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IMPLEMENTATION COMPLETION REPORT

CHINA

DAGUANGBA MULTIPURPOSE PROJECT
(LOAN 3412/CREDIT 2305)

September 23, 1999

Energy and Development Sector Unit
East Asia and Pacific Regional Office

CURRENCY EQUIVALENTS

Currency Unit = Yuan (Y)

1991	$1 = 5.45
1992	$1 = 5.75
1993	$1 = 8.70
1994	$1 = 8.45
1995	$1 = 8.32
1996	$1 = 8.30
1997	$1 = 8.30
1998	$1 = 8.30

FISCAL YEAR

January 1 - December 31

WEIGHTS AND MEASURES

Metric System

ABBREVIATIONS AND ACRONYMS

EIRR	-	Economic Internal Rate of Return
GOC	-	Government of China
HEPCO	-	Hainan Electric Power Company
HMC	-	High Main Canal
HMCMD	-	High Main Canal Water Management Division
ICR	-	Implementation Completion Report
MSDI	-	Mid-South Investigation and Design Institute
O&M	-	Operating & Maintenance
RCC	-	Roller-Compacted Concrete
SAR	-	Staff Appraisal Report
SDPC	-	State Development and Planning Commission

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PREFACE

This is the Implementation Completion Report (ICR) for the Daguangba Multipurpose Project in China, for which Loan 3412 in the amount of U$30,000,000 million equivalent and Credit 2305 in the amount of SDR 28,100,000 million (US$37,000,000 million equivalent) were approved on October 31, 1991 and made effective on February 20, 1992. The loan and credit were closed on December 31, 1998. They were fully disbursed, and the last disbursement took place on February 24, 1999.

The ICR was prepared by Barry Trembath and Yuling Zhu in the Energy and Mining Sector Unit, and Qun Li in the Rural Development and Natural Resources Sector Unit of the East Asia and Pacific Region, and reviewed by Mr. Yoshihiko Sumi, Sector Director. The Borrower/Beneficiary provided comments, which are incorporated in the ICR, its own completion report, an executive summary of which is included as an annex to the ICR.

Preparation of this ICR was begun during the Bank's final supervision mission in October 1998, and an ICR mission visited the Province in March 1999. A follow-up mission to obtain outstanding data was undertaken in June 1999. This ICR is based on the documents and data received during those missions, discussions with Beneficiary staff and consultants, Staff Appraisal Report, the Loan and Project Agreements, supervision reports, correspondence between the Bank and the Borrower/Beneficiary, and internal Bank memoranda.

CHINA
DAGUANGBA MULTIPURPOSE PROJECT
(LOAN 3412/CREDIT 2305)

EVALUATION SUMMARY

Introduction

1. The Daguangba Multipurpose Project is located in the western part of Hainan Island, the driest and poorest region of the Hainan Province. As a newly established province in China, Hainan's potential for economic growth remained largely untapped partly due to the lack of infrastructure. It was in this context that the Project was approved by the Bank and the Government of China. The Beneficiary of the Project was the Hainan Electric Power Company (HEPCO).

Project Objectives

2. The main objectives of the Project were to: (a) develop non-polluting and cost-effective hydropower resources; (b) increase agricultural production and the income of poor farmers; (d) improve the environmental quality and public health of the region by implementing an environmental management program; (e) promote prudent investment programming; (f) promote rational pricing of electricity and irrigation water; and (g) enhance the operational efficiency and financial management of HEPCO.

3. To meet the above objectives, the project included two categories of components: power and agriculture/resettlement. The power components included: (a) a 56 m high, 719 m long concrete gravity dam; (b) an underground powerhouse, equipped with four 60 MW generation sets; (c) some 36 km of double circuit 220 kV transmission line and a substation; (d) a computerized load dispatch system for the Hainan power grid; and (e) technical assistance and training in project design, power system planning and tariff studies, utility and financial management. The agriculture/resettlement components included: (f) a 16 km long main irrigation canal; (g) about 154 km of branch and lateral canals and on-farm works for irrigation of about 12,700 ha of which about 1,400 ha would be related to resettlement; (h) resettlement of about 23,800 people; (i) and agricultural support services.

4. The objectives remained unchanged for the duration of the project. They were clearly stated. The physical objectives were realistic. The institutional development objectives may have been too ambitious, given HEPCO's status as a province owned power bureau and an unlikely candidate to pilot reforms in the power sector. Both power and agricultural development objectives were important in supporting economic growth and alleviating poverty in an a very poor region.

Implementation Experience and Results

5. The project achieved its primary objective of developing hydropower resources, to provide needed peaking power and auxiliary services in a system which is now predominantly thermal. Though the irrigation facilities have not been fully completed due to shortage of counterpart funds, the project objective of increasing agricultural production and income of the poor farmers has been partly achieved and there are good prospects to extend this achievement with the recent allocation of funds by the provincial government to allow completion of this component by the end of 2000. The objective of improving environmental quality and public health of the region has been at least partly achieved with a general improvement of public health in resettlement villages. Success in achieving objectives of promoting rational pricing of electricity and irrigation water and institutional development has been modest.

6. The ex-post Economic Internal Rate of Return (EIRR), based on a minimum proxy of "willingness to pay" for power benefits is calculated as 16.1 percent in comparison with 15.0 percent estimated at appraisal using similar methodologies. The appraisal estimate is exceeded despite the fact that the irrigation component is not complete and energy production has been less than planned because of severe drought.

7. The major shortcoming in achievement of objectives is in relation to the restoration of income of resettlers. The overall standard of resettlement housing and community facilities is better than before the move and based on sample surveys average income is about 10 percent higher than that before the move, after allowing for inflation. However, incomes are unevenly distributed and about 40 percent of villages have average incomes which are still at least 20 percent lower than before the move. Development plans have been prepared specifically targeted at problem areas, and with the recent approval of additional funds by the provincial government it is hoped that needed agricultural development work can be completed by the end of 2000.

8. The dam and power plant were started and completed basically on schedule. The first generating unit commenced trial operation on December 29, 1993 and the entire power component was completed and put into commercial operation on December 30, 1995. The dam and power plant are of good quality. The reservoir first filled to full supply level in November 1996, and in 1997 the generation was close to the design level of 520 GWh. However, there was a decrease in 1998 due mainly to an exceptional drought in the region.

9. The power transmission facilities constructed under the project included: 35.4 km of double circuit 220 kV transmission lines from Daguangba to Emaoling and 194.2 km of 220 kV line fom Emaoling to Sanya; extension of Emaoling 220 kV substation and a new 220 kV substation in Sanya City. The Emaoling substation was put into operation in November 1993 and the Sanya substation in July 1995. The extension to Sanya was not included in the project scope but in May 1993, the Bank agreed that Bank financing could

be used to finance the purchase of imported materials and equipment for the extension to Sanya providing for a more effective usage of Daguangba power in the Hainan grid.

10. The first phase of the High Main Canal was also completed generally as planned and is of a high standard. It entered operation in June 1994 and has been operating successfully since then. The second phase is not yet complete due to shortage of local funds, however with the recent approval of additional funds by the provincial government it is expected that the project can be completed by the end of 2000. Achievements in agriculture support services substantially exceed appraisal targets. Agro-technical extension services system were also strengthened with construction and rehabilitation of four new county and township centers, and introduction of various new production technologies.

11. The detailed resettlement plan, prepared in 1987, provided for the relocation and re-establishment of 20,516 persons. The plan provided for resettlement to be primarily land based. Actual numbers of people requiring relocation increased to 22,243 which is still less than the SAR estimate of 23,800 people. However, the above numbers do not include a further 5,343 people in 13 additional villages who are affected by loss of land, raising the total number of project affected persons to 27,586. The original resettlement budget of Y 150.5 million was adjusted twice during implementation, in 1993 and in late 1997, eventually reaching 269.4 million. However, because of slow arrival of funds from the provincial government, by the end of 1998 only Y 206.3 million had been allocated by HEPCO. Achievements of the resettlement plan up until the end of 1998, included: construction of new housing and community facilities, providing substantially more floor space of considerably higher quality than before the move; land development accounting for 93 percent of the plan target. However for land-loss villages, because of the late start and lack of finance, only 14 percent of land development targets had been achieved. Restoration of livelihood is being achieved albeit gradually. According to the most recent survey carried out by the independent momitoring agency, the average per-capita income of all resettlers in 1997 was 9.7 percent higher than before the move after allowing for inflation. However, income restoration was unevenly distributed. Most villages served by the HMC have considerably improved their income. Another third of villages seem to be well on the way to full restoration, but about 40 percent had a 1997 per-capita income at least 20 percent below that before the move. Development plans have been prepared specifically targeted at the problem areas and with the provincial government approval, on August 13, 1999 of an allocation from the provincial development loan, HEPCO are optimistic that the remaining development work can be completed by the end of 2000.

12. The estimated cost of the project at appraisal (excluding interest during construction) was equivalent to a total of $193.0 million (Y 1,086.5 million). The final cost was equivalent to a total of $197.5 million (Y1,514.4 million). There is an apparent cost overrun of some 2.3 percent when expressed in US dollars and 39.4 percent when expressed in local currency. The difference in the two figures for cost overrun is due to the higher-than-expected-inflation in China and the devaluation of the local currency.

The comparison of costs expressed in US dollars is considered to give a reasonable estimate of cost overrun excluding the effects of inflation and devaluation. Given the size of the project and the uncertainties involved, this slight increase of 2.3 percent is considered to be reasonable.

13. The ex-post Economic Internal Rate of Return (EIRR), based on a minimum proxy of "willingness to pay" for power benefits is calculated as 16.1 percent in comparison with 15.0 percent estimated at appraisal using similar methodologies. The appraisal estimate is exceeded despite the fact that the irrigation component is not complete and energy production has been less than planned because of severe drought.

Summary of Findings, Future Operations, and Key Lessons Learned

14. The objectives of the projects were consistent with those of the Chinese Government and the Bank. While major objectives were achieved there is a significant shortfall in the area of resettlement where 40 percent of resettlement villages are still some way from full restoration of income. However, with recent approval of additional local funds, it is anticipated that this achievement will be eventually achieved.

15. Daguangba Hydropower Plant is well staffed and has comprehensive and well-documented operation and maintenance procedures in place to ensure proper operation and maintenance of the power plant. With regard to performance indicators, the Daguangba power plant has already been accredited as meeting State Power Corporation standards for safe and efficient operation as well as aesthetics and working environment. The HMC Phase I was completed and started operation in June 1994. The Water Resource Bureau of Dongfang City has operated and maintained the new irrigation facilities since May 1994. Future operations will focus on efficient operation and maintenance of the completed irrigation works and facilities so as to achieve the project's full development. To further enhance the project's economic benefits, the irrigation areas and agricultural support service facilities will be progressively adapted to a market-oriented production economy with a self-supporting operation mechanism, responsible for its own profits and losses.

16. For resettlement, the additional Y50 million recently allocated by the provincial government should allow general completion of the remaining works after which the reservoir maintenance fund will generate income based on energy production of about Y 2.1 million per year for ten years which should sustain annual workplans for the resettlement unit within HEPCO and two county resettlement offices.

17. In line with Bank management's response to the OED report "Recent Experiences with Involuntary Resettlement (Report No. 17538), it is recommended that the Bank continue to supervise the resettlement component until it is clear that incomes have been restored in real terms, or at least until physical facilities are in place to ensure this. It is recommended that in FY00, two supervision missions are mounted for this purpose.

18. Key lessons mainly relate to the resettlement and irrigation components. Those relating to resettlement serve to reinforce those derived from other Chinese reservoir resettlement projects. Lessons are:

(a) the need to carefully appraise: proposed institutional arrangements for resettlement, both at overall project level and implementation (county and township) level; the treatment of land acquisition even where, prima facie, relocation is not required; the feasibility of "moving back resettlement strategies where there is a tendency to over-estimate remaining land resources.

(b) the need to further advance resettlement planning at the planning stage to allow better assessment of resettlement strategies, and the preparation of more accurate cost estimates.

(c) the need to consider in the project design measures to ensure borrower commitment to all elements important to the success of the project, including increased level of Bank financing for these elements and staged performance targets so that implementation can be carefully monitored.

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PART I: PROJECT IMPLEMENTATION ASSESSMENT

A. STATEMENT/EVALUATION OF OBJECTIVES

1. The Daguangba Multipurpose Project is located in the western part of Hainan Island, the driest and poorest region of the Hainan Province. As a newly established province in China, Hainan's potential for economic growth remained largely untapped partly due to the lack of infrastructure. It was in this context that the Project was approved by the Bank and the Government of China (GOC).

2. The main objectives of the Project were to:

(a) increase the development of non-polluting and cost-effective hydropower resources to provide needed peaking power in a predominantly thermal system;

(b) increase agricultural production to meet the needs of a growing population;

(c) increase the income of the poor farmers by intensifying agricultural production and increasing the productivity of cropland by alleviating water shortages and optimizing the cropping pattern;

(d) improve the environmental quality and public health of the region by implementing an environmental management program;

(e) promote prudent investment programming and strengthen local capabilities in development planning of both power and agricultural sectors;

(f) promote rational pricing of electricity and irrigation water; and

(g) enhance the operational efficiency and financial management of HEPCO.

3. The development-based resettlement of the reservoir population, while not singled out as a specific development objective, would be carried out in the context of OPN 10.08 and OMS 2.33. These Bank directives called for the relocation of reservoir population in a manner that would leave them after relocation as well off as before, possibly better.

4. To meet the above objectives, the project included two main categories of components: power and agriculture/resettlement. The power component included:

(a) Construction of a 56 m high, 719 m long gravity dam of roller-compacted concrete (RCC), flanked by about 5,100 m long earth embankments;

(b) Construction of an underground powerhouse, equipped with four 60 MW generation sets, a surge shaft and 420 m long twin tailrace tunnels;

(c) Erection of about 36 km double circuit 220 kV transmission line and Changjiang substation;

(d) Installation of a computerized load dispatch system for the Hainan power grid; and

(e) Technical assistance and training in project design, power system planning and tariff studies, utility and financial management.

5. The agriculture/resettlement component included:

(a) Construction of the 16 km long High Main Canal (HMC), about 154 km long branch/lateral canals and on-farm works for irrigation of about 12,700 ha in Dongfang County, of which about 1,400 ha would be related to resettlement;

(b) Resettlement of about 23,800 people in Dongfang and Ledong Counties, and provision of housing, infrastructure (including public buildings), on-farm works and land development for irrigation of about 2,300 ha;

(c) Provision of agricultural support services;

(d) Provision of environmental management; and

(e) Technical assistance for the preparation of an agricultural development plan.

6. The objectives remained unchanged for the duration of the project. They were clearly stated. The physical objectives were realistic. The institutional development objectives may have been too ambitious, given HEPCO's status as a province owned power bureau and an unlikely candidate to pilot reforms in the power sector. Both power and agricultural development objectives were important in supporting economic growth and alleviating poverty in an a very poor region.

B. Achievement of Project Objectives

7. With the successful completion of the dam and the hydropower plant as originally designed, the project achieved its primary objective of developing hydropower resources, to provide needed peaking power in a system which is now predominantly thermal. There have been no major operating problems since the rather extensive teething

problems encountered in the early stages of project operation. As of end 1998, about five years after the commercial operation, all four units have generated a total of electricity of 1,981.3 GWh. The project improved the balance and location of thermal and hydro power resources in Hainan power grid. It also provides the badly needed functions of load following and frequency regulation in a grid which has become somewhat unbalanced towards large thermal plants.

8. Though the irrigation facilities have not been fully completed due to shortage of counterpart funds, the project objective of increasing agricultural production and income of the poor farmers has been partly achieved and there are good prospects to extend this achievement. The currently completed irrigation facilities can supply water to about 97,100 mu (6,473 ha) of agricultural land, and extensions are currently underway to increase this by 30,000 mu (2000 ha) by the end of 1999, thus irrigating two thirds of the originally planned area. In addition, funds have now been allocated to complete works required to irrigate the full planned area by the end of 2000. The irrigation system developed under the project can also supply water for industrial and residential use. It plays a significant role in alleviating the long-term drought situation in the southwest area of the province.

9. The ex-post Economic Internal Rate of Return (EIRR), based on a minimum proxy of "willingness to pay" for power benefits is calculated as 16.1 percent in comparison with 15.0 percent estimated at appraisal using similar methodologies. The appraisal estimate is exceeded despite the fact that the irrigation component is not complete and energy generation has been less than planned because of drought, because of higher demonstrated willingness to pay for power and higher irrigation benefits due to improved cropping patterns.

10. The objective of improving environmental quality and public health of the region by implementing an environmental management program has been at least partly achieved with a general improvement of public health in resettlement villages. Hygiene and sanitation have considerably improved and infectious diseases are dramatically down since before the move. The standard of health care in the villages has also improved considerably.

11. The major shortcoming in achievement of objectives is in relation to the restoration of income of resettlers. The overall standard of resettlement housing and community facilities is better than before the move, and based on sample surveys, average income is about 10 percent higher than that before the move, after allowing for inflation. However, incomes are unevenly distributed among the resettlement villages. Among 29 resettlement villages, only 7 villages have increased per capita income, while some 40 percent have incomes which are still at least 20 percent lower than before the move. Development plans have been prepared specifically targeted at the areas which are having difficulties re-establishing income, and budgets have been approved by central government authorities. However, both the provincial government and HEPCO have suffering severe funding shortages due to the economic downturn and fund allocations

have arrived very slowly. The situation is expected to improve with the allocation on September 13, 1999 of a provincial development loan to enable the resettlement development work to be completed.

12. Success in achieving objectives of promoting rational pricing of electricity and irrigation water has been limited. While power pricing studies were completed, the proposed tariff structure reform was not implemented because of lack of approval from the provincial government. Water charges are being levied but are well below O&M costs. Similarly, achievements with respect to the objective of enhancing the operational efficiency and financial management of HEPCO are also modest.

C. Implementation Record and Major Factors Affecting the Project

Background

13. The major factors affecting the project during preparation and implementation largely relate to the changing administrative, political and economic environment during this period summarized as follows:

(a) At the time of project identification, Hainan had only recently been granted provincial status and establishment of government administrative arrangements, including the status of HEPCO, significantly slowed down decision making. To some extent this administrative uncertainty continued throughout the preparation and implementation period with HEPCO's relationship to the provincial government changing several times. It was initially established as a provincial power bureau under the provincial government. Later it "piloted" a separation of government and commercial functions (although allocation of functions to bureau and company did not seem to have been thought through). It was then established as a joint stock company with joint ownership by provincial and local governments. Finally, it went back to being a wholly owned subsidiary of the provincial government. Throughout this process it appears to have had little autonomy from the provincial government, and required approvals for virtually all activities. This was complicated by several changes for responsibility for HEPCO within the government.

(b) The processing of the project in the Bank was adversely affected by the political events of 1989. Appraisal occurred in April 1989, but Board presentation was delayed until October, 1991. Large scale work started on the dam in March, 1990. Before Board presentation, Bank staff were limited in their ability to influence events on site with respect to construction, resettlement etc.

(c) The project design (in the larger sense) was very much dictated by the desire of the Hainan authorities to limit the use of foreign exchange,

particularly as the central government was insisting from the outset that Hainan should assume the responsibility for foreign exchange convertibility for loan repayment. Bank finance was thus limited to peripheral elements rather than the main work.

(d) Over the course of project preparation and implementation, Hainan went through a period of explosive economic growth from 1987 to 1995 with HEPCO energy sales increasing 25 percent per year on average. For 1997 and 1998 this reduced to about three percent before recovering to about 11 percent in 1998. The high growth period resulted in large provincial government commitments to infrastructure investments and power company commitments to power purchases, which left both in constrained financial conditions during the ensuing slow down.

Power Component

14. The Power component consisted of construction of a dam, an underground power house, associated transmission lines and substations, and installation of a computerized load dispatch system for the Hainan power grid, as well as the related technical assistance and training.

Implementation Organization

15. HEPCO, the owner of the project, was also the implementing agency. For the Daguangba Hydroelectric Power Plant, a special and temporary organization – the Project Command Office – was set up to manage construction. Mid-South Investigation and Design Institute (MSDI) served as the designer. Guangxi Electric Power Investigation and Design Institute served as the supervision engineer. A Special Board of Consultants consisting of domestic and international experts was also appointed to provide consulting and advisory services during the project implementation. The dam and powerhouse civil works and equipment were not financed by the Bank and contracts were awarded based on local procedures. The Changjiang Gezhouba Project Construction Bureau was selected as the civil works contractor. Dongfang Electric Power Equipment Corporation was the supplier of the turbine and generator sets and the Tenth Water Resources and Hydropower Project Bureau conducted the installation of mechanical and electrical equipment.

Implementation Status

16. The implementation schedule included in the SAR provided for commencement of the main civil works in the second quarter of 1990, commissioning of the first unit in the third quarter of 1993, the second unit in December 1993, the third unit in September 1994 and the fourth unit in December 1994.

17. The dam and power plant were started and completed basically in line with the above schedule. The civil works began in March 1990. It took 63 months for the

concrete dam to reach its design height in June 1995, involving concrete volumes of 910,900 m^3 including 258,500 m^3 roller-compacted concrete (RCC). Generating Unit 1 started operation on December 29, 1993, followed by Unit 2 on May 26, 1994, Unit 3 on October 29, 1994 and Unit 4 on March 29, 1995. The entire power component was completed and put into commercial operation on December 30, 1995.

18. The associated power transmission facilities constructed under the project included: (a) double circuit 220 kV transmission lines from Daguangba Hydropower Plant to Emaoling (the length of the double circuit lines are 35.3 km and 35.5 km respectively); (b) 220 kV transmission line from Emaoling to Basuo in the length of 48.9 km; (c) 220 kV transmission line from Basuo to Sanya in a length of 145.3 km; (d) extension of Emaoling 220 kV substation (with 2 GIS bays and 2 x 120 MVA transformer capacity) which was completed and started operation in November 1993; and (e) a new 220 kV substation in Sanya City, which was put into operation in July 1995. The scope of the transmission component exceeds that envisaged at appraisal in that the original project scope simply provided for the connection of the Daguangba project to the grid at Emaoling including extension of the substation there. In May 1993, the Bank agreed that Bank financing could also be used to finance the purchase of materials and equipment for a line from Emaoling to Basuo and thence to Sanya including a new substation at Sanya. This reinforcement provided for a more effective usage of Daguangba power in the Hainan grid taking into account the rapid growth rates in the Sanya region. The additional lines and substation also serve to strengthen the interconnection between north and south load centers of Hainan.

Implementation Experience

19. **Adoption of Roller-Compacted Concrete (RCC).** RCC was adopted in the construction of the Daguangba gravity dam. In the preliminary design, volcanic ash was selected to be the binding mixture in the process of making RCC. However, tests showed that the volcanic ash it was planned to use contained 50 percent of material which would accelerate setting and also cause drying shrinkage. Therefore, extensive testing was conducted on fly ash (which was available from a thermal power plant in the area) as a substitute for the volcanic ash and this testing eventually proved its suitability.

20. The proportion of the dam that was composed of RCC is substantially less - 28 percent - than in the original design, which projected 57 percent. This is attributed to the fact that detailing of the dam had been imperfectly adapted to accommodate RCC placing methods and the contractor found it impractical to use RCC in many areas. Review of the design by specialists with more experience in RCC may have allowed for the planned proportion of RCC to have been achieved with concomitant cost savings.

21. **Geological Treatment of the Main Dam Foundation.** Following completion of the dam and during reservoir filling, abnormal downstream movement (maximum about 11mm) was recorded in relation to one dam block. Drilling revealed a zone of weathered material, which was considered to be responsible for the movement beneath the dam,

which of the reservoir filling was temporarily halted and a 14 member panel was assembled to advise on required remedial works. Based on the recommendations of the panel, a program of drainage, buttress construction and anchoring was recommended and promptly implemented. On resumption of dam filling, no further abnormal movements were observed

Agriculture/Irrigation Component

Overview

22. During the initial identification of the Daguangba project, the irrigation component was limited to that associated with the resettlement in Dongfang County, with further development of the High Main Canal and the area served by it left to the future. However, the Bank preparation team found that, as a pure power project, the economic justification of Daguangba was particularly sensitive to load growth projections, and therefore requested that the full development of the Stage 1 irrigation area be included in the scope of the project. Significantly, however, Bank financing was not increased to cover this additional scope. The project file records the visit of a deputy governor to the site during the "hiatus" period, and his confirmation that the provincial government would take responsibility for the implementation of the full Stage 1 development. However, during project supervision in October 1996, the mission discovered that the government were not intending to develop the full area until well into the future. The mission reminded the government of their commitment in accordance with the Hainan agreement, and followed up several times after that. While these endeavors succeeded to some extent, by the end of 1998 the irrigation area developed and supplied with water as limited to 55 percent that envisaged at appraisal. Plans were to complete the balance by the end of 2000, but until recently definite funding had only been identified to cover about one fourth of this expansion. The situation has recently improved with provincial government approval of an allocation of loan funds available to the government to cover the financing gap.

Irrigation Development.

23. Despite the non-completion of the second phase of the HMC, and the associated restriction of irrigated area, physical targets of the irrigation component, as laid out in the SAR were largely achieved. The Phase I construction involved the construction of the HMC with a length of about 14.7 km and a discharge capacity of 14 cum/sec (about 94.2 and 116.7 percent of the SAR), 57.7 km of main branch canals (196 percent of the SAR), 47.1 km of lateral branch canals (245.3 percent of the SAR) and some 175.4 km of field ditches (154.8 percent of the SAR. Detailed comparisons are included in Table 5. The irrigation on-farm works resulted in improving 30, 000 mu of existing and expanding 97,100 mu of new irrigation areas, making a total of 127,100 mu (about 67 percent of the SAR). The extensions for Phase II are currently underway to increase this to 190, 000 mu (12,667 ha) by the end of 2000. The budget for HMC extension, approved by the government, is Y68 million. To date, about Y18 million has been financed, leaving a

financing gap of Y50 million. On September 13, 1999 the Provincial Development Planning Department approved an allocation from provincial development loan of Y100 million (Y50 million for the HMC, and Y50 million for resettlement). A copy of the approval document was provided to the Bank. With these funds, HEPCO are optimistic that remaining works will be completed in the year 2000. Farm development will be by contributed labor to the estimated value of Y17.75 million.

Agricultural Support Services

24. Achievements in agriculture support services substantially exceed appraisal targets. For agricultural inputs, one seed company was established, which supplied 225 kg/ha of quality seeds. A total of 2,836 tons of fertilizer and 141.8 tons of agro-chemicals were procured and distributed to the project area. Some 22 sets of agricultural machinery and equipment, and 110 tractors were purchased and operated to increase the level of farm mechanization. On land and soil improvement, some 9,122 ha of cultivated land were leveled and some 1,789 ha of soil improved. Agro-technical extension services system were strengthened with construction and rehabilitation of four new county and township centers, and introduction of various new production technologies.

Training

25. The project provided institutional strengthening and development mainly through staff training in project implementation and management and upgrading of technical skills and competence at all provincial and local government levels. Farmers completed 1,200 person-months of training, project staff 95 person-months, and project managers 8 person-months during implementation of the irrigation component. In addition, domestic study tours involving 30 person months and 450 person-months of domestic consultancy services were provided.

Resettlement

Implementation Organizations

26. Resettlement planning was carried out by MSDI and they were also employed periodically throughout implementation to carry out supplementary planning and to develop revised budgets for submission to central government authorities. In 1990, resettlement organizations were set up in the two affected counties and three state farms. In addition, for overall management of implementation, a resettlement office, with staff seconded from provincial departments, was set up under HEPCO project office. Unlike most other Chinese reservoir resettlement projects, there was no provincial resettlement office to provide leadership to the county offices in resettlement implementation.

27. HEPCO also employed MSDI to carry out a program of independent resettlement monitoring and evaluation as foreseen at appraisal. This monitoring and evaluation by MSDI is taking place over a five year period (1995 to 2000) and involves samples of 327 households and all 29 resettlement villages. The annual reports of this program have

proved to be very valuable in providing HEPCO and the Bank with regular information on progress of physical relocation, economic rehabilitation, and other measures of well-being of the resettled population.

Implementation Experience

28. The detailed resettlement plan, prepared in 1987, provided for the relocation and re-establishment of 20,516 persons living in 29 villages, 6 townships, two counties, 80 percent of whom were rural, and 20 percent urban[1]. The plan summarized in Annex 16 of the Staff Appraisal Report (SAR), provided for resettlement to be primarily land based. Each resettler would be provided with one mu of paddy and one mu of dry land plus some additional land for tropical trees crops, housing plot and fuel wood. All paddy land was to be irrigated.

29. Actual numbers of people requiring relocation increased to 22,243. This includes 1682 persons in three villages which were not originally planned to be relocated since village infrastructure and buildings were not to be inundated. However, a 1997 survey revealed that remaining land resources were not viable and relocation became necessary. The total number is still less than the SAR estimate of 23,800 people. However, the above numbers do not include a further 5,343 people in 13 additional villages who are affected by loss of land, raising the total number of project affected persons (PAPs) to 27,586. Some allowance was evidently included in initial budgets as compensation for lost land in these areas but no detailed rehabilitation planning was carried out. Detailed rehabilitation plan for villages affected by loss of land only were not prepared until the end of 1997.

30. The original resettlement budget was Y 150.5 million. This was adjusted twice during implementation, in 1993 and in late 1997 primarily for inflation, but in the last adjustment to fully take into account rehabilitation measures which would be needed for land loss villages. The finally approved budget was Y 269.4 million. However, because of slow arrival of funds from the provincial government, by the end of 1998 only Y 206.3 million had been allocated by HEPCO.

31. Achievements of the resettlement plan up until the end of 1998, included:

(a) Relocation of 22,243 persons, 18,162 of whom were agricultural;

(b) Construction of 318,810 m^2 of new housing and 107,837 m^2 of community facilities, providing 11.2 percent more floor space of considerably higher quality than before the move;

(c) Development of 25,002 mu of land accounting for 93.3 percent of the plan target. However for land-loss villages, because of the late start and lack of

[1] The SAR used a figure of approximately 23,800 people based on "1990 survey data adjusted for growth". No details of this survey are on file.

finance, only 14 percent of land development targets had been achieved, mostly located in two newly relocated villages although the pace of land development is accelerating now with the allocation of additional funds.

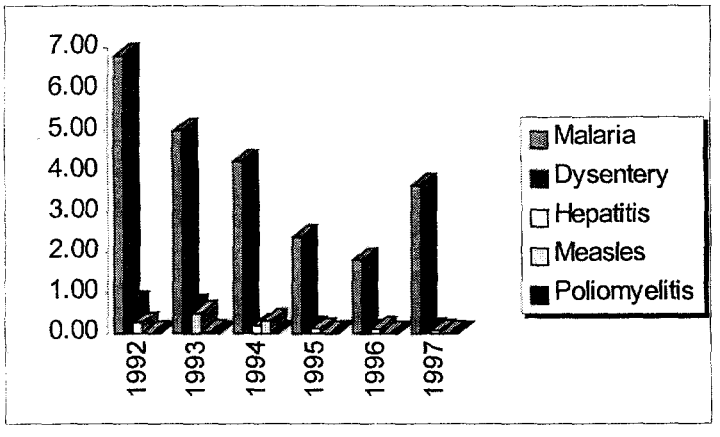
32. Restoration of livelihood is being achieved albeit gradually. According to the 327 sample household survey by MSDI, the average per-capita income of all resettlers in 1997 was Y 532, which was 10 percent higher than that in 1996 and 9.7 percent higher than before the move after allowing for inflation. However, income restoration was unevenly distributed among resettlement villages, with only seven of 29 villages restoring their income on a per-capita basis. In general, these are villages that moved to Datian resettlement area (served by the HMC) which now have reliable irrigation and developed paddy. Another third of villages seem to be on the way towards restoration of income. These are generally "moving back" villages in Ledong and Dongfang which have relatively greater land resources and developed irrigation. However, about 40 percent of villages have a per-capita income in 1997 at least 20 percent below that before the move. Development plans have been prepared specifically targeted at the areas which are having difficulties re-establishing income, and budgets have been approved by central government authorities. However, both the provincial government and HEPCO have been suffering severe funding shortages due to the economic downturn and fund allocations are arrived very slowly. The situation has recently improved with the provincial government approval, on August 13, 1999, of an allocation from the provincial development loan, which will basically cover the funding shortfall.

Environmental Issues

33. It is evident from a review of correspondence in the project preparation phase that health issues were of primary concern to resettlement specialists, particularly infectious diseases such as malaria and hepatitis. The Resettlement Monitoring and Evaluation program reports have consistently described a general improvement in health and hygiene in resettlement areas. With the establishment of a medical service network, access to health care has been greatly improved. Access to potable water has also generally improved in comparison with pre-move conditions, and work is continuing to ensure all resettlement villages will have access to potable water in all seasons. Sanitation is also substantially better in the new villages. All of these factors have resulted in substantial drops in the incidence of infectious diseases as can be seen from the following table, although there was a partical resurgence of Malaria in 1997. This was reportedly due to several factors including climate factors in 1997, and the extension of access roads to poorer isolated areas, thus extending reporting to these areas.

Infectious Diseases Among Resettlers
Incidence per 1,000 Population

	1992	1993	1994	1995	1996	1997
Malaria	6.80	5.00	4.25	2.39	1.82	3.65
Dysentery	0.75	0.67	0.10	0.14	0.04	0.08
Hepatitis	0.25	0.51	0.21	0.10	0.12	0.06
Measles	0.00	0.05	0.32	0.01	0.01	0.00
Poliomyelitis	0.00	0.01	0.00	0.00	0.00	0.00



34. In relation to other issues raised in the SAR:

(a) Water quality monitoring is less frequent than desirable. However, results to date show no change from the pre-project situation i.e. generally high quality except for an excessive bacterial count attributed largely to human waste from Ledong upstream. The project financed sewage treatment plant for this area has only just been completed (due to lack of finance) and when the completion mission visited the site was still not in operation. Since then, HEPCO have reported that it commenced trial operation on August 18, 1999. Water quality should be fully acceptable when the plant comes into full operation.

(b) Protection of the rare Datian deer has been improved by partially fencing-in and patrolling the protected area. The deer population is reported to have increased from about 40 at the time of appraisal to over 200.

(c) The afforestation around the reservoir rim recommended by the SAR has been partially implemented. Houmiling forestry farm land planted, between 1991 and 1992, 2,400 mu of forest on the right bank of Changhua river, and 600 mu of forest in Datian area. The trees are mainly eucalyptus. Erosion into the reservoir is not significant.

(d) The slight moderation in temperature adjacent to the reservoir (attributable to the reservoir itself) is reported to be beneficial to agriculture.

35. In the irrigation area, the completed irrigation and drainage facilities, land and soil improvements, and afforestation (forest belts and fruit trees) have improved the land productivity and enhanced the general ecological environment of the project area. The increased water diversion to the western region of Hainan has improved the environment for agriculture, aquaculture, urban and rural water supply.

Procurement

36. The procurement under the project was conducted in line with the agreed arrangements as stipulated in the Legal Agreements and SAR. Overall, 94 contracts worth $70 million equivalent were executed. As shown in the table below, ICB was the major procurement method used under the project, accounting for 67.7% of total contract value, in comparison with 63 percent projected in the SAR, followed by NCB for civil works contracts for irrigation and resettlement components. Procurement was generally uneventful. The only incidents occurred during initial LCB contracts when it was found that prior review procedures were not being correctly followed. On an exceptional basis, the Bank carried out post-review and accepted the contracts for financing.

Procurement Method	No. of Contracts		Contract Value	
	Number	% of Total	Value ($'000)	% of Total
ICB	33	35.1	47,403.5	67.7
LIB & IS	17	18.1	1,132.1	1.6
NCB (Works)	44	46.8	21,467.8	30.7
Total	94	100.0	70,003.3	100.0

Consultants

Project Management Consultants

37. The SAR envisaged that HEPCO would employ foreign consultants to assist HEPCO in managing project construction. In the event, this did not occur. Because of the delay in loan approval, the civil works commenced well before the effectiveness of the Bank loan. In early supervision missions, the Bank attempted to catalyze the employment of international consultants. Shortlists and terms of reference were agreed and proposals were requested from three firms. The Bank questioned HEPCO's recommendation for award. Protracted correspondence ensued. Eventually, HEPCO advised that the construction was already at its peak and local project managers seemed to be performing effectively and there was no longer any need to employ foreign consultants, particularly in view of the scarcity of foreign exchange. The Bank accepted HEPCO's decision.

Special Board of Consultants

38. Earlier in the project a Special Board of Consultants (financed by Technical Cooperation Credit), consisting of domestic and international experts, was appointed to provide certain quality control for the project. The consultants conducted three missions respectively in the preparation stage of construction, early stage of construction, and peak period of construction. They reviewed the preliminary design, construction drawings and the project site situation, and provided many suggestions and recommendations related to design, construction and future operation. Most of the suggestions and recommendations were adopted and proved to be useful.

Project Costs and Loan Disbursement

39. **Project Costs.** The estimated cost of the project at appraisal (excluding interest during construction) was $59.1 million in foreign costs and Y 754.5 million in local costs, equivalent to a total of $193.0 million (Y 1,086.5 million). The final cost was $68.4 million in foreign costs and Y954.1 million in local costs, equivalent to a total of $197.5 million (Y1,514.4 million) (see Table 8a and 8b for details). Considering overall costs (foreign plus local), there is an apparent cost overrun of some 2.3 percent when expressed in US dollars and 39.4 percent when expressed in local currency. The difference in the two figures for cost overrun is due to the higher-than-expected-inflation in China (91 percent between 1991 to 1996 compared with 37.5 percent estimated) and the devaluation of the local currency from an exchange rate of Y5.24 to the dollar at the time of appraisal to Y8.70 to the $1 in 1993 (with a slight recovery to 8.30 thereafter). The comparison of costs expressed in US dollars is considered to give a reasonable estimate of cost overrun excluding the effects of inflation and devaluation. Comparing the two sets of figures, major deviations are noted in the areas of civil works, canals and on-farm works beyond those required for resettlement. The civil work cost increase can be largely attributed to the increased proportion of conventional concrete in relation to RCC referred to earlier. The reduction in costs in relation to the irrigation canals can be attributed to the fact that this component is so far incomplete and the incomplete status has been taken into account in the economic analysis. The transmission cost increase relates to the revision of project scope to include the line to Sanya and an additional substation as referred to earlier. Given the size of the project and the uncertainties involved, this slight increase of 2.3 percent is considered to be reasonable.

40. **Loan Disbursement**. A comparison of the estimated loan disbursements at appraisal with the actual disbursements is given in Table 4. Loan disbursement was slower than the appraisal schedule in earlier years due to initial procurement delays for Bank financed contracts. However, by FY95 disbursements had accelerated and cumulative disbursements had reached 94 percent of the total amount of loan and credit. Thereafter, remaining funds were progressively reallocated to priority areas such as resettlement civil works, disbursement of which occupied the remaining time until project closure. Both the loan and the credit were fully disbursed. The last disbursement was made on February 24, 1999 for the loan and on March 3, 1999 for the credit.

Economic Performance

Power Benefits

41. At appraisal an analysis was carried out to verify that the Daguangba power project was part of the least cost development for the Hainan grid by comparing it with a notional thermal alternative (85 MW coal and 225 MW gas turbine). A similar analysis was carried out for the ICR. Capital costs and fuel costs were derived based on recent project justification reports for power projects in China. Distillate was assumed as fuel for the gas turbine, rather than gas as assumed in the appraisal report as gas supplies to Hainan are fully committed, and there are no immediate plans for further resource development. The analysis summarized in Table 9A, yielded hydropower costs (at 10 percent discount rate)of 46.4 fen/kWh if all joint costs are allocated to power and 40.5 fen/kWh if allocation of joint costs is carried out in accordance with the "separable-costs-remaining-benefits" methodology. This compares with an alternative thermal cost of 61.7 fen/kWh. The equalizing discount rate is 21 percent of joint costs are fully allocated to power and increasing to 41 percent if they are only partially allocated to power. The ratio of hydro to alternative thermal costs, assuming full allocation of joint costs is 75 percent compared to 53 percent estimated at appraisal. Differences can be explained by conservative allocation of full transmission costs (increased scope) to the hydro project, and that the appraisal analysis evidently did not allow for lower energy generation in early years until completion of spillway crest gates. Nevertheless, it is clear that Daguangba is considerably more economical than a thermal alternative.

Agricultural Benefits

42. The investment in the irrigation component has brought significant benefits in terms of increased agricultural yields and production due to the expanded irrigation facilities, improved extension services and input availability. The project was successful in expanding and improving an irrigation area of 8,473 ha with increases of crop intensity. At project completion, major grain crops (rice, corn, bean and sweet potato) and cash crops (off-season vegetables, sugarcane, mango and watermelon) generally exceeded the SAR-projected yields and production for the full development. Table 6B shows the area cultivated, yields and production achieved for each crop.

43. The main crop yields currently achieved in the project area are 4.7 tons for rice (109.2 percent of SAR), 1.9 tons for beans (105.8 percent of SAR), 10.3 tons for vegetables (103.1 percent of SAR), 51 tons for sugarcane (102 percent of SAR), and 21,221 tons for mangos (102.5 percent of SAR), respectively. Preliminary data show a further increase in yields and production for cash crop as farmers fully utilize the climate advantage of Hainan to diversify crop production and increase inputs in response to higher market prices. The total annual crop production increased during the project period (in 1998) by about 21,048 tons for rice, 2,653 tons for other grain, 1,594 tons for peanuts, 10,373 tons for off-season vegetables, 98,673 tons for sugarcane, 17,028 tons for mangos, 1,420 tons for pineapples, and 3,294 tons for melons. The increased outputs

from various crops resulted in higher incomes for beneficiary farm households. The annual gross value of crop production was estimated at about Y 197 million.

Rural Income and Poverty Reduction

44. The component has effectively reduced the incidence of poverty for the household beneficiaries (2,270 families/10,529 persons) in the project area, especially for about 5000 of the poorest families in the western region of Hainan. The implementation of the project generated employment opportunities, both short- and long-term, including employment for women. An annual increase of about three million labor-days per year, equivalent to about 10,000 new jobs have been created. Together with the production gains especially from high-value cash crops, the project has helped to raise the income level of the farmers. The MSDI sample surveys of farm income among resettlement villages in the irrigation area indicated that villages which are served by the HMC have increased their income by an average of about 30 percent over that before the move after allowing for inflation. No detailed data has been collected in relation to non-resettlers, but spot interviews indicate a much larger increase, attributable to the fact that per capita land areas are considerably greater.

Indirect Benefits

45. The irrigation project has contributed to an increase in local government revenues through the collection of agricultural and special product taxes derived from the expanded irrigated/reclamation land and the change of the cropping pattern (increased high-value cash crops) in the project area. The local governments, in turn, have invested in infrastructure (roads, electricity, water supply, etc.) and other social amenities (health clinics, schools, etc.), all of which have contributed to the overall improvement of the quality of life for the project beneficiaries.

Internal Rate of Return (EIRR)

46. At appraisal, an EIRR of 15% was calculated for the project as a whole based on the estimated benefits of power and irrigation. In the absence of willingness-to-pay data long run marginal cost was used as a proxy for benefit. For the ICR a "willingness-to-pay" type of analysis was carried out ex-post using prices of energy sold to the grid in 1996, plus power development surcharges applied at provincial levels. The generation tariff assumed was a 50/50 blend of two current generation tariffs: 59 fen/kWh from a 300 MW coal fired power plant and 65 fen/kWh for new industrial gas turbines burning gas[2]. The operating pattern for Daguangba supports this split with about 50 percent of output being scheduled for peaking. Surcharges of 2.4 fen/kWh for power development funds which are added at the consumer level were added to give a total tariff at generation level of 64.4 fen/kWh. The calculated ex-post EIRR with joint costs allocated in

[2] This is less than the 74 fen/kWh tariff recommended for Daguangba by expert team from SPDC and construction Bank but considerably more than the 37 fen/kWh "temporary" tariff currently allowed by the pricing commission.

accordance with the "separable-costs-remaining-benefits" methodology is 16.1 percent overall, 16.4 percent for power and 15.1 percent for irrigation. Table 9B provides details.

HEPCO Financial Performance

47. Comparative financial statements containing the appraisal projections and the actual data for the period of project implementation (1991 through 1998) are summarized in Annex A. Over the seven-year period of project implementation, HEPCO's energy sales have increased by a factor of 2.9, an average increase of 27.2 percent per annum, reflecting the fast economic growth in Hainan Province, the largest special economic zone in China. The average tariff has been increased by 65.3% from 32.0 fen/kWh in 1991 to 52.9 fen/kWh in 1998 (representing about six percent increase in dollar terms). The actual operating revenue in 1998 amounted to Y 1.45 billion, about 4.8 times of that in 1991 and 44.8 percent higher than projected at appraisal. Along with the increase in revenues, operating expenses also rose but more rapidly, largely due to much higher than expected power purchase costs. This resulted from changes in the power sector structure, whereby most new power plants were built by independent or semi-independent joint investment partnerships which sell power to the HEPCO grid. HEPCO role has thus changed to certain extent to that of a purchasing agency and transmission utility. HEPCO was profitable until 1996, but suffered losses in both 1997 (Y 1.6 million) and 1998 (Y 43.2 million). The main factor behind this change in fortune was the sharp slow down in demand growth that occurred in 1996, after HEPCO had entered into substantial power purchase commitments at high prices. Purchased power costs doubled from 1995 to 1996, while average tariff is actually lower in 1998 than 1995 due to lack of provincial government approval to pass through tariffs determined on the basis of the central government's "new power/new price" policy. For example, the "temporary" tariff approved by the provincial pricing commission for Daguangba power plant is only 37 fen per kWh in comparison with 74 fen recommended by a task force composed of representatives from Construction Bank and State Development and Planning Commission (SDPC). Another contributing factor to the losses is the wet season failure in 1998 which resulted in low inflows and low reservoir levels severely limiting the energy generation of Daguangba.

48. Three financial covenants were included in the Legal Agreements, namely: HEPCO should (a) cover all operating costs and debt service in 1991/92, and maintain a self-financing ratio of not less than 20 percent in 1993, 25 percent in 1994, and 30 percent thereafter; (b) ensure that its debt service coverage ratio is not less that 1.1 times in 1991-1993, 1.2 times in 1994-1996, and 1.3 times thereafter; and (c) maintain a debt/equity ratio of no more than 85/15 in 1991, 80/20 in 1992/93, 75/25 in 1994/95 and 70/30 thereafter. Over the course of project implementation, HEPCO has been basically in compliance with debt service and debt equity covenants, but has generally not been in compliance with self financing covenants, and failed to break even in 1997 and 1998.

D. Project Sustainability

49. Technically, the dam, power plant constructed under the project are of good quality, are being adequately maintained and operated. HEPCO could improve reservoir operations to maximize benefits. Financially, the "temporary" tariff allowed by the provincial government would not be adequate to sustain it as an independent power plant. However, as an operating unit of HEPCO its operations budget and debt repayment are being maintained. While HEPCO is in financial difficulties, it remains solvent partially through transfers from the provincial power development as "debt swaps". The situation should improve as power demand continues to recover and excess generating capacity is absorbed.

50. The irrigation component is likely to be sustainable because of: the good quality of the completed works; the commitment of the local government in the project area; the newly developed agricultural commodity (tropical crops) production bases; clearly defined and assigned responsibility in O&M Regulation of the HMC System to ensure sustained operation of the completed irrigation facilities; the effective agricultural support services system to ensure sustained agricultural production; and project-promoted growth of the local economy and generated revenue for the local governments that, in return, provide continued support for the project area.

51. The rehabilitation strategy for resettlement is land based supplemented by income from tropical tree crops, and therefore is potentially sustainable in all cases. Sustainability has been proven for about 60 percent of resettlers. For the remaining 40 percent it will be sustainable provided existing plans for land development and provision of irrigation facilities are implemented.

E. Bank Performance

52. During project preparation, there appears to have been a tendency to equate the project with similar power projects in China and underestimate the effect of special circumstances such as the multipurpose nature of the project, the fact that the power company involved was under the province rather than the state, and that Hainan itself had only recently been upgraded to provincial level. However, internal review procedures resulted in adequate consideration being given to these matters. The originally scheduled appraisal review meeting was downgraded to a peer review meeting and a further pre-appraisal mission was undertaken. During the hiatus period, several brief missions were carried out in conjunction with other operational work in China, followed by a full post-appraisal mission to update data and analyses. Thus, by the time the project was presented to the Board all important issues had been addressed. One shortcoming in the appraisal process was the apparent failure to recognize inadequate resettlement planning in relation to villages which lost a major portion of their land but were not planned to be relocated. In addition, more consideration could have been given to methods of ensuring the provincial government met its commitment to irrigation development beyond that required for resettlement, including specific covenants and partial Bank financing.

53. After loan approval, supervision was initially light, with the first supervision mission not occurring until about 15 months after Board presentation, although procurement review was intensive during this period. After this, supervision was intensified, particularly when it was recognized that there were shortcomings in resettlement implementation. From 1992 to 1999, there were a total of 14 missions 13 of which included a resettlement specialist. These missions (and the leverage applied at the time of closing date extension and ICR rating) played a role in improving resettlement implementation, including the contracting of the independent resettlement monitoring and evaluation program, the 1998 adjustment to the resettlement budget, preparation of a supplementary resettlement plan for land loss villages in 1998, the establishment of the reservoir maintenance fund in May, 1999 and finally in the approval of supplementary funds for the HMC Phase 2 and resettlement in August 1999. After recognition, in 1997, of the provincial government's intention to curtail irrigation development to the area serviced by the HMC Phase 1, supervision missions also focused on this aspect.[3]

54. Overall, it is considered that the Bank's performance was satisfactory.

F. BORROWER PERFORMANCE

55. The assessment of Borrower performance needs to cover the signatory to the various agreements: central and provincial governments and HEPCO. HEPCO's performance was good in relation to those aspects about which it cared most: the construction of the dam, power plant, transmission lines etc. It also performed adequately in construction of the HMC and reviewing and coordinating resettlement implementation. The resettlement office under HEPCO made great efforts in relation to the latter function. On the other hand, resettlement budget allocation apparently received a lower priority by HEPCO in comparison with other project components, often resulting in slow allocations and delayed completion of relocation and rehabilitation targets, although the slow arrival of provincial government funding was cited as the main reason for such delays. The central government generally performed satisfactorily including the approval of necessary revisions in revised resettlement budgets, not however without the usual delays associated with such revisions. It was also instrumental in putting together a financing plan for completion of the agricultural and resettlement components at the time of closing date extension in late 1997. However, this was not modified when the planned contribution from the Construction Bank of China did not materialize. The performance of the provincial government has been disappointing in the areas of fund allocation, approval of tariff level for Daguangba, approval of consumer tariff structure changes, approval of level of reservoir maintenance fund and approval of overseas training programs. On the other hand, it must be acknowledged that financing difficulties have been exacerbated by the East Asia economic crisis. The provincial government has now

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[3] The reason that this was not recognized earlier was due to confusion in the SAR definition of project scope which included HMC Stage 1, but the lengths given only covered Phase 1 of Stage 1. The remainder was apparently intended to be covered by Other Canals and On-Farm Works financed by the provincial government.

allocated funds to complete the project and HEPCO report that tariff restructuring is being accelerated. Considered as a whole Borrower performance is rated as Satisfactory.

G. ASSESSMENT OF OUTCOME

56. The overall assessment must take into account: the satisfactory achievement of objectives with regard to the power plant including environmental matters, the largely achieved objectives of the irrigation component, the limited achievement of institutional development objectives, and the currently unsatisfactory outcome with regard to the resettlement project, which however could be reversed in the near term with the recently approved allocation of resources and increased attention to this matter by HEPCO and the provincial government. Overall, a rating of Satisfactory is assigned.

H. FUTURE OPERATION

Power Plant

57. The Daguangba Hydropower Plant commenced operation on December 29, 1993 with the commissioning of the first generating unit. The commissioning of the fourth generating unit was on March 29, 1995. Since its operation, the power plant has generated a cumulative 1,981.3 GWh with breakdown by year as follows:

Year	1994	1995	1996	1997	1998	Total
GWh	312.4	372.6	426.1	501.5	368.7	1,981.3

58. The relatively slow buildup of generation can be attributed to the fact that in accordance with the design schedule, first generating units entered service prior to completion of spillway crest gates and reservoir filling. The reservoir first filled to full supply level in November 1996 and in 1997 the generation was close to the design level of 520 GWh. The decrease in 1998 was due to an exceptional drought in the area exacerbated by the fact that the dispatchers were overusing Daguangba generation based on system requirements. The reservoir water level has been at the minimum operating level for quite some time. The limited amount of water used each day is mainly to meet demands of irrigation and residential/industrial water supply.

59. Daguangba Hydropower Plant is well staffed with one director, two deputy directors (including one chief engineer), 83 employees in plant operation and maintenance, and 337 employees in non-core service businesses. Comprehensive and well-documented operation and maintenance procedures are in place to ensure proper operation and maintenance of the power plant. Methodology for efficient utilization of water, procedures for regular dam safety inspection and reporting as well as for flood forecasting and environment monitoring are also in place and followed. Nevertheless, it appears that there is room for substantial improvement in HEPCO's operation of Daguangba. Admittedly the project is unique in the HEPCO system and there is no previous experience in reservoir operation on this scale. Also the relative size of the

project in relation to the overall system will diminish. On the other hand flow diverted for irrigation – only nominal to date – will increase. As an overall guide, HEPCO should endeavor to maintain the reservoir at a relatively high level under normal conditions – closer to the MSDI upper rule curve. This will produce several advantages, namely: (a) maintaining plant capability at 240 MW; (b) minimizing the risk of reservoir failure, i.e. draw-down to MOL as at present; and (c) increasing energy by maintaining a higher average head.

60. With regard to performance indicators for the future, the State Power Corporation has set benchmarks including numerous parameters which collectively measure safety, reliability and efficiency of operation of hydroelectric power plants. Some of the main performance indicators are listed in Table 6A. In addition, a different set of criteria relate to factors such as cleanliness, aesthetics and working environment which, if met, qualify the power plant for "civilized" status. When both of these standards are met the power plant is accredited as having met the dual standards. A "first class" standard is also in place involving more rigorous performance indicators for some operating efficiency factors. The Daguangba power plant has already been accredited as meeting the dual standards.

Irrigation Facilities

61. The HMC Phase I was completed and started operation in June 1994. The Water Resource Bureau of Dongfang City has operated and maintained (O&M) the new irrigation facilities since May 1994. The High Main Canal Water Management Division (HMCMD) in the Bureau is the unit responsible for O&M of the HMC irrigation system. Under HMCMD, four water management stations were set up. The O&M for the main, sub-main, branch, and lateral canals is carried out by each station according to the O&M Regulation of the HMC Irrigation System and to a schedule prepared by the Dongfang Water Resource Bureau. Sub-laterals and field ditches are maintained by water users twice a year. In addition, each township government, village committee and agro-economic development organization takes an active part in assisting the water authority in the O&M work. The agriculture technical support was provided to the project area by the South China Academy of Tropical Crops and the Dongfang City Agriculture Research Institute for the introduction, testing, and extension of new and improved varieties. Future operations will focus on efficient operation and maintenance of the completed irrigation works and facilities so as to achieve the project's full development. The existing HMCMD and staff will be maintained to concentrate on O&M aspects of the project. To further enhance the project's economic benefits, the irrigation areas and agricultural support service facilities will be progressively adapted to a market-oriented production economy with a self-supporting operation mechanism, responsible for its own profits and losses.

Resettlement

62. With regard to resettlement, about Y 56 million of the approved budget of Y 262.33 million remains to be spent on production development. On June 15, 1999, HEPCO, based on a review of action plans prepared by the two counties, submitted a plan outlining a list of remaining resettlement works which need to be completed between July 1999 and June 2000. The total cost for these remaining works totals Y 56 million, but the source of funds was not identified. The Y50 million recently allocated by the provincial government should allow general completion of the remaining works after which the reservoir maintenance fund will generate income based on energy production of about Y2.1 million per year for ten years which should sustain annual workplans for the resettlement unit within HEPCO and two county resettlement offices.

Bank

63. In line with the management's response to the OED report "Recent Experiences with Involuntary Resettlement (Report No. 17538), it is recommended that the Bank continue to supervise the resettlement component until it is clear that incomes have been restored in real terms, or at least until physical facilities are in place to ensure this. It is recommended that in FY00, two supervision missions are mounted for this purpose.

I. KEY LESSONS LEARNED

64. Key lessons mainly relate to the resettlement and irrigation components. Those relating to resettlement serve to reinforce those derived from other Chinese reservoir resettlement projects. Lessons are:

(a) the need to carefully appraise: proposed institutional arrangements for resettlement, both at overall project level and implementation (county and township) level; the treatment of land acquisition even where, prima facie, relocation is not required; the feasibility of "moving back resettlement strategies where there is a tendency to over-estimate remaining land resources.

(b) the need to further advance resettlement planning at the planning stage to allow better assessment of resettlement strategies, and the preparation of more accurate cost estimates.

(c) the need to consider in the project design measures to ensure borrower commitment to all elements important to the success of the project, including increased level of Bank financing for these elements and staged performance targets so that implementation can be carefully monitored.

PART II: STATISTICAL TABLES

TABLE 1: SUMMARY OF ASSESSMENTS

Achievement of Objectives

	Substantial	Partial	Negligible	Not Applicable
Macroeconomics policies				X
Sector policies				X
Financial objectives			X	
Institutional development		X		
Physical objectives	X			
Poverty reduction		X		
Gender concerns				X
Other social objectives				X
Environmental objectives	X			
Public sector management				X
Private sector development				X

Project Sustainability

Likely	Unlikely	Uncertain
X		

Bank Performance

	Highly Satisfactory	Satisfactory	Deficient
Identification		X	
Preparation assistance		X	
Appraisal		X	
Supervision		X	

Borrower Performance

	Highly Satisfactory	Satisfactory	Deficient
Preparation		X	
Implementation		X	
Covenant compliance			X

Assessment of Outcome

Highly Satisfactory	Satisfactory	Unsatisfactory	Highly Unsatisfactory
	X		

TABLE 2: RELATED BANK LOANS

Loan Title	Purpose	Year of Approval	Status
Ln. 2382-CHA Lubuge Hydroelectric Project	To construct a rockfill dam, a spillway, an underground powerhouse, to install 4 generating units of 150 MW each, 3 single circuits of 220 kV transmission lines; to provide consultant services and a training program.	02/21/84	Loan was closed on 06/30/92.
Ln. 2493-CHA Second Power Project	To construct a 500 kV transmission line from Xuzhou to Shanghai and 5 associated substations totaling 3,500 MVA in capacity, to install tele-control and telecommunications equipment for load dispatching, and to provide training for 400 kV transmission lines and substations.	02/19/85	Loan was closed on 06/30/92.
Ln. 2706-CHA & Ln. 2955-CHA Beilungang Thermal Power Projects I and II	To construct a coal-fired thermal power project with two units of 600 MW and two single circuit of 500 kV transmission lines, and to carry out a tariff study, a study on ZPEPB reorganization and management improvement and a study for improvement of distribution networks for the cities of Ningbo and Hangzhou.	05/29/86 & 06/14/88	First loan closed 06/30/94. Second loan closed 06/30/95.
Ln. 2707-CHA Yantan Hydroelectric Project	To construct a 110 m high concrete gravity dam, a spillway, a powerhouse, and a shiplift; to install 4 generating units of 275 MW each, 2 single circuits of 500 kV transmission lines and 3 associated substations; and to carry out a training program.	05/29/86	Loan was closed on 06/30/94.
Ln. 2775-CHA & Shuikou Hydroelectric Project	To construct a 101 m high concrete gravity dam, a spillway, a powerhouse and a navigation lock; to install 7 generating units of 200 MW each; to carry out a resettlement program in the reservoir.	01/06/87	Closed 6/30/93.
Ln. 3515-CHA Second Shuikou Hydroelectric Project	To complete the ongoing Shuikou dam and hydroelectric power plan, upgrade the control and data acquisition system of the Fujian grid, carry out an action plan for tariff reform, and a training program for planning and financial management.	09/01/92	Closed 6/30/98. Current ICR..

Loan Title	Purpose	Year of Approval	Status
Ln. 3387-CHA & Ln. 3933-CHA Ertan Hydroelectric Projects I & II	To construct a 240 m high arch dam with an underground powerhouse, to install 6 550-MW generating units and associated equipment; to carry out an environmental management program, studies of power pricing and reservoir operation, and a training program.	07/02/91 & 08/22/95	Implementation under way. First loan closed 12/31/96. Closing date second loan 12/31/2001
Cr. 2305-CHA & Ln. 3412-CHA Daguangba Multipurpose Project	To construct a 56 m high gravity dam and an underground powerhouse with 4 x 60 MW generating units; to erect a 36 km long double-circuit 220 kV transmission line and to build canals to irrigate 12,700 ha of land.	10/31/91	Closed 12/31/98. ICR in preparation
Ln. 3433-CHA Yanshi Thermal Power Project	To install 2 300-MW generating units and 5 220-kV transmission lines and associated substations; to carry out a tariff study, a tariff action plan, and a training program for upgrading the technical, financial and management skills for HPEPB staff.	01/14/92	Closed 12/31/97.
Ln. 3462-CHA Zouxian Thermal Power Project	To install 2 additional 600 MW generating units; to construct 500 kV and 220 kV transmission lines and substations; and to carry out an air quality control study, a power tariff study, an action plan for tariff adjustment, and a training program for the technical, financial, and management staff of SPEPB.	04/12/92	Implementation under way. Closing date 06/30/99.
Ln. 3606-CHA Tianhuangping Hydroelectric Project	To construct a pumped-storage hydro-electric power plant with six 300 MW reversible pump-turbine units, together with upper and lower reservoirs, a water conveyance system, an underground powerhouse; to erect 250 km long 500 kV transmission lines; to carry out studies of optimal power plant operation and its output pricing; and to strengthen the beneficiary's organization through technical assistance and training.	05/18/93	Implementation under way. Closing date 12/31/2001.

Loan Title	Purpose	Year of Approval	Status
Ln. 3718-CHA Yangzhou Thermal Power Project	To construct a coal-fired thermal power plant with two 600 MW generating units; to erect two 500 kV transmission lines (30 km long); to extend technical assistance for the development and implementation of improved accounting and financial management information systems; and undertake management development and staff training.	03/22/94	Implementation under way. Closing date 12/31/2000.
Ln. 3848-CHA Sichuan Transmission Project	To construct a new 500 kV transmission network consisting of 2,260 km of transmission lines and 5,250 MVA of substations; provide technical assistance for implementation of sector reform plan, organizational improvements and financial management systems.	02/28/95	Implementation commenced. Closing date 12/31/2001.
Ln. 3846-CHA Zhejiang Power Development Project	To construct Beilungang Phase II power plant consisting of three 600 MW coal-fired units; to construct 400 circuit-km of 500 kV transmission lines, 2,250 MVA of 500 kV substations and reinforce distribution networks in Hangzhou and Ningbo; to extend technical assistance to assist the power company in commercialization and corporatization, establish computerized financial management information system, improve transmission and distribution planning and upgrade environmental monitoring.	02/28/95	Implementation commenced. Closing date 12/31/2002.
Ln. 3980-CHA Henan (Qinbei) Thermal Power Project	To construct two 600 MW coal-fired thermal power units; to erect two 165 km 500 kV transmission lines; to assist HPEPB in engineering, procurement and construction supervision; and to extend technical assistance to support the implementation of the power sector reform action plan.	2/27/96	Canceled 12/12/97 without disbursement.

Loan Title	Purpose	Year of Approval	Status
Ln. 41720-CHA Tuoketuo Thermal Power Project	To construct the first two coal-fired 600 MW units in Inner Mongolia Autonomous Region; to implement a desertification control and dryland management program: to assist TEPGC with the introduction; of modern accounting and financial management systems, environmental management, operation and maintenance of the power plant and involvement of private investors in existing and new power projects in Inner Mongolia. To construct two 220 kV indoor substations in Beijing: to add a 250 MVA transformer to Wangfujing substation in Beijing; and to assist NCPGC to implement accounting and financial management systems.	05/27/97	Implementation underway. Closing date 7/31/2004.
Ln. 41970-CHA Waigaoqiao Thermal Power Project	To construct two 900-1000 MW coal-fired supercritical units; to install FGD facilities at Shidongkou Power Plant to offset SO_2 emissions from the project; to construct two 500 kV transmission lines; to assist SMEPC to implement modern accounting and financial management systems, promote efficient management and power sector reforms including financial and corporate restructuring of the generation company.	06/24/97	Implementation underway. Closing date 1/31/2006.
Ln. 4304-CHA Energy Conservation Project	To achieve large, sustained and growing increases in energy efficiency and associated reductions in growth of carbon dioxide emissions and other pollutants by: (a) introducing, demonstrating and disseminating new project financing concepts and market-oriented institutions to promote and implement energy efficiency measures in China; and (b) developing a more efficient national energy conservation information dissemination program.	03/26/98	Implementation underway. Closing date 6/30/2006.

Loan Title	Purpose	Year of Approval	Status
Ln. 4303-CHA East China (Jiangsu) Power Transmission Project	To alleviate critical bottlenecks in power transmission infrastructure and increasing electricity trade on a commercial basis in the East China region by (a) the construction of 500 kV transmission lines and substations; (b) implementation assistance for engineering and construction management; (c) technical assistance for improved interprovincial power exchange policies and procedures; (d) technical assistance for improved accounting and financial management systems; and (e) institutional development and training.	03/26/98	Not yet effective. Implementation underway. Closing date 9/30/2004
Ln. 4350-CHA Hunan Power Development Project	To remedy power shortages in Hunan by providing efficient, reliable, and environmentally sound power supply. Project components include: (a) development of two 300 MW anthracite-fired generating units; (b) supply and installation of about 794 km of 220 kV lines and 1,920 MVA of transformer substations capacity; (c) provision of technical assistance for construction management ; (d) provision of technical assistance for preparation of commercial power purchase agreements and other relevant documentation; (e) provision of technical assistance for implementation of HEPC's restructuring plan; and (g) provision of technical assistance for improvement of the financial management system.	06/18/98	Not yet effective; Implementation underway; closing date 12/31/2004.

TABLE 3: PROJECT TIMETABLE

Steps in project cycle	Date planned	Date actual
Identification		09/23/1986
Preappraisal		05/15/1988
Appraisal		04/11/1989
Negotiations		03/05/1990
Board presentation		10/31/1991
Signing		11/22/1991
Effectiveness		02/20/1992
Project completion	12/31/1996	03/31/2000*
Loan closing	12/31/1997	12/31/1998

* The dam and power plant were completed before the planned completion date. The delays are mainly for HMC and resettlement components.

TABLE 4: LOAN/CREDIT DISBURSEMENT: CUMULATIVE ESTIMATE AND ACTUAL
(US$ million)

	FY92	FY93	FY94	FY95	FY96	FY97	FY98	FY99
Appraisal estimate	17.9	36.2	53.1	65.0	67.0			
Actual	7.76	15.43	44.50	60.92	64.10	64.70	67.72	69.28
Actual as % of adjusted estimate								
Date of final disbursement	February 24, 1999							

TABLE 5A: KEY INDICATORS FOR PROJECT IMPLEMENTATION

PHYSICAL CONSTRUCTION

Key implementation indicators in SAR	Appraisal Estimated Completion	Actual Completion	Comparison
Preparatory works	06/91	06/90	
Civil works dam & power facilities	12/94	12/95	
Hydraulic gates & hoists	09/93[1]	29/07/95	
Generating units			
Unit 1	09/93	12/29/93	
Unit 2	12/93	05/26/94	
Unit 3	09/94	10/29/94	
Unit 4	12/94	03/29/95	
Overall commercial operation	-	12/30/95	
Substation	09/93	11/93	
Transmission line	09/93	11/93	
PLC & load dispatch system	12/94	Planned 11/99[2]	
HMC & Sanjiaolu canal (3,667 ha)	06/94	06/94	
HMC Phase I		06/94	
HMC Phase II		Planned 03/2000	
Other canals (9,000 ha) & on-farm works	12/96	Planned 12/2000	
Resettlement (physical relocation)	12/95	08/95	
Environmental protection	12/93	Planned 12/99	
Resettlement budget adjustment including Baoying and Baoding villages		12/98	

[1] As reported in SAR, which was evidently not in accordance with HEPCO schedule.
[2] Delayed until new HEPCO building complete.

TABLE 5B: KEY INDICATORS FOR PROJECT IMPLEMENTATION

HEPCO TRAINING PROGRAM

Training Areas	Appraisal Estimates		Actual	
	Number of Trainees	Duration (months)	Number of Trainees	Duration (months)
2. TRAINING OF HIGH-LEVEL STAFF				
Overseas Training				
Department heads	5	1	6	1
Division chiefs	23	1	35	1
Domestic Training				
Department heads	5	6	6	1
Div. chiefs/project managers	23	6	40	2
Power plant superintendents	5	12	18	1
Teaching staff	20	12	10	5
Mgmt information system	5	6	10	3
Load dispatch & telecom.	10	6	20	9
Planning	5	6	5	3
3. TRAINING OF TECHNICAL STAFF (DOMESTIC TRAINING)				
Design staff				
Power plants	10	4	10	6
Transmission and distribution	10	4	10	6
Construction supervision				
Power plants	20	6	20	6
Transmission and distribution	20	6	20	3
Contract management	5	3	5	3
Tendering	3	3	10	2
Operation and maintenance				
Power plants	20	6	109	15
Transmission and distribution	20	6	50	6

TABLE 5C: KEY INDICATORS FOR PROJECT IMPLEMENTATION AGRICULTURAL COMPONENT

Item/Description	Unit	Estimated at Project Appraisal	Estimated at Project Completion (98-99)	Completed as % of SAR estimate
Irrigation Component				
Total irrigated area[a]	Ha	12667.0	8473.3	66.9
Maximum draw off through High Main Canal	Cum/s	12.0	14.0	116.7
High Main Canal	Km	15.6	14.7	94.2
Hongguan and Jiucun Branch Canal	Km	19.2	47.1	245.3
Sanjiaolu Branch Canal	Km	10.3	10.6	102.9
Lateral Branch Canal	Km	29.0	8.9	30.8
Field Ditches	Km	113.3	175.4	154.8
On-farm works and agriculture support				
Land leveling	Ha	4320	9122	211.2
Soil improvement	Ha	1200	1789	149.1
Fertilizer	Ton	1502.3	2836	188.8
Agrochemical	Ton	102.3	141.8	138.6
Seeds	Kg/ha	225	220	97.8
Seeds company	No	1	1	100.0
Agriculture service center	No	4	4	100.0
Training				
Irrigated agriculture research and training center	No	1	1	100.0
Farmers	m-month	500	1000	200.0
Project Manager	m-month	6	8	133.3
Project Staff (local training)	m-month	50	95	190.0
Consultant services	m-month	300	450	150.0
Study tour (domestic)	m-month	4	30	750.0

[a] A total of 6473.3 ha developed in 1994, and about 1333.3 ha has been developed for existing irrigation area to be supplied with supplementary irrigation. The balance of about 4000 ha will be completed by the end of year 2000, in which 666.7 will be completed by end of 1999.

TABLE 6A: KEY INDICATORS FOR PROJECT OPERATIONS POWER PLANT

Index	Unit	Actual Completion to 12/31/98	Target Value Dual Standard	Target Value First Class Standard[1]
1. Continuous Safe Operation	Days	1026	Three 100 day periods	Three 100 day periods
2. Human accidents at year end	No	0	0	0
3. Dam Safety Evaluation[2]		Regular Dam[2]	Regular Dam	Regular Dam
4. Annual Energy Output	GWh	368.7[3]	495.0	495.0
5. Station Services as % of generation	%	2.19	0.15	0.15
6. Average Availability	%	93.1		
7. Perfect Operation of Main Equipment	% of year	100	100	100
8. Perfect Operation of Flood Forecasting System	%	100	95	95
9. Accuracy of Forecast of Largest Flood	%	85 (peak) 84 (vol.)	92	92
10. Average accuracy of Flood Forecast	%	83 (peak) 89 (vol)	85	85

[1] In addition to meeting targets listed, first class performance standard requires following:
- (a) Computerized MIS system for.
- (b) Computerized SCADA and EMS for plant.
- (c) Automatic hydrological forecasting system in place.
- (d) No leakage from equipment.
- (e) Plant labor force less than 0.15 persons/MW.

[2] Routine safety evaluation every year. Reviewed by panel every five years. Compliance with all criteria required.

[3] See text.

TABLE 6B: KEY INDICATORS FOR PROJECT OPERATIONS AGRICULTURAL COMPONENT

	SAR estimate			ICR estimate			% of ICR/SAR		
	Area (ha)	Yield (ton)	Production (ton)	Area (ha)	Yield (ton)	Production (ton)	Area (%)	Yield (%)	Production (%)
Crops									
Rice	6000.0	4.3	25800.0	6018.0	4.7	28254.5	100.3	109.2	109.5
Corn	334.0	3.5	1169.0	340.0	3.5	1196.8	101.8	100.6	102.4
Peanuts	1140.0	2.1	2394.0	1150.0	2.1	2415.0	100.9	100.0	100.9
Beans	334.0	1.8	601.0	340.0	1.9	647.7	101.8	105.8	107.8
Sweet Potato	927.0	3.0	2781.0	930.0	3.0	2799.3	100.3	100.3	100.7
Vegetable	1334.0	10.0	13340.0	1350.0	10.3	13911.8	101.2	103.1	104.3
Watermelon	334.0	25.0	8350.0	340.0	25.0	8501.7	101.8	100.0	101.8
Sugar Cane	3212.0	50.0	160600.0	3153.0	51.0	160803.0	98.2	102.0	100.1
Pineapple	200.0	11.0	2200.0	157.0	11.0	1726.2	78.5	100.0	78.5
Pepper	134.0	2.5	335.0	0.0	0.0	0.0	0.0	0.0	0.0
Mango	1360.0	11.6	15780.0	1784.0	11.9	21220.7	131.2	102.5	134.5
Rubber	1534.0	1.3	2025.0	1100.0	1.4	1485.0	71.7	102.3	73.3
Sisal	1047.0	1.5	1571.0	439.0	1.5	658.5	41.9	100.0	41.9
Eucalyptus	NA	NA	NA	2733	?	?			

TABLE 7: STUDIES INCLUDED IN PROJECT

Study	Purpose as defined at Appraisal/Redefined	Status	Impact of Study
Power Pricing Study	To transfer to HEPCO modern methods of power tariff design based on the criteria of economic efficiency, financial viability and fairness to power consumers and suppliers; to look into the practical problems raised by the transition from the existing pricing system to more desirable pricing arrangements and to propose a medium-term action plan.	Completed 1994	Comprehensive tariff structure recommended. HEPCO proposed to the provincial government to implement new tariff structure including time-of-day tariff, but has not obtained the government's approval.
Power System Planning Study	To develop an appropriate methodology for establishing investment plans in Hainan which take into account uncertainties about load forecast, the availability and price of fuels, and the rate of connection of isolated systems to the main grid. This methodology later could be replicated for similar cases in mainland China. To strengthen HEPCO's capability in routinely applying some of the planning methods identified from the study and in developing and maintaining the required database.	Completed 1994	Least cost investment plan with specific power generation facilities identified. Such plan was implemented. However, due to economic downturn in recent years, there is now excessive generation capacity in Hainan.

TABLE 8A: PROJECT COSTS
(Yuan million)

Item	Appraisal estimate			Actual/latest estimate		
	Local	Foreign	Total	Local	Foreign	Total
Preparatory Works	24.0	0.9	25.0	41.7	0.0	41.7
Resettlement	135.4	15.1	150.5	205.8	63.6	269.4
Environmental Management	6.2	3.7	9.9	2.8	10.8	13.6
Civil Works (Dam and Power Facilities)	182.1	4.5	186.6	440.1	0.0	440.1
HMC and Sanjiaolu Canal System	39.1	13.2	52.2	24.4	64.2	88.6
Canals and on-farm works beyond resettlement	62.8	16.3	79.1	37.7	0.0	37.7
Major construction materials	5.2	133.1	138.3	75.6	192.5	268.1
Gates and Hoists	15.3	6.8	22.1	25.0	0.0	25.0
Turbines and Generators, and other plant equipment	70.1	6.3	76.4	65.2	15.2	80.3
T&G Governors and Static Excitation	0.9	19.6	20.5	0.0	20.5	20.5
PLC Equipment, transmission line, substation	11.6	26.5	38.1	14.2	161.8	176.0
Load Dispatch System for Hainan Island Grid	0.2	13.1	13.3	0.0	29.3	29.3
Agricultural Support Services	4.2	0.0	4.2	0.0	0.0	0.0
Project Management and Engineering	26.0	5.4	31.5	58.8	0.0	58.8
Technical Assistance and Training	5.0	7.0	12.0	0.4	2.4	2.8
Total Base Costs[4]	588.0	271.7	859.7			
Contingencies						
Physical	59.0	15.4	74.3			
Price	107.6	44.9	152.5			
Total Project Costs[5]	754.5	332.0	1,086.5	991.8	560.4	1552.2
Interest during Construction						
IBRD Loan[6]	26.5	12.2	38.7	0.0	9.2	9.2
Other Loans	101.5	0.0	101.5	451.9	0.0	451.9
Total Financing Required[7]	882.5	344.2	1,226.7	1443.7	569.6	2013.3

[4] The project is exempt from taxes and duties.

[5] The actual project cost excludes $12.1 equivalent (Y100 million) local cost allocated by the provincial government in August 1999 to complete HMC and resettlement components. Potential benefits also ignored in economic analysis.

[6] Interest during construction (IDC) is based on onlending rate for projected disbursements of loan/credit proceeds. Foreign currency portion of IDC is based on Bank loan variable rate for projected disbursements of loan proceeds.

[7] Figures may not total exactly due to rounding.

TABLE 8B: PROJECT COSTS
(US$ million)

Item	Appraisal estimate			Actual/latest estimate		
	Local	Foreign	Total	Local	Foreign	Total
Preparatory Works	4.9	0.2	5.1	7.7	0.0	7.7
Resettlement	25.9	2.9	28.8	26.8	7.6	34.4
Environmental Management	1.2	0.7	1.9	0.4	1.3	1.7
Civil Works (Dam and Power Facilities)	35.3	0.9	36.2	59.9	0.0	59.9
HMC and Sanjiaolu Canal System	7.5	2.5	10.0	4.1	7.5	11.6
Canals and on-farm works beyond resettlement	12.0	3.1	15.1	4.6	0.0	4.6
Major construction materials	1.0	25.7	26.7	9.1	24.8	33.9
Gates and Hoists	3.0	1.3	4.3	2.9	0.0	2.9
Turbines and Generators, and other plant equipment	13.5	1.2	14.7	7.7	1.8	9.5
T&G Governors and Static Excitation	0.2	3.8	3.9	0.0	2.4	2.4
PLC Equipment, transmission line, substation	2.2	5.1	7.3	1.7	19.2	20.9
Load Dispatch System for Hainan Island Grid	0.0	2.5	2.5	0.0	3.5	3.5
Agricultural Support Services	0.8	0.0	0.8	0.0	0.0	0.0
Project Management and Engineering	5.2	1.0	6.3	8.9	0.0	8.9
Technical Assistance and Training	1.0	1.4	2.3	0.1	0.3	0.4
Total Base Costs[8]	113.6	52.2	165.8			
Contingencies						
Physical	10.5	2.9	13.4			
Price	9.8	4.0	13.7			
Total Project Costs[9]	133.8	59.1	193.0	133.6	68.4	202.0
Interest during Construction						
IBRD Loan[10]	4.8	2.0	6.8	0.0	1.1	1.1
Other Loans	17.9	0.0	17.9	56.3	0.0	56.3
Total Financing Required[11]	156.5	61.1	217.7	189.9	69.5	259.4

[8] The project is exempt from taxes and duties.

[9] The actual project cost excludes $12.1 equivalent (Y100 million) local cost allocated by the provincial government in August 1999 to complete HMC and resettlement components. Potential benefits also ignored in economic analysis.

[10] Interest during construction (IDC) is based on onlending rate for projected disbursements of loan/credit proceeds. Foreign currency portion of IDC is based on Bank loan variable rate for projected disbursements of loan proceeds.

[11] Figures may not total exactly due to rounding.

TABLE 8C: PROJECT FINANCING
(US$ million)

Source	Appraisal estimate			Actual/late estimate		
	Local	Foreign	Total	Local	Foreign	Total
IBRD/IDA	17.0	50.0	67.0	0.0	69.3	69.3
TCC II[12]	-	0.3	0.3	0.0	0.2	0.2
UNDP	-	0.1	0.1	0.0	0.0	0.0
MWR	12.0	-	12.0	20.5	0.0	20.5
SEIC	21.0	-	21.0	45.7	0.0	45.7
Hainan Government						
Loans	98.5	10.7	109.2	87.7	0.0	87.7
Grants	8.0	-	8.0	31.5	0.0	31.5
Local Government				4.5	0.0	4.5
Total Financing Required[13]	156.5	61.1	217.7	185.4	69.5	259.4

[12] Credit 1664-CHA

[13] Includes IDC of about $25 million; all of the financing sources would finance IDC relating to their own loans.

TABLE 9A: ECONOMIC COSTS AND BENEFITS

Comparison to Alternative Thermal Power (85MW coal & 225MW GT Plant)
(Y million in 1997 Economic Prices)

Year	Thermal Fixed Costs					Output (GWh)		Fuel Costs			Summary Thermal Costs			Project Costs						Hydro - Thermal	
	Investment		O&M											Investment		O&M		Total			
	Coal	GT	Coal	GT	Total	Coal	GT	Coal	GT	Total	Invest.	O&M	Total	Power	Joint	Power	Joint	Allocated	Full	Allocated	Full
1990	46.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.8	0.0	46.8	0.0	102.4	0.0	0.0	84.6	102.4	37.9	55.7
1991	140.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	140.3	0.0	140.3	9.6	102.1	0.0	0.0	93.9	111.7	-46.3	-28.6
1992	187.0	90.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	277.0	0.0	277.0	57.1	270.7	0.0	0.0	280.7	327.8	3.7	50.8
1993	93.5	315.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	408.5	0.0	408.5	101.3	356.1	0.0	0.0	395.4	457.4	-13.1	48.9
1994	0.0	270.0	14.0	5.6	312.0	272.0	40.0	54.4	16.0	70.4	270.0	19.7	360.1	222.2	261.6	5.1	7.0	449.2	495.9	89.1	135.9
1995	0.0	0.0	14.0	16.9	373.0	253.0	120.0	50.6	48.0	98.6	0.0	30.9	129.5	70.7	163.1	10.1	14.1	227.2	258.0	97.7	128.5
1996	0.0	0.0	14.0	16.9	426.0	306.0	120.0	61.2	48.0	109.2	0.0	30.9	140.1	15.5	28.4	10.1	14.1	60.7	68.1	-79.4	-72.0
1997	0.0	0.0	14.0	16.9	501.0	381.0	120.0	76.2	48.0	124.2	0.0	30.9	155.1	16.4	72.0	10.1	14.1	97.7	112.7	-57.4	-42.4
1998	0.0	0.0	14.0	16.9	369.0	249.0	120.0	49.8	48.0	97.8	0.0	30.9	128.7	13.3	48.8	10.1	14.1	75.3	86.2	-53.4	-42.5
1999	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	10.1	14.1	21.7	24.2	-137.2	-134.7
2000	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
2001	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
2002	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
2003	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
2004	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
2005	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
2006	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
2007	0.0	90.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	90.0	30.9	248.9	0.0	0.0	8.3	11.1	17.5	19.4	-231.4	-229.5
2008	0.0	315.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	315.0	30.9	473.9	0.0	0.0	8.3	11.1	17.5	19.4	-456.4	-454.5
2009	0.0	270.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	270.0	30.9	428.9	0.0	0.0	8.3	11.1	17.5	19.4	-411.4	-409.5
2010	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
2011	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
2012	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
2013	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
2014	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
2015	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
2016	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
2017	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
2018	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
2019	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
2020	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
2021	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
2022	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
2023	0.0	0.0	14.0	16.9	520.0	400.0	120.0	80.0	48.0	128.0	0.0	30.9	158.9	0.0	0.0	8.3	11.1	17.5	19.4	-141.4	-139.5
Totals	**467.5**	**675.0**									**1817.5**			**506.1**	**1405.3**			**Equalizing Discount Rate**		**0.41**	**0.21**
Present Values																					
10%	362.8	558.2	90.3	101.7	3014.9	2291.9	723.0	458.4	289.2	747.6	921.0	192.0	1860.5	319.1	947.5	55.6	76.0	1220.2	1398.2	-640.4	-462.3
12%	346.1	493.7	71.8	80.0	2364.8	1795.9	568.9	359.2	227.6	586.8	839.8	151.8	1578.3	293.0	882.5	44.3	60.6	1116.3	1280.4	-462.0	-298.0
14%	330.5	441.8	58.1	64.1	1890.3	1434.3	456.0	286.9	182.4	469.3	772.3	122.3	1363.8	269.5	823.8	35.9	49.2	1026.6	1178.5	-337.2	-185.4

Investment data		
	Coal	GT
Y/kW	5500.0	3000.0

Installation		
1994	85.0	75.0
1995		150.0

Fuel Cost Data		
	Coal	GT
Y/kWh	0.2	0.4

Average Energy Costs (10% discount rate)

Thermal Cost	61.7	fen/kWh
Hydro Cost		
82.6% Joint to Power	40.5	fen/kWh
100 % Joint to Power	46.4	fen/kWh

TABLE 9B: ECONOMIC COSTS AND BENEFITS

Economic Internal Rate of Return (EIRR)

Assumed Tariff (fen/kWh) 64.4

Costs and benefits in Y million 1997 economic prices

	Energy	Benefits			Investment			O&M				Net Cashflow		
Year	GWh	Power	Irrigation (NET)	Total	Joint	Power	Irrigation	Joint	Power	Irrigation	Total	Power	Irrigation	Total
1990	0	0	0	0	102	0	0	0	0	0	102	-87	-15	-102
1991	0	0	0	0	102	10	8	0	0	0	120	-96	-24	-120
1992	0	0	0	0	271	57	30	0	0	0	358	-287	-71	-358
1993	0	0	0	0	356	101	41	0	0	0	498	-404	-94	-498
1994	312	201	0	201	262	222	15	7	5	3	514	-255	-58	-313
1995	373	240	44	284	163	71	12	14	10	3	272	9	3	12
1996	426	274	51	325	28	16	10	14	10	3	81	213	32	244
1997	501	323	66	389	72	16	14	14	10	3	129	223	37	260
1998	369	238	79	317	49	13	14	14	10	3	104	161	53	213
1999	520	335	84	419	0	0	0	14	10	3	27	313	79	392
2000	520	335	61	396	0	0	0	11	8	3	22	317	56	373
2001	520	335	79	414	0	0	0	11	8	3	22	317	74	391
2002	520	335	65	400	0	0	0	11	8	3	22	317	61	378
2003	520	335	66	401	0	0	0	11	8	3	22	317	61	378
2004	520	335	70	405	0	0	0	11	8	3	22	317	66	383
2005	520	335	70	405	0	0	0	11	8	3	22	317	66	383
2006	520	335	70	405	0	0	0	11	8	3	22	317	66	383
2007	520	335	70	405	0	0	0	11	8	3	22	317	66	383
2008	520	335	83	418	0	0	0	11	8	3	22	317	78	395
2009	520	335	70	405	0	0	0	11	8	3	22	317	66	383
2010	520	335	68	403	0	0	0	11	8	3	22	317	64	381
2011	520	335	73	408	0	0	0	11	8	3	22	317	68	385
2012	520	335	73	408	0	0	0	11	8	3	22	317	68	385
2013	520	335	73	408	0	0	0	11	8	3	22	317	68	385
2014	520	335	73	408	0	0	0	11	8	3	22	317	68	385
2015	520	335	69	404	0	0	0	11	8	3	22	317	64	381
2016	520	335	57	391	0	0	0	11	8	3	22	317	52	369
2017	520	335	52	387	0	0	0	11	8	3	22	317	47	365
2018	520	335	57	391	0	0	0	11	8	3	22	317	52	369
2019	520	335	57	391	0	0	0	11	8	3	22	317	52	369
2020	520	335	57	392	0	0	0	11	8	3	22	317	52	370
2021	520	335	57	392	0	0	0	11	8	3	22	317	52	370
2022	520	335	57	392	0	0	0	11	8	3	22	317	52	370
2023	520	335	57	392	0	0	0	11	8	3	22	317	52	370

PV at	Benefits			Investment			O&M				Net Cash Flow		
discount rate	Power	Irrigation	Total	Joint	Power	Irrigation	Joint	Power	Irrigation	Total	Power	Irrigation	Total
10%	1,941.57	384.02	2,325.59	947.48	319.15	90.70	75.97	55.64	18.64	1,507.58	695.99	122.02	818.01
11%	1,715.22	338.11	2,053.33	914.12	305.72	86.99	67.70	49.54	16.57	1,440.64	524.60	88.09	612.69
12%	1,522.96	299.05	1,822.01	882.45	293.00	83.49	60.61	44.32	14.81	1,378.69	383.24	60.08	443.32
13%	1,358.64	265.65	1,624.29	852.37	280.96	80.18	54.51	39.83	13.30	1,321.14	266.25	36.89	303.14
14%	1,217.37	236.92	1,454.30	823.76	269.55	77.05	49.21	35.94	12.00	1,267.51	169.13	17.65	186.79
15%	1,095.25	212.09	1,307.35	796.54	258.72	74.09	44.60	32.55	10.86	1,217.38	88.30	1.67	89.97
16%	989.13	190.53	1,179.66	770.63	248.45	71.29	40.56	29.58	9.87	1,170.40	20.90	-11.63	9.26
17%	896.44	171.72	1,068.16	745.95	238.70	68.64	37.01	26.98	9.00	1,126.27	-35.40	-22.71	-58.11

	Power	Irrigation	Total
Benefits	1942	384	2326
Share	83.5%	16.5%	
Separable Costs	374.79	109.34	484.13
Rem. Benefits	1,566.78	274.68	1,841.47
Share	85.1%	14.9%	
Joint Costs	870.79	152.66	1,023.45
Net Benefits	695.99	122.02	818.01
Total Costs	1,245.58	262.00	1,507.58
Share	82.6%	17.4%	
Sep. Investment	319.15	90.70	409.85
Joint Investment	806.15	141.33	947.48
Total Investment	1,125.30	232.03	1,357.33
Ben./Invest. Ratio	1.73	1.66	1.71

EIRR = 16.1%
EIRR Power = 16.4%
EIRR Irrigation = 15.1%

TABLE 10: STATUS OF LEGAL COVENANTS

Agree-ment	Section	Cove-nant type	Present Status	Original fulfillment date	Revised fulfillment date	Description of covenant	Comments
Credit	3.01(b)	3	C			The Borrower shall onlend the proceeds of the credit and the loan to Hainan for onlending to HEPCO, under the subsidiary loan agreement under terms and conditions satisfactory to the Association and the Bank.	
Project	2.02	3	C			Hainan will relend the proceeds of the loan/credit to HEPCO on terms satisfactory to the Bank/IDA.	
	2.01 (a) & (b), 2.02	7	CP			Hainan will carry out or cause to be carried out the agreed resettlement program.	
	3.01	1	C			Hainan shall maintain, or cause to be maintained records and accounts adequate to reflect in accordance with sound accounting practices; Hainan shall have the accounts audited annually by independent auditors acceptable to the Association and the Bank and furnished a certified copy of the Association and the Bank no later than six months after the end of each year.	
	3.02	2	CP			Hainan shall provide for adequate irrigation water charges which would be collected to meet at least the full operating and maintenance costs of irrigation system.	
	2.01	10	C			HEPCO shall complete the system planning and the tariff studies and shall review the findings of the study with the Association and the Bank not later than June 30, 1993.	
	4.01	1	C			HEPCO shall furnish its annual financial statements and project accounts certified by an acceptable auditor, within six months from the end of each financial year.	
	4.02	2	CP			HEPCO shall take measures to ensure that it earns a cash surplus sufficient to (a) cover all operating costs and debt service in 1991/1992; and (b) maintain a self-financing ratio of no less than 20 percent in 1993, 25 percent in 1994, and 30 percent thereafter.	
	4.03	2	CP			HEPCO shall not incur any debt unless its debt service coverage ratio is no less than 1.1 times in 1991-1993, 1.2 times in 1994-1996, and 1.3 times thereafter.	
	4.04	2	CP			HEPCO shall maintain a debt/equity ratio of no more than 85/15 in 1991, 80/20 in 1992/93, 75/25 in 1994/95 and 70/30 thereafter.	

Agree-ment	Section	Cove-nant type	Present Status	Original fulfillment date	Revised fulfillment date	Description of covenant	Comments
	4.05	1	C			HEPCO shall furnish its annual financial statements and project accounts, certified by acceptable auditors, within six months from the end of each financial year.	
	4.06	5	NC			HEPCO shall furnish to the Association/Bank no later than June 30, 1992, an action plan for organizing and staffing its internal audit unit, and shall thereafter implement such plan taking into consideration the Association/Bank's comments.	

Covenant Class:
1 = Accounts/audits
2 = Financial performance/revenue generation from beneficiaries
3 = Flow and utilization of project funds
4 = Counterpart funding
5 = Management aspects of the project or executing agency
6 = Environmental covenants
7 = Involuntary resettlement
8 = Indigenous people
9 = Monitoring, review, and reporting
10 = Project implementation not covered by categories 1-9
11 = Sectoral or cross-sectoral budgetary or other resources allocation
12 = Sectoral or cross-sectoral policy/ regulatory/institutional action
13 = Other

Status:
C = covenant complied with
CD = complied with after delay
CP = complied with partially

TABLE 11: COMPLIANCE WITH OPERATIONAL MANUAL STATEMENTS

There was no significant lack of compliance with an applicable Bank Operational Manual Statement (OD or OP/BP)

Statement Number and Title	Describe and Comment on lack of Compliance
1. OMS 2.33 – Social Issues Associated with Involuntary Resettlement	Income not yet fully restored.
2. OMS 2.36 – Environmental Aspects of Bank Work	Fully Complied.

TABLE 12: BANK RESOURCES: STAFF INPUTS

	Planned		Revised		Actual	
Stage of project cycle	Weeks	$'000	Weeks	$'000	Weeks	$'000
Preparation to appraisal					167.3	331.0
Appraisal					22.4	46.2
Negotiations through Board approval					44.8	97.3
Supervision					63.7	134.9
Completion					14.7	28.7
Total					312.9	638.1

TABLE 13: BANK RESOURCES: MISSIONS

Stage of project cycle	Month/ year	Number of persons	Days in field	Specialized staff skills represented /a	Performance rating		Type of problems /c
					Imple-mentation status /b	Devel-opment objectives	
Preidentification	09/86	1	2	HE			
Identification/ Preparation	02/87	5	6	HE,IE,E,PE,Ag, RS,PE			
	06/87	4	5	RS,FA,FA,HE			
Preappraisal	05/88	5	12	IE,FA,HE, Ec,E			
	11/88	3	13	Ec,FA,HE			
Appraisal	04/89	8	9	Ag,IE,Ec,FA,E, LC,CO,AS			
Negotiation	03/90						
Post-appraisal	03/90	2	10	Ag,Ec			
	04/90	2	3	FA,E			
	07/90	2	13	Ag,As			
	02/91	5	5	FA,RS,PC,HE,E			
	06/91	1	5	RS			
	11/91	1	10	HE			
Board approval	10/91						
Signing	12/91						
Effective	02/92						
Supervision 1	11/92	2	4	RS,RS/d			
Supervision 2	05/93	2	12	RS,PE	S	HS	
Supervision 3	04/94	7	5	A,FA,E,RS,Ec, Ec,HE	S	HS	
Supervision 4	10/94	3	6	IE,RS,IE	S	S	
Supervision 5	11/95	3	8	IE,RS,IE	S	S	
Supervision 6	05/96	1	3	HE/d			
Supervision 7	11/96	2	6	HE,RS	U	U	
Supervision 8	05/97	2	5	HE,RS	U	U	
Supervision 9	11/97	2	4	RS,IE	S	S	
Supervision 10	03/98	2	5	HE,RS	S	S	
Supervision 11	07/98	1	4	RS/d			
Supervision 12	11/98	2	4	HE,RS	S	S	
Completion	03/99	6	5	HE,RS,OO,IE			
	06/99	2	3	RS,OO			

/a A: Accountant, Ag: Agronomist, As: Agricultural Specialist, CO: Country Officer, E: Environmental Specialist, EC: Economist; HE: Hydro Engineer, PE: Power Engineer, IE: Irrigation Engineer, FA: Financial Analyst, LC: Legal Counsel, OO: Operations Officer, RS: Resettlement Specialist, S: Sociologist

/b HS: Highly satisfactory, S: Satisfactory, U: Unsatisfactory

/c Typical problems included: implementation delays in technical assistance and studies.

/d Form 590 not prepared.

DAGUANGBA MULTIPURPOSE PROJECT
HAINAN PROVINCIAL ELECTRIC POWER COMPANY LTD. (HEPCO)
Income Statement
(Yuan Million)

Year Ending December 31	1991		1992		1993		1994		1995		1996		1997		1998	
	SAR	Actual	SAR	Actual	SAR	Actual	SAR	Actual	SAR	Actual	SAR	Actual	SAR	Actual	SAR	Actual
Electricity Sales (GWh)	845	944	956	1,177	1,082	1,531	1,225	1,944	1,387	2,300	1,570	2,385	1,777	2,469	2,012	2,740
Annual Sales Growth (%)		27	13.14	24.70	13.18	29.99	13.22	26.99	13.22	18.35	13.19	3.70	13.18	3.50	13.22	10.99
Average Tariff (Fen/kWh)	33.50	31.96	30.60	33.99	45.00	39.13	47.50	46.31	47.50	51.10	51.60	54.49	50.50	51.41	49.70	52.85
Operating Revenue:																
Sales Revenue	282.5	301.8	292.4	400.2	486.6	598.8	582.1	900.1	659.0	1,175.4	810.7	1,299.7	896.6	1,269.4	1,000.5	1,448.4
Other Operating Income						9.5		3.0		-		-		-		
Less: Sales tax	-	-		-	-	-	-	1.1	-	1.1	-	2.8	-	1.9	-	
Total Operating Revenue	**282.5**	**301.8**	**292.4**	**400.2**	**486.6**	**608.3**	**582.1**	**902.0**	**659.0**	**1,174.4**	**810.7**	**1,297.0**	**896.6**	**1,267.4**	**1,000.5**	**1,448.4**
Operating Expenses:																
Fuel	92.9	104.8	78.9	163.4	100.2	312.4	104.5	181.6	111.6	231.3	130.6	192.7	171.5	201.5	219.7	222.4
Purchased Power	5.5	8.9	6.0	9.0	6.4	5.4	6.5	316.2	6.8	274.6	7.2	534.9	7.5	475.4	7.9	618.3
Operating & Maintenance	36.4	37.8	39.8	54.8	43.0	67.2	47.7	92.9	58.8	162.2	71.2	184.4	79.6	129.9	88.7	117.4
Administration	16.3	12.1	18.3	19.3	20.0	19.4	21.8	42.2	23.9	73.9	26.1	86.8	28.5	61.3	31.1	59.7
Depreciation	52.3	58.3	55.2	67.8	60.2	83.6	79.1	80.5	121.8	124.0	160.5	80.8	184.2	165.6	210.4	176.2
Other Expenses		4.4		7.3		43.1		44.7		86.7		111.9		73.6		72.5
Total Operating Expenses	**203.4**	**226.2**	**198.2**	**321.6**	**229.8**	**531.1**	**259.6**	**758.0**	**322.9**	**952.6**	**395.6**	**1,191.4**	**471.3**	**1,107.4**	**557.8**	**1,266.6**
Operating Income	**79.1**	**75.5**	**94.2**	**78.6**	**256.8**	**77.3**	**322.5**	**144.0**	**336.1**	**221.7**	**415.1**	**105.5**	**425.3**	**160.1**	**442.7**	**181.8**
Non-Operating Income																
Net Non-Operating Income		(1.4)		(0.5)		(2.2)		(36.7)		(82.0)		(12.5)		(1.8)		(4.7)
Investment Profit						8.5		1.8		11.5		3.4		6.0		4.1
Finance Expenses	66.4		71.4		79.9	63.1	110.2	97.7	144.0	71.5	156.5	83.3	154.2	165.1	148.9	214.4
Total Non-operating Income	(66.4)	(1.4)	(71.4)	(0.5)	(79.9)	(56.8)	(110.2)	(132.6)	(144.0)	(142.0)	(156.5)	(92.4)	(154.2)	(160.9)	(148.9)	(215.0)
Net Income Before Income Tax	**12.7**	**74.2**	**22.8**	**78.1**	**176.9**	**20.5**	**212.3**	**11.4**	**192.1**	**79.8**	**258.6**	**13.2**	**271.1**	**(0.8)**	**293.8**	**(33.2)**
Income Tax	11.9	11.1	14.1	11.7	38.5	0.8	48.4	3.0	50.4	1.4	62.3	0.4	63.8	0.8	66.4	10.0
Net Income (Loss)	**0.8**	**63.0**	**8.7**	**66.4**	**138.4**	**19.7**	**163.9**	**8.4**	**141.7**	**78.4**	**196.3**	**12.7**	**207.3**	**(1.6)**	**227.4**	**(43.2)**
Average Rate Base		1,000.0	984.8	992.5	1,022.2	1,071.4	1,358.9	1,068.0	1,986.1	1,159.3	2,425.9	1,382.3	2,651.1	1,365.5	2,904.8	1,251.8
Rate of Return (%)		7.55	9.57	7.92	25.12	7.21	23.73	13.48	16.92	19.13	17.11	7.63	16.04	11.72	15.24	14.52
Operating Ratio (%)	72.0	75.0	67.8	80.4	47.2	87.3	44.6	84.0	49.0	81.1	48.8	91.9	52.6	87.4	55.8	87.4

DAGUANGBA MULTIPURPOSE PROJECT
HAINAN PROVINCIAL ELECTRIC POWER COMPANY LTD. (HEPCO)
Balance Sheet
(Yuan Million)

Year Ending December 31	1991		1992		1993		1994		1995		1996		1997		1998	
	SAR	Actual	SAR	Actual	SAR	Actual	SAR	Actual	SAR	Actual	SAR	Actual	SAR	Actual	SAR	Actual
ASSETS																
Current Assets																
Cash	85.6	71.1	86.9	91.9	102.9	141.4	82.7	296.0	91.5	232.8	95.5	232.3	100.8	200.5	96.5	543.7
Account Receivables	23.2	152.0	24.0	239.7	40.0	108.6	47.8	187.2	54.2	235.8	66.6	262.3	73.7	263.2	82.2	326.6
Inventories	68.9	40.6	83.0	58.6	104.2	142.2	108.5	35.1	115.7	78.6	134.7	55.2	160.8	62.5	197.8	52.6
Other Current Assets	79.6		79.6	-	79.6	388.9	79.6	427.7	79.6	532.2	79.6	473.1	79.6	441.3	79.6	632.9
Total Current Assets	**257.3**	**263.7**	**273.5**	**390.1**	**326.7**	**781.1**	**318.6**	**946.0**	**341.0**	**1,079.3**	**376.4**	**1,022.9**	**414.9**	**967.6**	**456.1**	**1,555.9**
Long-Term Investment		-		-		99.0		413.3		438.7		414.8		413.1		416.9
Fixed Assets:																
Plant in Service	1,157.6	1,198.8	1,214.7	1,223.0	1,347.8	1,521.1	2,027.3	1,306.1	2,803.0	1,897.9	3,189.4	2,038.5	3,598.2	2,110.7	4,091.3	2,153.0
Less: Accumulated Depreciation	173.7	186.8	229.0	250.0	289.2	351.3	368.2	339.9	490.0	545.5	650.6	626.3	834.8	791.9	1,045.1	968.2
Net Plant in Service	983.9	1,012.0	985.7	973.0	1,058.6	1,169.8	1,659.1	966.2	2,313.0	1,352.4	2,538.8	1,412.2	2,763.4	1,318.7	3,046.2	1,184.8
Construction WIP	307.6	152.1	671.1	408.9	934.8	835.4	637.5	1,372.6	212.1	1,715.0	244.8	1,866.1	103.3	2,127.1	222.1	2,201.4
Total Fixed Assets	**1,291.5**	**1,164.1**	**1,656.8**	**1,381.9**	**1,993.4**	**2,005.2**	**2,296.6**	**2,338.8**	**2,525.1**	**3,067.4**	**2,783.6**	**3,278.3**	**2,866.7**	**3,445.8**	**3,268.3**	**3,386.2**
Special Fund Assets	3.0	35.0	3.2	27.8	5.0	-	6.2	-	8.5	-	9.6	-	12.2		14.4	
Intangible Assets & Deferred Assets				-		142.8		141.8		532.7		504.4		501.8		503.8
TOTAL ASSETS	**1,551.8**	**1,462.9**	**1,933.5**	**1,799.9**	**2,325.1**	**3,028.0**	**2,621.4**	**3,839.8**	**2,874.6**	**5,118.0**	**3,169.6**	**5,220.4**	**3,293.8**	**5,328.3**	**3,738.8**	**5,862.8**
LIABILITIES AND EQUITY																
Current Liabilities:																
Short-Term Loan	40.0	15.3	40.0	23.0	40.0	54.5	40.0	30.0	40.0	75.5	40.0	98.8	40.0	77.4	40.0	31.3
Account Payable	51.4	51.7	58.2	43.3	65.9	30.8	74.6	170.4	84.5	102.6	95.6	162.5	108.3	26.2	122.5	412.4
Other Current Liabilities	-	0.0		4.6		256.2		264.7		433.3		278.8		268.3		203.4
Current Portion of Long-Term Debts				-		75.0		42.4		53.5		19.1		15.9		88.5
Total Current Liabilities	**91.4**	**67.0**	**98.2**	**71.0**	**105.9**	**416.6**	**114.6**	**507.6**	**124.5**	**665.0**	**135.6**	**559.2**	**148.3**	**387.9**	**162.5**	**735.6**
Long-Term Loan	1,046.1	835.2	1,382.6	1,061.5	1,601.9	1,898.9	1,700.1	2,240.2	1,768.3	2,492.3	1,820.4	2,671.9	1,683.5	2,849.7	1,840.3	3,088.8
Total Liabilities	**1,137.5**	**902.2**	**1,480.8**	**1,132.5**	**1,707.8**	**2,315.4**	**1,814.7**	**2,747.7**	**1,892.8**	**3,157.3**	**1,956.0**	**3,231.1**	**1,831.8**	**3,237.5**	**2,002.8**	**3,824.5**
Minority Stockholder's Equity										234.3		264.4		234.3		234.3
Owner's Equity:																
Paid-in Capital	414.3	560.7	452.7	667.3	617.3	516.8	806.7	669.9	981.8	718.4	1,213.6	743.3	1,462.0	1,387.2	1,736.0	1,387.2
Capital Surplus						181.6		402.9		964.5		950.7		440.2		465.9
Surplus Reserves						3.7		5.4		(0.2)		0.6		0.6		9.2
Undistributed Profit						10.5		13.8		43.7		30.2		28.6		(58.2)
Total Owner's Equity	**414.3**	**560.7**	**452.7**	**667.3**	**617.3**	**712.6**	**806.7**	**1,092.1**	**981.8**	**1,726.5**	**1,213.6**	**1,724.8**	**1,462.0**	**1,856.6**	**1,736.0**	**1,804.0**
TOTAL LIABILITIES & EQUITY	**1,551.8**	**1,462.9**	**1,933.5**	**1,799.9**	**2,325.1**	**3,028.0**	**2,621.4**	**3,839.8**	**2,874.6**	**5,118.0**	**3,169.6**	**5,220.4**	**3,293.8**	**5,328.3**	**3,738.8**	**5,862.8**
Debt Equity Ratio (debt as % of debt+equity)	72	60	75	61	72	73	68	67	64	59	60	61	54	61	51	63
Current Ratio (times)	2.8	3.9	2.8	5.5	3.1	1.9	2.8	1.9	2.7	1.6	2.8	1.8	2.8	2.5	2.8	2.1

Note: a/ Paid-in capital projected in SAR and the actuals in 91/92 includes working capital fund, Government/fixed fund, construction allotment and special fund.

DAGUANGBA MULTIPURPOSE PROJECT
HAINAN PROVINCIAL ELECTRIC POWER COMPANY LTD. (HEPCO)
Funds Flow Statement
(Yuan Million)

Year Ending December 31	1991		1992		1993		1994		1995		1996		1997		1998	
	SAR	Actual	SAR	Actual	SAR	Actual	SAR	Actual	SAR	Actual	SAR	Actual	SAR	Actual	SAR	Actual
Internal Sources of Funds:																
Net Income	67	63	80	66	218	83	274	106	286	150	353	96	362	(2)	376	(43)
Depreciation	52	58	55	68	60	84	79	80	122	152	161	81	184	166	210	176
Amortization				-		1		38		24		35		7		1
Maintenance	14	15	14	17	15	-	16		24		33		38		44	
Other Internal Source of Funds		11		15		41		365		774		124		243		128
Total Internal Sources	**133**	**147**	**149**	**167**	**293**	**208**	**369**	**590**	**432**	**1,100**	**547**	**336**	**584**	**414**	**630**	**262**
Non-Internal Sources of Funds																
Distribution Expansion Fund	22	30	25	78	28	-	32		36		41		46		52	
Other Sources of Funds		9		17		218										
Total Non-Internal Sources of Funds	**22**	**39**	**25**	**95**	**28**	**218**	**32**	**-**	**36**	**-**	**41**	**-**	**46**	**-**	**52**	**-**
Borrowings																
Foreign Loans	-	-	161	46	119	120	98	275	42	52	3	15	-	24	-	20
Domestical Loans	229	235	208	246	214	500	171	455	204	163	297	117	119	77	431	266
Total Borrowings	**229**	**235**	**369**	**292**	**333**	**620**	**269**	**730**	**246**	**215**	**300**	**132**	**119**	**100**	**431**	**286**
Grants	5	-	4	-	2	-	-		-		-		-		-	
Increase of Minority Stockholder's Equity										234		30		(30)		
Total Sources of Funds	**389**	**421**	**547**	**554**	**656**	**1,045**	**670**	**1,319**	**714**	**1,548**	**888**	**498**	**749**	**484**	**1,113**	**548**
Capital Expenditures																
Increase in Fixed-Assets and WIP	264	193	421	266	399	708	383	334	353	934	420	292	270	333	614	117
Increase in Long-Term Investment	-	-		-		99		314		25		-		-		4
Increase in Intangible & Deferred Assets	-	-		-		143		37		415		6		5		3
Total Capital Expenditures	**264**	**193**	**421**	**266**	**399**	**950**	**383**	**685**	**353**	**1,374**	**420**	**298**	**270**	**338**	**614**	**123**
Operational Requirements																
Increase/Decrease in Working Capital	14	62	8	97	30	(32)	3	(81)	4	39	20	50	21	148	31	(103)
Increase/Decrease in Special Funds	-	14	-	(7)	-	-	-	-	-		-		-		-	
Debt Service (total)	97	64	104	109	192	63	282	560	321	198	404	124	410	30	423	141
Remittances to Government	-	6	-	5	-	2	-	-	-		-		-		-	
Special Fund Expenditures	12	96	13	65	19	-	22	-	27		40		43		49	
Surplus Reserves												26		-		44
Dividend						12		-								
Total Operational Requirements	**123**	**241**	**125**	**268**	**241**	**46**	**307**	**480**	**352**	**237**	**464**	**200**	**474**	**178**	**503**	**82**
Total Application of Funds	**387**	**434**	**546**	**533**	**640**	**996**	**690**	**1,165**	**705**	**1,612**	**884**	**498**	**744**	**516**	**1,117**	**205**
Increase/Decrease in Cash	**2**	**(13)**	**1**	**21**	**16**	**49**	**(20)**	**155**	**9**	**(63)**	**4**	**(0)**	**5**	**(32)**	**(4)**	**343**
Debt Service Coverage	1.37	2.30	1.43	1.54	1.53	3.30	1.31	1.05	1.35	5.55	1.35	2.70	1.42	13.76	1.49	1.86
Three Years Average Investment			361	470	401	634	378	1,003	385	786	348	670	435	253	295	154
Self-Financing Ratio (%)			6.3	16.7	44.1	2.2	56.1	4.6	49.9	19.1	74.4	3.3	62.4	-2.0	99.7	-21.2

ANNEX B: BORROWER'S CONTRIBUTION TO THE ICR

BORROWER'S PROJECT COMPLETION REPORT (Extract)

CHINA

DAGUANGBA MULTIPURPOSE PROJECT

(LOAN 3412/CREDIT 2305-CHA)

Prepared by Hainan Provincial Electric Power Company Limited

April 1999

Approved by: Zhu Wanshun
Examined by: Hu Xingpei
Prepared by: Feng Shengfu
Translated by: Han Jiachou

Preface

This is the Project Completion Report for Daguangba Multipurpose Project in China for which Loan 3412-CHA in the amount of U.S. $ 30 million and Credit 2305-CHA in the amount of SDR 28.1 million (U.S.S37 million equivalent) were approved on November 26, 1991. The IBRD Loan and IDA credit were used for the construction of Daguangba Multipurpose Project and implemented in accordance with the stipulations of Loan Agreement No.3412-CHA and Credit Agreement NO.2305-CHA.

The original closing date of the Loan and Credit was December 31, 1997, it was postponed to December 31, 1998 with the consent of World Bank.

A five member World Bank supervision mission headed by Mr. Barry Trembath, Principal Power Engineer of Energy and Mining Sector Unit visited Daguangba project area between March 14 to 20 1999. During the mission, the mission members commented and complemented on the Project Completion Report (draft) provided by the owner of the Project. This report (extract) was prepared in line with the guidelines and aide memoire advised by World Bank missions.

The construction of Daguangba Multipurpose Project was officially started in June 1990. The first generating unit was put in service in December 1993, and the hydro complex project was completed by the end of 1995. The reservoir impoundment started in December 1993, by end of December 1998 the accumulated energy generation of Daguangba hydropower Station reached 1981.296 GWh. The reservoir impoundment had reached the normal full reservoir level of 140 El (above sea Level at Yulin port) in November 1996. A construction quality inspection panel had conducted a completion acceptance check on Daguangba project and submitted a report in April 1996. The report concluded that "The construction of Daguangba Multipurpose Project is in good quality in general terms. It can operate with normal full impoundment of the reservoir, and is ready for acceptance test."

The owner of Daguangba Multipurpose Project has been Hainan Provincial Electric Power Company.

Project Objectives

1. The objectives of Daguangba Multipurpose Project were to: (a) construct a 56m high main dam with 5842 m total length, including a 719 m long concrete dam flanked by 5123 m long earth embankments; (b) construct a shallow-embedded type underground powerhouse with dimension (LxHxW) of 87.0m x 37.50m x 14.0m; (c) provide and install four generating units of 60 MW each, totaling at 240 MW capacity and the associated electric system including a 220KV step-up substation; (d) construct an overflow dam in the middle of the concrete dam and erect 16 sets of radial gate with outcropping top; and (e) introduce the latest technology and advanced equipment for Daguangba Hydropower Station construction.

2. The Daguangba reservoir has got a total storage capacity of 1.71 billion cubic meter. The construction of High Main Canal (HMC) will provide irrigation service for 190 thousand mu of farmland through sub-canal gravity irrigation, and will provide irrigation system for a total area of 0.995 million mu in the long term planning. The Daguangba reservoir will provide 81.90 million cubic meter of water supply for agricultural, industrial and residential consumption in the down stream area annually.

3. Erections of 35.48 Km double circuit 220KV transmission lines between Daguangba and Emaoling, and 48.872Km 220KV transmission line between Emaoling and Basun, and 144.762Km 220KV transmission line between Basuo and Sanya and two associated 220KV Substations. The above transmission facilities will transmit electric power generated by Daguangba Hydropower Station to outside area.

4. Resettlement of about 22,240 people in the reservoir area.

5. Conducting design liaison meeting and technical training abroad.

6. Upgrading the capability of Hainan Provincial Electric Power Company (HEPC) in financial management and management of large civil works contracts.

7. Strengthening local capabilities in Hainan power grid development planning, electric tariff study and promoting the economic development of Hainan province, China.

8. The objectives were relevant and important in the context of government and Bank Strategy in the power sector at the time of appraisal. Therefore the project implementation has facilitated the local capabilities upgrading in the aspects of funds financing, expertise introduction and enhancement of management, etc.

Implementation Experience and Results

9. **The Adoption of Roller-Compacted Concrete (RCC).** Rollers-compacted concrete was adopted in the construction of Daguangba gravity dam. In the preliminary design stage, volcanic ash was chosen as the binding mixture in the process of making

RCC. Due to the reason that the volcanic ash contains 50 percent of tuff which tends to cause fast-freeze and shrink effect in the RCC. To avoid this adverse after effect, experts had conducted an experiment on the adoption of flying ash as the mixture in the making of RCC. The experiment gave positive result, and the flying ash been applying in the construction practice and succeeded.

10. **Geological Treatment of Main Dam Foundation.** Excavation on the concrete dam foundation found certain faults and major fractures, analysis on the situation of composition and spread of the faults and major fractures indicates that the concrete dam formulation is not in a position of possible deep sliding.

11. In the original design philosophy, it is not required in principle to excavate further on the dam river-bed foundation, while it is necessary to trim the concrete dam foundation by clearing off weakly weathered granite loosen by joint fractures. Some faults and bigger fissure should be treated by slotting and then backfilling with concrete. The joint swarmed zones should be strengthened by consolidation grouting.

12. Based on the specific situation of dam foundation excavation as well as the comments of special Board of Consultants, an optimal design was undertaken which focused on the treatment of faults and fractured zone, adverse-effected zone, closely spaced joint zones and surrounding rocks of Class III. The special treatment included consolidation grouting, dam foundation curtain grouting and foundation consolidation treatment on No. 20 block of the concrete dam.

13. A quality report on the completion of dam construction issued by the Supervision Engineer had the following conclusion: "No structural treatment is required for concrete dam foundation against the Class I and Class II rock. In accordance with the design requirement, faults and fractured zones with widely distributed joint fissure should be treated by groove excavation, replacement with concrete plugs and drilling of reinforce steel for split resisting purpose. After the above structural treatment and enhancing consolidation grouting, the quality is considered good."

14. **Treatment on the Interfaces of Concrete Dam and Flanking Earth Dams.** Special Board of Consultants had suggested the following improvement measures on the original structural interfaces treatment, the implementation of these measures had produced positive results.

15. Earth dam foundation should be treated in line with that of concrete dam foundation. No any grooves which will have adverse effect on seepage resisting measures should be allowed when using form boarding in the concrete placement process. The adjacent area surrounding the three sides of the end of the concrete dams should be excavated to the top surface of the weakly weathered granite zone, the excavation should produce a three meters wide stripe area which should be backfilled by bond clay with better impermeability, earth dam on the downstream side of concrete dam should arrange seepage-control drainage body.

16. **Introduction of Advanced Equipment and the Latest Technology.** The project had utilized World Bank Loan/Credit for purchase of advanced equipment adopting international competitive bidding made, meeting the needs of effective and safe operation of Daguangba Hydropower Station. The advanced equipment included computer controlled supervision system and microcomputer regulated governor operation system both provided by NARI System Engineering International (NSI), and the generator excitation system provided by ABB Sweden.

17. The latest technology adopted in the construction of civil works comprised the following: roller compacted concrete; chimney drainage arrangement within the body of earth dam; riprap protection on the upstream slope of the earth dam; shallow-imbedded type underground power house; adoption of rock bolt crane beam in underground power house; utilization of the adit as the lower chamber of the surge shaft; cancellation of telescopic joint for the power intake penstocks; the adoption of hydrologic data automatic collecting and transmitting instrument.

18. **Effective Activities of Special Board of Consultants.** The Special Board of Consultants had conducted three missions of field inspection and consultation which resulted in many effective comments and suggestion on the improvement of preliminary design, construction process and post-construction operation. The design institute and construction units had studied these comments and suggestions carefully and adopted most of them. The adoption had facilitated the optimization of the original design and the construction operation.

19. **The Implementation of Resettlement Component.** The resettlement component had been implemented basically in synchronous with civil works construction of hydro complex in terms of funds allocation and detailed component implementation. The implementation had followed the approved budget and the approved construction schedule. Up to date, all the resettled people have been relocated in accordance with plans. No any casualty or riot of relocatee occurred. The resettlement task was carried out in general good condition.

20. Adjustment and complement had been made to the original resettlement plans in accordance with the physical condition. Up to the end of December 1998, a total number of 22,243 people had been relocated which account for 100 percent of the planned resettlement people.

21. **Assessment of Resettlement Component.** All the resettled rural people were Li and Miao minority ethnic who used to live in the poorest mountain area. The project had provided an opportunity for them to get rid of poverty and backwardness and to go to more developed and comparatively well off life.

(a) Relocatees living conditions had changed substantially: The relocatees new villages comprised of numerous new brick concrete structure houses with

the associated school building, clinic and grocery shop scattered. The relocatees had undergone a substantial changes for their living condition with economic fruit trees planted around the houses, residential environment had change greatly.

(b) Relative sufficient living space in the relocated area: Due to natural favorable condition, every resettled township in the reservoir area had got sufficient land resource, the average distributed land area per capita was above 20 mu while the reclaimable land resource was very rich which will guarantee the smooth implementation of "land for land" and "the same amount land compensation after land acquisition" for the resettlement component. The sufficient land resource had been the guarantee for the success of the implementation.

(c) Say good bye to the most simple agro-production: The relocatees had been leading the most simple slash and burn cultivation. They were not used to chemical fertilizer and tropical fruit trees. Now they began to accept new concepts and new technique of agricultural science, at the same time, the second and third industries had grown steadily.

(d) Improvement of the infrastructure construction and public facilities: The relocatees had transferred from inconvenient traffic mountain are to more open spaced area. The transfer had laid the foundation for improvement of infrastructure construction especially in the aspect of domestic water supply and irrigation service. In general terms, the residential infrastructure had been upgraded.

22. **Irrigation Component.** The High Main Canal is an important component of the project. The HMC will cover an area of 190 thousand mu.

23. **Project Objectives**. (a) The first stage of HMC will construct a gravity irrigation canal system of 58.6 Km; (b) Construction of 2 tunnels with total length of 4709m of which Erjia tunnel with 358m length, 3.4m bottom wide and 3.4m tunnel high, the cross section is horseshoe shaped. Hongling tunnel with 1124m length, 3.1m bottom wide and 3.6 tunnel high the cross section is circular arch straight wall shaped; (c) Construction of 12 aqueducts with total length of 2363 m of which Chongnan aqueduct located at the left bank of the main dam was 750 m length. The Chongnan aqueduct utilized precast concrete flume with 15 m span and weighted 78.51. A pedestrian bridge with 1 m wide arranged on the top surface of the aqueduct; (d) Construction of 5 culverts with total length of 1119 m of which No. 5 culvert is 449 m length; (e) Construction off associated structures including culverts under canal, canal gate drainage gate, etc.; (f) Construction of irrigation administration office building and apartment building; and (g) Construction of a canal head hydro plant with installed generating capacity of 2x1000KW.

24. **Benefit of HMC Project**. The HMC first stage construction started in March 1992 completed and went into service in June 1994. The completion acceptance was conducted in May 1996 and then the facilities were taken over by Water Resource Bureau of Dongfang City ever since. The HMC first stage current provides irrigation service for 97.1 thousand mu farmland.

25. **Second Stage of HMC**. The second stage consists of Datian lateral main canal lengthen 27.6 km with total length of 71 km of 13 branch canal lateral branch canal field ditch, etc. HMC second stage will be constructed between 1998 to 2000, 104.8 thousand mu of farmland will be benefited with irrigation service after the completion of second stage.

26. **Power Transmission Project**. (a) Erection a double circuits 220kv transmission lines from Daguangba Hydropower station to Emaoling 220KV substation. The length of double circuit lines were 35.33km and 35.48km respectively; (b) Erection a 48.87kv transmission line between Emaoling and Sanya substations; (c) Erection a 145.29km 220kv transmission line between Basao and Sanya Substations; and (d) Extension Project of Emaoling 220kv substation which comprised of 2 GIS bays and 2x120 MVA transformers. The extension project went into service in November 1993.

27. **Financial Performance.** In 1998 HEPCO took effective measures to expand power consumption market and strengthened internal management at the same time 2740 GWh of energy sale had been realized in 1998 which increased 11 percent compared with year 1997. The financial performance indicated that an obvious increase in economic benefit and in total assets of HEPCO. The assets quality had also improved (other economic performance indicators refer to attachments of Borrower's Project Completion Report).

28. **Environment.** Environment management had focused on water quality monitoring and reservoir peripheral protection. Artificial clearing had been undertaken on reservoir sedimentation for an area of about 81 square km. A sewage treatment plant located in the up stream end of reservoir had been constructed with the treatment capacity of 10,000 effluent daily the cost was 8.20 million Yuan RMB. The completion of sewage treatment plant will contribute to the protection of up steam water source.

(a) Environment monitoring and management had started simultaneously with the construction of hydro complex. The project owner and Hainan Provincial Environmental Projection and Natural Resources Department had played important roles in the environment project implementation. Official from the environment protection authority had chaired the design examination meeting of the sewage treatment plant. Experts from the authority had conducted field investigation and issued instructive comments on the environmental protection implementation.

(b) All the relevant organs including resettlement service center of Dongfang city, resettlement office of Ledong county, Guangba state farm, Shancong state farm and Houmiling forest farm took part in the reservoir sediment clearing. The shore area of about 81 square Km area above EL 114 m was subject to artificial clearing which included clearing, disinfecting and burying of old lavatories and manure pits, removal of bushes, etc. The clearing cost was 750 thousand Yuan.

(c) The sewage treatment plant in Ledong county seat was the important component of the environment protection program – Its treatment capacity is 10,000 tons daily and it costs 8.20 million Yuan. The competitive bidding was conducted in December 1977 in which a contractor was chosen. By end of December 1998, the construction of sewage treatment plant had basically completed. The completion of the project is expected to contribute to the protection of water source from pollutant and to improvement of resident's health.

(d) After the impounding of reservoir, an artificial lake was formed with much open lake surface. The reservoir contributes to the improvement of climate condition of Guangba Datian district the average ambient temperature is 2°C lower than that before the reservoir impounding also precipitation in the reservoir peripheral area has increased which will facilitate the growth of tropical economic crops. Taking Datian district for example, Dongfang city has conducted a large scale reclamation program which resulted in the formation of Datian ten thousand mu farmland the history of no paddy rice planting in Datian district had gone for ever. Large scale plantation had followed for example, 30 thousand mu of banana, 10 thousand mu of vegetable and about 10 thousand of fresh water breeding.

(e) Fruit trees planting resettlement offices of both Dongfang and Ledong had sent team to Dongjiang reservoir in Hunan province and shuikou reservoir in Fujian province for inspection and training. After the return of the team, they had mobilized the relocatees to undertake a large scale fruit trees planting along the shore of Daguangba reservoir and in the new resettled villages. A substantial amount of mango, coconut tree, longan, litchi trees had planted, and the relocatees had developed multicultural model from monocultural model.

ANNEX C: ICR MISSION'S AIDE MEMOIRE

1. A World Bank mission comprising Messrs. B. Trembath (mission leader), Y. Zhou, Ms. Q. Li, (Bank), D. Creamer, W. P. Ting, and Y. Zhu (Consultants), visited Hainan to review the status of preparation for the Implementation Completion Report (ICR) and the data requested prior to the arrival of the mission. The mission also reviewed the completion report prepared by Hainan Electric Power Company (HEPCO). In addition to meetings with staff from HEPCO, the mission visited the site and Dongfang and Ledong counties. After a wrap-up meeting the mission was also able to meet with Vice Governor Mr. Yu Xun to discuss areas where provincial government intervention is required. The main points and actions which were discussed and agreements reached are summarized below:

Completion Report

2. HEPCO provided a draft completion report for review but then withdrew it for finalization. *The mission requested that the finalized report be sent as soon as possible.* With regard to the overall project, the main shortcoming is the lack of a detailed cost table showing costs versus item on a yearly basis and in foreign and local currencies. HEPCO promised to provide this before departure of the mission but it was not received. With regard to the agricultural component information provided by HEPCO was far from complete, and some of the data in the report did not reflect the actual situation. The mission stressed the importance of ensuring the accuracy of the information prepared for the mission. The mission subsequently met with project staff from the Dongfang Water Conservancy Bureau and Bureau of Agriculture, and explained in detail regarding the information needed to evaluate the impact of the project. The Vice Mayor of Dongfang County, in-charge of the project assured the mission that most of the *materials requested will be given to the mission prior to their departure from Haikou and the rest will be forwarded to the Bank before March 31.* A detailed list of data requested for the agricultural component is included in Annex 1.

Uncompleted Work

3. **Resettlement.** Since last supervision mission (November 1998), little progress has been achieved with regard to resettlement implementation. Between November, 1998 and March 1999, only Y 3.74 million of resettlement budget had been allocated, which accounted for 6.7 percent of the remaining resettlement budget (56.08 million). According to the data provided by HEPCO and MSDI resettlement monitoring report, by the end of 1998, a total of Y 206.3 million of resettlement budget had been allocated by HEPCO, accounting 78.6 percent of total resettlement budget (Y 262.33 million approved

in 1997). The slow allocation of resettlement budget in the past four months has made it almost impossible to achieve the objective promised by HEPCO in November 1998 for completing all remaining resettlement work by the end of June 1999. More importantly, the slow allocation of resettlement funds will caused further delays of some critical resettlement works in two counties, and prolong the process of restoring income and livelihood for the resettlers.

4. Based on the information provided in Resettlement Monitoring and Evaluation Report No. 5, by the end of 1997 22 out of 29 resettlement villages in two counties had not restored their income to their previous levels, with per capita income being less than 80 percent of that before the move for 12 villages. Given the fact that there was serious draught in the reservoir area in 1998, the income for most resettlers (except for Datian resettlement area) in 1998 would have declined further compared with that in 1997. Although the current monitoring efforts did not cover the 15 land loss villages, based on available information, at least 50 percent of them did not restore their income to the previous levels. In other words, the objective of Daguangba resettlement in terms of restoring income and livelihood of the resettlers has not yet been achieved, even though the main power project was completed four years ago.

5. The two affected counties are fully aware of the areas where there are problems and have prepared detailed action plans to address them. They include building the long waited Nanmei and Nanba irrigation systems, relocating four villages to Datian area, developing more farmland, and completing all remaining infrastructure works. The total cost for the detailed action plans amounted to Y 53 million. The successful completion of the remaining works would address most of the remaining problems. *HEPCO should review these plans and reach agreements with the two counties in order to finalize the list of remaining resettlement works as well as the fund allocation schedule in 1999, and submit such plans to the Bank by the end of April 1999.*

6. With regard to the establishment of Reservoir Maintenance Fund for Daguangba Project which was supposed to occur by the end of February, 1999, no decision had been made yet by Hainan Provincial Government. The mission expressed serious concern over the delay in establishing the fund since the resettlement budget will be exhausted in 1999. Based on Y 400 per person and normal power generation amount by Daguangba Power Plant, a total of Y 7 million would be available each year for providing badly needed rehabilitation assistance for the affected people. *During the meeting with Vice Governer Mr. Yu Xun, this issue was raised by the mission; and an assurance received that such a fund would be established in the near future.*

High Main Canal Construction.

7. The provincial government has approved funds amounting to about Y68 million for the completion of this work, of which some Y 12 million is coming from remaining Bank funds. HEPCO is providing some Y 18 million. There is understood to be a funding gap of about Y 30 million. The most promising source for these funds is the provincial government itself. *This matter was also raised during the meeting with Vice*

Governer Mr. Yu Xun who promised to follow up on the funding issue. If funds are available, the remaining portion of the HMC could be completed in June, 1999.

Dam and Power Plant Operation

8. **Dam**. The problem of excessive leakage into the underground powerhouse has reportedly been solved by the addition of a drainage gallery. There have been no major operating problems since the rather extensive teething problems were corrected. There is a flood forecasting system and a warning is normally provided some 4 hours in advance of spillway operation. The spillway has apparently only operated on one occasion, in 1996, at some 7800 m^3/s – a fairly typical flood discharge. This did cause some damage to the scour area downstream of the apron – in a faulted zone subsequently repaired. Given the relatively high and frequent spillway discharges that should be expected, more repair work is probable and HEPCO should be prepared. The plant has been operating for some 1095 days without a significant accident. There is no requirement for any continuous riparian discharge from the plant. There is in any case no low level outlet. No survey has been made as yet on reservoir sedimentation, incoming sediment is thought to be very low.

9. **Power Plant**. The power plant has been in more-or-less full operation for over four years. The last of the 4x60 MW units was commissioned in May, 1995 and the reservoir was filled to close to its normal full supply level in late 1995. The natural flow regime is highly variable with an average flow of 97 m^3/s combined with a recorded minimum and maximum annual flows of 29 m^3/s and 168 m^3/s. Minimum dry season flows are of the order of 5 to 10 m^3/s. The large reservoir gives a considerable degree of flow regulation but the firm flow is a relatively low 34 m^3/s. The plant is designed primarily for peaking operation with an average plant capacity factor of 25%, during low-flow periods the capacity factor could be as low as 10%. The head range is quite large: from 85 to 62m, with a rated head of 73m. The effect is that at higher reservoir levels the plant output is constrained and at lower levels it reduces – to about 190 MW at the minimum operating level (MOL). Plant operation is guided by an operational study carried out by MSDI in 1997. This was based on a simulation of plant operation over the 41-year historical flow record from 1955-96. It is not clear which objective function e.g. firm or average energy, was chosen as the optimization target. The study produced recommended upper and lower reservoir rule curves as a guide to operation and derived the following energy capabilities:

- Average annual – 491 GWh or 56 MWe,[1]
- Firm annual – 309 GWh or 35.2 MWe with a guaranteed reliability of 93%,
- Firm monthly – 18.5 MWe.

[1] Slightly lower than reported in the SAR probably due to the inclusion of the recent lower flow years.

10. The MSDI study allowed for the full irrigation demand at the High Main Canal. Although a relatively modest 4 m^3/s on average, during drier years irrigation demand can be a quite significant, reducing dry season flow available for power generation by up to a third. The study also compared actual to simulated operation for the two-year period 1995-96. This showed that actual operations did not conform well to the optimized simulation. The main discrepancies were:

- Actual operation produced very low energy ~5 MWe, i.e. well below the nominal firm, over some periods,

- Actual operation tended to produce lower reservoir levels, hence less head and potentially less energy.

11. In discussions, HEPCO personnel confirmed that the MSDI rule curves are used as a guide to operations but have been frequently disregarded when overall system requirements – set by the dispatch center – dictate. Examination of a typical daily load duration curve shows that the Daguangba plant – when adequate flow is available – plays a very important role. It effectively handles most of the load variation during the daytime period, thus allowing for more efficient operation of the relatively large thermal plant units. Daguangba also provides local reactive power support during the nighttime off-peak period. This role for Daguangba is a function of the present relatively small power demand in comparison with the large size of the generating plants. Typical loads on the grid are around 250 MW off-peak and 550-600 MW at peak. The main Haikou coal fired plant has 2x125 MW units which can thus be base loaded. Other smaller thermal units pick up part of the load during the day with the 240 MW Daguangba plant and the smaller 80 MW Niululing hydro plant covering the rest. It is evident that a failure of one of the large thermal units would be best covered by increasing generation at Daguangba. Analysis of reservoir levels at Daguangba over the last four years shows that they have tended to be considerably lower than indicated by the rule curves. The reservoir reached its minimum operating level (MOL) at el.116m in late 1998 and has since been held at this level through the present dry season. In effect, there has been a 'failure' in that the target firm energy can not be supplied. During the last few months plant operation has been limited to an hour or so a day with typically only a single 60 MW unit on line. In this way the low natural dry season flow (~10 m^3/s) is passed downstream. Total generation in 1998 was some 370 GWh i.e. more than the nominal firm. Annual inflow to the reservoir was ~49 m^3/s i.e. low but not unprecedented. In effect, the failure was primarily attributable to excessive generation (at above firm) between August and November – coupled of course with the below normal inflow.

12. *In conclusion, it appears that there is room for substantial improvement in HEPCO's operation of Daguangba.* Admittedly the project is unique in the HEPCO system and there is no previous experience in reservoir operation on this scale. Also the relative size of the project in relation to the overall system will diminish. On the other hand flow diverted for irrigation – only nominal to date – will increase. *As an overall guide, HEPCO should endeavor to maintain the reservoir at a relatively high level under*

normal conditions – closer to the MSDI upper rule curve. This will produce several advantages:

- Maintaining plant capability at 240 MW,
- Minimizing the risk of reservoir failure, i.e. drawdown to MOL as at present,
- Increasing energy by maintaining a higher average head.

13. **Environmental Issues.** Comments on specific issues arising from the SAR follow:

- There is only minimal monitoring of water quality. This is done once a year, with samples taken by the plant personnel. Results to date show no change from the pre-project situation i.e. generally high quality except for an excessive bacterial count attributed largely to human waste from Ledong upstream. The project financed sewage treatment plant for this area has only just been completed and is still not in operation. The delay is attributed to lack of finance.

- Protection of the rare Datian deer has been improved by partially fencing-in and patrolling the protected area. The deer population is reported to have increased (from ~40 to over 200).

- The afforestation around the reservoir rim recommended by the SAR has not been implemented, in part due to the apparent minimal risk of erosion.

- There has been some increase in fishing but no attempt to develop a reservoir fishery to the benefit of the resettled population.

- The slight moderation in temperature adjacent to the reservoir (attributable to the reservoir itself) is reported to be beneficial to agriculture.

- The Independent Evaluation of Resettlement indicated some improvements to public health in some areas.

HEPCO Aspects

15. **Power System Expansion**. The SAR included an expansion plan as a means of assessing the cost-effectiveness of the Daguangba power plant. A subsequent MSDI study of October 1994 developed a least cost expansion plan. The following table compares these two plans to the actual situation as of 1998:

	SAR 1991 Plan	MSDI 1994 Plan	Actual Status
Peak Demand, MW	585	1073	627
Generation, GWh	2970	5376	~3000
Annual Load Factor	58%	57%	~55%
Installed Capacity, MW			
Hydro	370	525	370
Steam (Coal or oil-fired)	350	864	350
Gas Turbine and other	170	350	550
Total	890	1739	1270
Reserve capacity, MW	305	666	643

16. The table covers the Hainan Island power grid. The generation plant quoted by MSDI appears to include approximately 100 MW of small hydro plant that may not be connected to the grid. There are some very glaring differences: The SAR took a deliberately conservative annual load growth of about 14%, which has turned out to be reasonably accurate. In contrast MSDI used ~20%. In fairness, however, at the time of the MSDI review power demand had grown at a much faster rate than predicted in the SAR. MSDI anticipated that the 80 MW Gezhen hydro plant (downstream of Daguangba) and large amount of thermal steam plant would be installed. In actuality, no hydro projects are in the pipeline at present. The one major plant not foreseen by the SAR is a large gas turbine project (Yangpu) installed to meet the projected demand from an export-processing zone which has not yet materialized.

17. **HEPCO Financial Aspects**. HEPCO is currently facing some financial difficulties because of large capacity payment obligations for new power plants which are not being loaded, the drought which has severely limited Daguangba operations and the tariff which has been approved by the provincial pricing commission for Daguangba power plant which is only 37 fen per kWh in comparison with 74 fen recommended by a task force composed of representatives from Construction Bank and SDPC. *This matter was also raised with the vice governor.*

18. *Tariff Study.* Following the tariff study financed under the project, HEPCO applied to the provincial government to implement a time of day tariff structure but received no response. At the mission's suggestion, *HEPCO agreed to follow-up on their application.* A higher peak load consumer tariff would help to justify a higher power tariff for the Daguangba power plant.

Agriculture and Irrigation Component

19. Discussions were held with representatives from the provincial and Dongfang County Water Conservancy Bureaus and Agriculture Bureau. According to the SAR, the project will provide for the development of irrigation to serve about 190,000 mu (12, 667 ha). Thus far a total of about 97,000 mu have been developed (including about 35,000 mu for resettlement). About 20,000 mu has been developed under Phase II (including about 20,000 mu of existing irrigation area to be supplied with supplementary irrigation). The balance of 60,000 mu will be completed by the end of 2000.

20. **Operation and Maintenance (O & M).** The Dongfang County Water Resources Bureau has established the High Main Canal Management Division (HMCMD) as the unit responsible for operation and maintenance of the system. The division has a staff of 15 - four at HMCMD, four at the High Main Canal Water Management Station, five at the Sub-main Canal Water Management Station and two at the distributing sluice which supply water to the Lemei Reservoir and the sub-main canals. The O & M for the main, sub-main, branch and lateral canals is carried out by each station according to a schedule prepared by the Dongfang Water Conservancy Bureau. Sub-laterals and field drains are maintained by water users twice a year, first following summer harvest and the second following winter harvest. The mission was impressed with the quality of the completed works and the standard of O & M in the project areas visited. At present, funds collected from water charges (about Y 240,000/yr.) are inadequate to cover the annual O & M costs and these have to be partly funded by the provincial Water Conservancy Bureau and county. *The mission recommended that Dongfang County should estimate the total costs required for O & M for the completed works and that the water charges should at least cover the O & M costs.* In this respect, the county should work closely with the Price Bureau and Planning Bureau in determining an appropriate formula for water charges in the project area. Water Charges should be based on the amount of water delivered and type of crops grown by farmers. *Dongfang County has agreed to provide the mission with an English translation of the O & M regulation.*

21. The mission noted that water charges are very low (Y 32/mu for all irrigated land) and are inadequate to meet the major repairs and depreciation requirements. The mission recommends the following actions to be taken:

- O&M Manual for newly developed irrigation area. The O & M plan prepared for the new irrigation system (from the high main canals down to the branch canals, lateral canals and outlets) should be revised into a permanent manual for reference and use by the operation and maintenance staff. The revised draft should be sent to the Bank for review before issuing to the O & M staff;

- The annual operation and maintenance costs for the developed irrigation area from 1995 to 2000 (fully developed) should be provided by the local Water Resources Bureau, including the salary for O & M staff, O & M machinery and equipment, materials, utility, replacement cost, etc.;

- To improve the irrigation efficiency the collection of water charges should be based on the cost of total amount of water used for different crops, water measuring equipment should be installed during the construction of canal system and on-farm structure, and the monitoring system for the whole Daguangba irrigation system should be established;

- Most of the land in Phase I has been developed and in production and some of the land has been leased to private individuals from out of state. *To increase the efficient use of water, the mission recommended that the on-farm irrigation works of the leased land should follow the design standards of the Water Conservancy Bureau.* Land under Phase II has also been allocated and about 20,000 mu has been developed. There has been a considerable shift in the cropping pattern to higher value crops as compared to the SAR. In view of the demand on the mainland and overseas, the area under banana has increased significantly (about 30% of the project area), as well as seedless watermelon, mango and high value vegetables. Good technical support was provided by the South China Academy of Tropical Crops (SCATC) and the Dongfang City Agriculture Research Institute in the introduction, testing, and extension of new and improved varieties to the project area. *In order to sustain the development of the project area, it is important that the organization established under the project be maintained, especially the provincial PMO, and in particular the Dongfang High Main Canal Management Division. There is also need to strengthen the agriculture support services in the project areas.*

ATTACHMENT

Agricultural Component

Data Requirements for SAR

Economic and Financial Data. The mission reviewed the documents prepared by HEPCO for the ICR mission and agreed *that the following items will be completed before April 20, 1999*. HEPCO will complete, per ICR format, the necessary background data and analyses as discussed with the mission. A brief summary of the tables and related information requirements are as follows:

- Complete project investment costs and benefit analyses for Irrigation and Agriculture components by finalizing:
  - The actual detailed investment costs by year, components, and expenditure in Yuan and US$ (based on the information from annual financial and physical progress reports) for the Irrigation System, On-Farm Works and Soil Improvement, O & M Facilities and Equipment, and Agricultural Support Services components with the financing table, including the actual costs financed by the local government and farmer's contribution (see summary table in Annex 26 page 10), and the total costs allocation by year for the agriculture and irrigation components;
  - The current farm-gate prices (1999) for all farm inputs and outputs for agriculture and irrigation component (World Bank price projections or the actual export and import prices in Hainan should be used to estimate farm-gate prices in 1999 constant terms for traded inputs and outputs with domestic and international transport and handling), -- table 3 and 4, annex 26 in SAR;
  - The actual detailed crop budgets by year (to full development) for all the annual and perennial crops in project area:
    - detailed crop budgets should reflect the actual production from 1992 to 1998, and the estimated yield after 1998 (to full development) based on the experience of the crop production in Hainan for existing and planned cropping pattern (such as rice, peanut, sweet potato, vegetable, watermelon, sugarcane, banana, pepper, mango, rubber, sisal, etc.), and production without project in SAR;
    - quantity of seed, fertilizer, and farm chemicals should be the actual average and the incremental for optimal farm input applications (with project) in each area.
  - The actual cropping pattern and intensity for cultivated and sown land under irrigated, dry land and slopping land by year and crops (based on the actual phasing of investment expenditure for development of on-farm works development) -- see table 2, annex 26 in SAR.

- Farm household survey data from sampling of predetermined areas selected for typical beneficiary families, including actual detailed income from crop and fruit production, sideline activities and others; and expenditures for investment and operation cost, taxes, and other charges with and without project (refer to SAR, annex 26 table 7).
- Complete summary tables for Key Monitoring Indicators for project implementation at the start of the project, during Mid-term Review, and project completion at the end of the 1998 for agriculture and irrigation components (see tables in SAR, annex 12 and 20).
- The mission suggested the following areas that need to be strengthened and/or supplemented with the information/data required for the ICR:

  - Explanations should be provided for the substantial changes between the planned SAR, mid-term Review and actual completed quantities of various targets for each component; and if cost changes were significant, this should be discussed and, if possible quantified, such as changes in project scope/scale/design, estimates of physical quantities and base unit costs, changes in exchange rates, implementation delay, and performance of contractors;
  - Poverty alleviation and /or other social economic benefits should be discussed. Details regarding especially improved living standard and income for all farm households in project area, including the settlers; and the number of beneficiaries, incremental employment opportunity for farmers and the role of women in each component and the project as a whole.