India

Raichur Thermal Power Station Expansion Project

Report date: March 2001
Field survey: August 2000

1. Project Profile and Japan's ODA Loan

Site Map: Raichur, Karnataka State

Raichur Thermal Power Plant

1.1. Background

At the time of appraisal, the power sector in Kartanaka State was comprised of two organizations: Karnataka Power Corporation Ltd. (KPCL), responsible for the generation of electricity, and Karnataka State Electricity Board (KSEB), responsible for the transmission of power. Both organizations were owned by the state government and were supervised by the Ministry of Power, with KPCL handling the construction and operation of power plants and KSEB being responsible for the construction and management of power transmission facilities.

The thermal power plant at Raichur was the only such plant in the state and had just two generating units. As of the end of March 1988, energy from hydroelectric power had an 83.4% share of the total generating capacity of 2,530MW of power facilities in the state. However, the operating ratio of hydroelectric plants had decreased substantially as the result of three successive years of drought. In Kartanaka State, unstable supplies of hydroelectricity, which is highly dependent on the vagaries of the weather, and the lack of development of new power sources, produced a 5,176GWh shortage of electricity in fiscal 1986/1987, against demand for power, which had grown at an annual rate of 9.1% during fiscal 1980/1981 and fiscal 1986/1987.

The Kartanaka government purchased power from neighboring states and received energy supplied by the central government, however, this was still insufficient to meet the level of demand. Constant restrictions were imposed on supply with the aim of avoiding the drops in voltage contingent upon this shortage but the situation was exerting a serious negative impact on overall socioeconomic conditions in the state.

1.2. Objectives

Power supply in Kartanaka State is unstable, being 80% dependent on hydroelectric power generating facilities. The goal of this project was to add a fourth power generator unit (210MW × 1) at the Raichur thermal power station, the only such power plant in the state, thereby strengthening the coal-fired base load, enhancing the diversification of power sources and stabilizing the supply of energy in the state.

1.3. Project Scope

The Japan's ODA loan (the "ODA loan") covered the following project items: (1) the addition of one 210 MW set of thermal power generating equipment (boiler steam pressure: 680 tons/hour, turbine: 210 MW output/ 3,000 rpm, generator output: 277 MVA / frequency 50 Hz); (2) construction of incidental transmission and distribution facilities; and (3) the provision of consulting services relating to the above. The ODA loan covered the entire foreign currency portion.

1.4. Borrower/Executing Agency

President of India / KPCL (Karnataka Power Corporation Ltd.)

1.5. Outline of Loan Agreement

Loan amount/Loan disbursed amount	¥23.142 billion/¥20.028 billion
Exchange of notes/Loan agreement	October 1988/December 1988
Terms and conditions	Interest Rate: 2.5%, Repayment period (grace period): 30 years (10 years), Partially untied
Final disbursement date	June 1997

2. Analysis and Evaluation

2.1. Relevance

This project comprised the addition of generating facilities at the existing thermal power plant to meet the base load demand in Kartanaka State. It was deemed relevant in light of the necessity of balancing the composition of power sources, which laid disproportionate emphasis on hydroelectric power (83.4% of energy output), the supply of which is unstable due to the influence of weather conditions, in that it would add diversification to power sources, and contribute to stabilizing the power supply and easing the supply shortage.

2.2. Efficiency

(2.2.1.) Implementation Schedule

Project implementation was initially forecast to take three year and half, but in fact required six years to complete. There were two main reasons for this delay as follows. (1) The unexpected operational failure of the breaker caused by equipment

abnormalities occurring during test operations conducted after the installation of the generator caused the generator to malfunction. Although the generator was again operational three months later, it delayed construction of coal disposal facilities and ash disposal facilities. Some of these delays in construction necessitated suspension of generator operation; however, it was only possible to suspend operation during the rainy season when hydroelectric plants were fully operational due to the critical power shortages in Kartanaka State. (2) The procurement of spare parts was pushed back by delays in obtaining approval from CEA (Central Electric Authority).

(2.2.2.) Project Cost

The foreign currency portion of project costs was estimated at ¥16.200 billion at the time of appraisal, however the actual cost came to ¥14.364 billion, which was slightly less than forecasted. In contrast, the actual local currency portion came to 4.870 billion rupees against initial cost estimates of 1.404 billion rupees, producing a cost overrun of 347%. In addition to the above-mentioned delays in construction, the emergence of inflation in India caused sharp increases in personnel expenses and the price of raw materials.

2.3. Effectiveness

(2.3.1.) Stable Supply of Electricity

The operations of the No. 4 generator unit, which was added under ODA loan funds, substantially exceeded planned levels immediately after becoming commercially operational in 1996, indicative of stable, problem-free operating conditions. Despite concerns about the load on equipment produced by continuous operation, periodic inspections have been conducted in line with initial plans, and no problems have come to light. Moreover, the mean unit power sales price exceeded appraisal forecasts (refer to Table 2), so that revenue from purchases of power were considerably better than expected.

Table 1 Primary Indicators of No. 4 Generator Unit Achievement Ratio

(figures in parenthesis are achievement ratio against initial estimates)

Index		1996-1997	1997-1998	1998-1999	1999-2000	2000 (up to end of June)
Transmission Volume (GWh)	Actual	1,021 (135%)	1,306 (145%)	1,485 (157%)	1,534 (152%)	809 (-%)
	Planned	756	900	945	1,011	1,011
Operating Ratio (%)	Actual	77.73 (135%)	90.42 (198%)	92.89 (163%)	92.57 (152%)	98.76[*3] (-%)
	Planned[*1]	57.55	45.68	57.10	61.07	61.07
Sales Revenue (million Rp)	Actual	2,472 (345%)	3,290 (268%)	3,665 (211%)	3,880 (199%)	2,145 (-%)
	Planned[*2]	716	1,227	1,736	1,945	-

*1 Appraisal figures were calculated using operating hours ÷ 365 days ÷ 24 hours. However, since operation in the first year was scheduled to commence in October, the total number of days (181 days) to the end of the fiscal year (end of March) was used to give: 2,500 hours (planned number of operating hours in the first year) ÷ 181 days ÷ 24 hours = 57.55%.

*2 The Consumer Price Index (CPI) of the International Financial Statistics was used to revise the planned level to the actual retail price.

*3 The operating ratio as of the end of June was scheduled to become 92% after the periodic inspection timetabled for the same year.

Source: Raichur Thermal Power Station data

Table 2 Comparison of Unit Energy Price (Appraisal/Actual)

Nominal mean energy price at the time of appraisal (1988): 0.73 Rs/kWh=①

	1996-1997	1997-1998	1998-1999	1999-2000
Actual mean energy price * (Rs/kWh)	2.42	2.52	2.47	2.53
As above (1988 price) ** (Rs/kWh)②	1.17	1.20	1.14	1.27
Actual / planned ratio ②÷①	154%	158%	150%	167%

* Annual revenue from No. 4 generator unit ÷ annual output from No. 4 generator unit

** Actual mean energy prices for 1988 were calculated using the CPI of the International Financial Statistics

Source: Raichur Thermal Power Station data, appraisal data

(2.3.2.) Improvement to Critical Power Shortages and Stabilization of Power Supply in Kartanaka

Since the majority of power sources in Kartanaka State are dependent on hydroelectricity and hydropower production drops sharply during the dry season, the state is reliant upon supplies from NPTC and other states. Table 3 shows the ratio of hydroelectric to thermal power supplied by KPCL in Kartanaka State. While output of thermal power is increasing the generating volume year-on-year, since hydroelectricity is influenced by monsoon formation and rain conditions, it is not possible to furnish a stable supply of electricity.

In fiscal 1992/1993, dependency on hydroelectric power was high at 77%, but had dropped to 54% in fiscal 2000/2001, evidencing a decreasing reliance on unstable hydropower production. In addition to contributing to redressing the disproportionate emphasis on hydropower, since becoming operational, the No. 4 generating unit at this power station in Raichur has been providing high-standard, stable supplies of electricity and contributing to meeting the base load demand in Kartanaka State.

Table 3 KPCL Power Supply

Year	Thermal (GWh)		Hydro (GWh)		Total (GWh)	Growth rate (%)	
						Vs. standard year	Vs. preceding year
1992-93	2,732	(23%)	9,179	(77%)	11,911	Base	-2.02
1993-94	3,698	(28%)	9,638	(72%)	13,336	11.96	+11.96
1994-95	3,696	(24%)	11,856	(76%)	15,552	30.56	+16.62
1995-96	4,722	(33%)	9,537	(67%)	14,259	19.71	-8.31
1996-97*	5,152	(43%)	6,739	(57%)	11,891	-0.17*	-16.61
1997-98	5,538	(35%)	10,350	(65%)	15,888	33.39	+33.61
1998-99	6,068	(38%)	9,858	(62%)	15,926	33.71	+0.23
1999-00	7,762	(40%)	11,711	(60%)	19,473	63.50	+22.28
2000-01**	9,000	(46%)	10,363	(54%)	19,363	-	-

* Due to the absence of monsoon formation in 1996-97.
** The figures for 2000-2001 are KPCL planned levels.
Source: KPCL data

However, power output in the state remains insufficient and it is necessary to make up shortfalls by purchasing power from Independent Power Producers (IPP) within the state or from other states via the Central Grid (refer to Figure-1). Within the context of such power shortages, the No. 4 generating unit has supplied 9.15% (14.81% of thermal power output) of the total amount of power generated by KPCL in the period from April 1995 through March 2000, thereby improving the shortages and contributing to the stabilization of power supplies.

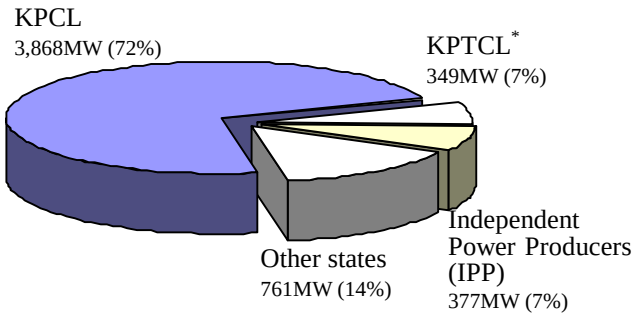

Figure-1 Composition of Power Sources in Kartanaka (created using KPCL data)

* KPTCL: Kartanaka Power Transmission Company Ltd. (also owns power stations)

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

FIRR, which was recalculated on the basis of the same assumption as used at the time of appraisal, came to 15.6%, thereby exceeding the 9.9% initially calculated. This was because, in addition to the fact that the operating ratio of the No. 4 generating unit exceeded initially planned levels, a comparison of the actual unit energy price (refer to Table 2) of 1.14~1.27 Rs/kWh against the nominal mean energy price for the same year (1988), reveals that actual levels were 55%~73% higher than the levels forecast at the time of appraisal.

Benefits: Revenue from output of the No. 4 generating unit at Raichur Thermal Power Station

Costs: Initial investment costs + operation and maintenance costs + fuel costs

Project life: 20 years

2.4. Impact

(2.4.1.) Environmental Impact

Monitoring of smoke discharge and water discharge is conducted on a weekly basis at the Raichur Station. Surveillance of ambient air impact is conducted at three monitoring stations respectively located within plant premises, in the residential compound and in the vicinity of the plant. Eight staff members are responsible for this monitoring, results from which reveal that all regulatory and environmental standards in India are being met, and that no particular problems have been generated.

The power plant produces 6,000 tons of fly ash per day, of which 1,500 tons are supplied gratis to Associated Cement Companies (ACC) and reused as admixture for cement. The fly ash is processed at ash disposal facilities constructed by ACC using its own funds on a plot of land that was allocated to the company within the plant's premises. The remaining fly ash is transported by pipeline as slurry*, and is dumped in ash ponds after temporary storage in silos. Ash ponds have been secured at two locations along the Krishna River, which will be viable for 13 years at the present dumping rate. The dumping of ash is not currently giving rise to any environmental issues, however, the plant is reducing the volume of ash being dumped in ash ponds and in the future aims to reuse 100% of coal ash generated.

Plans to make 20%~30% reductions in the volume of ash produced are being promoted at the plant via measures such as converting approximately 20% of fuel to imported coal which has a 3~4% lower ash-content (heat value: 6,600kcal/kg)(27,628kj/kg). Moreover, a research center has been established in the plant to study the potential for recycling coal ash as bricks, concrete and tiles, and employees are being given relevant training.

* A method via which water is added to fine particles of cement, coal ash, etc. to create slurry which is then transported in pipelines.

(2.4.2.) Increased Employment Opportunities

The Raichur Station currently employs some 2,155 people, with 118 exclusively assigned to the operation and maintenance of the No. 4 generating unit installed under this project. Many of the unskilled workers employed at the power plant are hired from local areas. The power plant has also provided a school and community facilities, a medical clinic and temple in its residential compound, which has a population of some 10-thousand, and has established a residential compound for the

300 or so people who were relocated due to the construction of facilities at the second ash pond (outside the scope of the ODA loan). Moreover, large numbers of people have migrated into the area and formed a village with the aim of providing daily commodities to these residential compounds and to the plant itself. In addition to the 118 workers specifically employed to handle the operation and maintenance of the No. 4 generating unit installed with funds from the ODA loan, this project is also making a reasonable contribution to employment creation among village residents in the region surrounding the plant.

2.5. Sustainability

(2.5.1.) Operation and Maintenance

The actual operation and maintenance of these facilities is undertaken by Raichur Thermal Power Corporation (RTPC), which is owned by KPCL. Currently, there are six generators installed at Raichur Power Station which are operated by a staff of 2,155 employees. Of these, 784 are regular full time employees and the remaining 1,371 are employed on a seasonal basis. In fiscal 1996/1997 RTPC received an official commendation from CEA in recognition of its financial soundness and operating conditions, receiving an incentive payment to the tune of 1.68 million rupees for its outstanding performance.

(2.5.2.) Stable Coal Supply

The coal that fuels the No. 4 generating unit is supplied by the Singareni coal fields in Andhra Pradesh State, located 550-km to the north of the power plant and by the coal fields in western Maharashtra State. Both coal fields have abundant deposits, which are capable of meeting future demand. The power plant utilizes 16,000 ~ 18,000 tons of coal per day. The coal used at the plant is of low quality and is ranked second from the bottom on a 6-grade scale according to domestic coal quality standards. Its heat value is low at approximately 3,500 kcal/kg (14,651 kj/kg), its ash content high at approximately 42%.

The coal is transported by rail, and in recent years, drastic reductions have been made in the ratio of quality and quantity lost during transit from 4.35% to 2.99%, a figure that is substantially lower than the national average of 6.0%. The plant has furnished a stockpile of coal on-site equivalent to the volume required for 20 days of power generation (approximately 400,000 tons) as a provision for emergencies, and to date, no particular problems have arisen in connection with the supply of coal.

(2.5.3.) Financial Situation of KPCL

Since its establishment in 1971, KPCL has continuously turned profits despite posting losses in four times, and the organization has experienced no specific problems in terms of its profitability. Moreover, a mechanism is in place whereby the

organization receives subsidies from the central government in order to maintain a gross assets profit ratio of 3%. In recent years, it received government subsidies in fiscal 1996/1997 and 1998/1999.

Table 4 Financial Indicators for KPCL in a Recent 5-Year Period

	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999
Gross Income (million Rp)	7,626.0	9,780.6	9,869.8	12,867.3	13,753.9
Gross Expenditure (million Rp)	6,290.4	8,517.3	9,945.0	11,360.1	12,403.5
Ordinary Profit (million Rp)	1,335.6	1,263.3	-75.2	1,507.2	1,350.4
Ordinary Sales Profit Ratio (%)	17.5%	12.9%	-0.8%	11.7%	9.8%
Gross Assets (million Rp)	29,125.5	31,390.5	32,642.3	40,893.6	45,480.2
Gross Assets Profit Ratio (%)	4.59%	4.02%	-0.23%	3.69%	2.97%

Source: KPCL data

The concern about KPCL's finances relates to the accounts receivable. In fiscal 1998/1999, KPCL sells 12.16 billion rupees equivalent energy to KSEB, of which it was able to collect 85% or 10.28 billion rupees within the year, making its accounts receivable 1.88 billion rupees for that financial year. Thereafter, inter-business chain debt* adjustment was executed under the leadership of the government, resulting in the cancellation of all KPCL's receivables for that year and a reduction in cumulative receivables from 7.52 billion rupees in fiscal 1998 to 7.15 billion rupees in fiscal 1999. However, this sum was equivalent to 52.0% of KPCL's revenue from energy, 13.75 billion rupees, for the same year, thus receivable remain a major issue for the corporation.

* A chain of debts between state enterprises/public corporations, etc. The phenomenon represents a vicious spiral in which underachieving enterprises fall into arrears in their payments to other enterprises; the enterprises unable to collect monies due are in turn unable to make repayments on their debts to other enterprises.

State Electricity Boards (SEB) throughout India including KSEB are on the verge of financial collapse as the result government controlled low energy tariffs, ineffective operating conditions and so on. Radical structural reforms are currently being undertaken in the Indian power sector with the support of the World Bank, and improvements are eagerly anticipated.

(2.5.4.) Structural Reform of Kartanaka Power Sector

To date, the energy generated by KPCL-owned power stations and the power stations of IPPs has been sold wholesale to KSEB, which then levies charges on transmission and distribution or to final demand consumers. KSEB has subsequently been dissolved, with the power transmission department being transferred to Karnataka

Power Transmission Co., Ltd. (KPTCL), which is wholly funded by Karnataka State (summer 2000).

The regions under KPTCL jurisdiction have been divided into five areas with regional business centers (RBC) handling power transmission positioned in each area. The RBCs are responsible for levying power charges to final demand consumers in line with the target levels set by KPTCL. RBCs were scheduled to be incorporated as transmission companies at the end of 2000 and privatization of these companies is targeted for the end of 2001. Moreover, in order to facilitate self-supporting operation of RBCs in Kartanaka State, the decision was made to transfer all KSEB liabilities to KPTCL; accordingly, none of KSEB's debts will be transferred to the RBCs.

There are currently no plans to privatize KPTCL, the owner of the Raichur Thermal Power Station.

* Source: India Business Line, August 19, 2000

(2.5.5.) Sustainability and Potential for Development

Raichur Thermal Power Station currently has six 210MW generator units installed. Since generating unit 1 became operational in March 1985, there have been no major problems with the operation of any of the units. Further, no problems have come to light in terms of the operation and maintenance, or of the fuel supply with the No. 4 generating unit that was additionally installed under this project. As cited above, results of periodic monitoring demonstrate that equipment is not exceeding the levels stipulated under environmental standards. Furthermore, the power plant is making various efforts to factor in environmental considerations including the promotion of plans to reduce the volume of coal ash and to recycle generated ash.

Although there are no specific concerns regarding the operation and maintenance of the No. 4 generating unit installed at this power plant, it will be necessary to monitor the financial conditions of KPTCL and the structural reforms taking place in the power sector in Kartanaka State.

Comparison of Original and Actual Results

Item	Plan	Actual
1. Project scope	One 210 MW set of thermal power generating equipment Boiler steam pressure: 680 t/hr Turbine: 210 MW output / 3,000 rpm Generator: 247 MVA output / frequency 50 Hz Construction of incidental transmission and distribution facilities Consulting services	Same as left
2. Implementation schedule	April 1989 ~ September 1992 (42 months)	November 1990 ~ November 1996 (73 months)
3. Project cost Foreign currency Local currency Total Exchange rate	 ¥16.200 billion Rp. 1.404 billion ¥29.956 billion Rp. 1 = ¥9.8 (Apr. 1988)	 ¥14.364 billion Rp. 4.870 billion ¥32.919 billion Rp. 1 = ¥3.81 (weighted average for 1990~1998 period)