China

Jiangxi Jiujiang Thermal Power Plant Project (1) (2)

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Field Survey: September 2007, March 2008

1. Project Profile and Japanese ODA Loan

Map of project area

Interior of Jiujiang Thermal Power Plant Part III

1.1 Background

Jiangxi Province is part of the Zhujiang Delta Economic Zone, where economic development has begun slightly behind the coastal regions. With demand for electric power in the province exceeding the volume which the province has traditionally been able to supply, it has been receiving a supply of electric power from surrounding provinces. The power consumption volume of the province grew from 12.8TWh in 1990 to 20.8TWh in 2000, an average annual increase of 5.0%, while from 2000 onwards it grew by an annual average of 13.6% to reach 44.6TWh in 2006. However, as the province has no river with the size and head drop necessary to produce hydroelectric power, there is no room for expanding hydroelectric power, and the province is also far from natural gas production fields. Consequently, a strong emphasis has come to be put upon the construction of coal-fired thermal power plants with both high efficiency and consideration for the environment, to run on coal which can be procured relatively cheaply within China. As a result, among the province's total electric power generation volume (43.6TWh) the percentage of thermal power generation is high at 79.7% (as of 2006).

The expansion of the Jiujiang Thermal Power Plant is part of this policy, and this project is positioned as an electric power generation expansion project using larger-scale and more efficient thermal power generation, leading on from the

1983/1984 Phase I (125MW x 2 lines) and the 1991/1992 Phase II (200MW x 2 lines).

1.2 Objective

To meet the increasing demand for electric power for household, industrial and agricultural use through the construction of a 600MW-grade thermal power plant (300MW-grade x 2 lines) using Chinese coal as its fuel as Part III of the Jiujiang Thermal Power Plant at approximately 5km northeast of the city of Jiujiang in northern Jiangxi Province, thereby contributing to the development of the economy of the region.

1.3 Borrower/Executing Agency

The Government of the People's Republic of China/Ministry of Electric Power

1.4 Outline of Loan Agreement

Loan Amount Disbursed Amount	(1)12,030 million yen/11,390 million yen (2)17,570 million yen/14,279 million yen
Exchange of Notes Loan Agreement	(1) January 1995/January 1995 (2) October 1995/November 1995
Terms and Conditions - Interest Rate - Repayment Period - Grace Period - Procurement	 (1) 2.6%/(2) 2.3% 30 years 10 years General Untied
Final Disbursement Date	(1) February 2002/(2) December 2005
Main Agreement (over 1 billion yen)	Hitachi, Ltd. (Japan), Itochu Corporation (Japan) , Foster Wheeler Energy Corporation (United States)
Consultant Contracted (over 100 million yen)	Tokyo Electric Power Services Co., Ltd. (Japan)
Feasibility Study(F/S) ,etc.	1992 Feasibility Study (Part II: Ministry of Electric Power East China Electric Power Design

	Institute) 1993: First SAPROF study 1994: Second SAPROF study

2. Evaluation Result (Rating: A)

2.1 Relevance (Rating: a)

2.1.1 Relevance at the time of appraisal

In China's 8th National Five-Year Plan (1991-1995), a plan was set out for the expansion of the electric power supply volume in response to increasing demand for electric power across the country. The 9th National Five-Year Plan (1996-2000) also put emphasis on the development of the electric power sector centered on the construction of new high-efficiency large-scale thermal power plants, as a further increase in demand for electric power was foreseen.

As a result, infrastructure development relating to the electric power supply including thermal power plants, and the promotion of industrialization and urban development are set as objectives in the 9th Five-Year Plan of Jiangxi Province (1996-2000), which plans the further construction of new 3,000MW-grade power plants including the Jiujiang Thermal Power Plant Part III. At the time, there was a plan to increase investment in electric power around 7% each year in the province, but it was still predicted that, there would be a continuing shortfall of electric power due to further rises in demand for electric power. The importance of this project was high as it was considered that its implementation would contribute to the development of the region's economy by meeting the increasing demand for electric power.

2.1.2 Relevance at the time of evaluation

The 11th National Five-Year Plan (2006-2010) and Five-Year National Energy Development Plan (2006-2010) each promote the construction of large-scale, environmentally-friendly and efficient thermal power plants.

The 11th Five-Year Plan of Jiangxi Province (2006-2010), while setting the diversification of energy sources as an objective, also emphasizes the promotion of construction of thermal power plants in order to meet the continually increasing demand for electric power. Furthermore, it also sets out the objectives of constructing new power plants of over 5,000MW and raising the total power generation volume of the province to over 12,000MW by 2010. However, despite

the start of operations at all the power plants constructed in the province as the 11th and 12th Five-Year Plans have been implemented, and the purchasing of electric power from other provinces, it is predicted that the province will be unable to meet its demand for electric power, and that the electric power generation volume will fall short by 850MW in 2010 and 4,750MW in 2015. Therefore, the developmental needs of the electric power sector, including the continuing construction of power plants, are high. The new construction of a Part IV Power Plant in the Jiujiang Thermal Power Plant is also envisaged.

The implementation of this project is in accordance with the National Plans and development needs at both the time of appraisal and the time of ex-post evaluation, and its relevance is thus extremely high.

2.2 Efficiency (Rating: b)

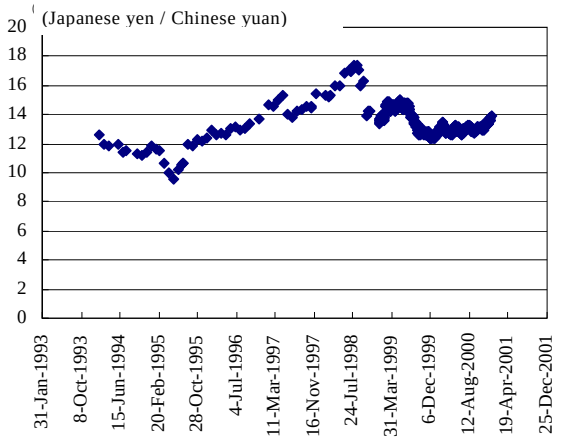
2.2.1 Outputs

In this project, two coal-fired thermal power plants with a maximum output of 350MW (Generators No. 5 and 6 in the Jiujiang Thermal Power Plant) and attached facilities were constructed largely as planned. At the time of appraisal, the securing of a space for the installation of an exhaust gas desulfurizer within the power plant site was planned; the installation of such equipment is completed for the Generator No. 6 (as of August 2007), and is currently being installed for the Generator No. 5, planned to commence operations from January 2009.

2.2.2 Project period

The planned project period was for 61 months from January 1995 to January 2000. However, the project actually required 107 months from January 1995 to December 2003, meaning that the project exceeded the plan by 46 months (175%). The main reasons for this were (1) Time was required for the preparation and implementation of the tender due to the fluctuations in the exchange rate and the cumbersome nature of tender procedures; (2) There was a fall in the national demand for electric power over the 1998-1999 period which was

Figure 1: Fluctuations in the exchange rate



(Source: IMF, International Financial Statistics Online)

temporary but nationwide, and the National Development and Reform Commission put a nationwide freeze on permits for embarking on construction projects for power plants. Due to the former reason, the preparation period (from the tender to the submission of the application for embarking on construction) which was planned to take 15 months in fact took 26 months. Due to the latter reason, it took 21 months to acquire the permit for construction.

In contrast, once the permit for embarking on construction had been acquired, the project was carried out extremely promptly and efficiently, and the installation of the power generation facilities, which had been planned to take 30 months, was in fact completed in 24 months.

As it may be considered that (2) above was an external factor which was beyond responsibility of the executing agency of the project, it has been decided that in the ex-post evaluation of this project, the delay caused by (2) will be excluded from the evaluation of the project period, and the exceeded period is therefore considered to be 25 months (141% of the plan).

2.2.3 Project cost

The total project cost estimated at the time of appraisal was 47,735 million yen (of which Japanese ODA loan was 29,600 million yen), and the actual total cost was 54,898 million yen (of which Japanese ODA loan was 25,670 million yen), 115% of the original plan. The reasons for this were (1) the rise in prices due to the extension of the construction period; (2) the rise in costs caused by amendment to the law, including compensation for resettlement and land acquisition; and (3) fluctuations in the exchange rate.

Because the project cost slightly exceeded the plan and the project period exceeded the plan by around 140%, the efficiency of this project is judged to be medium.

2.3 Effectiveness (Rating: a)

A comparison of the planned and actual figures for the operation and effect indicators, a verification of the qualitative effects, and a recalculation of the internal rate of return were carried out. As a result of the analysis of these factors, it was judged that the effects had been realized by the implementation of this project largely as planned, and that the effectiveness of the project was therefore high. The analyses of each item are shown below.

2.3.1 Operational Status of the Jiujiang Thermal Power Plant

Using the operation and effect indicators of thermal power projects, the planned figures set by the executing agency and actual figures regarding the Jiujiang Thermal Power Plant Part III Facilities were compared and compiled in Table 1.

Table 1: Planned and actual figures for operation and effect indicators of the Jiujiang Thermal Power Plant Part III

Indicators		Unit	Target Figures at Time of Completion (Generator No.5 and 6)	2003		2004		2005		2006	
				Generator No.5	Generator No.6	Generator No.5	Generator No.6	Generator No.5	Generator No.6	Generator No.5	Generator No.6
Maximum Output		(MW)	300-350MW x 2lines	350	350	350	350	350	350	350	350
Net Electric Energy Production		(GWh/year)	4,550	2,260		3,913		3,571		3,889	
Plant Load Factor		(%)	74.2	45.9	29.4	66.5	69.1	59.6	64.2	63.7	70.6
Availability Factor		(%)	74.2	62.8	37.2	91.0	92.0	80.8	83.0	84.2	87.9
Auxiliary Power Ratio		(%)	6.5	5.7		5.9		5.6		5.5	
Gross Thermal Efficiency		(%)	41.1	45.8		49.0		46.8		46.7	
Outage Hours for Every Cause	Human Error	(Hours/Year)	N/A	0	0	0	0	0	0	0	0
	Machine Trouble	(Hours/Year)	N/A	2,102	1,216	13.2	3.1	163.5	3.1	0	0
	Planning Outage	(Hours/Year)	N/A	377.8	426.5	0	321.6	725.1	589.3	326.7	0
Outage Times for Every Cause	Human Error	(Times/Year)	N/A	0	0	0	0	0	0	0	0
	Machine Trouble	(Times/Year)	N/A	11	8	2	1	1	3	0	0
	Planning Outage	(Times/Year)	N/A	1	1	0	1	1	1	1	0

Source: Jiujiang Thermal Power Plant

Note: Plant Load Factor = volume of annual electric energy production / (rated output x number of hours a year) x 100
Availability Factor = (hours of operation a year / number of hours a year) x 100
Auxiliary Power Ratio = (volume of electric power consumption within a plant a year / annual electric energy production) x 100
Gross Thermal Efficiency = (annual electric energy production x 860) / (annual fuel consumption volume x fuel calorific value) x 100

At the time of appraisal, the target for net electric energy production was set at 4.55 billion kWh/year; but, because the operation hours was short due to the long outage hours for inspection and repair of equipment, the target figure was not achieved. However, the electric energy production volume is increasing year by year to approach the planned level. Furthermore, although the plant load factor also falls slightly below the target figure for the same reason, this figure is also increasing year on year and is approaching the planned figure.

The availability factor has been maintained at a higher level than the plan. The auxiliary power ratio has maintained a lower figure than the plan, which shows that the facilities are operated efficiently. In addition, the gross thermal efficiency greatly exceeds the national average at 46.7% (as of 2006), and as a coal-fired thermal power plant, this indicates the energy efficiency level of a developed

country[1].

The outages other than the planned outages were caused by machine trouble; there were no outages caused by human error. Operations were halted due to machine trouble at the start of trial operations and start of public use, but the repair for these has been completed. On the other hand, the Italian-made coal haulage equipment frequently breaks down, so in order to minimize disruption to the operation, this is being repaired at the power plant while operations go on.

Figure 2: Coal haulage equipment

2.3.2 Qualitative effects

It was envisaged that this project would promote the development of the region's economy through the alleviation of the electric power shortage in Jiangxi Province. The Jiujiang Thermal Power Plant Part III started electric power production from 2002-2003 (trial operations), and with the demand for electric power in Jiangxi Province rising sharply in this period, the newly constructed power plants alleviated the electric power shortfall in Jiangxi Province and the nature of the dependence on sources outside the province, and contributed greatly not only to the industrial sector where the electric power consumption volume is great, but also to the development of commercial and agricultural sectors. Furthermore, the Jiujiang Thermal Power Plant not only contributed to the local economy, industry and services of the city of Jiangxi through creating a stable supply of electric power, but also employed thousands of local citizens during the construction of the power plant, and thus contributed to the local labor market.

The supply of electric power was halted several times in the winter of 2007 due to the heavy snow caused by unusual weather conditions which had never been experienced in southern China, but even during the time of disruption, the Jiujiang Thermal Power Plant contributed to the stable supply of electric power without outages, and played a major role in running the regional economic activities of Jiangxi Province and Jiujiang City.

[1] The gross thermal efficiency of coal-fired thermal power plants in various countries (2004) were 41.5% in Japan, 36.3% in the United States, 37.8% in the UK, 38.2% in Germany, and 39.4% in France, while the average rate in China was 29.8% (Source: ECOFYS (2007), "Comparison of efficiency fossil power generation.")

2.3.3 Recalculation of internal rates of return (IRR)

2.3.3.1 Financial internal rate of return (FIRR)

When the financial internal rate of return (FIRR) was recalculated taking the revenue from the sale of electricity as benefits, the initial investment for the construction of the power plant and the costs of operation and maintenance as costs, and the project life as 25 years, the FIRR was 9.78%, falling somewhat below the figure of 12.12% calculated at the time of appraisal. This was caused by the rise in the price of coal; the unit price of coal was given as 220 yuan/t at the time of the appraisal, but rose to 427 yuan/t in 2003. In addition, the price of the electric power sold was estimated at 310 yuan/MWh at the time of appraisal, but from 2003 to 2006 the average price of electric power sold was 283 yuan/MWh, due to the fact that a low level had been set for political reasons. However, it is considered that the project is maintaining a constant level in terms of profitability.

2.3.3.2 Economic internal rate of return (EIRR)

In order to calculate the indirect benefits of the project, beneficiaries' willingness to pay (WTP) for the benefits of a reduction in outages and benefits of a reduction in air pollution (reduction in respiratory disease) was taken from a beneficiary survey. The survey was carried out targeting 285 residents (from whom 212 valid replies were received) of Jiujiang City, where the power plant was constructed. It calculated the WTP for the reduction in outage times and the reduction in outage hours individually, and then calculated the total benefits of the improvement in outage times and outage hours which was actually achieved. EIRR was calculated based on the assumption that the benefits of this project have had a wide-ranging ripple effect on Jiangxi Province as a whole. As a result, EIRR was calculated at 12.11%, which shows a good level of benefit.

2.4 Impact

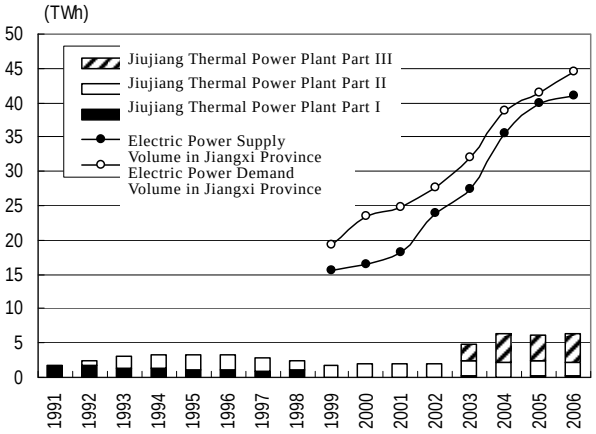
2.4.1 Contribution to infrastructure improvement for economic growth

2.4.1.1 Improvement of the balance between electric energy supply and demand

The volume of both demand for and supply of electric power is increasing overall across the Jiangxi Province as a whole (Figure 3). The demand for electric power for the province as a whole increased by an average of 12.6% a year between 1999 and 2006. With the electric power supply volume increasing by an average of 14.8% a year over the same period, the electric power supply volume is increasing over and above the increasing demand for electric power; however,

there is still a shortfall in the electric power supply volume in the province. Currently, the Jiujiang Thermal Power Plant as a whole supplies approximately 17.5% of the province's total electric power supply volume. With the Jiujiang Thermal Power Plant Part III constructed through this project making up 10.0% (as of 2006) of the total figure, it is making a steady contribution to the improvement of the electric power supply.

Figure 3: Jiangxi Province's electric power demand and supply



(Source: Jiujiang Thermal Power Plant)

2.4.1.2 Contribution to economic growth

The economy of Jiangxi Province has been growing rapidly since 2000, with secondary industry in particular experiencing major growth and the expansion of its share (Figure 4, Table 2). The annual average actual growth rate by sector from 2000 to 2006 shows high rates of growth for primary industry at 7.2% and tertiary industry at 10.2%, but above all it was secondary industry where the growth rate was outstanding at over 20%. It may be said that the stable supply of electricity brought about by this project is making a contribution to the industrialization and economic growth of Jiangxi Province.

Figure 4: Jiangxi Province's GDP

(100 million yuan : price in 2000)

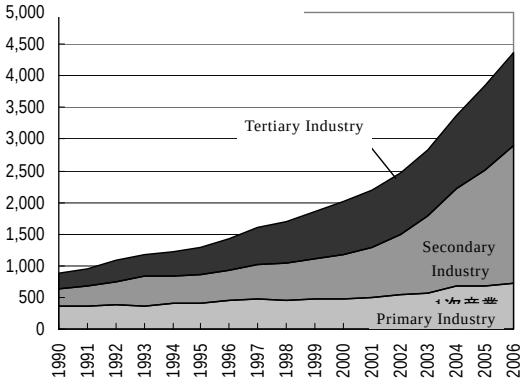


Table 2: Jiangxi Province's GDP growth rate by industry

	Primary	Secondary	Tertiary	Total
1990-2000	3.1%	9.9%	12.9%	8.6%
2000-2006	7.2%	20.7%	10.2%	13.9%

(Source: China Statistical Yearbook for each year for Figure 4 and Table 2)

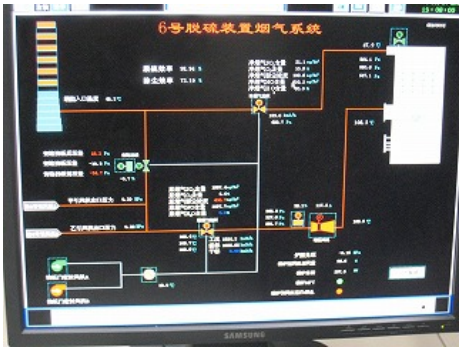
Because the electric power generated is distributed all over Jiangxi Province, it is believed that the benefits are accrued to the entire province. The estimated

number of beneficiaries of this project is the total population of Jiangxi Province, or 43.39 million people[2]; this is 3.4 times the population of Tokyo (12.67 million people).

2.4.2 Impact on the natural environment

2.4.2.1 Countermeasures against air pollutants and state of emissions

Figure 5: Exhaust gas desulfurizer monitor



As a countermeasure against sulfur oxide (SOx) at the Jiujiang Thermal Power Plant Part III, the use of low-sulfur coal with 0.35% sulfur was planned, but actually coal with a higher percentage of sulfur (0.8-0.9%) than planned is used. This is because there was a national shortage of coal, and the project had to switch from the large-scale national mining company originally agreed upon as a source for the procurement of coal, to medium- and small-scale coal mines.

An exhaust gas desulfurizer has already been installed in the Generator No. 6 of the Plant Part III, and another is being installed in the Generator No. 5. As a result of the installation of the desulfurizer, the sulfur has been reduced from 1,968.4mg/N m^3 (before desulfurization) to 19.9mg/N m^3 (after desulfurization, both figures being instantaneous values), thus achieving a removal rate of 99% (instantaneous value).

Because of the installation of the desulfurizer, it is possible to reduce costs by using high-sulfur coal which has a lower cost; however, Jiujiang Thermal Power Plant Part III was designed for the use of the high-calorie coal (with a high price but a low percentage of sulfur) which is transported in by railway. Because of this, a design alternation is currently being planned for the boiler and coal transportation facilities which will allow the use of Sichuan coal (with a low price, a high percentage of sulfur, and low calories) which is low in price and transported in by ship.

Because the temperature of the furnace is rising due to the change in the type of coal used, the emissions of nitrogen oxide (NOx) are, at 800ppm, rising above the figure of 400ppm or below which was planned.

As countermeasures against dust emission, the emission volume has been kept low (<100mg/N m^3) through the introduction of high-performance electrostatic precipitators, and an inner cylinder tall stack (over 210m) has been adopted.

[2] Figures for 2006, China Statistical Yearbook 2007

Table 3 shows the results of monitoring of the state of air pollution in Jiujiang City. Levels of nitrogen dioxide (NO_2) and PM10[3] have been kept within national emission standard levels (Level II). The emission volume of sulfur dioxide (SO_2) has increased since 2004 when the Jiujiang Thermal Power Plant Part III came into full-fledged public use, but remains within the emission standard level as of 2007. This is because the installation of a desulfurizer in the Generator No. 6 from August 2007 has contributed to the reduction in the emissions of sulfur dioxide (SO_2). Currently, a desulfurizer is being installed in the Generator No. 5, and the closure of the plants within the Jiujiang Thermal Power Plant where desulfurizers are not installed is planned (Generators No. 1 and 2 of Part I are planned to be closed by the end of the fourth quarter of FY2008, while the time for the closure of Generators No. 3 and 4 of Part II has not yet been set). Thus, it is foreseen that the current volume of sulfur dioxide (SO_2) emissions will fall by a large margin. Furthermore, the calcium sulfate, a byproduct produced by desulfurization is recycled as a material for cement, as consideration for the environment.

Table 3: Air Pollution in Jiujiang City

(Unit: mg/l)

	SO_2	NO_2	PM10
2001	0.061	0.039*	0.288**
2002	0.060	0.042	0.176**
2003	0.061	0.038	0.180**
2004	0.089	0.043	0.091
2005	0.072	0.037	0.090
2006	0.071	0.039	0.088
2007	0.045	0.023	0.076
National emission standards (Level II)	0.060	0.080	0.100

Note: *refers to emissions of NOx, **refers to emissions of TSP
Source: Jiujiang Environment Protection Bureau

2.4.2.2 Countermeasures against water pollutants and state of discharges

Wastewater discharged by the plant is discharged into the Yangtze River after carrying out wastewater treatment. Table 4 shows the results of monitoring of the state of discharge from the Jiujiang Thermal Power Plant Part III. The water quality of the wastewater fully meets the planned standard figures, and a high level of water quality is maintained.

Figure 6: Water quality study

[3] PM (particulate matter) 10: particulate organic matter of less than 10 microns

Table 4: State of monitoring of wastewater from Jiujiang Thermal Power Plant Part III

	PH	SS	COD	BOD
Planned discharge standards figure*	6-9	Under 70	Under 100	Under 30
Actual state of discharge	7.8	22	45	17

Note: Standard figures are according to the Integrated Waste Water Discharge Standard

2.4.3 Resident resettlement/land acquisition

Approximately 300 residents were resettled and 61.9ha of land acquired for the construction of the ash disposal site. The cost of resident resettlement at 49.77 million yuan greatly exceeded the planned cost of 17.33 million yuan. This was caused by the rise in prices and the increase in unit cost of compensation for resettlement in line with national standards, and the cost of compensation for resettlement was paid by the government. The Jiujiang Thermal Power Plant paid the local government 1.28 million yuan for job introduction services for the resettled people, thus contributing to resolving the employment issues.

2.5 Sustainability (Rating: a)

There are no issues concerning either the capabilities of the executing agency or the maintenance system of this project, and it is evaluated that a high level of sustainability can be foreseen. Below is the analysis of the operation and maintenance system and financial status of the executing agency and the state of maintenance.

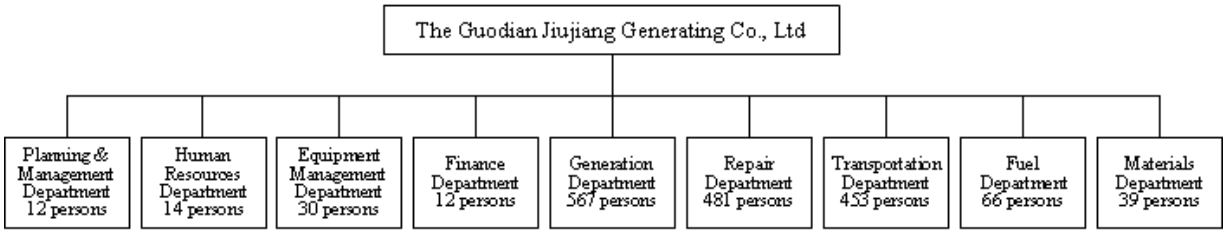
2.5.1 Executing agency

2.5.1.1 Operation and maintenance structure

The Guodian Jiujiang Generating Co., Ltd. undertakes the operation and maintenance for this project, and an organizational diagram of the operation and maintenance organization is shown in Figure 7. Of this, the Equipment Management Department is responsible for operation and maitenance of the Jiujiang Thermal Power Plant as a whole. The Generation Department, Repair Department and Transportation Department each carry out administration of their departments individually, and administration, management, monitoring and training of engineers for each of the power plants has been carried out at the Generation Department from Part I to Part III. Inspection, repair and maintenance

of the various facilities and equipment are being carried out by the Repair Department, and the Transportation Department carries out stock management and quality control of the coal, and the management of the railway line. As the personnel necessary are stationed in each department, there are no issues with regard to the operation and maintenance structure.

Figure 7: Structural diagram of Jiujiang Thermal Power Plant



2.5.1.2 Technical capacity

Figure 8: Manuals in place

The Equipment Management Department of Jiujiang Thermal Power Plant formulates an inspection plan for the power plant facilities on the lines of Jiangxi Province's inspection guidelines for power generation, and the power plant's Repair Department is carrying out regular inspections. In addition, the Equipment Management Department is carrying out regular reviews of the contents of inspections. Inspection manuals and manuals for responding to emergencies are also in place in each facility.

A training system has been established, and technical staff receive training at the training center and technical school each year. The power plant also invites instructors from outside and provides lectures at the plant.

At the power plant, 86 persons possess high-level technical qualifications, 343 possess medium-level specialist technical qualifications, and 403 persons possess basic level specialist technical qualifications; depending on the department of the power plant, the qualifications and administration differ. Inspection manuals, systems and facilities for training, research and the acquisition of qualifications are established, and there are no technical problems in operations and maintenance.

2.5.1.3 Financial status

Table 5 shows the financial status of the Guodian Jiujiang Generating Co., Ltd. from 2005 to 2007. In 2005/2006, the company received financial instruction from four banks including the Deutsch Bank and the China Everbright Bank, and recovered profitability. While profitability has been deteriorating in recent years because of the rising price of coal, the company has secured sufficient operation and maintenance costs steadily, and with the profit rate improving in 2007, no major financial problems are seen in operation and maintenance.

Table 5: Financial status of the Guodian Jiujiang Generating Co., Ltd.

	2005	2006	2007
Current assets(10,000 yuan)	67,821	70,745	66,409
Fixed assets (10,000 yuan)	330,743	308,482	296,574
Total assets (10,000 yuan)	401,806	382,524	363,045
Current liabilities (10,000 yuan)	153,679	109,138	104,485
Total liabilities (10,000 yuan)	374,405	340,739	305,931
Equity capital (10,000 yuan)	27,402	41,785	57,115
Sales volume (10,000 yuan)	106,512	112,756	175,140
Net profit (10,000 yuan)	24,944	2,502	7,623
Operation and maintenance costs (10,000 yuan)	1,926	2,205	1,931
Liquidity rate (%)	44.1	64.8	47.3
Ratio of net profit to sales (%)	23.4	2.2	4.4
Ratio of net profits to total assets (%)	6.2	0.7	2.1

2.5.2 Operation and maintenance status

All places in the power plant where parts have broken down or problems have occurred have been replaced or repaired. However, the Italian-made coal haulage equipment (the power shovel etc.) frequently breaks down. The Repair Department creates purchasing plans for spare parts, which the Materials Department purchases, classifies and stores. There are no problems, as places where there are problems and places which need repair are all dealt with appropriately.

Manuals relating to health hazards for employees have been created, and regular health checks are carried out.

3. Conclusion, Lessons Learned and Recommendations

3.1 Conclusion

Because the project period was extended and the project's costs rose slightly as outlined above, this project is evaluated as medium in terms of efficiency, but as there are no problems in relevance, effectiveness or sustainability, the evaluation for the project as a whole is extremely high.

3.2 Lessons Learned

Through the installation of an exhaust gas desulfurizer in a coal-fired thermal power plant, it is possible to almost completely avoid emitting sulfur into the atmosphere and thus prevent air pollution even when using low-cost, low-grade coal (with a high sulfur content). For future coal-fired thermal power plant projects, it would be desirable to include the installation of desulfurizers in the design.

3.3 Recommendations

For the executing agency: The profitability of the Guodian Jiujiang Generating Co., Ltd., which is the operation and maintenance organization of this project, has been deteriorating in recent years in line with the increasing price of coal. Therefore, it would be desirable to carry out a design change of the boiler and coal transportation facilities which will allow the use of low-price, high-sulfur coal at an early stage.

Comparison of Original and Actual Scope

Item	Plan	Actual
(1) Outputs		
1) Generation plant	300MW-grade coal-fired thermal power plants x 2 lines	350MW-grade coal-fired thermal power plants x 2 lines
2) Boiler, steam turbine Generator	Output: 300-362MVA; Power factors: 0.85; Two bases each	As planned
3) Transformer	Main transformer: 360MVA, 220/20kV; Transformer within plant: 20/6.3kV	As planned, except that the main transformer was 445MVA
4) Coal hauling equipment, ash disposal site	Complete set	As planned
5) Main building and supplementary building	Complete set	As planned
6) Concrete assembly inner cylinder tall stack	Height: 210m	As planned
7) Incoming railway line		As planned
8) Water purification equipment, waste water treatment equipment, oil tank		As planned
9) Construction machinery, various		As planned

experimental equipment, tools etc. 10) Consulting services	60MM	As planned
(2) Project Period	January 1995-January 2000 (61 months)	January 1995-December 2003 (107 months) * The project conclusion is the time when commercial operations commence at Generators No. 5 and 6
(3) Project Cost Foreign currency Local currency Total Yen Loan Portion Exchange rate	 29,600 million yen 18,135 million yen (1,550 million yuan) 47,735 million yen 29,600 million yen 1 yuan = 11.7 yen (October 1995, appraisal study paper)	 25,670 million yen 29,228 million yen (2,118 million yuan) 54,898 million yen 25,670 million yen 1 yuan = 13.8 yen (average over January 1998-December 2005)