881	1,400		1,875	540-23	-
1994/95	2,908	2,133	1,652	2,038	1,970	537-10	8
1995/96	2,908	2,105	1,624	2,220	2,087	545-10	1
1996/97	2,908	2,148	1,667	2,410	2,114	674-20	2
1997/98	3,091	2,320	1,839	2,638	2,136	711-32	9
1998/99	3,603	2,850	2,369	2,881	2,449	774-16	16
1999/2000	3,711	2,665	n.a.	3,149	2,665	536-10	-

Source: BPDB

Note: 1) Installed Capacity as of June.
2) Generation Capability is the Maximum available generation capacity after maintenance outage.
3) Firm Capacity is capacity on a steady basis.
4) Demand Forecast figures are from the Reference Forecast of Power System Master Plan prepared in 1995.
5) The dates of maximum demand and maximum available generation capacity may not be the same.
6) Load shedding shows the maximum and minimum figures for the year.
7) Reserve Margin (%) = (Generation Capability - Demand Served) ×100 / Demand Served

Table 7: Load Shedding during 1987/88-2000/2001

Year	Load shedding during peak hour	
	Days	Duration (hr)
1987/88	54	74
1988/89	62	117
1989/90	29	51
1990/91	70	113
1991/92	232	660
1992/93	264	638
1993/94	210	670
1994/95	230	763
1995/96	301	1,007
1996/97	338	2,872
1997/98	346	2,119
1998/99	335	1,690
1999/2000	255	872
2000/2001	283	1,042

Source: BPDB

Table 8: Planned Load - Generation Balance (Summary)

(Unit: MW)

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07
Generation Capability							
Existing: Public	3,145	3,165	3,082	2,984	2,840	2,814	2,694
Existing: Private	450	450	450	450	450	450	450
Total (Existing)	3,595	3,615	3,532	3,434	3,290	3,264	3,144
New: Public	0	100	679	1,579	2,439	2,589	2,949
New: Private	235	400	1,020	1,020	1,320	1,470	1,470
Total (New)	235	500	1,699	2,599	3,759	4,059	4,419
Peak Demand 2)	3,394	3,659	4,393	4,766	5,172	5,603	6,071
Firm Capacity 1)	3,180	3,434	4,251	5,053	6,069	6,313	6,553
Surplus (Shortfall)	(214)	(225)	(142)	287	897	710	482
Reserve Margin (%)	13%	12%	19%	27%	36%	31%	25%

Source: BPDB

Note: 1) Firm Capacity is capacity on a steady basis.

2) Reference forecast up to 2001-02 & thereafter high forecast of Power System Master Plan prepared in 1995.

2.4.2 Impact on Environment

BPDB observed no serious negative environmental impact in the project area. Since the purpose of this project was the rehabilitation of existing facilities, its implementation has had no additional impact on the environment. Regarding the noise produced by the gas turbines in the barge, since both C-BMPP and K-BMPP are located on the riverside and are isolated from residential areas, the problem is minimal.

2.4.3 Impact on Local Residents

K-BMPP and C-BMPP were installed in existing power stations and commissioned at Khulna and Chittagong, in 1980 and 1986. Therefore, the project did not involve the relocation or resettlement of local residents.

2.5 Sustainability

2.5.1 Operation and Maintenance

Bangladesh Power Development Board (BPDB), established in 1972, is responsible for the generation, transmission, and distribution of electricity throughout the country, except for areas where the Dhaka Electricity Supply Authority (DESA) and the Rural Electrification Board (REB) oversee distribution. BPDB is under direction of the Ministry of Energy and Mineral Resources.

Actual day-to-day O&M activities are handled by each power station, and the BPDB head office in Dhaka provides for technical training. There are 50 O&M staff people for K-BMPP and similar number for C-BMPP. The general impression from the site surveys at C-BMPP and K-BMPP was that both project sites were well maintained, with the exception of Unit 1 of K-BMPP, which was damaged in the fire.

2.5.2 Technical Capacity

Generally, local maintenance staffs at the plant perform scheduled maintenance based on the maintenance plan prescribed by the manufacturer. Major maintenance and work to repair breakdowns are generally performed in the presence of foreign experts from the manufacturer, since the local maintenance staff does not have experience in carrying out major inspection /overhauling works. Generally, overhauling is done at the manufacturer’s maintenance workshop in Japan.

Although the number of O&M staff seems to be satisfactory, their technical skills need to be improved as:

(i) BPDB did not provide technical training for the development of O&M personnel, including training for the maintenance of an aero-derivative machine (i.e. an aircraft engine), (ii) quite a few maintenance staff members who received technical training from the manufacturer at the initial installation were transferred to other stations or different sections/departments of PBDP, or have already left PBDB, and (iii) technical skills have not been transferred effectively to new staff through on-the-job training (OJT).

BPDB reports that it is trying to bring back the staff trained at the beginning of the project. Moreover, BPDB plans to provide some training for O&M personnel next time a BMPP is rehabilitated.

In the procurement of spare parts, there is a constraint that cannot be resolved easily. Because repair of the generator's control panel card at C-BMPP was outside the scope of the project, it was allowed to deteriorate, and now the maker is no longer able to supply a new card. According to the staff of the plant, the manufacturer claims that there is no solution except the replacement and upgrading of the total system. Therefore, the generator at C-BMPP is forced to continue operating without spare parts. This may also be true at K-BMPP.

BPDB has invited international tender for the rehabilitation of K-BMPP Unit 1, operation of which was suspended after the fire in 1998, and Unit 2. With this second rehabilitation, BPDB plans to continue operating K-BMPP for another eight years .

2.5.3 Financial Status

Comparing the financial statements made available by BPDB for 1997/98 and 1998/99, it can be seen that operating income increased about 60%, with the growth of operating revenues (12.22%) exceeding operating expenses (8.9%). However, net income has fallen, due to large foreign exchange losses. Accounts receivable increased about 27% (about 5.3 billion Taka) from 1997/98 to 1998/99.

Table 9: Comparative Income Statement

(Unit: Taka)

	Actual FY 1998-99	Actual FY 1997-98	Increase/ Decrease
Operating Revenue			
Electricity Sales	23,628,358,167	21,018,838,094	12.42%
Other Operating Income	415,753,466	406,154,999	2.36%
Total Operating Revenue	**24,044,111,633**	**21,424,993,093**	12.22%
Operating Expenses			
Fuel Cost	9,669,177,843	9,940,558,885	(2.73%)
Electricity Purchase from IPP	1,216,811,509	-	100.00%
Depreciation	6,655,652,647	6,438,606,768	3.37%
Repair & Maintenance	1,571,851,586	1,035,305,457	51.82%
Personnel Expenses	1,886,458,048	1,832,089,820	2.97%
Office and Administrative Expenses	798,612,352	770,115,372	3.70%
Assets Insurance Fund	15,000,000	15,000,000	0.00%
Total Operating Expenses	**21,813,563,985**	**20,031,676,302**	8.90%
Operating Income / (Loss)	**2,230,547,648**	**1,393,316,791**	60.09%
Non-Operating Expenses			
Interest on Loans	2,554,609,968	2,583,228,343	(1.11%)
Loss due to Exchange Rate Fluctuation	2,879,972,218	(1,107,429,706)	(360.06%)
Net Non-Operating Expenses	5,434,582,186	1,475,798,637	268.25%
Net Income/ (Loss)	**(3,204,034,538)**	**(82,481,846)**	3784.53%

Source: BPDB

Table 10: Balance Sheet

Property & Assets

(Unit: Taka)

	June 30, 1999	June 30, 1998
Fixed Assets		
Written Down Value	121,940,554,434	119,528,365,051
(Project-in-Progress)	20,065,362,595	19,983,798,461
Total Fixed Assets	142,005,917,029	139,512,163,512
Current Assets		
(Accounts Receivable-Trade)	24,933,693,608	19,592,134,456
(Accounts Receivable-Others)	2,904,685,591	2,831,987,131
(Provision for Bad & Doubtful Debts)	(527,223,891)	(464,059,767)
Total Current Assets	44,927,737,560	38,748,605,061
Total Property & Assets	**187,992,166,130**	**178,414,204,936**

Capital & Liabilities

(Unit: Taka)

	June 30, 1999	June 30, 1998
Authorized Capital	100,000,000,000	100,000,000,000
Capital & Reserve	81,807,854,726	81,994,614,003
Long Term Liabilities [1)]	54,551,085,717	50,924,087,690
Medium Term Liabilities [2)]	1,921,193,151	1,948,363,122
Current Liabilities	45,597,729,008	39,268,952,619
Clearing Account [3)]	4,114,303,528	4,278,187,502
Total Capital & Liabilities	**187,992,166,130**	**178,414,204,936**

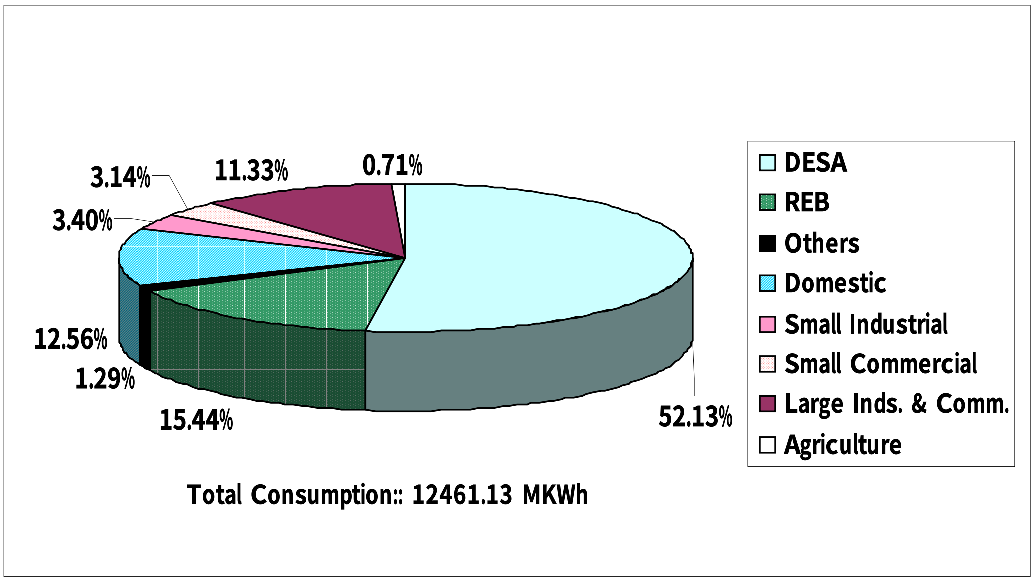
Source: BPDB

Note: Selected items shown in the table:

1) Long term liability includes government loans, foreign loans, and debenture/loans.
2) Medium tem liability includes security deposits (consumers), GPR&CPF, and pension funds.
3) The clearing account is used for interoffice transactions, transfer of funds from the head office to local offices and fund transfers from the field to the head office.

According to the latest financial statements of BPDB, accounts receivable (principal amount) at the end of June 2001 totaled 33,995.90 million Taka, equivalent to the amount billed for 12 months. DESA owed 24,817 million Taka, so if DESA had paid in full, the amount outstanding would have equaled only 3.24 months' worth (please see breakdown by type of consumer in Figure 3). The low collection ratio is one of the major constraints affecting the financial soundness of BPDB.

Figure 3: BPDB Consumption (FY2000)



Source: BPDB

Major maintenance works on the generators, such as overhauling and breakdown works, can only be done at the manufacturer's or at an airline company's workshop. This is because maintenance of the aero derivative machine (aircraft engine) adapted for the generators requires specific advanced technical skills and equipment/facilities. Furthermore, maintenance requires a lot of money, which makes it difficult for BPDB to maintain the project facilities.

In the project appraisal, major factors leading to the frequent occurrence of trouble at the plants were identified: (i) chronic power shortages compelled BPDB to run the generators without breaks for maintenance work, (ii) O&M capacity was not sufficient, and (iii) the BPDB O&M budget was insufficient. Unfortunately, this situation has not improved. In this regard, the relevance of the basic design of the project -- introducing an aero derivative machine for the generator – is considered problematic.

2.5.4 Power Sector Reform

The Government of Bangladesh has set development objectives for the power sector in its 5th Five Year Plan (1977-2002) as follows: (1) to ensure reliable and uninterrupted power supply and the balanced expansion of the transmission and distribution network; (2) to make utilities self-reliant through efficient management, reasonable restructuring of electricity tariffs and favorable financial arrangements; (3) to reduce system loss[3]; (4) to encourage private sector participation in the power sector; and (5) to expand power supply in rural areas.

In cooperation with the World Bank and the Asian Development Bank, GOB established (i) the Power Grid Company of Bangladesh (PGCB) to take over transmission from BPDB; and (ii) the Dhaka Electric Supply Company (DESCO) to succeed DESA. This privatization of the power sector is ongoing.

There is a series of power sector reforms on the agenda: (1) the establishment of an independent regulatory board, (2) reform of electricity tariffs, (3) division of BPDB into four regional units, and (4) the provision of necessary legal arrangements for implementation of the reforms. Nonetheless, the pace of reform remains very slow.

JBIC, in cooperation with JICA, will designate one Bangladesh power sector project as a model for improving O&M, and is making efforts to support improvements in executing agencies' performance in financial management, organization, total quality management and other key areas. It is expected that the results of these efforts will be incorporated into this project.

3. Lessons Learned

The project appraisal should have focused on building the institutional capacity of the executing agency, including its technical and financial capacity. In addition, the project design should have been given more deliberate consideration.

[3] The higher rate of system loss is one of the major constraints in the power sector of Bangladesh. Rrecent statistics indicate that system loss in the power system overall is 33.65%. The main reasons for this are: (a) illegal connection to incoming lines, (b) broken consumer meters, (c) manipulation of consumer meters, (d) manipulation and/or no issuance of invoices, and (e) manually issued invoices.

Comparison of Original and Actual Scope

Item	Plan	Actual
1. Project Scope K-BMPP	1. Hot Section Routine Inspection (2 Units) 2. Purchase of spare Parts 3. Purchase of Consumables for 5 years 4. Modification of Hydraulic Oil System 5. Modification of Lube Oil Separator 6. Inspection, Repair, Reconditioning and Painting of Under-water Hull, etc 7. Overhauling of Gas Generator (1 Unit) 8. Corrective Measures to Overcome Fuel Control Valve Failure 9. Modification of G.T. Inlet Air Filter 10. Test Equipment for Woodward Control Equipment/Instrument including Expert Services 11. Generator Breaker Maintenance, Generator Control and Protection 12. Rehabilitation of Fire Fighting System	1. Same as plan 2. Same as plan 3. Same as plan 4. Same as plan 5. Same as plan 6. Not done 7. Done for 2 Units (105 and 115) 8. Done by GOB 9. Same as plan 10. Same as plan 11. Same as plan 12. Only Inspection was done during commissioning of the plants (Additional scope) Repair of 1 Gas compressor and overhauling of 2 Gas compressors, repair of main transformer, and a governor for speed control of the turbine of K-BMPP.
C-BMPP	1. Hot Section Routine Inspection (2 Units) 2. Additional of Electronic Instrument 3. Purchase of Spare Parts and Consumables for five years Consumption 4. Overhauling of Gas Generator (2 Units) 5. Service Engineer for Instrument and Control (1 year)	1. Same as plan 2. Same as plan 3. Same as plan 4. Done for 3 Units (107, 109 and 112) 5. Service Engineer for I&C (6 months)
2. Implementation Schedule (from preparation of tender documents to completion of the project work)	January 1993 – June 1996 (42 months)	December 1993 – December 1997 (49 months)

3. Project Cost Foreign Currency Local Currency Total ODA Loan Portion Exchange Rate	 1,561 million Yen 213 million Yen (54.6 million Taka) 1,774 million Yen 1,561 million Yen 1 Taka = 3.9 Yen (US$1=JPY38=Tk.35.4 in 1993)	 1,561 million Yen 209 million Yen (74.6 million Taka) 1,770 million Yen 1, 561 million Yen 1 Taka = 2.8 Yen (US$1=JPY121.0=Tk.43.9 in 1997)

Independent Evaluator's Opinion on Barge-Mounted Power Plant Rehabilitation Project

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Despite substantial increase in installed capacity over the past two decades, shortage in electricity supply remains a problem affecting economic activities in Bangladesh. A significant portion of the installed capacity cannot be utilized for power generation due to lack of proper maintenance and rehabilitation. Adequate and reliable power supply, however, has been a key priority for economic growth and overall socio-economic development of the country under the successive development plans. As there is scarcity of domestic capital, the development of the power sector has generally been dependent on external funding. As a major donor, Japan has been contributing to economic and social development of Bangladesh through providing financial and technical assistance to different sectoral projects including the power sector. Two Barge-Mounted Power Plants, each of 56 MW, were set up at Khulna and Chittagong in 1980 and 1986 respectively with funding from Japan.

Both Chittagong Barge-Mounted Power Plant (C-BMPP) and Khulna Barge-Mounted Power Plant (K-BMPP) had operated suboptimally due to frequent technical faults and, as a result, they had not realized the expected outcomes. In order to improve the efficiency and utilization of C-BMPP and K-BMPP, a rehabilitation project was implemented over a period of about four years, from December 1993 to December 1997. The responsibilities of implementation, operation and management of the project lies with the Bangladesh Power Development Board (BPDB), a state owned agency engaged in generation, transmission and distribution of electricity. In 2002, JBIC carried out an evaluation of the project focusing on its relevance, efficiency, effectiveness, impact and sustainability.

The project has direct relevance in the context of short-term and long-term development of the power sector as well as the overall socio-economic development of the country. Availability of electricity enhances the growth potential of the economy and of different regions. A great majority of the country's population is still deprived of power facilities. K-BMPP is located in the western part of the country having poor power supply compared to the eastern part where most of the generating plants are located because of availability of natural gas. More recently, three barge-mounted power plants implemented by the private sector have started operation since 1999. C-BMPP and K-MBPP are marked by significant variations in performance following their rehabilitation. Annual energy generated by K-BMPP was only 18 percent of the annual energy generated by C-BMPP in the year 2000.

The project however contributes to the installed generation capacity and the utilization of indigenous natural gas by C-BMPP reduces the country's dependence on imported oil leading to foreign currency saving. As natural gas is a clean fuel, pollution from C-BMPP is within the permissible limit. Environmental monitoring including air and water pollution, however, should assess the impact of water pollution on fish resources. As an important infrastructure, the power supply project has positive impacts on employment generation through both backward and forward linkages to other sectors, improved living standards and alleviation of poverty.

The sustainability of the power sector requires major reforms and efficiency improvement. The reforms measures that are already underway include the unbundling of the BPDB into separate entities for generation, transmission and distribution. In addition to expediting the reforms, adequate technical skills of the O & M staff, proper motivation and discipline of the workers, technology transfer and tariffs rationalization would contribute to the sustainability of the sector. The cooperation from JBIC and other development partners in capacity building of the executing agencies would help improve the financial performance and total quality management of the power sector.