CHINA

Tianshengqiao Hydro Electric Power Generation Project (1)-(6)

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Field Survey: August, 2001

1. Project Profile and Japan's ODA Loan

Site Map: Three southern provinces of the feeding target

Site Photo: The second Tianshengqiao hydro electric dam

1.1 Background

In China, energy supply to the south that is engaged in active development particularly special economic zones, has been a huge challenge to deal with, because coal accounting for 70% of Chinese energy resources, is unevenly distributed in the north.

Therefore, the Chinese Government designated energy and transportation industries as top priority sectors in the 6th Five Year Plan (1981 to 1985), to stimulate a substantial increase in energy supply to the south in accordance with the development policies described below. In this context, this project was designated as the priority project.

(1) To strengthen railway transportation capacity for coal.
(2) To build more thermal power plants as well as to shift from transportation of coal to electrical distribution by expanding power grid.
(3) To modernize medium and small coal mines in the south.
(4) To develop abundant water resources as well as to construct more hydro power plants in the south.

Ministry of Water Supply and Energy has worked out "Hongshui River General Utilization Plan" to develop Hongshui River, one of the major rivers of the south, as part of above development policy ④, which was approved by State Council in November, 1981. The plan targets to construct ten power plants (11,120MW in total) including those in this project and to strengthen power supply in the south, especially in Guangdong province in projection of power shortage caused by industrial development in the special economic zone.

Increasingly tightened power supply to the three southern provinces such as Guangdong, Guangxi, and Guizhou, which are the main targets of the Project, necessiated them to import electric power of 372GWH or 43,890,000 RMB from Hong Kong in 1983. Subsequently, such power supply shortage was expected to continue until the completion of the Project in 1990 (estimated maximum shortage was 3,590GWH).

1.2 Objectives

(1) To mitigate supply-demand imbalance in Guangdong province with high probability of economic development especially in the special economic zones, and to increase capacity of power supply in

Guangxi and Guizhou, through taking advantage of abundant water resources in the south,

(2) To facilitate power accommodation and to enhance credibility on power supply, among Guangdong, Guangxi, and Guizhou, which remain yet to be linked to each other, by linking these three provinces through networking power supply systems.

(3) To ease tightened railway transportation derived from mass transit of coal, through shifting energy source from coal to hydro electric power.

1.3 Project Scope

This project was designed to construct a hydro power plant of 880MW (220MWx4) as the first phase of the plan to establish the second Tianshengqiao hydro power plant of total 1,320MW (220MWx6) at the Tianshengqiao (Basuo) on Nanpan River, the upper Hongshui River. Japan's ODA loan financed the entire foreign currency portion of the project including dams, channels, power stations, a 500KV power line between Tianshengqiao and Guangzhou (1,155km), and a 500KV power line between TIanshengqiao and Guiyang (285km) as well as four transformer substations.

1.4 Borrower/Executing Agency

Ministry of Foreign Trade and Economic Cooperation of the People's Republic of China/National Electric Power Company (former Ministry of Water Supply of the People's Republic of China)

1.5 Outline of Loan Agreement

Item	First (1984)	second (1985)	Third (1986)	Fourth (1987)	Fifth (1988)	Sixth (1989)
Loan Amount	12,400million yen	12,353million yen	18,015million yen	11,372million yen	4,000million yen	19,235million yen
Loan Disbursed Amount	12,400million yen	11,483million yen	15,401million yen	10,293million yen	3,996million yen	18,357million yen
Date of Exchange of Notes	October, 1984	July, 1985	May, 1986	June, 1987	July, 1988	May, 1989
Date of Loan Agreement	October ,1984	August,1985	June ,1986	July, 1987	August, 1988	May, 1989
Terms and Conditions						
Interest Rate	Interest rate: 3.25%	Interest rate: 3.5%	Interest rate: 3.5%	Interest rate: 3.0%	Interest rate: 2.5%	Interest rate: 2.5%
Repayment Period (Grace Period)	Maturity 30 years (Grace Period 10 years) GeneralUntied (partially Untied)	Maturity 30 years (Grace Period 10 years) General Untied (Partially Untied)	Maturity 30 years (Grace Period 10 years) General Untied	Maturity 30 years (Grace Period 10 years) General Untied	Maturity 30 years (Grace Period 10 years) General Untied	Maturity 30 years (Grace Period 10 years) General ntied
Final Disbursement Date	October, 1989	December, 1991	May, 1991	July, 1992	July, 1993	May, 1996

2. Results and Evaluation

2.1 Relevance

The project was worked out in line with the development policy of the 6th Chinese Five Year Plan (1981－1985). The 10th five year plan, which was announced in March, 2001, states that development of infrastructures is one of the major objectives concerning economic structure adjustment to be promoted more intensively in the future. It emphasizes not only that in accordance with “Xidiandongsong”(which means transmitting electricity from West to East), which is closely related with the Project, construction of three major routes (north, central, and south) should be carried out for the purpose of accelerating completion of nation-wide networking, but also that they would focus on strategic projects such as development of water resources. Thus, this Project will continue to maintain a significant position in the Chinese national strategy not only as a project to optimize energy structure but also to promote the grand west development strategy. No major changes in its background and external conditions to which the Project may be subjected can be anticipated, and the Project objective proved to be appropriate even at the time of assessment.

2.2 Efficiency

2.2.1 Project scope

The project scopes were extended with the following reasons:

(1) In the original plan, the second Tianshengqiao power plant construction was to start prior to the first one, and further the construction of the former was divided into two stages; four 220MW turbines were planned to be installed in the first stage and two 220MW turbines in the second stage and the second stage construction was planned to start after starting the construction of the first power plant. But, because the First Power plant construction started earlier than scheduled and the first stage construction proceeded, the distinction of the two stages of the second power plant construction was eliminated and the second stage construction was added to the scope of the project. As a result, the number of turbines to be installed resulted in 6 as a whole.

(2) New drainage tunnel was drilled, because vast amount of ground water, which was not expected in the original design, could exert excessive pressure on the planned tunnel.

(3) The power plant construction site, which was initially planned to locate on the slope near the dam, was moved 110m to the south and 60m to the east to secure long-term safe operation of the power plant. As a result, originally designed number, length, and diameter of conduit tube had to be necessarily revised.

2.2.2 Implementation Schedule

The schedule was considerably delayed from the original plan to cope with the unexpected problems occurred during the implementation period, that are:

(1) Construction to check the river flow has postponed from December, 1985 to November, 1986 because of a landslide at the construction site in 1985.

(2) In addition to the delayed start of the dam construction due to above incidence, there was a warning of a landslide in the right bank of the River, and so bank protection work has been added.

(3) As more than 80% of the strata of sections where conduit tunnels has been constructed in the project was limestone and dolomite, many defective strata requiring specific measures has been found during the construction. Eventually, such sections in three conduit tunnel construction amounts to 5,426m (48 sections), which accounts for 18.5% of the total length of the tunnels. This is another reason for the vast delay of the construction.

2.2.3 Project Cost

Japan's ODA loan has been used much less than estimation of the plan. The reasons are as follows , with the details shown in table 1.

① The shift of procurement source of concerned materials such as cement and exhaust systems from overseas to domestic suppliers resulted in a reduction in purchase amount on basis of foreign currency that was covered by Japan's ODA loan.

② Due to appreciation of the yen, procurement cost of production facilities from overseas has been maintained so low that it was not necessary to expend reserve fund. (1 dollar equals to 234 yen at the time of appraisal in the beginning of 1980s, while 123 yen in the beginning of 1990s when the procurement of the facilities started.)

Table 1: Comparison of Japan's ODA loan expenditure plan and results by item

(Unit: 1 million yen)

Item	Plan	Achievement
Total	154,000	71,930
1． Equipment for hydro power plant construction	25,626	24,072
(1) Equipment for construction	22,284	19,559
(2) Parts	3,343	4,513
2． Construction materials	14,113	7,636
(1) lumber	1,901	475
(2)steel	4,618	6,996
(3)cement	6,424	0
(4)materials concerning weld and exhaust	1,170	164
3． Electric equipment	36,756	10,487
(1)Turbine generator	15,444	6,103
(2)Other main electric equipment	21,312	4,384
4． Equipment for investigation and measurement	1,170	468
5． Equipment for observation	702	403
6． Consultant fee	1,404	811
7． Reserve fund	24,700	0
8． Equipment of power transmission and transformation	49,528	28,054

Source: China electric power company /Nanfang company

Actual domestic fund was 5,689 million RMB (approximately 853 milliion yen), which exceeded substantially the planned amount of 1,548 million RMB (approximately 238 million yen), because of the following reasons:

(1) As a result of increased volume of power plant construction, conduit tubes, conduit tunnels and drainage by above mentioned change of power plant construction site, expenditure within domestic fund has increased by about 2.5% from the budget plan.
(2) Implementation of countermeasure against geological phenomenon increased by about 11.2%demand in domestic fund.
(3) Ongoing inflation since 1985 has also increased the amount by about 15.2%. (See table 2)
(4) Expenditure within the local currency has increased additionally by about 51.7% because of the following factors: increase in the cost of construction design, investigation, measurement, and test; wage adjustment factor; and various taxes.

Table 2: Trend in unit prices of main construction materials

(Unit: RMB/ton)

Material	Plan	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Cement	158	161	161	161	161	161	252	264	479	649	694	670	730	647	678
Explosive	1,297	1,453	1,453	1,453	1,453	1,453	3,120	3,120	3,145	3,941	3,941	4,297	5,000	4,974	5,529
Diesel	725	725	725	725	725	725	1,825	1,703	2,364	3,093	2,871	2,808	3,136	3,014	2,920
Steel	760	760	760	760	760	760	760	760	2,541	4,311	4,311	4,311	4,311	4,311	4,311
Lumber	247	247	247	247	247	247	636	619	1,614	960	1,331	1,164	1,193	1,166	1,176

Source: National Electric Power Company /Nanfang Company

2.3 Effectiveness

2.3.1. Electricity production by the project

Table 3 shows the trend of electricity production by the project. Electricity production has started to increase since the completion of the project in 1997, as can be seen in 1999 with 4.8 billion kwh and in

2000 with 5.9 billion. The estimated production in 2001 is 7.3 billion kWh (planned annual production: 4.92 billion kWh).

Table 3: Electricity production trend of the second Tianshengqiao power plant

(Unit: 100 million kWh)

	1993	1994	1995	1996	1997 Complete	1998	1999	2000	2001
Electricity generation	14.45	27.42	28.85	31.02	33.22	39.45	48.38	59.34	73.00

Note: estimated number is used for 2001

Source: Chinese National Electric Power Company /Nanfang company

2.3.2. Factor load[1], capacity utilization rate[2], and failure rate[3]

Between 1996 and 2001, the factor load of the second Tianshengqiao power plant is increasing and exceeds the planned level. The capacity utilization is almost keeping the planned level and the achievement of the failure rate has been controlled below targeted level since 1999. So far as these factors are concerned, the target of the project has been achieved in comparatively high level.

Table 4: Target and achievement of factor load, capacity utilization and failure rate

(Unit: %)

		1996	1997 Complete	1998	1999	2000	2001
Factor load	Plan	45.0	45.0	50.0	65.0	70.0	70.0
	Achievement	68.9	68.9	70.4	76.8	84.8	96.1
Capacity utilization	Plan	95.0	95.0	95.0	95.0	95.0	95.0
	Achievement	93.0	96.0	92.5	93.0	95.7	95.0
Failure rate	Plan	0.10	0.10	0.10	0.10	0.10	0.10
	Achievement	2.30	0.04	0.30	0.01	0.07	0.01

Note: Estimated numbers are used for 2001

Source: Chinese National Electric Power Company /Nanfang company

2.3.3. Indicators concerning transmission and transformation of electricity

The capacity utilization rate of the newly constructed transformer substations in the project is good as a whole, although Wuzhou transformer substation's capacity utilization remains as low as 10%. This was because, until 1999, Wuzhou transformer substation has been used merely for a switching station between Laibin transformer substation and Guangzhou transformer substation, and it operates as a transformer substation since 2000. But the rate is now prospected to improve gradually. On the other hand, the transmission loss betweentransformer substations stays from 0.2 to 0.7%.

[1] Factor load = electricity output during a certain period (kWh)/ electricity production capacity during the same period (kWh)

[2] Capacity operating rate = operation hour during a certain period (hr.) / total hour calculated from calendar days during the same period (hr.)

[3] Failure rate = mechanical downtime/ (operation hour + mechanical downtime)

Table 5: Trend of capacity utilization of transformer substation[4], transmission loss rate[5] and failure rate

(unit: %)

		1997 Completed year	1998	1999	2000	2001
Capacity utilization of a transformer substation	Pingguo transformer substation	70.0	76.0	81.0	98.0	89.0
	Laibin transformer substation	60.0	61.0	82.0	85.0	86.0
	Wuzhou transformer substation	N.A.	N.A.	N.A.	10.0	10.0
	Guangzhou transformer substation	51.0	57.0	60.0	57.0	56.0
	Guiyang transformer substation	72.0	76.0	81.0	80.0	75.0
	average of 5 transformer substations	63.5	67.5	76.0	64.2	63.2
Transmission loss factor	Pingguo transformer substation	0.41	0.52	0.62	0.68	0.69
	Laibin transformer substation	0.35	0.42	0.52	0.58	0.59
	Wuzhou transformer substation	0.35	0.43	0.53	0.59	0.60
	Guangzhou trance former substation	0.34	0.43	0.53	0.60	0.61
	Guiyang transformer substation	0.25	0.22	0.28	0.34	0.37
	average of 5 transformer substations	0.34	0.40	0.50	0.56	0.57
Failure rate of a transformer substation =[number of failures/total capacity of facilities (MVA)] x [standard capacity /year]	Pingguo transformer substation	N.A.	N.A.	N.A.	0.08	N.A.
	Laibin transformer substation	N.A.	N.A.	N.A.	N.A.	N.A.
	Wuzhou transformer substation	N.A.	N.A.	0.33	N.A.	N.A.
	Guangzhou transformer substation	N.A.	N.A.	N.A.	N.A.	N.A.
	Guiyang transformer substation	N.A.	N.A.	N.A.	N.A.	0.07
	average of 5 transformer substations	N.A.	N.A.	N.A.	N.A.	0.02
Power line failure rate = [number of failures/total power line length (km)] x [standard power line length (km)/ year]	Tianshengqiao～ Guangzhou	N.A.	N.A.	N.A.	N.A.	N.A.
	Tianshengqiao～ Guiyang	N.A.	N.A.	37.80	N.A.	N.A.
	Total of 2lines	N.A.	N.A.	4.97	N.A.	N.A.

Note: Figure of 2001 is an estimate

Source: Chinese National Electric Power Company /Nanfang Company

[4] Capacity utilization of a transformer substation = Maximum load (MW) / Power factor/ Rated capacity of main transformer (MVW)

[5] Transmission loss = [net output – (net system energy demand + consumed electric energy inside a transformer substation)] /net output

2.3.4. Financial Internal Rate of Return (FIRR)

As a result of recalculation from the actual data, based on 50 years of investment payback period, FIRR is 11.3 %, which is in the same level with the one at the time of appraisal (11.4 % on the basis of 54 years of investment payback period). More increase in annual electricity production and higher sales price than the figures estimated at the time of appraisal seem to have been offset with the negative factor derived from 7 years of construction delay.

On the other hand, EIRR was not calculated, as was the case of the appraisal.

Table 6: Relevant data of this power plant

Item	as of the planning date	Present
Power sales price	0.1385 RMB/kWh	0.21 RMB/kWh
Tax	0.003366 RMB/kWh	—
Power loss rate	10%	10%
Annual operation / mainenance cost	1.5 % of investment cost	80 million RMB
Annual power generation	'90 615 million kWh '91 3,075 million kWh '92～ 4,920 million kWh	7.3 billion kWh (actual power sales: 6.57 billion kWh)

Source: Chinese National Electric Power Company /Nanfang Company

2.4 Impact

2.4.1. 3 Provincial power generation capacity, power generation output, power supply, and power consumption

2.4.1.1.Power generation capacity and power output

As shown in table 7, in 1993 when a part of the facilities of the project started its operation, total generation capacity and generation output of three provinces comprising Guangdong, Guangxi and Guizhou has increased more than four times of the number at the time of appraisal in 1982 and it has continued to grow since then. On the contrary to above situation, the share of hydro power generation is in downward trend, because each province has been investing more capital on thermal power plants than on hydro power plants.

Table 7: Trend of power generation capacity and power output in Guangdong, Guangxi, Guizhou

		Generation capacity (10 thousand kWh)				Power output (100 million kWh)			
		Guangdong	Guangxi	Guizhou	Total	Guangdong	Guangxi	Guizhou	Total
1982	Total power supply	209	111	161	482	105	45	52.7	203.0
	Hydro electric	91 (44)	62 (56)	88 (55)	241 (50)	35 (33)	30 (66)	26 (51)	91 (45)
1993	Total power supply	1,476	436	317	2,229	573	175	143	891
	Hydro electric	402(27)	266(61)	139(44)	807(36)	106(18)	101(58)	49(34)	256(29)
1994	Total power supply	1,982	502	385	2,869	771	187	170	1,128
	Hydro electric	454(23)	303(60)	184(48)	941(33)	119(15)	115(61)	58(34)	292(26)
1996	Total power supply	2,631	583	465	3679	909	226	214	1,349
	Hydro electric	479(18)	358(61)	221(48)	1,058(29)	128(14)	139(62)	71(33)	338(25)
1997	Total power supply	2,813	600	479	3,892	981	237	235	1,453
	Hydro electric	499(18)	369(62)	218(46)	1,086(28)	154(16)	157(66)	86(37)	397(27)
1998	Total power supply	2,907	611	528	4,046	1,039	244	257	1,540
	Hydro electric	551(19)	375(61)	224(42)	1,150(28)	153(15)	146(60)	82(32)	381(25)
1999	Total power supply	3,033	635	603	4,271	1140	253	289	1,682
	Hydro electric	655(22)	402(63)	231(38)	1,288(30)	111(10)	154(61)	80(28)	345(21)
2000	Total power supply	3,190	742	606	4,538	1,353	289	316	1,958
	Hydro electric	702(22)	416(56)	236(39)	1,534(30)	156(12)	169(58)	91(29)	416(21)

Note 1: The project was completed in 1997

Note 2: The parenthesized numbers are the share (%) of hydro electric generation in total power supply

Source: Chinese Electric Power Statistics Almanac

2.4.1.2. Power supply and consumption

As shown in the data published since 1996 when consumption data became available (see Table 8), electric power supply during the period has come to satisfy demand. Although this mainly owes to development of thermal generation, this project also made some contribution.

In Guangdong, according to table 7 and table 8, power output is greater than power supply and also power supply is greater than power consumption, which seems to contradict to the objective to transmit western power to the east. This is because of the following reasons: the statistics counts many facilities of various small power plants distributed in Guangdong without coordination with the electric power systems and their power output, while as for power supply, it counts only power supply from the grid; and the electric power supplied from Guangdong to Hunan province and Hong Kong is not reflected on the power consumption data.

Table 8: Power supply and consumption of the three provinces

					Power consumption (100 million kWh)			
					Guangdong	Guangxi	Guizhou	Total
1993					N.A.	N.A.	N.A.	N.A.
1994					N.A.	N.A.	N.A.	N.A.
1996					696	219	177	1,092
1997					794	219	186	1,199
1998					831	236	190	1,256
1999					952	252	213	1,417
2000					1,160	281	238	1,680

Note: The project has completed in 1997

Source: Chinese Electric Power Statistics Almanac (Editions of each year)

2.4.1.3. Contributions of the project for the power supply in each province

Table 7 and 8 indicate stability of electric power supply in Guangdong, Guangxi, and Guizhou. Regarding the contribution for the power supply in each province, table 9 shows the contribution in Guangdong being relatively high.

Table 9: Contribution of electric power from the second Tianshengqiao power plant for power

	Power supply (100 million kWh)				Contribution of the second Tianshengqiao power plant (%)			
	Guangdong	Guangxi	Guizhou	Total	Guangdong	Guangxi	Guizhou	Total
1993	455	149	125	729	0.96	3.78	3.55	1.98
1994	469	169	148	786	3.82	3.92	1.93	3.49
1996	771	239	189	1,199	1.92	5.87	1.16	2.59
1997	841	240	1960	1,277	1.55	3.64	0.74	1.82
1998	867	258	199	1,324	2.66	5.83	0.70	2.98
1999	970.	275	223	1,468	2.73	7.29	0.84	3.29

Note: Consumption within the power plant is counted among the contribution for Guizhou province.

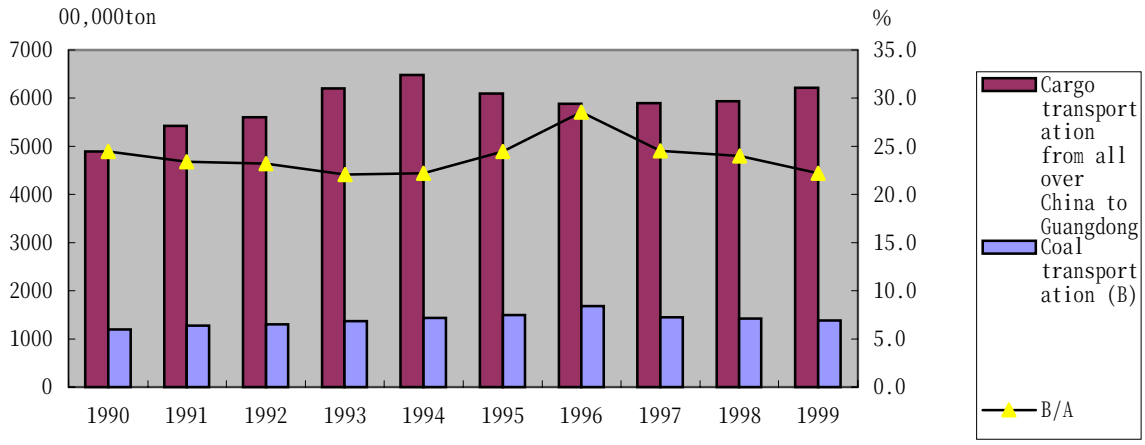
Source: Chinese National Electric Power Company /Nanfang Company

2.4.2. Percentage of coal transportation in railway transportation

According to the appraisal, percentage of coal transportation by railway (north – south) reached as high as 30% in 1983. And as shown in Chart 1, percentage of coal transportation by railway from all over China to Guangdong (mostly from the north) raised from 24 % in 1990 to 29 % in 1996, which indicates tight situation of north-south railway transportation. But the percentage tends to gradually decrease (25% in 1997, 24% in 1998, and 22% in 1999) since completion of the project.

Main cause of such decrease in the percentage of coal transportation is as follows: railway cargo transportation from all over China to Guangdong has increased from 58.83 million ton (1996) to 62.18 million ton (1999), while coal transportation from all over China to Guangdong has decreased from 16.81 million ton (1996) to 13.81 million ton (1999). This is considered to be the result of Guangdong's efforts to control coal consumption and the completion of the project also have contributed to the decrease of coal-fired power plant, which in turn helps control coal consumption.

Chart 1: Trend of the percentage of coal transportation in total railway cargo transportation from all over China to Guangdong



Source: China Traffic Almanac (editions of each year)

2.4.3. Effects on residents and the environment

On construction of dam for the second Tianshengqiao power plant, 115 residents have moved in 1992. All these residents are compensated for their moving cost under the governmental regulation. According to Nanfang company, the residents have more job opportunities generated by the hydro power plant construction, which have consequently improved their income and living standards. The increase of job opportunity means the job creation not only in the construction of dam and power plant itself, but also in service industries related to or surrounding the facilities.

Nanfang company added that the project had exerted no negative effect on the environment such as ecosystem, water quality, riverbed fluctuation, and sight-seeing resources. And the project gave stimulus to the development of social infrastructures such as traffic and electric power supply in the western inland. Also, educational and cultural facilities such as schools, hospitals, and movie theaters have been constructed. Thus, the development has improved residential environment.

2.5 Sustainability

2.5.1. Operation and management system

The organization responsible for the Operation and Management of the Project that was assumed at the time of appraisal was the management office of Tianshengqiao hydroc power plant and ultra-high voltage power line/transformer substations, which belonged to Southern Chinese Electric Power Management Company. In 1999, the office changed to be a branch of National Electric Power Company and was named as National Electric Power Company /Nanfang company.

Now, National Electric Power Company/Nanfang company totally controls the second Tiangshengqiao hydro power plant and power lines (Tianshengqiao-Guangzhou and Tianshengqiao-Guizhou). To be specific, the second Tianshengqiao hydro power plant manages Tianshengqiao hydro power generation company and each ultra-high voltage management office is responsible for the power line (Tianshengqiao-Guangzhou, Tianshengqiao-Guizhou).

Although there is no problem as to staffing and management systems of each sectors, related with the project, which have been managed by Nanfang company, the number of staffs to be assigned to operation of maintenance of the second Tianshengqiao hydro power plant has to be increased up to 240 or 250 from present 185 in accordance with the latest staffing standard of National Electric Power Company. And the number of employee of each high voltage office belonging to Nanfang company (including a part of the project) is required to increase up to 562 from present 450 according to the National Electric Power Company's standard. But there seems to be no problem in sustainability of the

project because current systems are satisfactory for the operation and maintenance of the project.

2.5.2. Technology concerning operation and maintenance system

According to the company, the existing technology of Nanfang company is satisfactory for operation and maintenance of the project. Besides, the company actively proceeds with in-house human resources development and recruitment of engineers from outside of the company.

Comparison of Original and Actual Scope

Item	Plan	Actual
1. Project Scope		
(1) Dam (concrete gravity dam)		
Height	58.7m	same as the left
Width of upper base	471m	〃
Water storage capacity	26 million	〃
(2) Conduit tunnel		
Number of tunnels	2	3
Tunnel length	9.53km	same as the left
Diameter of tunnel	9m	〃
Drainage tunnel	—	1 (7.4km× 4m)
(3) Surge tank and conducting tube		
Number of surge tanks	2	3
Length of surge tank	88m	same as the left
Diameter of surge tank	26m	21m
Number of conducting tubes	2	6
Length of conducting tube	510m	588m
Diameter of conducting tube	5.5m	5.7m
(4) Turbine		
Type	Fransis	same as the left
Output x number of turbines	220MW× 4	220MW×6
(5) Generator		
Capacity	251.4MVA	same as the left
Frequency	50 Hz/second	〃
(6) Power line		
Total length	980km (～Guangzhou)	same as the left
Voltage	279km (～Guiyang)	〃
Number of lines	500KV	〃
(7) Transformer substation		
Number of transformer substations	1 4 (Pingguo、Laibin、Wuzhou Guangzhou)	〃 5 (Pingguo、Laibin、Wuzhou Guangzhou、Guiyang)
2.Implementation Schedule		
(1) Preliminary construction	January, 1982 ～December, 1985	January,1982～Novenber,1986
Construction to turn flow of a river	January,1984～April,1986	January,1984～June,1986
(2) Dam	March,1988～May,1988	
(3) Intake	December, 1984～April,1990	December,1984～April,1992
(4) Tunnel for water conduction	January,1984～June,1985	May,1992～Novenber,1992
(5) Surge tank	Novenber,1988～May,1989	February,1986～June, 2000
(6) Water conduction tube	January,1984～April,1990	June,1986～September,1993
(7) Power plant	October,1983～October,1989	February,1987～March,1994
(8) Power generation facilities (installed)	Novenber,1984～October,1989	Novenber,1984～December, 1993
(9) Power line and transformer substation	January,1984～March,1989	November, 1997
	December, 1990	October,1988～December 1993
	January,1986～December, 1989	Novenber,1997
	～December, 1990	
3. Project cost		
Foreign currency	154,000 million yen	71,930 million yen
Domestic currency	23,762 million yen	85,329 million yen
(Local equivalent)	(1,584 million RMB)	(5,689 million RMB)
Total	177,762 million yen	157,259 million yen
Japan's ODA loan portion	77,375 million yen	71,930million yen
Exchange rate	RMB1=JP¥15 (Average in 1997)	RMB1=JP¥15 (Average in 1997)