

ASIAN DEVELOPMENT BANK

PCR:PRC 26369

PROJECT COMPLETION REPORT

ON THE

**GUANGZHOU PUMPED STORAGE STAGE II PROJECT
(Loan 1242-PRC)**

IN

THE PEOPLE'S REPUBLIC OF CHINA

November 2001

CURRENCY EQUIVALENTS

Currency Unit		Yuan (Y)	
		At Appraisal	At Project Completion
		7 February 1993	December 2000
Y1.00	=	\$0.1746	\$0.1208
\$1.00	=	Y5.7290	Y8.277

ABBREVIATIONS

ADB	–	Asian Development Bank
BOO/BOT	–	build-own-operate/build-operate-transfer
CFS	–	Complementary financing scheme
DSCR	–	debt-service coverage ratio
DSM	–	demand side management
EA	–	Executing Agency
EIRR	–	economic internal rate of return
FIRR	–	financial internal rate of return
GNIC	–	Guangdong Nuclear Investment Company
GP	–	Guangdong Province
GPHC	–	Guangdong Pumped Holding Company
GPSJVC	–	Guangdong Pumped Storage Joint Venture Company
HKCLP	–	Hong Kong China Light and Power
HKPSDC	–	Hong Kong Pumped Storage Development Company
ICB	–	international competitive bidding
MIS	–	Management information system
PRC	–	People's Republic of China
SP	–	State Power Corporation
TA	–	technical assistance

WEIGHTS AND MEASURES

V	(volt)	–	Unit of voltage
kV	(kilovolt)	–	1,000 volts
A	(ampere)	–	Unit of current
W	(watt)	–	Unit of active power
kW	(kilowatt)	–	1,000 W
MW	(megawatt)	–	1,000 kW
MVA	(megavolt-ampere)	–	1,000,000 VA
Wh	(watt-hour)	–	Unit of energy
kWh	(kilowatt-hour)	–	1,000 Wh
GW	(gigawatt)	–	1,000 MW
GWh	(gigawatt-hour)	–	1,000 MWh
m	(meter)		
km	(kilometer)		

NOTE

The fiscal year (FY) of the Government and the Executing Agency ends on 31 December.

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BASIC DATA**A. Loan Identification**

1.	Country	People's Republic of China
2.	Loan Number	1242-PRC
3.	Project Title	Guangzhou Pumped Storage Stage II Project
4.	Borrower	People's Republic of China
5.	Executing Agency	Guangdong Pumped Storage Joint Venture Company (GPSJVC)
6.	Amount of Loan	US\$200 million
7.	PCR Number	PCR: PRC 642

B. Loan Data

1.	Appraisal	
	- Date Started	07 Feb 1993
	- Date Completed	19 Feb 1993
2.	Loan Negotiations	
	- Date Started	24 May 1993
	- Date Completed	28 May 1993
3.	Date of Board Approval	3 August 1993
4.	Date of Loan Agreement	5 January 1994
5.	Date of Loan Effectiveness	
	- In Loan Agreement	5 April 1994
	- Actual	5 April 1994
	- Number of Extensions	none
6.	Closing Date	
	- In Loan Agreement	31 December 1999
	- Actual	15 December 2000
	- Number of Extensions	1
7.	Terms of Loan	
	- Interest Rate	Currency Specific Lending US\$
	- Maturity (number of years)	25
	- Grace Period (number of years)	6
8.	Terms of Relending	
	- Interest Rate	same as loan
	- Maturity (number of years)	25
	- Grace Period (number of years)	6
	- Second-step Borrower	GPSJVC

9. Disbursements

a. Dates

Initial Disbursement 18 May 1994	Final Disbursement 2 October 2000	Time Interval 6 years, 4 months
Effective Date 05 April 1994	Original Closing Date 28 Dec 1999	Time Interval 5 years, 9 months

b. Amount (US\$ million)

Cat. No.	Loan Category	Original Allocation	Revised Allocation	Amount Disbursed	Amount Cancelled
01	Equipment and Materials	140.0	131.3	131.3	8.7
02	Consulting Services	4.0	2.8	2.8	1.2
03	IDC	36.0	31.0	31.0	5.0
04	Unallocated	20.0	0.0	0.0	20.0
	Total	200.0	165.1	165.1	34.9

10. Local Costs (Financed)

- Amount	:	Nil
- Percent of Local Costs	:	Nil
- Percent of Total Cost	:	Nil

C. Project Data

1. Project Cost (US\$ million)

Item	Appraisal Estimate	Actual
Foreign Exchange Cost	263.0	228.1
Local Currency Cost	192.8	195.5
Total	455.8	423.6

2. Financing Plan (US\$ million)

Cost	Appraisal Estimate			Actual		
	Foreign	Local	Total	Foreign	Local	Total
Implementation Costs						
Borrower-Financed	0.0	192.8	192.8	0.0	92.5	92.5
ADB-Financed	164.0	0.0	164.0	134.1	0.0	134.1
Other External Financing	51.5	0.0	51.5	54.8	88.9	143.7
Sub-total	215.5	192.8	408.3	188.9	181.4	370.3
IDC Costs						
Borrower-Financed	0.0	0.0	0.0	0.0	0.0	0.0
ADB-Financed	36.0	0.0	36.0	31.0	0.0	31.0
Other External Financing	11.5	0.0	11.5	8.2	14.1	22.3
Sub-total	47.5	0.0	47.5	39.2	14.1	53.3
Total	263.0	192.8	455.8	228.1	195.5	423.6

ADB = Asian Development Bank; IDC = interest during construction.

3. Cost Breakdown by Project Component (US\$ million)

Component	Appraisal Estimate			Actual		
	Foreign	Local	Total	Foreign	Local	Total
(a) Civil Works	14.0	72.0	86.0	21.1	84.8	105.9
(b) Electromechanical Equipment	137.7	22.5	162.2	129.6	4.4	134.0
(c) Metal Structures	4.8	4.2	9.0	9.9	0.0	9.9
(d) Management Consultancy Services, Vehicles, Training	4.8	13.2	18.0	4.9	26.7	31.6
(e) Transmission Lines and Substations	26.7	35.4	62.1	23.4	65.5	88.9
(f) Taxes	-	2.5	2.5	0.0	0.0	0.0
(g) Contingencies	26.5	43.0	69.5	0.0	0.0	0.0
(h) Interest During Construction	47.5	-	47.5	39.2	14.1	53.3
Total	263.0	192.8	455.8	228.1	195.5	423.6

4. Project Schedule

Milestone	Appraisal Estimate	Actual
Date of Contract with Foreign Consultants		Feb 1994
Equipment and Supplies Dates		
First Procurement		Apr 1994
Last Procurement		Dec 1998
Completion of Equipment Installation	Jan 1996 to Jun 1997	Dec 1996 to Jul 1998

Milestone	Appraisal Estimate	Actual
Date of Construction		
Access Road	Aug 1993	Aug 1994
No. 6 Adit	Feb 1994	Jun 1995
Access Tunnel	Aug 1994	Apr 1994
Ventilation Tunnel	Mar 1994	Aug 1994
Underground Power House	Jun 1997	May 1996
Tailrace Tunnel	Jan 1996	Nov 1996
High Pressure Tunnel	Dec 1996	Dec 1996
Shafts and Tunnel	Dec 1996	June 1997
Date of Testing		
Unit No. 5	Aug-Dec 1997	Apr 1999
Unit No. 6	Aug-Dec 1997	Dec 1999
Unit No. 7	Aug-Dec 1997	Dec 1999
Unit No. 8	Aug-Dec 1997	Mar 2000
Date of Commissioning		
Unit No. 5	Jan 1998	Dec 1999
Unit No. 6	Jul 1998	Mar 2000
Unit No. 7	Jan 1999	Mar 2000
Unit No. 8	Jul 1999	Jun 2000

D. Data on Bank Missions

Name of Mission	Date	No. of Persons	No. of Person-days	Specialization of Members
1) Reconnaissance Mission	10-14 Aug 92	1	5	a
2) Fact-Finding	23 Sep-6 Oct 92	3	42	a,b,d
3) Follow-Up Fact-Finding	25-30 Nov 92	1	6	a
4) Follow-Up Fact-Finding	18-19 Dec 92	1	2	a
5) Appraisal	7-19 Feb 93	5	45	a,b,c,d,g
6) Review	6-12 Feb 95	1	7	a
7) Review	16-19 Dec 97	3	12	a,b,h
8) Review	16-19 Mar 99	2	8	a,h
9) Review	18-20 Jul 00	2	6	a,h
10) Project Completion Review	14-17 Jun 01	3	12	a,b,h

a - engineer, b - financial analyst, c - counsel, d - economist, e - procurement/consultant specialist, f - control officer, g - programs officer, h - assistant project analyst, i - staff consultant.

I. PROJECT DESCRIPTION

1. Guangdong is one of the fastest developing provinces in the People's Republic of China (PRC). It was among the first provinces to experiment with the country's economic reform program; three of the initial four Special Economic Zones are located within the province. Because of its high industrial growth rate of over 10 percent per year during the 1980s, electricity supply could not keep pace with electricity demand, despite the fact that new power plants were built that could supply about an additional 2,300 megawatts (MW) per year. Consequently, Guangdong Province in the 1990s faced shortages of electricity, which were further compounded by the sharp peaking experienced during daytime. The large unmet daily demand and the inability to meet the peak demand inevitably led to extensive load shedding, which caused serious economic losses.¹ Further, the power system was dominated by coal-fired thermal power plants (70 percent of total generating capacity), which cannot operate efficiently below a certain minimum level and do not allow for fast load variation.

2. The Project, the second stage in the development of the Guangdong Pumped Storage Power Station, involved the addition of 1,200 MW of generating/pumping capacity to the first stage capacity of 1,200 MW. When the Project was completed, the power station, with a total installed capacity of 2,400 MW, became the largest pumped storage facility in the world. It is located in Lutian Town, Conghua County, about 120 kilometers (km) northeast of the provincial capital, Guangzhou City. The site was chosen because of its proximity to Guangzhou City and the major load centers for the Guangdong power network, and because it has ideal geographical conditions, including natural basins for upper and lower reservoirs.

3. The Project represented the least-cost alternative and provided an environmentally sound means of alleviating the severe peak power shortages experienced in Guangdong Province. The Project enhanced the overall utilization efficiency of the predominantly coal-fired thermal power system by storing off-peak energy available at nighttime to meet peak energy demand. The objectives of the Project were (i) to support the continued rapid economic development in Guangdong Province in particular and in the PRC in general, and (ii) to promote increased efficiency in the energy sector by providing badly needed peak capacity while allowing the existing thermal and nuclear power plants to operate at higher efficiency. Three complementary technical assistance (TA) projects helped to advance these goals.²

II. EVALUATION OF IMPLEMENTATION

A. Project Components

4. The Project comprised the following: (i) a water conduit system consisting of a headrace tunnel, upstream surge shaft, high-pressure tunnel, reinforced-concrete manifold and penstocks; (ii) an underground power cavern containing four 300 MW reversible turbines and motor generators and auxiliary facilities; (iii) an underground transformer cavern containing four 360 megavolt-ampere (MVA) 18/500 kilovolt (kV) transformers; (iv) two tailrace tunnels with downstream surge shafts; (v) an outdoor switchyard with gas-insulated switchgear; (vi) a 500 kV transmission line to Zengcheng station and an interconnecting 500 kV line connecting stages

¹ Despite imports of 700-800 MW from Hong Kong, China, load shedding of about 800 MW occurred daily.

² TA 1920-PRC: *Electricity Efficiency Study*, for \$340,000, approved on 3 August 1993; TA-1921-PRC: *Financial and Management Information Systems Study*, for \$375,000, approved on 3 August 1993; and TA 1922-PRC: *Support for Sector Tariff and Financing Reforms*, for \$450,000, approved on 3 August 1993.

I and II, rearrangement of one 500 kV line originally connected to stage I, and a 500 kV line between the North suburb and Zengcheng substations; (vii) expansion of substations at Zengcheng, North suburb, and Lou Dong; and (viii) consulting services and training. The Project components were implemented as envisaged at appraisal. A 21 x 48.7 x 152 meter (m) powerhouse cavern and a 17.2 x 17.3 x 138.1 m main transformer room and about 3.88 km of communication, ventilation, and cable tunnels were excavated underground. In addition, about 4.1 km of tunnels for water conveyance were excavated. The design, civil works, and project supervision were all carried out by a domestic design institute and its contractors utilizing the institute's in-house expertise and resources, except for the design of the high-pressure concrete manifold, which was done by international consultants under an earlier TA grant.³ The chronology of major events in project implementation is listed in Appendix 1.

B. Implementation Arrangements

5. Guangdong Pumped Storage Joint Venture Company (GPSJVC) was the Executing Agency for the Project. GPSJVC was established in 1988 by three shareholders: Guangdong Power Holding Company (GPHC; 54 percent), Guangdong Nuclear Investment Company (GNIC; 23 percent), and State Development and Investment Company (23 percent). Appendix 2 provides the organization chart of the executing agency. A domestic design institute was responsible for the design, with two domestic hydropower firms as the supervising engineers. A domestic contractor carried out the civil and erection works. Electromechanical equipment was provided by a foreign supplier but was installed by the domestic contractor under the supervision of the international consultants. These implementation arrangements worked out well, with proper coordination performed by GPSJVC. There was good cooperation and teamwork among all parties involved. The project facilities were well constructed, with actual performance meeting design standards.

C. Project Costs and Financing

1. Project Costs

6. The actual cost of the Project was US\$423.6 million equivalent, of which foreign exchange cost amounted to US\$228.1 million (54 percent) and local cost to US\$195.5 million equivalent (46 percent); this total was US\$32.2 million or 7 percent less than the appraisal estimate of US\$455.8 million. The breakdown of the appraisal estimate and actual project costs is provided in Appendix 3. This cost translates to about US\$352 per kilowatt (kW) installed, as compared to an average cost of about US\$660 per kW for comparable projects elsewhere in the PRC and about US\$1,000 per kW in other developing countries. The actual foreign exchange cost was lower than the estimate (US\$228.1 million, as compared with the appraisal estimate of US\$263 million) due to strong competitive bidding, a favorable exchange rate for Deutsche mark-denominated contracts, and well-formulated technical specifications. However, this saving was slightly offset by higher local costs (US\$195.5 million equivalent, as compared with an estimated US\$192.8 million equivalent). The higher local costs were due to increasing cost of domestic construction materials and skilled labor for civil works, substations, and transmission line installation, and a more extensive excavation work and the provision of a new circuit of 500 kilovolt (kV) transmission lines between the project site and Luodong substation to provide an alternative power transmission routing.

³ TA 1051-PRC: *Technology Transfer in Hydropower Design*, for US\$375,000 from the Japan Special Fund, approved on 27 October 1988.

2. Financing

7. The financing plan at appraisal consisted of a loan of US\$200.0 million from the Asian Development Bank (ADB) and a cofinancing loan of US\$63.0 million under the complementary financing scheme (CFS)⁴ to finance the entire foreign exchange costs, or 58 percent of the estimated project cost. The remaining requirement of US\$192.8 million equivalent in local currency, or 42 percent of the total cost, was to be provided by equity from GPSJVC. In fact, the local currency costs of US\$195.5 million equivalent were financed partly by equity from GPSJVC (US\$92.5 million) and partly by domestic borrowing from the Construction Bank of China (US\$103.0 million). The loan was for 15 years, including a grace period of 5 years, and carried a variable interest rate that is determined annually in accordance with the People's Bank of China's lending rate system for domestic loans. The interest rates for domestic loans have ranged from a high of 15.3 percent in 1995 to a low of 6.2 percent in 2001. ADB's loan was not fully utilized because of the savings realized during the bidding for the imported equipment. Actual drawing from the ADB loan was only US\$165.1 million. The remaining ADB loan funds of US\$34.9 million were canceled on loan closing date. On the other hand, the CFS loan in the amount of US\$63.0 million was fully utilized. The actual financing mix became 54 percent from ADB and cofinancing loans and 46 percent from domestic loan and equity. A comparison of the appraisal and actual project financing plan is presented in Table 1.

**Table 1: Project Financing Plan
(US\$ Million)**

Source	Appraised			Actual		
	Foreign	Local	Total	Foreign	Local	Total
ADB	200.0	0.0	200.0	165.1	0.0	165.1
Cofinancing	63.0	0.0	63.0	63.0	0.0	63.0
GPSJVC	0.0	192.8	192.8	0.0	92.5	92.5
Domestic Loan	0.0	0.0	0.0	0.0	103.0	103.0
Total	263.0	192.8	455.8	228.1	195.5	423.6

ADB = Asian Development Bank; GPSJVC = Guangdong Pumped Storage Joint Venture Corporation.

D. Project Schedule

8. Site work started in September 1994 and the Project was physically completed in December 1998. Project activities from preparation to actual construction and installation were generally on target, hindered only by the unexpected delay in the last unit. The first unit was commissioned on 6 April 1999, followed by the second and third units on 1 and 16 December 1999, respectively. The last unit was commissioned on 14 March 2000, after the problems with the thrust bearing were rectified. Commercial operation of the units followed successively from December 1999 to June 2000. All four units of stage II, together with the four units under stage I, are performing satisfactorily in terms of providing much-needed peaking power supply, frequency regulation, and reactive power correction to the system. The appraisal and actual implementation schedules are shown in Appendix 4.

⁴ Part of a CFS loan for US\$78.0 million, approved on 13 April 1994, covering two projects (Loan 1242-PRC: Guangzhou Pumped Storage Stage II Project and Loan 1116-PRC: Anqing Acrylic Fiber Project).

E. Engagement of Consultants and Procurement of Goods and Services

9. As envisaged at appraisal, GPSJVC engaged two domestic consultants to design the project facilities and to supervise project implementation. Only the supervision of the installation of the electromechanical equipment was carried out by international consultants. All international consultants were engaged in accordance with ADB's *Guidelines on the Use of Consultants*. The same international consultants were also involved with the preparation of technical specifications, bid evaluation, factory inspection, and training in the use of the electromechanical equipment. Another international consulting firm was engaged by GPSJVC to carry out the economic evaluation of the Project. A domestic procurement agency was engaged to manage the procurement through international competitive bidding (ICB). A domestic contractor was selected through local competitive bidding to carry out civil works and erection work. For the implementation of the three complementary technical assistance projects (footnote 2), ADB engaged international consultants in accordance with ADB's *Guidelines on the Use of Consultants*.

10. The procurement of goods and services was carried out as scheduled, with the first contract awarded in February 1994. The last contract was awarded in December 1998. The main consulting services, major equipment, and transmission supplies were procured through ICB. Only minor expenditures, mostly related to software and hardware acquisition for the management information and telecom systems, were procured through direct purchase, because of the need to ensure functional compatibility with stage I equipment and its proprietary nature. Appendix 5 shows the contracts financed by ADB.

F. Performance of Consultants, Contractors and Suppliers

11. The performance of international and domestic consultants was satisfactory and appreciated by GPSJVC. The thorough geological investigation, and the well-formulated technical proposal and design, helped to ensure smooth and timely project implementation. As a result, no major problems were encountered. Strict supervision by the implementation consultants and GPSJVC during equipment manufacturing and project implementation and the engagement of experienced contractors helped ensure high quality civil and erection works, as evidenced by the relatively infrequent occurrence and small quantity of water leakage. Suppliers of electromechanical equipment, substation equipment, switchgears, cables, and control systems completed the manufacturing and delivery of the goods on time. The suppliers performed in accordance with the terms and conditions provided in the respective contracts and no major disputes were noted. However, technical problems were encountered in the installation of the electromechanical equipment. The supplier failed to anticipate that the specification of the thrust bearing could not cope with a static head exceeding 600 m in height. There were difficulties in rectifying the repeated failure of the thrust bearing. Ultimately, this technical problem was rectified, with GPSJVC taking the lead in formulating the solution.

G. Conditions and Covenants

12. Overall, the Project was implemented satisfactorily in compliance with the loan covenants, except for the delayed submission of the annual reports on benefit monitoring and evaluation, the first of which was only received in late 2000, a year behind schedule. The report provided good project performance indicators. Likewise, GPSJVC's decision to lease out the project facilities was made after the loan approval. ADB was subsequently advised by GPSJVC that, like several pumped storage developers in other countries, a type of leasing operation was preferable to that of conventional power plant operation, where revenues are determined by the

quantity of power generated and sold to the grid. Leasing would simplify the valuation process, since it is difficult to compute the cost and benefits associated with a pumped storage facility. ADB, at the request of the Borrower, agreed to delete the covenant on return on rate base when GPSJVC's business was transformed from a conventional power utility operation into a leasing corporation. The computation of the debt-service coverage ratio (DSCR) was also modified to take into account the lease revenues. The loan agreement was amended to delete the rate of return covenant under Section 2.16 of the agreement, since the covenant is not applicable to GPSJVC as a leasing company. The DSCR in Section 2.17 (Section 2.16) was redefined.⁵

13. The status of compliance with covenants in the Loan and Project Agreements is listed in Appendix 6. The loan covenants have been complied with. The DSCR of 1.2 was adequately met. The debt-to-equity ratio, which is set at a maximum of 75:25, was likewise complied with. Audited financial statements were submitted regularly and on time. However, these carried qualifications pertaining to the accounting treatment of lease income from the first 600 MW of stage 1, and some observed deficiency in inventory control.

H. Disbursements

14. Of the US\$200 million approved loan, a total of US\$165.1 million was disbursed over the period 1994–2000. The amount of US\$34.9 million was cancelled as of loan closing date. A major portion of the loan funds was disbursed through ADB commitment letters and a small portion through imprest funds and direct payments. Disbursements from loan funds remained low during the first three years as most of the activities involved civil works utilizing local currency financed from GPSJVC's own resources. Disbursements subsequently accelerated and peaked in 1997, when most of the ADB-financed equipment was delivered. The CFS loan of US\$63 million was fully disbursed in 1997, as scheduled. Disbursement control procedures were satisfactory and accounts were properly maintained. Equipment and materials accounted for the major part (80 percent) of the loan amount. Actual interest during construction amounted to US\$39.2 million. A comparison table and graph of projected disbursements at appraisal and actual disbursements are shown in Appendix 7.

I. Environmental and Social Impacts

1. Environmental Impact

15. Environmental impact was generally positive, as an extensive environmental protection program was developed before project start-up. The program was implemented concurrently with project implementation. Construction effluent and domestic sewage were properly treated before they were discharged into the lower reservoir. Soil erosion was kept to a minimum, as all cut slopes were properly covered with grass and planted with trees. Over the years, more than 1.2 million tree seedlings were planted and more than 1.8 million square meters of turf were added. Aquatic life such as carp and catfish was introduced into the two reservoirs to control algae growth. The reservoir water was regularly tested and the water quality is now rated as class I potable water. GPSJVC continues to allocate more than Y2 million annually for the maintenance and upkeep of the surrounding landscape. In fact, the two reservoirs attract more than 20,000 domestic visitors and tourists per year. To ensure that the influx of tourists will not

⁵ The DSCR was redefined as the difference between (i) revenues from all sources and (ii) operating and nonoperating expenses (including taxes and payments in lieu of taxes but excluding provision for depreciation, other noncash charges, interest, and other charges for debt) **plus** collection of lease principals **divided** by the sum of principal and interest payments on long-term debts.

have a negative impact on the reservoir water, all domestic wastewater was collected and treated to meet water discharge standards before discharge into the reservoirs.

2. Social Impact

16. The Project required acquiring 439 hectares of residential land, wasteland and farmland at a total cost of Y52.2 million. It also necessitated the resettlement of 1,252 affected poor farmers who used to live in shabby houses clustered in the lower reservoir basin. There was no school nearby, no tap water or electricity, and no proper access road. All affected people were relocated to newly constructed double-story houses close to their former homes, with a proper access road. Each house was provided with potable water and electricity, as well as telephone lines. The resettlement operation was carried out smoothly, and had the active participation of the local government and the affected community. A new primary school was set up in their neighborhood and GPSJVC extended scholarships to qualified students. In addition, GPSJVC regularly conducts public awareness campaigns on environmental protection among the resettlers. An annual reward of Y2.0 million is given to the resettlers to fund their social activities if they carry out sound environmental management. Alternative employment opportunities were also provided to farmers who decided to quit farming.

J. Performance of the Borrower and the Executing Agency

17. The performance of the Government as the Borrower was generally satisfactory. Communications with ADB were timely. The loan agreement and the subsidiary loan agreement for the relending of the loan proceeds to GPSJVC were signed and made effective within about nine months of loan approval. As GPSJVC is technically qualified and experienced in project implementation, government supervision and monitoring of the Project was minimal. GPSJVC's performance as executing agency for the Project was also satisfactory. Quarterly progress reports were well prepared and submitted on time. GPSJVC, staffed with well-qualified and experienced personnel, was effective in managing the Project. The company's books of accounts were properly maintained, using the financial management and information system procured under the Project. GPSJVC assisted the turbine supplier in resolving the repeated failure of the thrust bearings by identifying the cause of the failure, which was excessive deformation of the bearing thrust pad. GPSJVC subsequently recommended the on-site scrapping of the thrust pad and reshaping of the oil-cup on the pad to increase the contact area between the bearings and the thrust pad, which was accepted by the equipment supplier as the best technical solution to the problem. A stringent quality control system and a command office staffed with qualified engineers was established at the site to oversee all matters pertaining to the safety, quality, and physical progress of the Project. Regular weekly meetings were held among all the major participants at the site to ensure smooth and timely project implementation. A modern supervisory control and data advisory system was installed to ensure efficient and effective operation of the project facilities. A lean force of 144 staff managed the entire facility, including the first stage units. Performance indicators for the Project are shown in Appendix 8.

18. To assist in the technology transfer and to share the management expertise imparted by the Project, a training center was established at the project site to train operation and maintenance engineers from other plants, including engineers from the World Bank-financed 3,300 MW Ertan Hydropower Project, the 1,800 MW Tianhuangping Pumped Storage Project, the 100 MW Shahe Pumped Storage Project, and the ADB-financed 1,500 MW Daochaoshan Hydropower Project. The training program was well received by the trainees, because the course involved the use not only of simulators but also of prototype machines. GPSJVC senior staff were often invited to provide consulting services to other pumped storage projects.

K. Performance of the Asian Development Bank

19. ADB's performance in completing the Project was satisfactory. There were no major disagreements among the Government, GPSJVC, and ADB on implementation arrangements, including bid evaluation and contract awards. Communications among the Government, GPSJVC, and ADB were smooth and effective. GPSJVC confirmed that ADB's project administration and various missions had provided valuable assistance in achieving the project objectives and realizing the full project benefits, despite the frequent turnover of ADB project staff.⁶

III. EVALUATION OF INITIAL PERFORMANCE AND BENEFITS

A. Financial Performance

20. GPSJVC derives its revenues from the lease of the entire capacity of its power generation facilities. All operating revenues of the company have been in the form of lease rentals instead of income from the sale of power. These rentals are fixed throughout the period of lease, except for periodic adjustments as provided in the lease agreements, regardless of whether or not the power plants are in operation. The lease agreements have the following terms:

- (i) Of stage 1, 600 MW is leased to Hong Kong Pumped Storage Development Company (HKPSDC) for 40 years. The first 15 years is for a total of HK\$2.1 billion, with an initial payment of HK\$420 million. The remaining HK\$1,680 million is payable annually in equal installments of HK\$120 million, with interest at the rate of 8.3 percent per year on the remaining balance. Thereafter, payments will be at HK\$100 million annually. In addition, HKPSDC will pay half of the annual operation and maintenance cost adjusted to the consumer price index in Hong Kong. Capital and any extraordinary expenditures will likewise be shared equally.
- (ii) The other 600 MW of stage 1 is leased to GPHC and GNIC on a 50:50 basis for three years (renewable). The amount of the lease is US\$20 million per year, with annual adjustments to be mutually agreed upon by the parties. The actual lease payment in 2000 was US\$21 million.
- (iii) Of stage II, 1200 MW is leased to GPHC for a yearly renewable lease. Lease rental in 2000 was Y405 million, with provision for yearly adjustments to take into account plant availability and inflation. Agreed payment for 2001 is Y550 million.

21. The financial performance of GPSJVC, since it started commercial operation of its stage I power plant in 1994, has generally been satisfactory. However, the audited financial statements were prepared on the basis of the PRC's accounting standards and carried qualifications pertaining to the manner by which the net accumulated income from the lease of the first 600 MW capacity of stage I was classified in the books of accounts.⁷ The income statements and balance sheets of the company, presented in Appendix 9, were not revised to take into account the auditor's qualifications. However, the cash flow statements have been

⁶ From commencement to completion, four different ADB staff members were responsible for project implementation.

⁷ Starting in 1995, lease revenues from the first 600 MW of stage I, which were leased to HKPSDC, were permitted by the Guangdong provincial authorities to be classified as investment under the capital surplus account in GPSJVC's balance sheet.

adjusted to consider the additional internally generated funds for purposes of determining the DSCR in accordance with ADB's definition, as amended. With these adjustments, ADB's DSCR covenant for the last seven years was adequately met. The debt equity ratios were likewise complied with. The change from equity financing to loan financing did not adversely affect the financial performance of the Project and the EA, as adequate profits and cash flows are being generated from operations to support the additional borrowing cost.

22. The addition of GPSJVC'S stage II power plant, which went into commercial operation in 2000, is expected to enhance the company's profitability. Financial projections submitted by the company for the next 10 years (Appendix 10) show expected satisfactory performance. The yearly drawdown in cash balance shown in the projected cash flow statements is merely on account of the substantial expenditures assumed for a new pumped storage project that the company intends to undertake.⁸ GPSJVC assumed that profits and excess cash generated from the existing operations would be partly utilized for the new project.

23. The financial internal rate of return (FIRR) was recomputed for the completed Project. Revenue and cost assumptions were based on the figures provided by GPSJVC. Lease revenues based on the present payment level in the existing contracts were assumed to be realized throughout the life of the Project. Only incremental operating and maintenance costs from the start of the commercial operation of the Project were considered, since stages I and II share common facilities. Capital costs were based on actual investments made. All costs and benefits were recomputed in year 2000 prices.

24. The reevaluated FIRR of the Project is 10.1 percent, compared with the appraisal estimate of 8.4 percent. The higher FIRR is due to the combination of favorable factors accruing to the Project, e.g., lower actual investment cost, more stable revenue stream, and lower incremental operating and maintenance costs. The FIRR also compares favorably with the weighted average cost of capital, in real terms, of 2.8 percent. Details of the financial reevaluation are shown in Appendix 11.

B. Economic Performance

25. The economic evaluation of the Project follows the methodology used at appraisal. The assumed economic life of the Project at 50 years was maintained. Updated cost and revenue data provided by GPSJVC were converted to their economic values using the domestic price numeraire. The financial prices of the nontraded goods and services were converted to their economic prices using conversion factors⁹ commonly used for PRC projects. The economic prices for equipment were estimated based on their international market prices adjusted by the domestic transportation cost from the port to the site. The economic benefits for the Project output were measured based on the consumers' willingness to pay and consumer tariffs. The willingness to pay was estimated by calculating the energy cost of an alternative electricity or energy source for each major category of consumers, i.e., industrial, commercial, urban residential, and rural residential. It was assumed that 35 percent of the consumers would be willing to pay the price for the alternative energy source. The other 65 percent of the consumers would not use any alternative source of energy and would pay only the average tariffs. The reevaluated economic internal rate of return (EIRR) is 19.7 percent, compared to the appraisal

⁸ GPSJVC is planning to develop another pumped storage project in Huizhou with a proposed installed capacity of 2,400 MW.

⁹ The conversion factors used in this evaluation are: 0.94 for civil works, 2.00 for skilled labor, 0.67 for unskilled labor, and 0.95 for others.

estimate of 18.5 percent (Appendix 12). The higher EIRR is primarily due to the lower capital and input costs. As at appraisal, the benefits of the Project are conservatively valued, since the improvement in the operation of the base load plants in the system, and the improved voltage regulation and frequency control resulting from the Project, have not been quantified.

C. Attainment of Benefits

26. The objective of improving the safety and supply quality of GPHC and Hong Kong China Light and Power (HKCLP) systems has been achieved. In addition, the Project helps to improve and enhance the safe and stable operation of the Daya Bay nuclear power plant. With the Project in operation, the Daya Bay nuclear power plant was able to increase its base load factor steadily from 66 percent in 1994 to 85 percent in 2000. As a result, its annual power generation for the past seven years exceeded its nominal designed capacity of 10,000 GWh, without compromising its safety, by a big margin of 2,021 GWh, as shown in Appendix 13.

27. Every power system must have a reasonable margin of operating reserve to ensure safety and steady operation. The pumped storage plant, with its flexibility and ability to respond quickly, has been a reliable reserve, particularly with its spinning reserve. Its reliability was proved during the sudden tripping of the nuclear power plant unit 1 in the early morning of 24 February 1996, the Chinese Spring Festival, resulting in a power deficiency of 851 MW. While one pumped storage unit was pumping at full throttle, the pumping unit automatically changed into generating mode. At the same time, two other pumped storage units were brought into full-load generation. All this happened within a time span of 3 minutes and 33 seconds. The quick response not only prevented system-wide failure but also ensured steady power supply. Statistics showed that the Guangdong and HKCLP grids were hit by 99 system faults between 1995 and 1999, caused either by unexpected tripping of a large-capacity base-load generator or by sudden disconnection of power from other networks. The pumped storage plant came to the rescue on each occasion.

28. Peak-load shaving is the most critical service that the project's facilities provide to its connected system networks. Statistics taken between 13 and 19 August 2000 indicated that the peak-shaving capacity from the project facilities alone accounted for about 50 percent of all the peak-shaving capacity of the Guangdong system, as shown in Appendix 14. In the past HKPSDC had to rely on its costly gas turbines for its peak-shaving service. Now, HKPSDC depends heavily on the project facilities to perform this service, resulting in net savings of over HK\$100 million.

29. In addition, the project facilities serve as an ideal tool for system frequency regulation. Its ability to carry out synchronous condenser operation is well recognized, since this type of operation can be achieved either in generating or pumping mode, depending on system circumstances and requirements, without relying on more expensive synchronous condensers.

IV. TECHNICAL ASSISTANCE

A. TA 1920-PRC: Electricity Efficiency Study

1. Objectives and Scope

30. The extraordinary pace of economic development in Guangdong Province and the corresponding high growth in the demand for electricity had resulted in a serious shortage of power. In addition to augmenting generating capacity (supply side measures), a comprehensive

power demand analysis was required in order for the province to establish a basis for load management and energy conservation (demand-side measures) that would help GPHC deal with the severe power shortage prevailing in the province.

31. The primary objective of the TA was to specify the framework, structure and funding arrangements for a demand-side management (DSM) program to be implemented by GPHC. The study involved review and updating of the available data on electricity demand and consumption in major consumer sectors in the province, as well as industrial end-use consumption information, and made recommendations with regard to load management and end-use energy conservation measures and policies. The total cost of the TA was estimated at US\$391,000 equivalent. ADB was to provide a total of US\$340,000 equivalent to meet the entire foreign exchange cost and US\$15,500 of the local currency cost. The balance of the local currency cost (US\$51,000) was to be met by GPHC.

2. Evaluation of Inputs

32. A consulting firm from the United Kingdom provided about 10 person-months of international and 27 person-months of domestic consulting services, including secretarial support, over a period of about 16 months. The consulting team comprised experts on DSM, power economics, and customer surveys.

33. The study was carried out in two phases from June 1994 to October 1995. An intensive site monitoring on electricity utilization by 36 representative companies covering 120 individual site circuits was carried out for three weeks and analyzed for detailed electricity energy consumption patterns and potential energy savings. Concurrently, a market research survey was carried out on a sample of 250 industrial and 60 commercial users representing all major sectors in Guangzhou, and the data analyzed for the most important electricity utilization patterns. Based on the study conducted, the consultants recommended the promotion for residential users of low energy refrigerators via energy labeling, low energy spray fill washing machines, ice-storage air conditioners, and low energy lighting. As for commercial and industrial users, the recommendations were for ice-storage air conditioning, low energy lighting, motive power (using inverter controls for variable speed motors and introducing high efficiency motors), and hollow core building (introduction of thermal storage concepts in building design) and energy efficiency industrial technology. It was estimated that the implementation of these recommendations would result in potential energy savings of 745 GWh per year, equivalent to about 8.4 percent of the industrial and commercial energy consumption in 1994 and a saving of US\$160 million over a 10-year period. In addition, the consultants recommended to GPHC the phased replacement of transformers with low loss units and the introduction of a time-of-use tariff and capacity charge for all commercial users as part of the DSM programs.

34. Out of the US\$340,000 grant provided by ADB, the actual expenditure was US\$331,458 equivalent. The balance of the TA fund of US\$8,542 was cancelled at closure of the TA in May 1998.

3. Evaluation of Outputs

35. GPHC considered the study to be limited in its coverage, as heavy industry and mines were not represented, and the recommended DSM programs such as motive power, replacement of low-efficiency and high-loss equipment, though well formulated, could not be implemented immediately due to high capital costs. The time-of-use tariff was not also adopted: GPHC considered it of limited use for the Guangdong network, which comprises many power

generation sources, including captive generators, and many local power supply networks. Also, major users were already provided with incentives that had effects similar to the time-of-use tariff to stop operation during peak hours through guarantee of no power cuts during off-peak hours. GPHC is also continuously studying various DSM alternatives that will not involve high capital costs to implement.

36. The performance of the international and domestic consultants was generally satisfactory. However, due to the limited coverage of the study and the limited acceptance of the consultants' recommendations, the TA was rated as less than successful.

B. TA 1921-PRC: Financial and Management Information Systems Study

1. Objectives and Scope

37. The objectives of the TA were to review the existing financial and management information systems in operation within GPSJVC, ascertain financial and information system requirements, and make recommendations for appropriate systems, taking into consideration GPSJVC's projected scope of operations. The recommendations included identification of appropriate software and associated computer hardware equipment, assistance in the installation of the system, training of staff, and the production of operations manuals covering both manual and computerized procedures. The total cost of the TA was estimated at US\$410,000 equivalent. ADB was to provide a total of US\$375,000 equivalent to meet the entire foreign exchange cost. The balance of the local currency cost (US\$35,000 equivalent) was to be met by GPSJVC.

2. Evaluation of Inputs

38. An international consulting firm from Hong Kong was engaged by ADB to implement the TA in three phases from May 1994 to July 1995. Based on a critical review of the financial and operational aspects of GPSJVC, the consultants recommended the adoption of a standard financial and accounting software module known as "SCALA". Likewise recommended was the establishment of new roles for a systems accountant and an internal auditor to oversee system and accounting practices relating to SCALA to ensure that correct policies and procedures were being followed. The consultant provided training to six staff members on systems application and prepared reference manuals for GPSJVC.

39. Actual TA cost was US\$358,631 equivalent, out of the total ADB grant of US\$375,000. The balance of TA fund of US\$16,369 was cancelled at the closing of the TA in October 1998.

3. Evaluation of Outputs

40. Overall, the TA was rated successful. The standard module recommended by the consultants is now being implemented and generally meets the accounting and management information system needs of GPSJVC, including the preparation of financial forecasts. The module likewise provides a level of flexibility to handle a broader scope of financial and management information system requirements. However, GPSJVC is not able to take full advantage of the benefits of the system, as the module contains many system applications designed for industrial processes such as contract management, production cost control, and inventory control. The training provided by the consultant was considered too short to allow an effective transfer of knowledge on the use and maximization of the system applications.

GPSJVC would have preferred that the systems supplier conducted the required training and prepared the reference manuals.

C. TA 1922-PRC: Support for Power Sector Tariff and Financing Reforms

1. Objectives and Scope

41. The objective of the TA was to assist the Government to develop appropriate policies to mobilize foreign and private investment to finance the huge capital requirements of the power sector. The TA was to (i) familiarize decision makers with the various foreign investment options available and ways to create a policy and legislative environment to support such investment; (ii) review and disseminate the results of a State Power Corporation (SP), study on corporatization and shareholding options in the power sector to support further private sector investment; and (iii) assist the Government in developing the analytical base necessary for informed and efficient power pricing policy, which was essential to attract foreign and private investment to the power sector.

42. The components of the TA were (i) Part A: Foreign Investment Seminar, designed to examine ways of mobilizing foreign investment; (ii) Part B: Corporatization and Shareholding Options Seminar, to discuss the results of a study on the corporatization of power sector enterprises and shareholding options; and (iii) Part C: Tariff Management Information System (MIS), which involved the development of a national MIS incorporating various power price data on each major network and provincial system, and sector-wide cost and technical parameters. The MIS would allow SP to compare existing tariff levels throughout the country with economic costs of supply and financial requirements, to formulate informed and efficient power pricing policy. The total cost of the TA was estimated at US\$525,000 equivalent. ADB was to provide a total of US\$450,000 equivalent to meet the entire foreign exchange cost and US\$50,000 of the local currency cost. The balance of the local currency cost (US\$125,000 equivalent) was to be met by SP.

2. Evaluation of Inputs

43. A consulting firm from Australia provided about 15 person-months of international and 13 person-months of domestic consulting services over a period of about 1.5 years. The consulting team comprised 7 specialists in power system planning, financial management, tariffs, and economics.

44. The first seminar on International Seminar on Power Sector Financing in PRC was held in Shanghai on 5–8 September 1994. The focus of the seminar was on build-own-operate/build-own-transfer (BOO/BOT) types of power projects, since the implementation of the projects by way of private/foreign investment through BOO/BOT mode, particularly under the competitive process, was relatively new to PRC. A total of 84 delegates, representing both policymakers and potential implementation parties of the BOO/BOT power projects from the regional and provincial power utilities, attended the seminar. A total of 17 international speakers, including private sector power specialists, legal experts, financial experts, representatives from multilateral financial institutions, country representatives, utility representatives, and private power developers, presented papers on related topics. The sharing of country experience under different stages of private power development provided very useful insights. Similarly, the presentations from private power developers were very useful, as BOO/BOT issues related to this area were extensively discussed.

45. The second seminar on Corporatization and Shareholding Options in the PRC Power Sector was held in Suzhou near Shanghai during 29–31 May 1995. The objective of the seminar was to discuss the issues of corporatization of power utilities and their implications and the requirements for mobilization of finances by the power utilities through shareholding options. Eighty-four participants representing policymakers and regional and provincial power utilities and power companies attended it. A total of 10 international speakers presented their papers.

46. An international consulting firm was engaged by ADB to design the PPMIS. The working version of the PPMIS was installed in Beijing and running since 1995.

47. ADB financed US\$450,000, of which the actual cost was US\$423,191. The balance of the TA fund of US\$26,819 was cancelled on closure of the TA on July 1997.

3. Evaluation of Outputs

48. The seminars provided a forum for the exchange of views and ideas and effectively contributed to the subsequent formulation of policies, rules, and regulations on BOO/BOT projects and the corporatization of power utilities in the PRC.

49. The seminars were well organized and the consultants prepared good manuals and briefing materials. Considering the quality of discussion and the reactions of the participants, the seminars were considered successful in imparting additional knowledge on this subject to PRC power sector managers.

50. The PPMIS as designed included a comprehensive database of all major generation, transmission, distribution and consumer data for PRC. The key information available from the system includes optimal generation expansion plans, long-run marginal costs, revenue forecasts, economic and financial costs of supply, and financial performance indicators. The system was used extensively by SPC to set tariffs and to forecast load and prioritize its investments. Because of non-availability of data on power supply agencies under the auspices of county government and the paucity of data, the system could only provide reasonably accurate information for every province. However, the system could be relied on to provide adequate data and information for decision-making.

51. To ensure the PPMIS can continue to perform as designed, it is essential that data is updated regularly. Consideration should be given to include data from county and villages' power supply agencies under the county government so that a comprehensive database of all generation, transmission, distribution and consumer data is available for the whole of PRC.

52. With this TA and the subsequent TAs on the BOO/BOT concept,¹⁰ ADB played a significant role in the PRC's effort to attract foreign and private capital for the power sector and the ongoing corporatization of regional and provincial utility companies. This TA was rated as highly successful.

¹⁰ TA 2170-PRC: *Introducing BOO/BOT Concept for Shanghai Waigaoqiao Stage II Project*, for US\$600,000, approved on 27 September 1994, and TA 2730-PRC: *BOT Changsha Power*, for US\$597,000, approved on 23 December 1996.

V. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

53. The Project is rated as highly successful based on the criteria of relevance, efficacy, efficiency, sustainability, and institutional development and other impacts as shown in Appendix 15. The Project met its objectives of providing an environmentally sound solution to the problem of severe peak power shortages in Guangdong Province and improving the overall utilization efficiency of the predominantly coal-fired thermal power system by converting off-peak energy to peak energy, thereby ensuring the peak demand for power was met in Guangdong Province. The Project also improved the safety and stable operation of the Daya Nuclear Power Plant in particular, and the Guangdong and Hong Kong power systems. Major operational indices compare favorably with other pumped storage projects in the world. The Project achieved many firsts in the PRC, such as the highest static head concrete manifold, a power cavern supported by rock-anchored bolts and a concrete membrane, prestressed spiral case encased in concrete, and the largest slip-forming for the inclined penstocks. The Project, together with the first stage units, is, at 2,400 MW, the world's largest pumped storage facility.

54. The reevaluated FIRR of 10.1 percent is higher than the appraisal estimate of 8.4 percent, indicating the financial success of the Project. The reevaluated EIRR of 19.7 percent is also higher than the appraisal estimate of 18.5 percent, confirming the Project's economic viability.

55. The environmental impact of the Project is positive, as all cut slopes have been covered with grass and planted with trees. Domestic sewage and waste water generated by residents and tourists are treated before discharge into the reservoirs. Solid wastes are collected regularly and disposed of in secure municipal landfill sites. There is abundant aquatic life in the two reservoirs and the water quality of the impounded water in the two reservoirs has improved and is maintained at class I standard. In fact, the surrounding landscape has been beautified. The two reservoirs attract more than 20,000 domestic visitors and tourists per year. The resettlement plan was well executed, and the better housing, amenities, and higher income levels have improved the quality of life of the affected persons.

B. Lessons Learned

56. As successfully demonstrated by the Project, strong ownership and experienced EA staff supplemented by competent consultants are essential for the timely and smooth implementation of complex projects such as hydropower and pumped storage, where precision and quality in workmanship, excavation, tunneling, and erection of electromechanical equipment are critical factors in subsequent project performance.

57. Detailed and clear bid specifications, and properly administered bidding process can produce very favorable results in terms of bringing down project cost. The highly competitive bidding process and the favorable experience gained by the EA in the execution of Stage I weighed heavily in achieving lower cost.

58. The lease arrangement approach to pumped storage plant operation is more advantageous compared to the conventional power plant operation where revenues are determined based on the energy sold, as the benefits and value of the service provided by the Project are more appropriately priced. The implementation of the lease arrangement is also much simpler.

59. A well-planned and properly designed and executed hydropower project such as this one can contribute to overall environmental improvement.

C. Recommendations

1. Project-Related

60. If selected for postevaluation, a project performance audit report should be prepared by 2003, when the Project will have been in operation for more than three years and when additional operational performance data will become available for a better project assessment.

2. General

61. The Project successfully demonstrated that a pumped storage plant, when properly designed, constructed, and managed, can be a least-cost alternative in meeting peak load demand in a system power grid in which the daily variation is substantial. This is particularly so for a power system grid that is predominantly supplied by coal-fired thermal and nuclear power plants, which cannot operate efficiently with variable operating levels. The operation of a pumped storage plant can have a positive environmental impact and is highly reliable in quickly providing peak load. At the same time, it can serve as an ideal tool for system frequency regulation and synchronous condenser operation. As such, ADB should continue to support pumped storage projects as part of ADB's operational strategy in the energy sector, for sustainable utilization of natural resources and improved management of environmental and natural resources.

APPENDIXES

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CHRONOLOGY OF MAJOR EVENTS

A. Loan 1242-PRC: Guangzhou Pumped Storage Stage II Project

10–14 Aug 92	Reconnaissance mission fielded.
23 Sep–6 Oct 92	Fact-finding mission fielded.
13 Nov 92	Management Review Meeting.
7–19 Feb 93	Appraisal mission fielded.
8 Feb 93	The Asian Development Bank (ADB) approved the advance action for the procurement of main generating/pumping equipment and retroactive financing, not exceeding US\$6 million.
9 Mar 93	ADB approved the advance selection of implementation consultants to facilitate accelerated implementation of the Project.
1 Apr 93	Staff Review Committee Meeting.
24–28 May 93	Loan negotiations.
3 Aug 93	ADB approved a loan amounting to US\$200 million from ordinary capital resources (L1242-PRC). Three piggy-backed technical assistance (TA) grants, charged to the ADB-funded TA program, amounting to US\$1.17 million, were also approved to (i) undertake an electricity efficiency study for the Guangdong Power Holding Company (TA 1920-PRC); (ii) to set up a modern financial and management information system for Guangdong Pumped Storage Joint Venture Company (GPSJVC); and (iii) to assist the State Power Corporation to promote foreign and private investments in the power sector (TA 1922-PRC).
5 Jan 94	Loan, Project, and Technical Assistance Agreements were signed.
5 Apr 94	Loan was declared effective.
6–12 Feb 95	Review mission 1.
16-19 Dec 97	Review mission 2.
23 Apr 98	ADB approved the changes in the Project Agreement covering the deletion of the rate of return covenant and modification of the debt-service ratio covenant to include collection of lease rentals, as GPSJVC will be engaged in leasing operations rather than generating and selling power.
11 Aug 98	ADB approved GPSJVC's recommendation to lease the Guangzhou Pumped Storage Stage II Project facilities upon completion.
16–19 Mar 99	Review mission 3.

18–20 Jul 00	Review mission 4.
2 Oct 00	Savings of US\$36 million were cancelled from the loan account.
15 Dec 00	Loan account was closed.
14–17 Jul 01	Project completion review mission.

B. Loan 28-PRC (c) Complementary Financing Scheme

17–19 Mar 94	Loan negotiations for Complementary loan agreement was carried out in Guangzhou.
19 Apr 94	Complementary Loan Agreement was signed between ADB and the People's Republic of China (PRC); Participation Agreement between ADB and participating financial institutions was signed.
30 Sep 94	1 st drawdown from the CFS for US\$34,000.
3 Jun 97	2 nd and final drawdown from the CFS for US\$29,000.

Civil Works

8 Jan 94	The contract for civil works was awarded under local competitive bidding.
Mar 97	Civil works completed.

Equipment and Materials

25 Mar 94	ADB approved the award of contract for construction equipment.
4 Aug 94	ADB approved the award of contract for pump-turbines, generators and supervisory control and data advisory system.
27 Jan 95	ADB approved the procurement of spare parts and technical services for construction equipment financed from CFS through direct purchase.
25 Oct 95	ADB approved the award of contract for transformers, cables and accessories.
22 Nov 95	ADB approved the award of contract for gas-insulated switchgear and accessories.
31 Jan 97	ADB approved the procurement of composite optic fiber ground wire cable through repeat order.
6 Mar 98	ADB approved the award of contract for steel-cored aluminum wires.
Dec 99	Commissioning of Unit 5.

23 Dec 99	ADB approved the extension of the loan closing date from 31 Dec 1999 to 30 June 2000.
Mar 00	Commissioning of Units 6 and 7.
Jun 00	Commissioning of Unit 8.

Consultants

14 Jan 94	ADB approved the award of contract for implementation consultants.
19 Jul 94	ADB received the consultants' report on assistance in the evaluation of bids for Package 1 (Group I: pump-turbines and mechanical accessories; Group II: generator-motor, generator-voltage equipment, station service equipment; Group III: SCADA, protection system, direct current system and industrial TV).
10 Oct 98	Consultants from US were engaged to carry out engineering services and economic evaluation of the pumped storage.
11 Dec 99	Engineering services and economic evaluation completed.

C. TA 1920-PRC: Electricity Efficiency Study

5 Jan 94	TA Agreement was signed.
17 Mar 94	Contract with TA consultants was signed.
12 Sep 96	ADB received the Final Report.

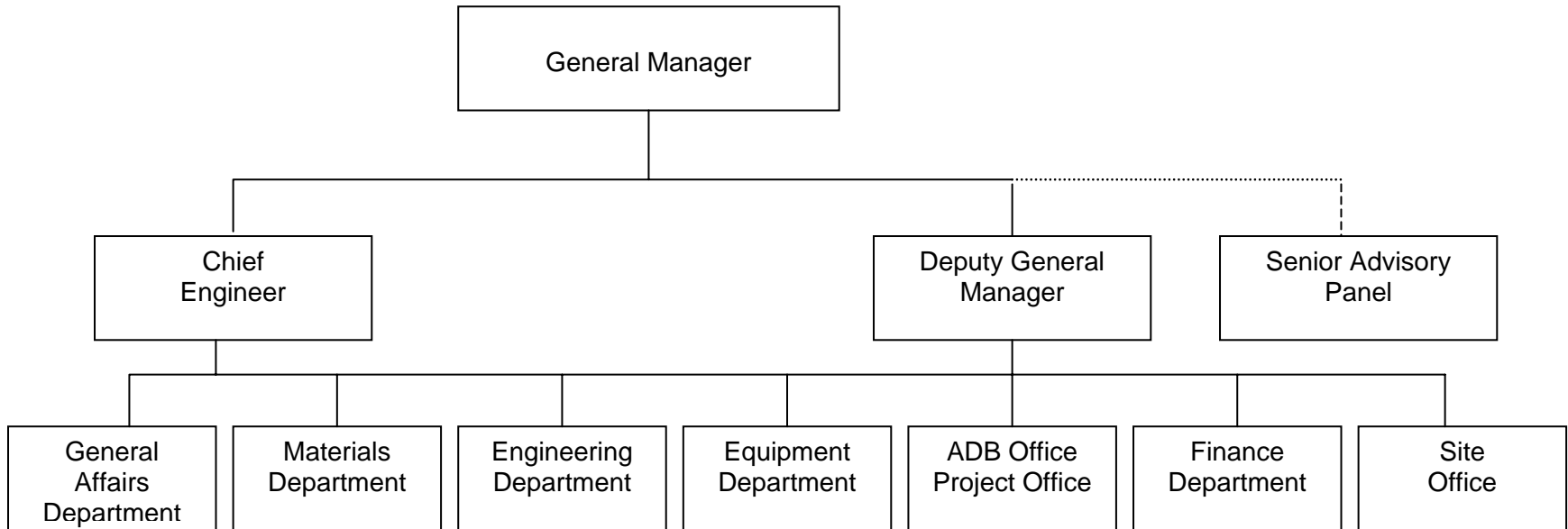
D. TA 1921-PRC: Financial and Management Information Systems Study

13 Apr 94	Contract with TA consultants was signed.
26 Jul 96	ADB received the Final Report.
Jul 97	Training of GPSJVC staff with Energy Australia in international financial and power company management commenced.

E. TA 1922-PRC: Support for Power Sector Tariff and Financing Reforms

6 Sep 93	TA Agreement was signed.
14 Mar 94	Contract with TA consultants was signed.
5-8 Sep 94	International Seminar on Foreign Investment in the Power Sector of China was held in Shanghai.
29-31 May 95	Seminar on Corporatization and Shareholding Options in the PRC Power Sector was held in Suzhou near Shanghai.
2 Oct 95	ADB received the Final Report.

ORGANIZATION CHART OF THE EXECUTING AGENCY



**APPRAISED AND ACTUAL PROJECT COSTS
(US\$ million)**

Item	Appraised			Actual		
	Foreign	Local	Total	Foreign	Local	Total
I. Base Cost						
Civil Works	14.0	72.0	86.0	21.1	84.8	105.9
Electromechanical Equipment	138.7	22.5	161.2	129.6	4.4	134.0
Metal Structures	4.8	4.2	9.0	9.9	0.0	9.9
Management, Consultancy Services, Vehicles, Training	4.8	13.2	18.0	4.9	26.7	31.6
Transmission Lines and Substations	26.7	35.4	62.1	23.4	65.5	88.9
Taxes	0.0	2.5	2.5		0.0	0.0
Base Cost	189.0	149.8	338.8	188.9	181.4	370.3
II. Contingencies						
Physical	3.4	6.5	9.9	0.0	0.0	0.0
Price	23.1	36.5	59.6	0.0	0.0	0.0
Sub-total	26.5	43.0	69.5	0.0	0.0	0.0
III. Interest During Construction	47.5	0.0	47.5	39.2	14.1	53.3
Total	263.0	192.8	455.8	228.1	195.5	423.6

SUMMARY OF ADB-FINANCED CONTRACTS

PCSS No.	Country of Procurement	Description	US Dollar Equivalent	Mode of Procurement	Date of Contract
0001	GER	Consulting Services	2,709,807	ICB	28-Jan-94
0002	HKG	Rubber-wheeled three-boom hydraulic drilling jumbo, mobile shotcreting equipment, and hydraulic cherry picker	2,504,377	ICB	4-Apr-94
0003	SWE	Rubber-wheeled loaders	631,360	ICB	12-Apr-94
0004	HKG	Bolting jumbo	540,430	ICB	13-Apr-94
0005	HKG	Fifteen-ton dump trucks	1,393,563	ICB	14-Apr-94
0006	JPN	Track hydraulic front shovel excavator	500,352	ICB	29-Apr-94
0007	GER	Pump turbine, generator motor, supervision	84,169,752	ICB	15-Sep-94
0008	UKG	500 kV transformers	8,050,947	ICB	11-Nov-95
0009	FRA	500 kV cable	5,289,144	ICB	14-Nov-95
0010	GER	500 kV gas insulated switchgear	22,897,800	ICB	27-Nov-95
0011	KHG	Spare parts for caterpillar wheel loader	25,558	ICB	29-Dec-94
0012	PRC	Carbon steel plates	72,501	ICB	28-Mar-95
0013	HKG	SCALA Software	29,057	DP	28-Mar-95
0014	HKG	Training fee for use of SCALA	18,240	DP	28-Mar-95
0015	HKG	Transportation of construction equipment	5,000	DP	6-Jun-95
0016	PRC	Computer hardware	55,014	DP	3-Mar-95
0017	GER	500 kV silicone rubber composite insulators	266,960	IS	25-Aug-97
0018	ITA	35 kV circuit breakers	227,500	IS	9-Oct-97
0019	USA	PABX and optical equipment	349,101	Other	24-Nov-97
0022	FRA	74M 500 kV cable	61,575	Other	5-Feb-98
0023	UKG	Extra cost for delivery of 500 kV transformers	120,000	Other	5-Feb-98
0024	PRC	Steel-cored aluminum strans for 500 kV	3,736,978	ICB	7-Mar-98
0025	PRC	Closed-circuit television and monitor unit work	59,586	DP	31-Dec-97
0026	PRC	Video telecom systems	56,686	DP	1-Apr-98
0027	PRC	Erection of fire-fighting system	41,400	DP	20-Sep-96
0028	PRC	Automated management system	147,084	DP	10-Sep-98
0029	PRC	Hitachi Inverter	16,907	DP	24-Dec-98
0030	USA	Consultancy (economic evaluation)	75,868	DP	00-Oct-98
			134,052,547		

DP = direct purchase; ICB = international competitive bidding; IS = international shopping.

COMPLIANCE WITH LOAN AND PROJECT AGREEMENTS

Covenants	Reference to Loan Documents	Status of Compliance
1. Implement the Project diligently and efficiently and in conformity with sound administrative, financial, engineering, environmental, and public-utility practices.	Loan Agreement (LA) Section 4.01 (a) and Project Agreement (PA) Section 2.01 (a)	Complied with.
2. Make available, promptly as needed, the funds, facilities, services, land, and other resources required, in addition to the proceeds of the Loan, for the carrying out of the Project.	LA Section 4.02	Complied with.
3. Employ competent and qualified international consultants in accordance with procedures of the Asian Development Bank (ADB), and domestic consultants in accordance with procedures acceptable to ADB.	LA Schedule 5, paras. 2, 3, 4 and 5, PA Section 2.03	Complied with.
4. Establish a project-site office to carry out daily implementation of the Project and a project-administrative office to coordinate project Implementation with ADB.	LA Schedule 6, para 1	Complied with.
5. Provide land, rights in land, and rights of way for the Project	LA Schedule 6, para. 2	Complied with.
6. Execute the Legal Instruments prior to effective date.	LA Schedule 6, para. 3	Complied with.
7. Engage domestic contractors for civil works in accordance with arrangements satisfactory to ADB.	LA Schedule 6, para. 4	Complied with.
8. Establish a Supervisory Board to provide advice on civil works, especially all underground excavation and construction.	LA Schedule 6, para. 5	Complied with.
9. Ensure that the Project is designed and maintained, and that the project facilities are operated and maintained, in strict conformity with national environmental-impact standards and the project environmental impact assessment.	LA Schedule 6, para. 6	Complied with.
10. Ensure timely availability of funds and resources required for operation and maintenance of project facilities.	LA Schedule 6, para. 7	Complied with.
11. Undertake regular benefit monitoring and evaluation of project facilities in accordance with the methodology agreed with ADB.	LA Schedule 6, para. 8	Complied with.
12. Obtain cofinancing prior to 30 June 1994.	LA Schedule 6, para. 10	Complied with.

Covenants	Reference to Loan Documents	Status of Compliance
13. Organize a national conference to promote the use of demand-side management options for enhancing operational efficiency of the power subsector.	LA Schedule 6, para. 11	Complied with.
14. Organize a national conference to determine ways and means for strengthening the commercial orientation of power companies, attracting foreign investment, and encouraging private ownership of facilities in the power subsector.	LA Schedule 6, para. 12	Complied with.
15. Carry out the Project in accordance with plans, design standards, specifications, work schedules, and construction methods acceptable to the ADB.	PA Section 2.04	Complied with.
16. Promptly inform ADB of any condition that interferes with, or threatens to interfere with, the progress of the Project and the performance of its obligations.	PA Section 2.07 (b)	Complied with.
17. Submit quarterly reports on the execution of the Project and the operation and management of the project facilities.	PA Section 2.08 (b)	Complied with.
18. Submit a report on the execution and initial operation of the Project not later than three months after physical completion of the Project.	PA Section 2.08 (c)	Complied late.
19. Submit audited accounts (within six months after the close of the fiscal year to which they relate) and related financial statements for the Project in English.	PA Section 2.09 (a)	Complied with.
20. Annual return on average gross historical value of fixed assets of not less than 10 percent starting 1993.	PA Section 2.16	Deleted in April 1998 when the nature of operations shifted from power generation and sales to leasing.
21. Maintain a debt-service ratio of at least 1.2 times.	PA Section 2.17	Complied with.
22. Maintain a debt-to-equity ratio of not greater than 75:25.	PA Section 2.18	Complied with.

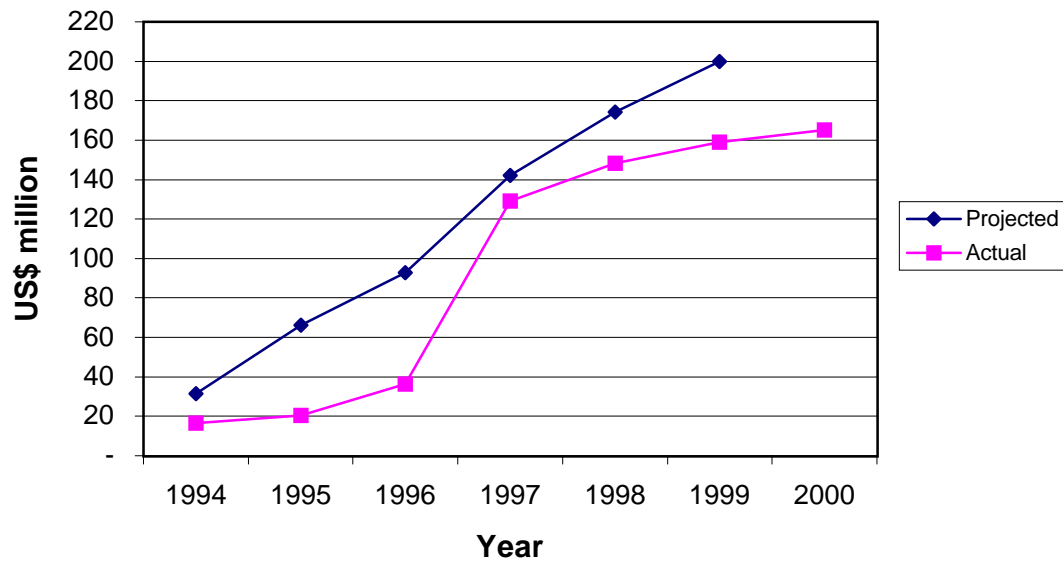
PROJECTED AND ACTUAL DISBURSEMENTS

Table A7.1: Disbursement Schedule
(US\$ million)

Year	For the Year		Cumulative		
	Projected	Actual	Projected	Actual	% of Loan
1994	31.59	16.60	31.59	16.60	10%
1995	34.56	3.80	66.15	20.40	12%
1996	26.53	15.90	92.68	36.30	22%
1997	49.40	92.87	142.07	129.17	78%
1998	32.29	19.17	174.37	148.34	90%
1999	25.63	10.72	200.00	159.06	96%
2000		6.04		165.10	100%
Total	200.00	165.10			

Annual projections exclude interest during construction (IDC); submitted annually by Guangdong Pumped Storage Joint Venture Company.

Table A7.2: Cumulative Disbursements



OPERATIONAL STATISTICS
August to December 2000

Table A8.1: Unit Operating Hours and No. of Starts

Mode	Unit 5				Unit 6				Unit 7				Unit 8			
	H	No. of Times			H	No. of Times			H	No. of Times			H	No. of Times		
		S	F	T		S	F	T		S	F	T		S	F	T
Generating	761.6	273	2	1	946.4	324	6	3	967.4	312	3	1	741.8	257	1	3
Pumping	652.4	193	4		849.8	234	4	1	789.9	213	14	1	657.5	177	11	
Reactive Generating									0.1	2			0.1	1		
Reactive Pumping	3.3	24	1		2.6	19	1	1	4.8	20	1		4.6	22		1
Launching	1.0	19	5		0.9	17	2		0.5	13	5		0.8	9	3	
Total	1,418.3	509	12	1	1,799.7	594	13	5	1,762.7	560	23	2	1,404.8	466	15	4

H = Hours S = Success F = Failure T = Tripping
Note: Total Operating Hours: 3,672

Table A8.2: Starting Reliability (%)

Mode	Unit 5	Unit 6	Unit 7	Unit 8	Station Overall
Generating	99.3	98.2	99.1	99.6	99.0
Pumping	98.3	98.3	93.8	94.2	96.1
Reactive Generating			100.0	100.0	100.0
Reactive Pumping	96.0	95.0	95.2	100.0	96.6
Launching	79.2	89.5	72.2	75.0	79.5
Overall	97.7	97.9	96.1	96.9	97.1

Note: Total Operating Hours: 3,672

Table A8.3: Unit Availability (As defined by North America Electricity Reliability Council)

Index	Unit 5	Unit 6	Unit 7	Unit 8	Station Overall
Equivalent Availability Factor	89.2	88.8	86.0	89.4	88.4
Scheduled Outage Factor	0.1	10.8	9.8	10.0	7.7
Equivalent Forced Outage Rate	21.7	1.1	9.7	1.7	8.5
Available Hours	3,275.0	3,261.0	3,157.8	3,282.4	3,244.1
Forced Outage Hours	393.4	15.0	152.9	24.3	146.4

Note: Total Operating Hours: 3,672

Table A8.4: Success Ratio (Percentage)
(From 1 August to 31 December 2000)

Mode	Unit 5	Unit 6	Unit 7	Unit 8	Overall
Generating Mode	97.5	100.0	99.4	100.0	99.2
Pumping Mode	99.5	100.0	100.0	98.9	99.7
Reactive Generating Mode	-	-	100.0	100.0	100.0
Reactive Pumping Mode	100.0	100.0	100.0	100.0	100.0
Launching Mode	91.7	89.5	100.0	100.0	94.5
Overall	98.1	99.7	99.7	99.6	99.3

Note: Total operating hours: 3,672

Table A8.5: Performance (MWh)
(From 1 August to 31 December 2000)

Description	Unit 5	Unit 6	Unit 7	Unit 8	Total
Export MWh (Main 18kV)	184,335	213,870	237,240	180,660	816,105
Import MWh (Main 18kV)	217,155	282,720	259,110	222,255	981,240
Export (MWh (500kV)	182,470	227,209	235,582	179,783	825,044
Import MWh (500kV)	218,824	280,882	259,670	223,571	982,947
Auxiliary Work MWh	1,318	1,667	1,386	899	5,270

Note: Total operating hours: 3,672

Table A8.6: Start-up Duration
(Seconds)

	Stage I	Stage II (The Project)
Generating Mode	310	120
Pumping Mode	630	320
Reactive Generating Mode	430	145
Reactive Generating to Generating Mode	120	80
Generating to Reactive Generating Mode	130	90
Pumping to Reactive Pumping Mode	240	70
Reactive Pumping to Pumping Mode	120	80
Generating Efficiency	92.9%	93.5%
Pumping Efficiency	92.4%	93.3%

**FINANCIAL PERFORMANCE OF GUANGDONG PUMPED STORAGE JOINT VENTURE CORPORATION
(ACTUAL)**

Table A9.1: Audited Income Statement
(Y million)

Year Ending December 31	1994	1995	1996	1997	1998	1999	2000
Revenues	287.8	146.9	168.6	168.8	168.6	169.7	580.1
Less: Sales Tax	13.6	8.3	9.5	9.5	9.5	8.9	20.9
Gross Revenues	274.2	138.6^a	159.1	159.2	159.0	160.8	559.2^b
Operating Expenses							
Major Repair	6.1	13.5	15.4	6.1	13.4	6.8	33.4
Wages	1.6	3.8	4.4	4.4	5.1	5.1	8.2
Employee Welfare Fund	0.3	0.8	1.2	0.9	0.7	0.7	1.1
Maintenance	5.1	8.9	4.3	4.3	5.7	7.4	26.8
Administration	4.2	6.2	13.0	26.8	26.0	28.4	38.9
Water Resources	0.0	0.0	1.6	1.8	0.0	2.5	1.1
Reception and Training	1.0	1.0	0.7	1.3	1.4	2.0	2.6
Technical Development	0.0	0.0	0.2	0.1	0.2	0.2	0.8
Property Insurance	2.4	1.9	3.5	3.2	3.2	3.1	4.1
Depreciation	70.4	58.7	78.1	69.8	72.0	77.2	219.0
Other Expenses	6.3	0.8	(11.5)	(12.0)	(23.9)	(18.9)	0.5
Total Operating Expenses	97.4	95.5	110.9	106.9	103.8	114.5	336.5
Profit From Operations	176.9	43.2	48.2	52.4	55.2	46.3	222.7
Non-operating Expenses	0.0	0.0	0.0	(0.7)	(0.7)	(0.0)	(0.2)
Income from Investment		0.8	2.7	8.2	9.8	7.3	6.6
Profit Before Interest	176.9	43.9	51.0	59.9	64.4	53.6	229.1
Interest Expense	(36.1)	30.1	31.8	29.7	24.7	26.8	150.4
Profit Before Tax	213.0	13.8	19.1	30.2	39.7	26.7	78.7
Income Tax	70.3	2.5	5.5	7.4	21.7	6.6	24.3
Net Profit	142.7	11.3^a	13.6	22.8	18.0	20.2	54.4

^a Decrease due to change in accounting treatment of the lease revenues from the first 600 MW of Stage I, which were reclassified as capital surplus.

^b Increase due to commercial operation of the Project during the year.

**FINANCIAL PERFORMANCE OF GUANGDONG PUMPED STORAGE JOINT VENTURE CORPORATION
(ACTUAL)**

Table A9.2: Audited Balance Sheet
(Y million)

Year Ending December 31	1994	1995	1996	1997	1998	1999	2000
ASSETS							
Current Assets							
Cash in Bank/Investments	416.1	485.2	626.5	611.8	692.3	695.9	910.2
Accounts Receivable - Power Sales	7.4	0.1	0.2	0.2	0.0	0.0	1.1
Inventories	1.0	45.4	108.6	128.9	60.0	52.2	107.4
Other Current Assets	92.3	382.1	208.8	169.1	178.2	51.6	120.2
Total Current Assets	516.8	912.8	944.1	910.0	930.5	799.7	1,138.9
Long Term Investment	25.3	0.8	26.2	121.2	131.6	88.2	143.6
Fixed Assets							
Gross Assets in Service	2,677.1	2,680.1	2,577.9	2,589.7	2,646.4	2,659.6	5,682.4
Less: Depreciation	70.4	94.0	172.2	242.0	379.0	521.3	1,029.3
Net Plant in Service	2,606.7	2,586.1	2,405.7	2,347.7	2,267.4	2,138.3	4,653.1
Work in Progress	436.4	634.4	1,028.1	2,338.1	3,009.1	3,344.4	335.3
Total Fixed Assets	3,043.1	3,220.5	3,433.8	4,685.8	5,276.5	5,482.7	4,988.4
Deferred and Intangible Assets	175.0	164.1	220.4	183.0	155.7	164.0	119.0
Total Assets	3,760.2	4,298.3	4,624.5	5,899.9	6,494.2	6,534.5	6,389.8
LIABILITIES							
Current Liabilities							
Advance Receipt	365.7	0.0	0.0	0.0	13.4	0.1	0.0
Accrued Expenses	13.6	7.2	54.2	48.1	77.6	76.9	103.4
Other Current Liabilities	42.9	85.2	162.6	115.2	190.2	79.5	197.7
Total Current Liabilities	422.2	92.4	216.8	163.4	281.3	156.5	301.1
Long-Term Debt							
Foreign Currency Loans	2,113.6	2,147.3	2,104.9	2,904.1	3,013.6	2,832.8	2,819.9
Domestic Currency Loans	40.0	591.6	899.1	1,092.0	1,372.0	1,478.1	1,208.5
Total Long-Term Debt	2,153.6	2,738.9	3,004.1	3,996.0	4,385.6	4,310.9	4,028.4
Total Liabilities	2,575.9	2,831.3	3,220.8	4,159.4	4,666.9	4,467.4	4,329.5
EQUITY							
Paid-in Capital	1,020.9	660.0	660.0	660.0	830.0	830.0	830.0
Reserves/Accumulated Profit	163.5	807.0	743.7	1,080.5	997.4	1,237.1	1,230.3
Total Equity	1,184.4	1,467.0	1,403.7	1,740.5	1,827.4	2,067.1	2,060.3
TOTAL LIABILITIES AND EQUITY	3,760.2	4,298.3	4,624.5	5,899.9	6,494.2	6,534.5	6,389.8
Financial Indicator:							
Debt to Equity Ratio	0.6	0.7	0.7	0.7	0.7	0.7	0.7

**FINANCIAL PERFORMANCE OF GUANGDONG PUMPED STORAGE JOINT VENTURE CORPORATION
(ACTUAL)**

Table A9.3: Audited Cash Flow Statement
(Y million)

Year Ending December 31	1994	1995	1996	1997	1998	1999	2000
Fund Sources							
Net Profit After Tax	142.7	11.3	13.6	22.8	18.0	20.2	54.4
Add: Depreciation	70.4	58.7	78.1	69.8	72.0	77.2	219.0
Other Non-Cash Charges	379.6	(24.1)	20.3	37.5	92.2	92.3	334.0
Interest Expense	0.0	31.5	29.6	27.9	24.7	24.3	150.4
HPSDC Revenues Classified as Surplus	609.8	282.7	(63.7)	335.6	88.5	239.7	36.2
Total Funds From Operations	1,202.5	360.1	77.9	493.5	295.5	453.7	794.0
Other Sources							
ADB Loan including Cofinancing	427.3	31.3	132.0	1,016.5	158.5	88.6	49.9
Other Loans	311.3	651.0	280.0	101.3	382.0	129.6	0.0
Total Other Sources	738.6	682.3	412.0	1,117.8	540.5	218.1	49.9
Total Sources of Funds	1,941.1	1,042.3	489.9	1,611.4	836.0	671.8	844.0
Application of Funds							
Capital Expenditure	1,357.4	201.0	368.1	1321.8	727.7	348.1	13.7
Debt Servicing	164.5	128.5	176.5	153.8	175.6	317.2	513.4
Other Application of Funds	46.6	(13.10)	38.44	116.53	30.07	42.55	77.8
Increase in Working Capital	(27.3)	656.79	(234.40)	33.92	(177.86)	(39.64)	24.7
Total Application of Funds	1,541.2	973.22	348.59	1,626.01	755.54	668.21	629.7
Changes in Cash	399.9	69.08	141.31	(14.63)	80.46	3.59	214.3
Cumulative Cash Total	416.1	485.2	626.5	611.8	692.3	695.9	910.2
Financial Indicators:							
Debt Service Coverage Ratio	7.3	2.8	1.8 ^a	1.8	1.7	1.4	1.5

^a Adjusted to reflect income recognized only in the following year.

**FINANCIAL PERFORMANCE OF GUANGDONG PUMPED STORAGE JOINT VENTURE CORPORATION
(PROJECTED)**

**Table A10.1: Projected Income Statement
(Y million)**

Year Ending December 31	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Revenues	720.0	720.0	720.0	720.0	756.0	756.0	756.0	756.0	756.0	778.7
Less: Sales Tax	38.9	38.9	38.9	38.9	40.8	40.8	40.8	40.8	40.8	42.0
Gross Revenues	681.1	681.1	681.1	681.1	715.2	715.2	715.2	715.2	715.2	736.6
Operating Expenses										
Major Repair	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
Wages	13.0	14.3	15.7	17.3	19.0	20.9	23.0	25.3	27.9	30.7
Employee Welfare Fund	2.0	2.2	2.4	2.7	2.9	3.2	3.5	3.9	4.3	4.7
Maintenance	25.0	26.3	27.6	28.9	30.4	31.9	33.5	35.2	36.9	38.8
Administration	18.0	19.8	21.8	24.0	26.4	29.0	31.9	35.1	38.6	42.4
Water Resources	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Reception and Training	3.0	3.2	3.3	3.5	3.6	3.8	4.0	4.2	4.4	4.7
Technical Development	4.0	4.2	4.4	4.6	4.9	5.1	5.4	5.6	5.9	6.2
Property Insurance	12.0	12.6	13.2	13.9	14.6	15.3	16.1	16.9	17.7	18.6
Depreciation	260.0	260.0	260.0	260.0	260.0	260.0	260.0	260.0	260.0	260.0
Other Expenses	20.0	21.0	22.1	23.2	24.3	25.5	26.8	28.1	29.5	31.0
Total Operating Expenses	396.0	402.5	409.5	417.0	425.1	433.8	443.2	453.4	464.3	476.1
Profit From Operations	285.1	278.6	271.6	264.1	290.1	281.3	271.9	261.8	250.9	260.5
Nonoperating Income(from HKCLP)	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Income from Investment	5.0	5.5	6.1	6.7	7.3	8.1	8.9	9.7	10.7	11.8
Profit Before Interest	320.1	314.1	307.7	300.8	327.4	319.4	310.8	301.6	291.6	302.3
Interest Expense	190.0	188.0	178.0	167.0	155.0	143.0	130.0	115.0	100.0	84.0
Profit Before Tax	130.1	126.1	129.7	133.8	172.4	176.4	180.8	186.6	191.6	218.3
Income Tax	42.9	41.6	42.8	44.1	56.9	58.2	59.7	61.6	63.2	72.0
Net Profit	87.2	84.5	86.9	89.6	115.5	118.2	121.1	125.0	128.4	146.3

HKCLP = Hong Kong China Light and Power

**FINANCIAL PERFORMANCE OF GUANGDONG PUMPED STORAGE JOINT VENTURE CORPORATION
(PROJECTED)**

Table A10.2: Projected Balance Sheet
(Y million)

Year Ending December 31	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
ASSETS										
Current Assets										
Cash in Bank/Investments	1,118.9	1,019.0	729.3	674.8	667.6	648.0	522.6	382.3	346.7	574.9
Accounts Receivable - Power Sales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Accounts Receivable - Others	739.0	684.2	629.4	574.7	519.9	465.1	410.3	355.5	300.8	246.0
Prepayment	20.0	22.0	24.2	26.6	29.3	32.2	35.4	39.0	42.9	47.1
Inventories	82.0	84.5	87.0	89.6	92.3	95.1	97.9	100.8	103.9	107.0
Other Current Assets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Current Assets	1,959.9	1,809.7	1,469.9	1,365.7	1,309.0	1,240.3	1,066.3	877.6	794.2	974.9
Fixed Assets										
Gross Assets in Service	5,762.0	5,762.0	5,762.0	5,762.0	5,762.0	5,762.0	5,762.0	5,762.0	5,762.0	5,762.0
Less: Depreciation	1,289.0	1,549.0	1,809.0	2,069.0	2,329.0	2,589.0	2,849.0	3,109.0	3,369.0	3,629.0
Net Plant in Service	4,473.0	4,213.0	3,953.0	3,693.0	3,433.0	3,173.0	2,913.0	2,653.0	2,393.0	2,133.0
Work in Progress	30.0	235.5	663.2	1,279.1	2,257.2	3,529.2	4,848.5	6,106.8	6,991.8	7,472.3
Total Fixed Assets	4,503.0	4,448.5	4,616.2	4,972.1	5,690.2	6,702.2	7,761.5	8,759.8	9,384.8	9,605.3
Deffered & Intangible Assets	119.0	107.1	95.2	83.3	71.4	59.5	47.6	35.7	23.8	11.9
Total Assets	6,581.9	6,365.3	6,181.3	6,421.1	7,070.6	8,002.0	8,875.4	9,673.1	10,202.7	10,592.2
LIABILITIES										
Current Liabilities										
Accrued Expenses	150.0	154.5	159.1	163.9	168.8	173.9	179.1	184.5	190.0	195.7
Other Current Liabilities	526.5	472.5	418.8	265.8	316.8	268.4	220.6	173.6	127.5	134.4
Total Current Liabilities	676.5	627.0	578.0	429.7	485.6	442.3	399.7	358.1	317.5	330.1
Long-Term Debt										
Foreign Currency Loans	2,588.1	2,392.0	2,194.9	2,064.3	1,929.8	1,790.9	1,647.3	1,498.4	1,366.4	1,250.7
Domestic Currency Loans	1,256.3	1,017.9	790.3	631.0	519.1	398.7	276.9	144.8		
Loans (Huizhou Project)	30.0	135.5	163.2	579.1	1,357.2	2,529.2	3,648.5	4,706.8	5,491.8	5,972.3
Total Long-Term Debt	3,874.4	3,545.3	3,148.4	3,274.4	3,806.0	4,718.8	5,572.8	6,350.0	6,858.2	7,223.0
Total Liabilities	4,550.9	4,172.3	3,726.3	3,704.1	4,291.6	5,161.0	5,972.4	6,708.1	7,175.7	7,553.2
EQUITY										
Paid-in Capital	830.0	930.0	1,130.0	1,330.0	1,330.0	1,330.0	1,330.0	1,330.0	1,330.0	1,330.0
Reserves/Accumated Profit	1,201.0	1,263.0	1,325.0	1,387.0	1,449.0	1,511.0	1,573.0	1,635.0	1,697.0	1,709.0
Total Equity	2,031.0	2,193.0	2,455.0	2,717.0	2,779.0	2,841.0	2,903.0	2,965.0	3,027.0	3,039.0
TOTAL LIABILITIES AND EQUITY	6,581.9	6,365.3	6,181.3	6,421.1	7,070.6	8,002.0	8,875.4	9,673.1	10,202.7	10,592.2
Financial Indicator:										
Debt to Equity Ratio (% Debt)	0.7	0.6	0.6	0.5	0.6	0.6	0.7	0.7	0.7	0.7

**FINANCIAL PERFORMANCE OF GUANGDONG PUMPED STORAGE JOINT VENTURE CORPORATION
(PROJECTED)**

**Table A10.3: Projected Cash Flow Statement
(Y million)**

Year Ending December 31	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Fund Sources										
Net Profit After Tax	87.2	84.5	86.9	89.6	115.5	118.2	121.1	125.0	128.4	146.3
Add: Depreciation	260.0	260.0	260.0	260.0	260.0	260.0	260.0	260.0	260.0	260.0
Other Non-Cash Charges	76.9	76.9	76.9	76.9	76.9	76.9	76.9	76.9	76.9	76.9
Interest Expense	190.0	188.0	178.0	167.0	155.0	143.0	130.0	115.0	100.0	84.0
HKSDC Revenues Classified as Surplus	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Total Funds From Operations	664.1	659.4	651.8	643.5	657.4	648.1	638.0	626.9	615.3	617.2
Other Sources										
Sources for Huizhou Project & Other Changes	146.0	(82.9)	(149.9)	206.6	813.1	1,107.0	1,054.3	993.3	720.0	415.6
Paid-in Capital		100.0	200.0	200.0						
Total Other Sources	146.0	17.1	50.2	406.6	813.1	1,107.0	1,054.3	993.3	720.0	415.6
Total Sources of Funds	810.1	676.5	702.0	1,050.1	1,470.5	1,755.1	1,692.3	1,620.2	1,335.3	1,032.8
Application of Funds										
Capital Expenditure	30.0	205.5	427.7	615.9	978.1	1,272.0	1,319.3	1,258.3	885.0	480.6
Debt Servicing	497.0	499.1	490.2	412.6	401.4	402.2	395.3	396.0	376.8	199.6
Dividends	74.2	71.8	73.8	76.1	98.2	100.5	103.0	106.3	109.1	124.4
Total Application of Funds	601.2	776.4	991.7	1,104.6	1,477.7	1,774.7	1,817.6	1,760.6	1,370.9	804.6
Changes in Cash	208.9	(99.9)	(289.7)	(54.5)	(7.2)	(19.6)	(125.3)	(140.4)	(35.6)	228.2
Cumulative Cash Total	1,118.9	1,019.0	729.3	674.8	667.6	648.0	522.6	382.3	346.7	574.9
Financial Indicators:										
Debt Service Coverage Ratio (times)	1.3	1.3	1.3	1.6	1.6	1.6	1.6	1.6	1.6	3.1

HKPSDC = Hong Kong Pumped Storage Development Company

FINANCIAL EVALUATION

1. At appraisal, the financial evaluation of the project was conducted by assuming certain revenue and cost streams for a pumped storage power station generating at a 25-percent load factor or at full capacity for six hours a day. It was assumed that generation would be sold to Guangdong Pumped Holding Company (GPHC) at tariffs that would be set to satisfy the Asian Development Bank's (ADB) covenants. It was also assumed that a policy of tariff equalization would be adopted so that fluctuations between the level of tariff increase in individual years would be eliminated. The power that would be used to pump the water to the higher reservoir would be supplied by GPHC at no cost to Guangdong Pumped Storage Joint Venture Company (GPSJVC). Economic life of 50 years after its commissioning in 1999 was assumed. On this basis, the financial internal rate of return (FIRR) of the Project was calculated at 8.4 percent. The weighted average cost of capital (WACC) on the other hand, was estimated at 7 percent.
2. In the reassessment of the FIRR for the Project, the actual cash flows generated from the lease of the entire capacity of the Stage II plant (the Project) to GPHC were considered. Although the lease contract is only for a period of one year, this can be renewed every year, where annual lease payments can be adjusted to take into account the plant availability and inflation factors. The actual lease payments for 2001 were assumed to be the level of realizable annual revenues for the entire period in the financial projections. Only incremental operating and maintenance costs resulting from the commercial operations of Stage II were considered, since Stages I and II share common facilities. No cost was provided for input pumping energy as this was supplied, free of charge, by GPHC. A tax of 33 percent was deducted from the income. As at appraisal, a cash flow stream for 50 years was assumed.
3. The resulting FIRR, at constant year 2000 prices, is now estimated to be 10.1 percent. This is higher than the appraisal estimate of 8.4 percent, due to the lower actual project costs and higher revenue generation that resulted from the change to lease arrangements.
4. The revised WACC, in real terms, is estimated at 2.8 percent. This was derived using the actual capital mix and costs of funds. Actual interest rates of loan funds were considered, while the cost of equity was assumed to be 12 percent. A foreign exchange rate premium of 1.4 percent was assumed based on the forecast behavior between the US dollar and the local currency. Income tax was assumed at 33 percent and average domestic inflation at 3.8 percent per year. The higher WACC calculated at appraisal was primarily due to the much higher foreign exchange rate risk premium of 8 percent assumed then (Table A11.1).
5. A sensitivity analysis for the FIRR was not considered essential, since the lease revenues are determinable and the operating costs are reasonably predictable.

Table A11.1: Financial Internal Rate of Return (FIRR)
(In Y million)

Year	Total Income	Capital Cost	Total Operating Costs	Net Cash Flow ^a
1993		191.8		(191.8)
1994		251.1		(251.1)
1995		210.7		(210.7)
1996		261.3		(261.3)
1997		1,200.1		(1,200.1)
1998		532.4		(532.4)
1999		321.3		(321.3)
2000	387.9	146.0	60.0	121.9
2001	520.3		80.0	384.2
2002	520.3		80.0	397.7
2003	520.3		80.0	397.7
2004	520.3		80.0	395.0
2005	520.3		80.0	392.1
2006	520.3		80.0	388.8
2007	520.3		80.0	385.5
2008	520.3		80.0	381.8
2009	520.3		80.0	377.6
2010	520.3		80.0	373.3
2011	520.3		80.0	368.6
2012	520.3		80.0	364.0
2013	520.3		80.0	359.1
2014	520.3		80.0	354.1
2015	520.3		80.0	349.2
2016	520.3		80.0	344.2
2017	520.3		80.0	343.2
2018	520.3		80.0	343.2
2019	520.3		80.0	343.2
2020	520.3		80.0	343.2
Total	10,793.9	2,923.0	1,660.0	4,730.5

FIRR = 10.05%

^a Excludes 33% income tax.

ECONOMIC EVALUATION

A. Basic Assumptions

1. The economic evaluation of the Project was carried out following the same methodology as used in the appraisal. Incremental costs and benefits associated with the Project were determined to calculate the net benefit stream. The economic life of the Project is maintained at 50 years, as originally assumed. All prices and costs are expressed in year 2000 values. Import duties, taxes, and all financial charges, including interest during construction, have been excluded.

B. Costs

2. The economic capital costs of the Project were derived from the actual financial costs of the electromechanical equipment, civil works, metal structures, transmission lines and substations, consultant and technical services, and staff training. The costs of tradable items were translated into their border prices by using international market prices plus transport and handling costs from the port to the project site. The costs of nontradable items, on the other hand, were converted into economic costs by applying the appropriate conversion factors.¹

3. The same approach was used to express the financial operating and maintenance costs as economic costs. The economic costs of labor and other expenses were calculated by applying the relevant conversion factors.

C. Benefits

4. The economic benefits of the project output were measured based on the consumers' willingness to pay (WTP) and consumer tariffs. The WTP was estimated by calculating the energy cost of the alternative electricity or energy source for each major category of consumers, i.e., industrial, commercial, urban residential, and rural residential. It was assumed that 35 percent of the consumers would be willing to pay the price for the alternative energy source. The other 65 percent of the consumers would not use any alternative source of energy and would only pay the average tariffs. As in the appraisal, the benefits of the Project are conservatively valued, since the improvement in the operation of the base load plants in the system, and the improved voltage regulation and frequency control resulting from the Project, have not been quantified.

D. Economic Internal Rate of Return (EIRR)

5. The reevaluated EIRR of the Project using the above-mentioned assumptions is now at 19.7 percent, compared with 18.5 percent at appraisal. Details of the calculation are presented in Table A12.1. The higher EIRR is primarily due to the lower capital cost and the sustained level of costs and benefits which were in line with original expectations.

¹ The conversion factors used in this evaluation are: 0.94 for civil works, 2.00 for skilled labor, 0.67 for unskilled labor, and 0.95 for others.

Table A12.1: Economic Internal Rate of Return (EIRR)
(In Y million)

Year	Economic Benefits	Capital Cost	Total Operating Costs	Net Economic Benefits
1993		178.0		(178.0)
1994		238.4		(238.4)
1995		203.6		(203.6)
1996		253.7		(253.7)
1997		1,160.5		(1,160.5)
1998		534.6		(534.6)
1999		294.6		(294.6)
2000	1,138.3	136.8	68.4	933.1
2001	985.5		75.3	910.2
2002	985.5		79.1	906.4
2003	985.5		83.2	902.4
2004	985.5		87.5	898.0
2005	985.5		92.3	893.3
2006	985.5		97.3	888.2
2007	985.5		102.8	882.7
2008	985.5		108.8	876.7
2009	985.5		115.2	870.3
2010	985.5		122.2	863.4
2011	985.5		122.2	863.4
2012	985.5		122.2	863.4
2013	985.5		122.2	863.4
2014	985.5		122.2	863.4
2015	985.5		122.2	863.4
2016	985.5		122.2	863.4
2017	985.5		122.2	863.4
2018	985.5		122.2	863.4
2019	985.5		122.2	863.4
2020	985.5		122.2	863.4
Total	50,414.2	3,000.3	5,918.1	32,862.0
			EIRR =	19.69%

PERFORMANCE INDICATORS OF DAYA BAY NUCLEAR POWER PLANT

Year	GWh Sales	Equivalent Availability Factor	Average Load (MW)	Load Factor
1994	10,780	88.65	1,450	66.00
1995	10,060	66.25	1,840	61.67
1996	11,530	72.57	1,900	70.69
1997	12,000	76.53	1,870	73.57
1998	12,300	82.62	1,780	75.41
1999	13,450	86.36	1,860	82.46
2000	14,030	87.00	1,840	85.00

Average annual capacity = 12,021 GWh

GUANGDONG ELECTRIC POWER SYSTEM PEAK DEMAND AND GENERATION

Demand

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MW	6,180	—	—	—	—	—	15,000	16,530	17,730	19,530	23,500
GWh	35,900	—	50,500	62,560	73,190	78,800	85,760	91,880	98,780	108,620	133,450

Contribution from

GPSJVC											
MW				600	1,200	1,200	1,200	1,200	1,200	1,500	2,400
GWh				181	910	1,061	1,118	1,260	934	1,197	2,934
Percentage of GWh				0.3	1.2	1.4	1.3	1.4	1.0	1.1	2.2

GPSJVC = Guangdong Pumped Storage Joint Venture Company; GWh = gigawatt-hour; MW = megawatt.

PROJECT RATING ANALYSIS

	Results/Remarks
A. Relevance	
Relevance of project preparation to project output at the time of approval	Yes
Relevance of project output to achievement of project goals and purposes at the time of approval	Yes
Priority in the context of the development strategy at the time of approval	Yes
Priority in the context of the development strategy of the Asian Development Bank (ADB) for the country at the time of approval	Yes
Priority in the context of the country's development strategy at the time of evaluation	Yes
Priority in the context of one or more of ADB's strategic objectives at the time of evaluation	Yes
Appropriate changes made at the midterm review/other reviews to make the Project more relevant	Yes
Percentage of subcriteria that met assessment	100
Equivalent rating	3
B. Efficacy	
Achievement of most project physical outcomes	Yes
Achievement of most project intangible outcomes (e.g., technical assistance)	No
Likelihood of project outcomes leading to project goals	Yes
Percentage of subcriteria that met assessment	66.7
Evaluation Rating	2
C. Efficiency	
Manner of ADB's internal processing of the Project	Yes
Organization and management of executing agency and implementing agencies	Yes
Effectiveness of project management	Yes
Efficiency in recruitment of consultants and other procurement	Yes
Timely and adequate availability of counterpart funding	Yes
Percentage of subcriteria that met assessment	100
Evaluation rating	3

	Results/Remarks
D. Sustainability	
Availability of adequate and effective demand for project services and products	Yes
Probable operating and financial performance of the operational entity and ability to recover costs	Yes
Probability of the existence of appropriate maintenance policy and procedures	Yes
Probability of fund availability (cash flow) for continued operations, maintenance, and growth requirements	Yes
Probable availability of skills to continue project availability	Yes
Probable availability of appropriate technology and equipment to operate the Project	Yes
Probable availability of the enabling environment (subsidies, tariffs, prices, competitiveness, and political developments) in which Project is operating at the time of evaluation	Yes
Government ownership and commitment to the Project	Yes
Extent to which the operation affects the environment and renewable or nonrenewable resources	No
Extent to which community participation and beneficiary incentives are adequate to maintain the project benefits	Yes
Percentage of subcriteria that met assessment	90
Equivalent rating	3
E. Institutional Development and Other Impacts	
Country formal laws, regulation, and procedures	Yes
The people's informal norms and practices	No
Institutional or organizational strengthening	Yes
Institutional skill levels and capacities	Yes
Participatory attitudes of the society	Yes
Macroeconomic or sector policy framework	Yes
Impacts on poverty	Yes
Impacts on environment	Yes
Impacts on social organization	No
Impacts on political developments	No
Percentage of subcriteria that met assessment	70
Evaluation Rating	2

Table A15.1: Assessment of Project Overall Performance

Criteria	Weight (%)	Assessment Rating	Weighted Rating
Relevance	20	3	0.60
Efficacy	25	2	0.50
Efficiency	25	3	0.75
Sustainability	15	3	0.45
Institutional and Other Development Impacts	15	2	0.30
Overall Rating			2.6
			(Highly Successful)