Pakistan

Bin Qasim Thermal Power Station Unit 6 Project

Report date: March 2001
Field survey: August 2000

1. Project Profile and Japan's ODA Loan

Project Site: 50-km east of the city of Karachi

Site Photo: Bin Qasim Thermal Power Station

1.1. Background

At the beginning of the 1990s, maximum load demand for power in Karachi and surrounding areas, which are served by Karachi Electric Supply Corporation Ltd. (KESC), was increasing year on year, and in fiscal 1989/1990 (1989/7~1990/6) and fiscal 1990/1991 (1990/7~1991/6) installed generation capacity fell short of peak demand. The increase rate for maximum load demand was predicted to exceed 9% in and after fiscal 1991/1992 as the result of sweeping increases in the demand for power for household and industrial uses. Electrification of agricultural villages and the dissemination of domestic electrical appliances was projected to yield sizable increases in household demand for power. Whilst the easing of regulations relating to trading policies, the abolition of foreign exchange controls and policies to promote foreign investment, in combination with the activation of private investment, was forecast to have a similar effect on power demand for industrial uses.

In contrast, from a supply perspective, despite the fact that a third generating unit was scheduled to become operational at Bin Qasim Thermal Power Station (BQTPS) in fiscal 1992/1993, projected suspension of operations at the seriously deteriorated West Wharf thermal power plant and the Karachi nuclear power plant, which supplies KESC catchment areas, and the leveling off of installed generation capacity, was expected to result in the reemergence of supply shortages in and after fiscal 1993/1994.

In order to handle these additional load requirements and the shortfalls in supply, the construction of a thermal power station powered by imported heavy oil was urgently necessary.

1.2. Objectives

In order to resolve the projected shortfalls in supply within KESC jurisdictional areas in and after fiscal 1993/1994, this project was to add a sixth generating unit (210MW) to the facilities at BQTPS, located approximately 50km to the east of Karachi, by way of plant expansion. The project also involved the provision of high voltage transmission lines (220KV × 2, 35km) as part of the planned transmission circuit system in order to strengthen the supply system within the catchment area.

1.3. Project Scope

The Project covered the provision of a steam turbine generator (fuelled by heavy oil/natural gas; 210MW × 1), the addition of new equipment at Korangi West Grid Sub station (220KV transformer or breaker), the installation of transmission lines between BQTPS and Korangi West Grid Sub station (220KV, 2 lines, 30km), and related consulting services. The Japan's ODA loan (the "ODA loan") covered part of the local and foreign currency portions of the project.

1.4. Borrower/Executing Agency

President of the Islamic Republic of Pakistan / Karachi Electric Supply Corporation Ltd. (KESC)

1.5. Outline of Loan Agreement

	Phase I	Phase II*
Loan amount/Loan disbursed amount	¥13.551 billion/¥12.959 billion	¥13.974 billion/¥12.130 billion
Exchange of notes/Loan agreement	January 1992/March 1992	November 1994/November 1994
Terms and conditions	Interest Rate: 2.6%, Repayment period (grace period): 30 years (10 years), Partially untied	Interest Rate: 2.6%, Repayment period (grace period): 30 years (10 years), Partially untied
Final disbursement date	March 1999	February 2001

* Since construction work for this project covered a total period of 6 years, the project was divided into two phases: Phase I in the first 3 years and Phase II in the second 3 years, as an attempt to meet the demand for funds.

2. Results and Evaluation

2.1. Relevance

The development targets for the power sector under Pakistan's 7th Five-Year Plan (1988~1993) included the following provisions: (1) sufficient power supply, dissolution of supply restrictions, and rural electrification; (2) developmental promotion of domestic petroleum, coal, natural gas, hydroelectric power generation; and (3) effective use of energy and reductions in system loss. Specific developmental policies were as follows: i) additional installed generation capacity; ii) construction of

oil/gas-fired thermal power stations for the short-term relief of supply restrictions; iii) secure supply via the construction of large-scale thermal power stations that are not affected by seasonal changes in the weather; iv) promotion of rural electrification, and v) utilization of the private sector. Development target (1), and the specific development policies i), ii) and iii), were applicable to this project.

Moreover, in recent years, Pakistan has been promoting the development of gas fields and the construction of gas pipelines against a background of soaring heavy oil import prices and environmental considerations, and is proceeding with the conversion to gas-fuelled power stations. Imported heavy oil was to be employed at BQTPS in order to fulfil short-term demand requirements, however, joint heavy oil/gas boilers were installed with a view to the future developmental promotion of gas power in Pakistan and a system was arranged in conformity with such changes in the external environment. Accordingly, the construction plan for this power station is considered relevant.

2.2. Efficiency

Since the executing agency has not prepared any relevant data, there are no accurate reports available. However, as far as the portion covered by the ODA loan is concerned, a 2-year extension was made to the Phase I disbursement period, which is considered to have delayed the overall construction period. According to the executing agency, these delays were primarily caused by the general strikes in Karachi and delays in procuring imported materials and equipment contingent upon changes in the customs procedures system, among other things. Moreover, although the disbursed amount was less than the approved loan amount, it has not been possible to obtain reports on overall project costs from the executing agency.

2.3. Effectiveness

(2.3.1.) Stable Power Supply

Table 1 is a comparison of the main operating results of the No. 6 generating unit, which was constructed under this project, against the levels planned at the time of appraisal. The data shows that the project has achieved results in excess of planned levels. As Table 2 shows, the operating status of the newest No. 6 generating unit is favorable in terms of its high maximum output, thermal efficiency and utilization factor, and low auxiliary factor, even when compared with the other units installed at BQTPS.

On the other hand, however, although actual maximum output, total power generation and the plant utilization factor have all exceeded planned levels, over-loading and the fact that periodic inspections are not being performed means that there is a risk of early deterioration of the facilities, and it will be necessary to bear these factors in mind in the future.

Table 1 Comparison of Planned / Actual Operating Conditions of Unit 6

Figures in parenthesis are achievement ratios against planned levels

		1997-98	1998-99	1999-2000
Maximum Output (MW)	Planned level	210	210	210
	Actual level	219 (104%)	213 (101%)	210 (100%)
Total Electricity Generation (MWh)	Planned level	981,194	1,174,210	1,174,210
	Actual level	931,155 (95%)	1,443,015 (123%)	1,467,960 (125%)
Plant Utilization Factor* (%)	Planned level	63.83%	63.83%	63.83%
	Actual level	60.57% (95%)	73.63% (115%)	75.13% (118%)

*Plant utilization factor = annual electricity generation / (rated output × 365 days × 24 hours)

Table 2 Operating Conditions for All Generating Units at BQTPS in Fiscal 1999/2000

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6
Rated Output (MW)	210	210	210	210	210	210
Maximum Output (MW)	190	180	120	150	190	210
Total Electricity Generation (MWH)	702,420	872,495	826,705	905,240	1,336,820	1,467,960
Thermal Efficiency* (%)	33.81%	35.24%	29.70%	31.08%	35.90%	38.17%
Auxiliary Power Ratio** (%)	6.98%	7.08%	7.90%	7.41%	5.71%	5.85%
Plant Utilization Factor (%)	35.52%	44.07%	41.39%	45.56%	68.52%	75.13%
Suspended Operation (hrs)	299.12	58.58	822.20	1596.50	122.85	72.28

* Thermal efficiency: ratio of heat capacity of transmitted electricity against heat capacity of fuel used

** Auxiliary power ratio: ratio of gross electricity generation against auxiliary power consumption

Source: Bin Qasim Thermal Power Station (BQTPS) data

(2.3.2.) Meeting Rapidly Increasing Demands for Power

Figure 1 shows the increases in maximum load requirements in the KESC catchment area against the potential output of all power plants owned by KESC. In the last five years, maximum load demand has posted an increase of 5.14%, however, the installed capacity of KESC power stations has leveled off and furthermore, potential output is falling far short of installed capacity. It is thus possible to comprehend that KESC power generation facilities alone are becoming unable to meet maximum load requirement.

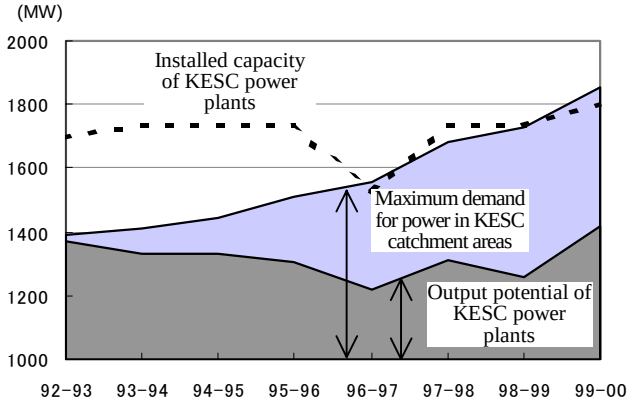

Figure 1 KESC Regular Output and Maximum Demand for Power

In order to remedy this situation, KESC is purchasing power from the Water and Power Development Authority (WAPDA) and from the power stations of

Independent Power Producers (IPP), and there is a year-on-year increasing trend in such external power purchasing (refer to Figure 2). Power shortages in the KESC catchment area are chronic even in spite of such power importing and planned outages ('load-shedding') are necessary, particularly during the summer months (refer to Table 3).

Against these circumstances, the No. 6 generating unit, which was additionally installed at BQTPS under this project, has continued to operate stably as a base load generator, and in the two year period from July 1998 through June 2000, was supplying 13.6% of the total supply within the KESC catchment area. It is thus contributing to improving the tight power supply situation within this region.

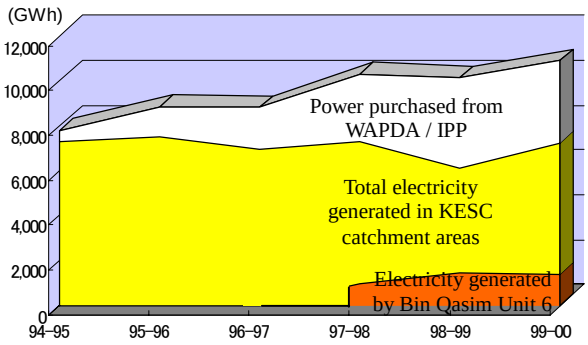

Figure 2 Power Supply Conditions in KESC catchment areas

Table 3 Planned Load Shedding in KESC catchment areas

	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00
Maximum Power Supply Cuts (MW)	286	268	341	300	338	238
Power Supply Cut (MWh)	30,853	53,188	85,934	50,201	101,963	7,307

Source: KESC data

(2.3.3.) Recalculation of Financial Internal Rate of Return (FIRR)

At the time of appraisal, FIRR was calculated to be 9.3%, on the following assumptions:

Benefits: increases in revenue from power sales from the No. 6 generating unit

Costs: investment costs/fuel costs/operation and maintenance costs

When actual results data were used for recalculation of the same items, it became clear that FIRR was negative because the net present worth of the costs (Rp 49.631 billion) surpassed the net present worth of benefits (Rp 45.319 billion).

The main reasons for this were increases in the system loss ratio caused by the rising incidence of power theft, and low-level government controlled low power tariffs despite climbing domestic petroleum prices.

Table 4 Comparison of Planned / Actual FIRR Calculation Bases

	Electricity generation (GWh)	Unit Price (Rp/kWh)	Fuel Price per kWh (Rp/kWh)	System Loss Ratio (%)
At appraisal①	1,174.2	1.89	0.373	21.0
Actual level②	1443.0～1468.0	2.33～2.56	1.16～1.85	31.5%～38.6
Deviation②÷①	1.23~1.25 fold	1.233~1.35 fold	3.113~4.96 fold	1.503~1.84 fold

* All prices are fixed-price indicators for fiscal 1997

2.4. Impact

(2.4.1.) Impact on Society

Planned load shedding in the KESC catchment area extends to general households and the industrial sector, and is considered to have had a considerable effect on industries and public welfare in metropolitan Karachi. The maximum power supply cut value of approximately 102.0GWh recorded in fiscal 1998/1999, was substantially reduced in fiscal 1999/2000 to 7.3GWh (refer to Table 3). This was the result of increases made to the capacity of transmission lines linking the WAPDA grid system and the KESC grid system, and to power supplies from IPP. The installation of the No. 6 generating unit at BQTPS is also considered to have made a proportionate contribution to this improvement.

(2.4.2.) Environmental Impact

BQTPS is located some 50km to the east of the city of Karachi in an unpopulated desert area on the Arabian Sea, therefore it is not generating an impact from noise or vibrations. Further, the heated effluent employed as coolant at the power station is carried in pipes and discharged into the ocean at a spot 3km away; however, the temperature differential to sea water is less than 7^{o}C and is in line with initial projections, thereby maintaining environmental standards and exerting no particular impact on the marine environment. Initially, the measurement results of smoke emissions monitoring could be confirmed in real time on panels in the control room, however, the equipment has not been repaired since it broke down in 1998 and was not operating at the time of the field survey by the ex-post evaluation mission in February 2001. Nonetheless, a survey of the surrounding environment conducted by the consultant employed by Kreditanstalt für Wiederaufbau (the German Development Bank: KfW) in 1999, confirmed that there were no specific problems at the time. The Planning and Rehabilitation Division of BQTPS has subsequently surveyed atmospheric conditions in the vicinity of the power station using the mobile monitoring unit procured using the fund, and no particular issues have come to light. However, the executing agency considers it necessary for repairs to be conducted to the smoke emissions monitoring system.

2.5. Sustainability

(2.5.1.) Operation and Management System

In Pakistan, two public corporations, WAPDA and KESC, which are supervised by the Ministry of Water and Power play a central role in the supply of electricity. KESC is a government-linked company involved in power generation, transmission and distribution of electricity in the greater Karachi metropolitan area (part of the state of Baluchistan), and 63% of its stock is owned by the government of Pakistan. As of the end of June 1999, KESC had 12,499 employees.

Operation and maintenance work is carried out by BQTPS under the supervision of KESC. The power plant currently employs 862 workers, 122 of whom are administrators, whilst the remaining 740 are employed as operators. On the other hand, however, KESC head office originally approved a staff of 1,105, which means that 243 posts are currently vacant. This is because KESC is proceeding with rationalization of its organization under the guidance of the Asian Development Bank (ADB), and both the recruitment of new staff and the replacement of retiring employees have been forbidden for the last ten years, including at BQTPS. As of the end of June 1993, the number of consumers per employee, which is one of the indicators of productivity, stood at 85 for the entire KESC. By the end of June 1999, this figure had risen to 116, evidencing a considerable improvement in productivity.

KESC is planning to adopt various policies including the promotion of outsourcing for welding / metal processing operations, and is intending to proceed with reductions in staff numbers and personnel expenses.

(2.5.2.) Current Operation and Management Conditions

The No. 6 generating unit has been operating favorably since it became operational. Moreover, at the present time BQTPS has stored sufficient consumables to operate and maintain the equipment for 5 years, and to date, no particular problems have risen in terms of its maintenance. However, over-loading and the fact that periodic inspections are not being performed means that there is a risk of early deterioration of the equipment, and it will be necessary to pay due attention to these factors in the future.

The aging of generating units 1~4 has been accompanied by a deterioration in the operating conditions at BQTPS, however, overhauls were conducted on unit 1 between December 1999 and February 2000, and on unit 2 from March through July 2000, which yielded considerable results as shown in Table 5. In addition, inspections of the operating conditions of units 3 and 4 have been completed and plans have been laid to overhaul the boilers and turbines of the units one by one from 2001 onwards.

Table 5 Results of Overhauls (O/H) of Units 1 and 2

	Rated Output (MW)	Maximum Output (MW)		Cost of O/H (million Rs)	Benefits* (million Rs/month)	Thermal Efficiency (%)	
		Before O/H	After O/H			Before O/H	After O/H
Unit 1	210	80	190	81.48	59.43	29.5	36.20
Unit 2	210	140	200	65.49	28.38	34.75	37.50

* Total monthly revenue from sales of power operating at a load factor of 80%
Source: BQTPS data

(2.5.3.) Financial Status of KESC

Profitability of KESC has been worsening year on year and the organization has been posting losses since fiscal 1995/1996. Its pre-tax losses for fiscal 1998/1999 were Rp. 7.364 billion, marking its worst deficits to date. There are three main reasons for its worsening profitability. The pricing policies for power selling set by KESC have failed to reflect the rising prices of heavy oil, system loss is on the rise (power thefts are increasing), and it has high financial costs.

Table 6 KESC Statement of Profits and Losses

(Unit: million Rupees)

	93-94	94-95	95-96	96-97	97-98	98-99
■ Income						
- Income from power sales	11578.11	12,383.28	15,988.03	15,796.78	20,726.39	23,284.92
- Other income	218.69	307.66	351.40	493.64	412.56	496.23
Total	11,796.80	12,690.94	16,339.43	16,290.42	21,138.95	23,781.15
■ Expenditure						
- Generation	5481.51	5344.3	7392.59	10980.67	10468.95	9312.09
- Power purchasing expenses	836.28	1,390.23	1,704.40	3,444.09	7,739.79	11,400.58
- Depreciation expenses	1962.39	1,667.77	2,843.28	1,719.23	2,139.66	2,726.20
- Interest	1387.33	1,720.32	1,793.37	2,112.35	3,161.41	3,041.65
- Bad debts reserve	*	*	*	1,438.03	1,698.30	1,212.93
- Other expenses	1953.41*	2,379.77*	3,074.66*	3,375.40	2,787.55	3,452.15
Total	11,620.92	12,502.39	16,808.30	23,069.77	27,995.66	31,145.60
■ Pre-tax profits and losses	175.88	188.55	(468.87)	(6,779.35)	(6,856.71)	(7,364.45)

* For fiscal 1993/1994 ~ fiscal 1995/1996, the reserve for bad debts is included in other expenses.
Source: KESC annual report (1995~1999: 83rd~87th)

Table 7 KESC Balance Sheet

(Unit: million Rupees)

		1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999
Assets	Current assets	6,746.70	8,845.58	11,623.88	12,938.91	16,364.87	19,466.76
	Fixed assets	26,131.08	31,908.07	40,410.92	49,133.81	50,226.58	49,751.03
	Investments & other assets	126.50	128.64	199.17	191.16	481.12	392.25
	Total assets	33,004.28	40,882.29	52,233.97	62,263.88	67,072.57	69,610.04
Liabilities	Short-term liabilities	6,873.09	12,675.92	17,874.98	30,039.48	41,807.90	29,101.52
	Fixed liabilities	18,829.81	20,725.40	27,246.33	30,716.94	29,434.93	49,113.44
	Total liabilities	25,702.90	33,401.32	45,121.31	60,756.42	71,242.83	78,214.96
Capital	Paid-up capital	1,473.12	1,620.43	1,782.47	1,782.47	1,782.47	4,827.59
	Reserves	5,828.21	5,860.49	5,330.18	(275.01)	(5,952.72)	(13,432.51)
	Total capital	7,301.33	7,480.92	7,112.65	1,507.46	(4,170.25)	(8,604.92)
	Capital + liabilities	33,004.28	40,882.29	52,233.97	62,263.88	67,072.57	69,610.04

Source: KESC annual report (1995~1999: 83rd~87th)

The receivables turnover period has long been a problem for KESC and has been deteriorating year on year. In the last five years, it has become 5~7 months. Looking at a breakdown of the receivables in fiscal 1998/1999, receivables from federations, the state government and the state-owned enterprises under its jurisdiction accounted for 16.6% of the total. In addition, since KESC's profit potential and liquidity are low it is unable to secure sufficient internal reserves for investment in development, thus its financial costs remains high because it is dependent on borrowing, which is in turn pushing up its liabilities.

Table 8 Changes in KESC Principal Financial Indicators

	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999
Sales working profit ratio	1.49%	1.49%	-2.87%	-41.62%	-32.44%	-30.97%
Gross assets working profit ratio	0.53%	0.46%	-0.90%	-10.89%	-10.22%	-10.58%
Gross assets turnover ratio	161.57%	169.64%	229.72%	1080.65%	-506.90%	-276.37%
Credit defrayal ratio	11.76%	13.56%	10.98%	12.97%	14.96%	12.79%
Liquidity ratio	98.16%	69.78%	65.03%	43.07%	39.14%	66.89%
Equity ratio	22.12%	18.30%	13.62%	2.42%	-6.22%	-12.36%
Receivables turnover period	4.68 months	5.51 months	5.98 months	7.05 months	6.49 months	6.00 months

Source: Calculated on the basis of KESC's annual report

Furthermore, the transmission and distribution loss ratio from the KESC grid system, which stood at 19.77% in fiscal 1988/1989, had risen to 38.84% by fiscal 1998/1999 and is extremely high. The primary reason for this is the high incidence of power theft (illegal connections to transmission lines and rigged meters) on the distribution side. According to the predictions of the executing agency, power theft accounts for 20~25% of transmitted electricity. Loss of power due to power theft has a direct impact on corporate profits and is an extremely serious problem. KESC has been covering distribution lines in a pilot area and has implemented measures to crack down on power theft across the whole of its catchment area, however, such steps have failed to produce any tangible results at this time.

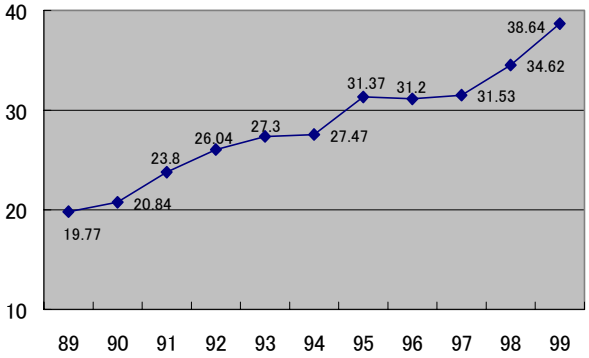

Figure 3 Transmission and Distribution Loss Factor of KESC System

Increased purchases of power from WAPDA and the launch of operations at BQTPS enabled KESC to put a temporary stop to load shedding in its catchment areas, however, in the months from July through November 2000, it again became necessary to carry out rotating blackouts amounting to 82,148MWh. This is due to the fact that KESC, which has a tendency to fall into arrears in its payments to Pakistan Petroleum Ltd. (PPL), is now required to pay for its heavy oil in advance or on the day of purchase. This has caused its capital turnover situation to deteriorate thereby preventing it from being able to make sufficient purchases of heavy oil.

(2.5.4.) Conversion to gas fuelling

Soaring prices of heavy oil imports due to the falling local currency and rising international heavy oil prices, and the 15% sales tax that began to be imposed on petroleum and gas on July 1, 1999, have pushed up generating costs and increased KESC's business liabilities. Looking at fuel costs per KWh of power generation, it is possible to see that gas is cheaper than either light or heavy oil (refer to Table 9).

In view of these circumstances, the government of Pakistan has been increasing production volumes of domestically produced natural gas year on year and has decided to prioritize allocation of this resource to the power sector. In line with increases in the gas quota agreements for BQTPS, the volume of gas used to fuel generating units 1~6, which are jointly operated using natural gas/heavy oil, is currently being increased, and in February 2001, gas was being used to generate some 44% of electric power at the plant.

Table 9 Bin Qasim Unit Fuel Costs (Paisa/kWh)

	1996-1997	1997-1998	1998-1999	1999-2000
Gas	-	-	1.06	1.31
Light oil	1.41	1.52	2.73	3.13
Heavy oil (Bunker C)	1.72	1.69	1.35	2.06
Mean fuel costs	1.41	1.52	1.35	2.04

* Fuel costs are averaged for BQTPS Units 1~6
Source: BQTPS data

(2.5.5.) Sustainability (of the effects)

As has already been mentioned above, the operating conditions of the No. 6 generating unit installed under this project are favorable. Moreover, since appropriate maintenance work is being conducted on the other units at BQTPS, including overhauls and so on, there are not considered to be any problems with power generation facilities in terms of their operability. Personnel reductions at the power station are causing slight confusion on site, but there are no specific problems from a technological or personnel perspective. From an environmental standpoint, there are no specific issues at the present time, and given the move towards the use of gas to fuel power generation, reductions in the burden on the environment can be expected.

Nonetheless, if KESC is to secure operation and maintenance costs and a stable supply of power, it will need to implement various countermeasures including the construction of an appropriate tariffs system reflecting its costs, further crackdowns on power theft, the promotion of receivables collection and the use of domestically produced gas, in order to improve its deteriorating financial status.

As cited above, starting with the financial status of KESC, the sound sustainability of government enterprise management in Pakistan's power sector is giving cause for concern. The government of Pakistan has, however, demonstrated its focus on the structural reform of the power sector ((1)the three separate functions of policy drafting, regulation of this industry and operation of government enterprises,(2) liberalization of the energy market, and (3) structural reform of government-owned corporate systems and restructuring via the gradual advancement of privatization).

3. Lessons Learned

None

4. Recommendations (not for publication)

There are major concerns about the business conditions of all Pakistan's government-owned corporations including KESC. Since the collective proposals of the

World Bank and ADB will play a vital role in the Pakistani government's implementation of structural reforms in the power sector, it will also be necessary for JBIC to follow such movements.

Comparison of Original and Actual Results

Item	Plan	Actual
1. Project scope	Power station	
	(a) Boiler: heavy oil/natural gas	Same as left
	(b) Turbine generator: rated output 210 MW	Same as left
	Transmission lines	
	(a) Zone: BQTPS ~ Korangi West Grid Station	Same as left
	(b) No. of lines: 2	Same as left
	(c) Length: 30-km	35-km
	(d) Voltage: 220kV	Same as left
	Grid station	
	(a) Transformer capacity: 250MVA	Same as left
	(b) Switchgear SF_6/gas-insulation type 220kV	Same as left
2. Implementation schedule	Power station: January 1994 ~ July 1996 (31 months)	Power station: February 1994 ~ April 1998 (51 months)
	Transmission lines: June 1994 ~ April 1996 (24 months)	Transmission lines: May 1994 ~ September 1998 (53 months)
3. Project cost		
Foreign currency	¥24.221 billion	N/A
Local currency	Rp 3.7841 million	N/A
Total	¥38.260 billion	N/A
ODA loan portion	¥26.166 billion	¥25.089 billion
Exchange rate	Rp. 1 = ¥3.71 (February 1994)	N/A