

China

Hubei Ezhou Thermal Power Plants Construction Projects (Phase I, II, and III)

Report Date: September 2002

Field Survey: August 2001

1. Project Profile and Japan's ODA Loan



Site map: Hubei Province, China



Site Photo: Ezhou Thermal Power Plant, Hubei

1.1 Background

In the 1980s, with the economic progress based on the reform and liberalization policy, China had constructed power plants generating more than 6 million kW, which led to an increase in generation of electricity by 7.5% and by 8.5% especially in the latter 5 years on an annual average basis respectively. At the time of appraisal of this project in 1990, the capacity of electric power facilities were 135.76 million kW, and the production of electricity were 618.0 billion kWh. Coal was a main electric energy source, accounting for more than 70% of the total source. In April 1991, the 10-Year Project for social and economic development/the 8th 5-Year Plan was adopted in China. The plan aimed at an increased generation of electricity by 5.6% for 1991-1995 and 6.3% for 1996-2000 on annual average respectively.

The Hubei Province, where the present project was implemented, made a remarkable economic development and in the 1980s recorded very high rate of growth such as approximately 10% annually on average, especially more than 12% on the same basis for the first 5 years. In contrast, the power supply capacity increase was only 8.4%, resulting in short supply of electricity by 400-500MW in 1990. Furthermore, the hydropower generation, which supplied 50% of the electric energy, depended mostly on a run-off-river-type of hydropower generation, which caused the power supply ability to decline drastically during the dry season starting from November through May (as much as 30% less than August through December in 1990).

1.2 Objectives:

To construct a new thermal power plant (2unit x 300MW), utilizing the domestic coal for fuel, in Ezhou city gedian, Hubei Province in order to cover serious shortage of electric power supply and to promote an improvement in credibility of electric power supply.

1.3 Project Scope:

The ODA loan covers total foreign currency necessary for construction of a full set of equipment for coal-fueled electric power plant (2unit x 300MW) and the relevant consulting service.

1.4 Borrower/Executing Agency:

People's Republic of China/National Electric Company Ltd. (Old name - Department of Energy)

1.5 Outline of Loan Agreement

Item	Phase I	Phase II	Phase III
Loan Amount	4,000 million yen	12,431 million yen	15,461 million yen
Loan Disbursed Amount	3,995 million yen	12,431 million yen	15,298 million yen
Date of Exchange of Notes	Oct. 1992	Aug. 1993	Jan. 1995
Date of Loan Agreement	Oct. 1992	Aug. 1993	Jan. 1995
Terms and Conditions			
Interest Rate	Interest Rate: 2.6%,	Interest Rate: 2.6%,	Interest Rate: 2.6%,
Repayment Period	Repayment Period 30	Repayment Period 30	Repayment Period 30
(Grace Period)	(10) years	(10) years	(10) years
Procurement	General Untied	General Untied	General Untied
Final Disbursement Date	November 1997	September 1998	February 2001

2. Results and Evaluation

2.1 Relevance

The objective of the Plan is to remedy the serious shortage of and raise credibility of power supply in the Hubei province, in order to encourage further economic growth of Hubei province with remarkably-developed heavy and chemical industries that consume a great deal of electric power, and was in accordance with the development plan of Chinese government at that time.

At the time of appraisal, the Chinese government had their plan to accelerate development of the thermal electric power generation under the 10th 5-Year Plan (2001-2005) for the purpose of "further adjustment of electric energy source structure". In this context, as part of the Plan, the Government established the electric power industry scheme to close down gradually the obsolete inefficient coal-fired power plants of small scale and replace them with coal-fired power plant with the large-scaled units of high fuel efficiency. The Project is, thus, in line with the current power industry policy of Chinese government.

2.2 Efficiency

2.2.1 Schedule

The scope of the project remained unchanged, but the completion of main construction was wholly delayed than original schedule. The reasons were (1) the delay in payment for import tax and value-added tax due to the local currency shortage, (2) the delay in delivery from suppliers and (3) the quality problems of imported goods resulting from designing and manufacturing. Among them, however, the first reason contributed most to the delay.

No import tax had been imposed on all the equipment relating to the foreign government loan, but this tax policy was abolished during the period from 1996 to 1997. Accordingly, the project had to be temporarily subject to this change in tax policy.

2.2.2 Project Cost

The expenditure to be borne in local currency by the Chinese government was increased to RMB 2,008.78 million, nearly double of that planned originally, RMB 1,059.13 million. The immediate cause of this increase is that the procurement source for equipment and materials were switched to domestic suppliers where payment is made with the local currency by Chinese government, from the overseas procurement by foreign currency. For example, in terms of electricity and I&C system, local currency portion in expenditure is largely increased, while foreign currency portion was substantially decreased. Also, as to steel and construction materials, expenditures in foreign currency was eliminated and replaced by those in local currency.

In addition to the fact that the local products (such as electricity, I&C system, steel and construction materials) became competitive, the rise in cost of import goods caused by the temporary change of Chinese government policy in 1996, as explained above, is the main reason for the overseas procurement system being switched to the local. Hubei province government implemented the following measures to cope with shortage of local funds;

- (1) The issuing of bonds of electric power company
- (2) Securing a loan of RMB 335 million from a company belonging to the project committee of Hubei
- (3) Obtaining a loan of RMB 180 million from Hubei Province Electric Power Company
- (4) Borrowing funds from the domestic financial banks

2.3 Effectiveness

2.3.1 Utilization factor , availability factor and accident ratio of the project-related facilities

The electric power plants 2unit x 300MW were constructed in 1999 under the project. Utilization factor¹ of the facility constructed by the project was on an average about 40% for 2 years, 2000 to 2001, after completion of the project, and availability factor² was lower than 57% for the same period. These rates are under the level that was set originally (See table 1). The reason of lower availability factor is due to less demand for electric power supply than expected under the economic stagnation in Hubei province and the problem of power supply shortage had been solved by the time of completion of the project. Specially lower utilization and availability factor in 1999 compared with that in 2000 and 2001 are due to the fact that the operation of power plant started from 2nd April, not in the beginning of the fiscal year. Low accident ratio³ suggests that the hours of facility suspension were short.

Table 1 : Utilization factor, Working factor and Accident ratio in actual achievement (unit:%)

		1999 completion of the project	2000	2001
Utilization factor	No. 1 plant	22.73	33.20	34.16
	No.2 plant	32.11	41.84	52.50
	Plan	60	60	60
Working factor	No. 1 plant	30.37	50.99	48.43
	No.2 plant	39.45	63.07	67.42
	Plan	68.5	68.5	68.5
Accident ratio	No.1 plant	17.20	0.79	0.49
	No.2 plant	12.98	3.99	2.05

Source: Ezhou thermal power plant

¹ Utilization ratio = Electric Energy Output(kWh) in a certain period / (Rated Output(kW) x Total hours in the period counted by calendar day

² Working ratio = Working time (hr) of facility in a certain period / Total hours in the period counted by calendar day

³ Accident ratio = Hours of suspension of the facility by accident / (Working hours + hours of suspension)

2.3.2 Contribution to reducing the power supply shortage

The power supply in Hubei province has become sufficient for the demand, and they provided their electric energy of 10.46billion kWh to other provinces in 1996, three years before the completion of this project, and 12.25billion kWh in 1999. The power generation capacity of the facility of the project was 4.1 % of the total power capacity installed in Hubei, and actual power supply generated by the project plant accounts for 2.5 % in that of all provinces base (See table 2 and 3).

Table 2: Progress of Power generation facility, power generation, and power consumption in Hubei province

		1993	1994	1995	1996	1997	1998	1999 completion of the project	2000
Generation facility (MW)	Plan	N.A.	N.A.	7540	8040	N.A.	N.A.	N.A.	N.A.
	Actual	9047.5	9813.6	N.A.	10774.9	11781.0	13172.3	14493.2	15109.3
Thermal power plant facility (MW)	Plan	N.A.	N.A.	3500	4000	N.A.	N.A.	N.A.	N.A.
	Actual	3566.6	3602.1	N.A.	4430.6	5382.1	6640.6	7916	8038.8
Electric power generation output (100million kWh)	Plan	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Actual	402.5	427.1	N.A.	467.2	490.5	500.5	522.8	559.1
Thermal electric generation output (100million kWh)	Plan	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Actual	147.1	181.5	N.A.	196.9	244.6	262.2	283.9	277.7
Electric consumption (100million kwh)	Plan	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Actual	N.A.	N.A.	N.A.	362.6	376.7	420.1	400.3	420.7
Supply-demand gap(100million kWh)	Plan	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Actual	N.A.	N.A.	N.A.	104.6	113.8	80.4	122.5	138.4

Note : Electric consumption includes the spared electricity to the other province

Source : " Chinese Statistical Year Book for Electric Power" in each year

Table 3 : Progress of Power generation facility, power generation, power consumption of this project

		1999 (Completion of this project)	2000	2001
Thermal power plant facility (MW)	Plan	600	600	600
	Actual	600	600	600
Proportionate share in gross capacity of Hubei power facilities (%)		4.1	N.A.	N.A.
gross output (GWH)	Plan	N.A.	N.A.	N.A.
	Actual	1295.4	1926.8	N.A.
Proportionate share in gross power output of Hubei power facilities (%)		2.5	N.A.	N.A.
net output (GWH)	Plan	3050	3050	3050
	Actual	1199.8	1788.0	N.A.

Source: Ezhou Thermal Power Plant

During the period from 1990 to 1996, big project for power plants including Qingjiang-Geheyan Hydropower Plant had been completed, which is the main reason why the electricity supply became sufficient⁴. In addition, actual demand for electric power was considerably less than that originally estimated due to the unpredictable factor of great change in external surroundings such as economical stagnation caused by Asian currency crisis in 1997, which led to surplus capacity of electricity.

The growth rate of total export in China remarkably went down to 0.5% in 1998 from 21.0% in 1997, and also import growth rate declined down to (-)1.5% in 1998 from 2.5% in 1997. Accordingly total amount of overseas trade decreased to (-) 0.4% in 1998. The remarkable decrease in export made the domestic consumption more sluggish, decreasing consumer price index growth rate to (-) 0.8% in 1998, and (-) 1.4% in 1999, whereas it was 2.8% in 1997. Under the pressure of slowing economy, the growth rate in productivity of added-value dropped from 11.3% of 1997 to 8.9% in 1998, and further to 8.5% in 1999, while GDP declined from 8.8% of 1997 to 7.8% in 1998, and to 7.1% in 1999 respectively.

Under these general tendencies toward recession, GDP growth rate of Hubei province China plunged to 13.0%, 10.3% and 8.3% in 1997, 1998 and 1999 respectively, for the 3 consecutive years since the Asian currency crisis emerged. Growth of power demand also went fluctuated to 3.9%, 11%, and (-) 4.8%. An average of power demand 3.9% in the same period is in lower level than 6.9% that of the original plan, while the growth of Hubei power generation capacity jumped to 9.3%, 11.8% and 10.0% in 1997, 1998 and 1999 respectively from 8.5% in 1994. These values were higher than 6.9% that was expected in the plan.

The favorable treatment policy for hydropower generation by the Government caused a ratio of YoY growth of hydropower output to boost up to 17.79%, while that of thermal power output decreased (-) 2.17%. As its result, some change was brought to the structure of electric power: the proportionate share of hydropower generation of Hubei in the total electric power generation increased to 50.3% in 2000 from 45.7% in 1999, meantime the share of thermal generation decreased to 49.7% from 54.3%.

2.3.3 Financial internal rate of return (FIRR)

Profit of the organization relating to the project was in the lower level than expected in the original plan, owing to the following reasons: (1) the decreased power output due to sluggish demand and (2) the low electric power price⁵ established by the Government (See Table 4). The economic situation of Hubei province has been gradually turning for the better since 2000, and the electric consumption is expected to increase⁶. As described hereinafter, the profit status of the project will be improved slowly in 2001 as the Government changed the policy toward the increase of electricity charges.

As a result of recalculation for FIRR based on the further estimation as mentioned above, where the increasing rate of income is 5%, it is 7.9% for the payback period of 30 years and this is below the level at the time of appraisal (10.31% for 30 years). The reason is that the profit was lower and the cost was higher than expected in the plan. On the assumption of lower growth in profit rate (2% increases on average for 2001 to 2009) in anticipation of slower recovery of electric power demand, FIRR will be figured out to 5.1%.

⁴ Qingjiang-Geheyan Hydropower Plant(Completed in 1994, Capacity 2,7150,000kW),Hanchuan Thermal Power Plant(Completed in 1994 600,000kW),Yangluo Thermal Power Plant (Completed in 1994 600,000kW) and other plant had been completed.

⁵ In China, power generation companies can offer their sales price of electricity to the electric company, based on the initial cost and running cost, but the final price is to be settled by the economy planning committee of the province and the price bureau, taking into consideration the local price level and the supply-demand situation of electricity. The sales price of the project (0.249 RMB/kWh) was 0.041 RMB/kWh lower than that of averaged sales price (0.29 RMB/kWh) by other power plants in Hubei province.

⁶ Annual GDP growth rate of Hubei province had been declining since 1995, but it was showing a sign of recovery through turning up to the level of 9.3% in 2000 from the level of 8.3% in 1999.

Table 4 : Actual profit and O&M cost (1998-2000)

(Unit: million RMB)

		1998	1999 (completion of the project)	2000
Profit	plan	686.33	686.33	686.33
	actual	104.35	276.34	413.16
O&M cost	plan	477.14	477.14	477.14
	actual	72.25	185.21	276.59

Note: "Profit" – cash flow in, "O&M cost" cash flow out base

Source: Ezhou thermal power plant

Table 5 : Estimation of Profit and O&M cost(2001- 2009)

(Unit: million RMB)

	2001	2002	2003	2004	2005	2006	2007	2008	2009
Profit	650.79	683.33	731.16	782.32	837.09	885.29	958.35	1,025.47	1,097.25
O&M cost	297.72	312.61	328.24	394.65	361.88	379.97	398.97	418.92	439.87

Note: "Profit" – cash flow in, "O&M cost" cash flow out base

Source: Ezhou thermal power plant

2.4 Impact

An evaluation of impact on the life and economy of local people is not yet made, because only two years have passed since the project completed and the utility factor of the project-related facility is below the expected level of the plan.

2.4.1 Impact on the residents who are forced to relocate

At the time of appraisal, Ezhou government decided to provide new residences and jobs to the people who were forced to relocate by the project implementation, as well as the expense and compensation for the relocation. According to the information obtained from Ezhou thermal power plant at the time of this evaluation, large majority of the people were satisfied with all the relevant measures taken for the relocation. The reason is that all measures including payment of relocation expense and compensation fees for 7 villages, 466 households, 1,727 people, one brick factory and one primary school, job placement to relocated residents, and compensations to the families composed of only over-51 years old people were all implemented duly as per planned.

2.4.2 Impact on the environment

This project was implemented in accordance with the environmental standard, and therefore no special issue was reported. As shown in the table 6, at the time of completion of the project in 1999 and also in 2000, measured indicators of air and water pollution were all below the standard level. According to the organization who implemented this project, also, there were no reports concerning adverse effects such as noise and vibration emitted by the project plant.

Table 6: measurement values related to air and water pollution

category	measurement index	standard value of emission (the 3rd grade)	1999 the completion of the project	2000
Air	SO x	17.56t/h	1.322	1.0675
	NO x	120ppm	100.4	—
	dust	100mg/N	22.44	49.6
water	pH	6 ~ 9	8.50	8.50
	suspended solid	< 150mg/L	25.36	24.4
	COD	150mg/L	46.14	17.6

Source: Ezhou thermal power plant

Note: No measurement of NOx was made in 2000.

2.5 Sustainability

2.5.1 Organization in charge for operation and maintenance (O&M)

Ezhou thermal power plant has changed its name to Hubei Ezhou power plant Ltd. on 22 December 2000, and the implementation agencies are Hubei Province Power Company and Hubei Ezhou power plant Ltd.,. The later is in charge of operation and maintenance of the power plant. In the old company, the organization structure and business function were provisional, and their main duties were management and construction of the project. In the new company, organization was expanded and their business function was fully provided. Their duties were shifted to operation and maintenance of the power plant. They have now 12 departments instead of 7, while Department of General Construction was abolished.

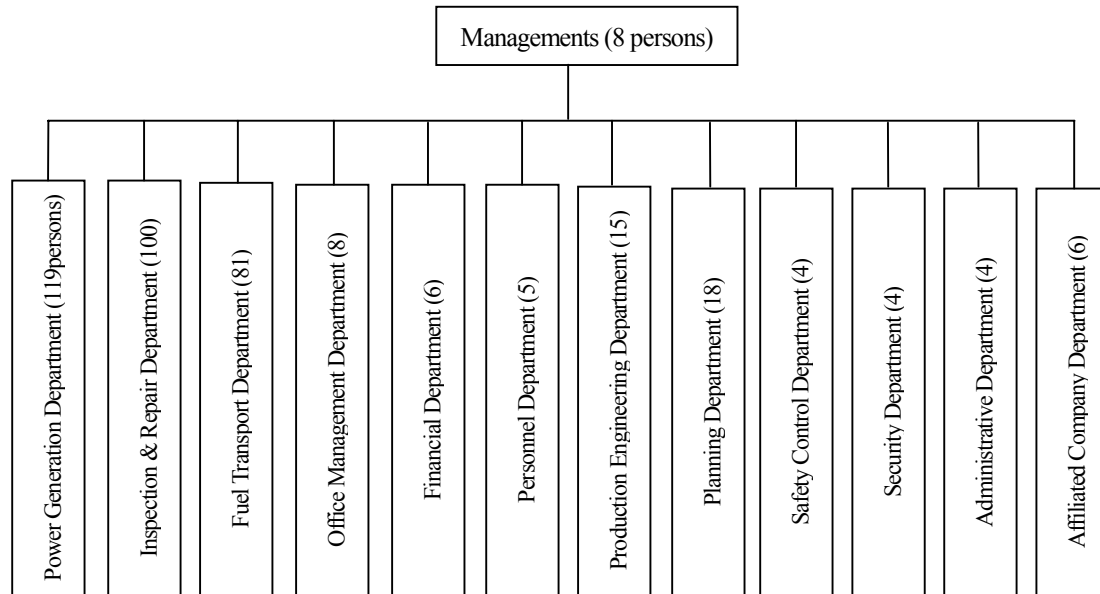
2.5.2 Organization structure for operation and maintenance

Organization chart of Hubei Ezhou Power Plant Ltd. is shown in Figure 1. Departments in charge of the O&M of the project facility are Production technology Department, Power Generation Department and Inspection & Repair Department. The staffs are properly assigned to the each facility section for maintenance and management.

Quantitative evaluation standard is not yet defined, but technical capability of personnel responsible for maintenance and management are determined based on annual test for technique in which personal executive ability is also regarded as an important factor.

In order to upgrade the technical level in maintenance and management departments, the company has organized to hold the monthly program of technical questions and answers for all the engineers by senior executives. Also the meeting for technical problem reporting by the elected representatives from each section of maintenance and management has been held every month.

Fig. 1: Organization chart of Hubei Ezhou Power plant Ltd.



Source: Ezhou Thermal Power Plant

2.5.3 Financial Situation

The trial operation of the project facility was performed partially in 1998, and the actual operation of two plants started on April 2nd, 1999. The company profit much lower than the original plan is owing to the small output of power generation rather due to the decreased demand for electricity in general.


The economic situation of Hubei province, however, is gradually picking up and the demand for electric power is also likely to expand. As for the outlook of an increase in electric power sources, large-scaled hydropower plant projects such as the Three Gorges Construction are basically aiming at providing electric power to the east coast territory with expanding demand, as part of the “Send West Electricity to the East” project, which means that power supply to Hubei province will be rather limited. There is no project of big hydropower plant planned in near future in Hubei.

Therefore, excessive supply will be gradually reduced for the future. Reflecting these situations, profit of the project will be expanded in the future. According to the comment by Ezhou thermal power plant, the electric power rates will be raised to 0.3247 RMB/kWh in 2001 from 0.249 RMB/kWh. As its result, 37% of growth in profit is expected in 2001, and the profit during the period of 2001-2009 will rise by 5% on average.

3. Lesson Learned

It is absolutely necessary to survey on whether or not other power plant projects are scheduled or in consideration in the project area, and if any, identify an impact that may have on the Project. It is also necessary to analyze precisely specifically demand in the province and in the network at the time of appraisal.

Comparison of Major Plan and Actual Scope

Item	Plan	Actual
1. Project Scope (1) Power Plant Generation Capacity Fuel Steam Pressure Steam Temperature (2)Boiler and fittings Type Capacity Dust Collector (3)Steam Turbine and other equipments Type Rotational Speed Steam Condition (4)Power Generator Type Output Power factor Frequency (5) Other equipments	300MW× 2 Coal 183bar 540 Forced subcritical pressure boiler or natural circulation boiler, with balanced draft system 1072 t/h Electric Dust Collector Tandem-compound turbine, reheating double flow 3000r.p.m. 167.8bar、 537 Water cooling type and hydrogen cooling-type turbine, Exciter 353MVA x 2 0.85 50HZ	 same as the left column
2. Implementation Schedule (1) Main Plant (2) 220KV Switching plant (3) Coal Transportation System (4) Ash Pond	May 1993 – Sept.1996 Sept. 1993 – Sept. 1996 Nov. 1993 – Dec. 1995 Nov. 1993 – Jun. 1995 May 1993 – Jan. 1995	
3. Project Cost Foreign currency Domestic currency (Local Equivalent) Total ODA loan Portion Exchange Rate	31,892million yen 24,784million yen (RMB1,059.13 million) 56,676million yen 31,892million yen RMB1=JP¥23.4 (1992)	31,724million yen 30,132million yen (RMB 2,008.78million) 61,856million yen 31,724million yen RMB1=JP¥15 (weighted average in the project implementation period)