

**PROJECT PERFORMANCE AUDIT REPORT**

**ON THE**

**POWER REHABILITATION PROJECT  
(Loan 1345-CAM[Sf])**

**IN**

**CAMBODIA**

**July 2003**

## CURRENCY EQUIVALENTS

Currency Unit – riel (KR)

|        |   | <b>At Appraisal</b><br>August 1994 | <b>At Completion</b><br>August 1999 | <b>At Operations Evaluation</b><br>April 2003 |
|--------|---|------------------------------------|-------------------------------------|---|
| KR1.00 | = | \$0.0004                           | \$0.00026                           | \$0.00025                                     |
| \$1.00 | = | KR2,500                            | KR3,850                             | KR3,950                                       |

## ABBREVIATIONS

|        |   |   |
|--------|---|---|
| ACCPAC | – | Accounting Package (integrated accounting software) |
| ADB    | – | Asian Development Bank                              |
| EA     | – | executing agency                                    |
| EAC    | – | Electricity Authority of Cambodia                   |
| EdC    | – | Electricité du Cambodge                             |
| EIRR   | – | economic internal rate of return                    |
| FIRR   | – | financial internal rate of return                   |
| HFO    | – | heavy fuel oil                                      |
| IAP    | – | international accounting practice                   |
| IPP    | – | independent power producer                          |
| MEF    | – | Ministry of Economy and Finance                     |
| MIME   | – | Ministry of Industry, Mines and Energy              |
| O&M    | – | operation and maintenance                           |
| OEM    | – | Operations Evaluation Mission                       |
| PCR    | – | project completion report                           |
| PPAR   | – | project performance audit report                    |
| SCF    | – | standard conversion factor                          |
| SDR    | – | special drawing rights                              |
| TA     | – | technical assistance                                |
| UNDP   | – | United Nations Development Programme                |
| VAT    | – | value added tax                                     |
| WB     | – | World Bank  |

## WEIGHTS AND MEASURES

|     |   |                               |
|-----|---|-------------------------------|
| GWh | – | gigawatt-hour (1 million kWh) |
| kV  | – | kilovolt                      |
| kWh | – | kilowatt-hour                 |
| MW  | – | megawatt (1 million watt)     |

## NOTES

- (i) The fiscal year (FY) of the Government ends on 31 December.
- (ii) In this report, "\$" refers to US dollars.

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**BASIC DATA**  
**Power Rehabilitation Project (Loan 1345-CAM[SF])**

**Institution Building Technical Assistance**

| <b>TA No.</b> | <b>TA Name</b>                                 | <b>Type</b> | <b>Person-Months</b> | <b>Amount</b> | <b>Approval Date</b> |
|---------------|--|-------------|----------------------|---------------|----------------------|
| TA 2243       | Power Sector Manpower Development and Training | ADTA        | 15.0                 | \$500,000     | 15 Dec 1994          |

ADTA = advisory and operational technical assistance, TA = technical assistance.

| <b>KEY PROJECT DATA (\$ million)</b> | <b>As per ADB Loan Documents</b> | <b>Actual</b> |
|--------------------------------------|----------------------------------|---------------|
| Total Project Cost                   | 35.3                             | 31.5          |
| Foreign Exchange Cost                | 27.0                             | 25.9          |
| ADB Loan Amount/Utilization          | 28.2                             | 25.9          |
| ADB Loan Amount/Cancellation         |                                  | 2.2           |

ADB = Asian Development Bank.

| <b>KEY DATES</b>                     | <b>Expected</b> | <b>Actual</b>  |
|--------------------------------------|-----------------|----------------|
| Fact-Finding                         |                 | 9–20 May 1994  |
| Appraisal                            |                 | 17–26 Aug 1994 |
| Loan Negotiations                    |                 | 14–16 Nov 1994 |
| Board Approval                       |                 | 15 Dec 1994    |
| Loan Agreement                       |                 | 3 Mar 1995     |
| Loan Effectiveness                   | 1 Jun 1995      | 15 May 1995    |
| First Disbursement                   |                 | 18 Dec 1995    |
| Project Completion                   | 30 Jun 1999     | 30 Jun 2000    |
| Loan Closing                         | 31 Dec 1999     | 26 Sep 2000    |
| Months (effectiveness to completion) | 49.0            | 61.5           |

**ECONOMIC AND FINANCIAL INTERNAL RATES OF RETURN**

|               | <b>FIRR (%)</b>  |            |             | <b>EIRR (%)</b>  |            |             |
|---------------|------------------|------------|-------------|------------------|------------|-------------|
|               | <b>Appraisal</b> | <b>PCR</b> | <b>PPAR</b> | <b>Appraisal</b> | <b>PCR</b> | <b>PPAR</b> |
| Phnom Penh    | 24.1             | 6.6        | 8.9         | 37.4             | 44.3       | 18.3        |
| Sihanoukville | 9.1              | 13.6       | 15.2        | 15.6             | 24.9       | 16.1        |
| Siem Reap     | 12.9             | 14.9       | 11.9        | 19.8             | 33.2       | 15.5        |

EIRR = economic internal rate of return, FIRR = financial internal rate of return, PCR = project completion report, PPAR = project performance audit report.

|                         |   |
|-------------------------|---|
| <b>BORROWER</b>         | Kingdom of Cambodia   |
| <b>EXECUTING AGENCY</b> | Ministry of Industry, Mines and Energy<br>Electricité du Cambodge |

**MISSION DATA**

| <b>Type of Mission</b>             | <b>No. of Missions</b> | <b>Person-Days</b> |
|------------------------------------|------------------------|--------------------|
| Consultation                       |                        |                    |
| Fact-Finding                       | 1                      | 20                 |
| Appraisal                          | 1                      | 60                 |
| Project Administration             |                        |                    |
| Review                             | 6                      | 25                 |
| Project Completion                 | 1                      | 30                 |
| Operations Evaluation <sup>1</sup> | 1                      | 57                 |

<sup>1</sup> The Operations Evaluation Mission comprised H. Wang (Evaluation Specialist/Mission Leader), G. Brown (International Staff Consultant), and E. Orr (Local Staff Consultant). The Mission visited Cambodia from 31 March to 16 April 2003.

## **EXECUTIVE SUMMARY**

In 1994 when the Power Rehabilitation Project (the Project) was appraised, Cambodia was emerging from a period of political turmoil and civil war that had lasted for two decades. As a result, the electricity infrastructure had suffered from years of neglect. The generation and distribution facilities were in extremely poor condition because of age and lack of proper maintenance. The capacity of the power supply was inadequate, system losses were unacceptably high, and the reliability and quality of supply were poor. The expertise necessary for proper management and maintenance of the power system was not available.

The Project was formulated to address those issues. Its design emerged from an ongoing policy dialogue between the Government and the Asian Development Bank and complemented the efforts of other aid agencies. It recognized the urgent need to rehabilitate the physical electricity supply infrastructure to help stimulate economic growth. In addition, the Project was designed to strengthen the institutional arrangements supporting the supply of electricity within Cambodia.

The Project consisted of (i) construction of a new 5-megawatt diesel power station in Sihanoukville; (ii) rehabilitation and expansion of the high- and low-voltage distribution systems in Sihanoukville, Siem Reap, and the northeast of Phnom Penh; (iii) provision of a technical training center, and training aids to train the staff of Electricité du Cambodge (EdC) in construction, operation, and maintenance techniques for electricity generation and distribution systems; and (iv) provision of a modern commercially based accounting system in Sihanoukville and Siem Reap.

The Project was implemented largely as planned in terms of scope, cost, and schedule. The power station and distribution systems installed under the Project are well designed, operated, and maintained. Since commissioning, EdC has maintained the power station engines and generators in accordance with the manufacturer's recommendations. The distribution systems contain no moving parts, are inherently designed for a much longer life, and need less regular maintenance. These networks were designed to standards developed prior to project commencement and so are similar to networks funded by other external assistance agencies. A major design objective was reliability. Accordingly, the high-voltage distribution system backbone is fully underground in urban areas, while the overhead low-voltage distribution uses aerial bundled conductors. The high-voltage network backbone has ample capacity to meet the foreseeable electricity demand in the project areas and can be extended to serve the surrounding areas. Electrical losses in the project areas are now around 15%, compared with up to 50% at the time of appraisal.

The new training center on the outskirts of Phnom Penh is well managed and continues to meet EdC's ongoing staff training requirements. After completion of the Project, a training advisor, funded under a French grant, worked with EdC staff through mid-2001 and assisted with the development of course curricular and detailed training materials. This has contributed to the success of the training component. The training center will be used to train staff from other provincial capitals as their distribution networks are absorbed into EdC.

The attempt to install a modern integrated accounting package in Sihanoukville and Siem Reap was not successful, and the accounting software provided under the Project has not been used in either office since early 1998. Accounts in both offices are now kept on spreadsheets, using hardware and software provided under the Project. These accounts meet all requirements of EdC, the Ministry of Mines and Energy, and the Ministry of Economy and

Finance and are a significant advance from the paper-based accounting methods that were used at appraisal. On hindsight, the objective of moving to a modern integrated accounting system appears to have been overly ambitious.

EdC is a much more professional and better managed organization than it was at the time of appraisal. It was corporatized in 1997 in accordance with one of the loan covenants, and its compliance with other nonfinancial loan covenants has further contributed to its becoming a more disciplined and better structured organization. Since completion of the Project, reform has continued in the power sector. In particular, the passing of the Electricity Law in February 2001 has led to the establishment of the Electricity Authority of Cambodia as an independent regulator.

The Project had no unintended socioeconomic impacts during construction and operation. It has significantly reduced the visual impact of electricity distribution by replacing the proliferation of conductors that existed prior to rehabilitation with a limited number of larger conductors, designed and installed in an aesthetic way. No adverse environmental impacts were anticipated at appraisal and none have occurred. Nevertheless, the Project has not been able to replace the large number of inefficient, small, privately owned generators to the extent envisaged at appraisal in either Sihanoukville or Siem Reap, where even relatively small businesses such as restaurants still rely on private generation to meet the bulk of their electricity requirements.

Overall, the Project is rated successful. The performance of both ADB and the Government is rated satisfactory.

The key issue for the future of EdC is the need to improve its financial performance so as to ensure long-term sustainability. EdC's financial problems arise from its high generating costs, due to its almost exclusive reliance on oil-fired, low-speed reciprocating engines. This problem is exacerbated by the fact that it is very heavily taxed. As current tariffs in Cambodia are the highest in the region, efforts must focus on reducing costs, particularly the cost of generation, rather than raising revenues through increasing tariffs. The prospects for reducing generation costs are good, particularly over the longer term. In the shorter term, cost reduction efforts must focus on possible tax reductions, replacement of diesel with heavy fuel oil, and further loss reduction initiatives.

It is therefore recommended that a policy dialogue be initiated with the Government over the economic impact of the current high level of taxation and the appropriate level of taxation to be applied to EdC. It may be that tariff reductions resulting from lower levels of taxation will stimulate economic growth to the extent that the loss of revenue to the Government will be fully offset.

The Project has yielded four main lessons. First, support for the introduction of a commercially based accounting system in Sihanoukville and Siem Reap was inadequate. The transition to the use of a computerized state-of-the-art accounting system required a major cultural shift, which necessarily takes a significant time to implement and establish. The consultant should have been required to assist with preparing the annual accounts for 1997 and also to be available as required throughout 1998. Second, questions arise on the extent of the relevance of the accounting system that was implemented to the requirements of EdC's provincial officers. There is little evidence of systematic needs analysis undertaken to determine exactly what was required. Such an analysis could well have identified the need for a less complex customer billing system. Third, EdC's inability to utilize the automatic plant control

simulator highlights the lack of coordination between the delivery of the equipment and completion of civil works. Lastly, a project design weakness was the absence of policy components that address broader sector issues such as high tariff and reliance on oil-fired power generation, which resulted in less than expected socioeconomic impacts of the Project.





## **I. BACKGROUND**

### **A. Rationale**

1. At the time of project appraisal in 1994, electricity infrastructure in Cambodia was suffering from years of neglect due to a long civil war. The generation and distribution facilities were in extremely poor condition because of age and lack of proper maintenance. The capacity of the power supply was inadequate, system losses were unacceptably high, and the reliability and quality of supply were poor. The expertise necessary for proper maintenance of the system was not available. The Project<sup>1</sup> was formulated to address these issues while meeting the Government's objectives for the power sector and consistent with the Asian Development Bank (ADB) strategy for the sector. This was the first ADB loan to the energy sector after ADB resumed operations in Cambodia in 1992 although an earlier emergency loan<sup>2</sup> included a component for rehabilitating electricity supply facilities in Phnom Penh.

### **B. Formulation**

2. The design of the Project emerged from an ongoing policy dialogue between the Government and ADB. It complemented the efforts of other aid agencies and recognized the urgent need to rehabilitate the physical electricity supply infrastructure to help stimulate economic growth. Furthermore, it recognized the need to strengthen the institutional arrangements supporting the supply of electricity within Cambodia, following neglect throughout the civil war.

3. During the Country Programming Mission in January 1994, the Government requested ADB assistance to rehabilitate the power generation and distribution facilities in Siem Reap and Sihanoukville, continue the rehabilitation and upgrading of the distribution system in Phnom Penh, and provide a technical training facility for Electricite du Cambodge (EdC). The Project was processed without project preparatory technical assistance (TA). ADB staff formulated the Project on the basis of information gathered in a Fact-Finding Mission in May 1994 and an Appraisal Mission in August 1994. Loan negotiations were completed in November 1994.

### **C. Purpose and Outputs**

4. The Project had two major objectives. The first was to rehabilitate and expand the power supply infrastructure in a part of Phnom Penh (the political and commercial center of the country with a population of 600,000), Sihanoukville (the only maritime port in the country with a population of 80,000), and Siem Reap (the major tourist city with a population of 69,000), thereby assisting EdC to meet the increasing demand for electricity efficiently and economically and supporting economic growth. The second was to provide training and support to EdC staff in technical and administrative areas to ensure that sufficient skills exist in the organization to operate and maintain the rehabilitated systems. In conjunction with the loan, an attached advisory TA<sup>3</sup> was provided for the preparation of a manpower development and training program for EdC.

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<sup>1</sup> Loan 1345-CAM(SF): *Power Rehabilitation Project*, for \$28.2 million equivalent, approved on 15 December 1994.

<sup>2</sup> Loan 1199-CAM: *Special Rehabilitation Assistance Loan*, for \$67.7 million, approved on 26 November 1992. The power sector component consisted of construction of an 18 megawatt (MW) power plant in Phnom Penh, provision of urgently needed spare parts for 7x2.1 MW generating sets, and reinforcement and rehabilitation of part of the distribution system in Phnom Penh. The total cost of these facilities was \$19.0 million.

<sup>3</sup> TA 2243-CAM: *Power Sector Manpower Development and Training*, for \$500,000, approved on 15 December 1994.

5. At appraisal, the Project had the following components:

- (i) construction of a diesel power plant of 5 MW in Sihanoukville;
- (ii) rehabilitation and expansion of the medium- and low-voltage distribution networks in Sihanoukville;
- (iii) construction of a diesel power plant of 1 MW in Siem Reap;
- (iv) rehabilitation and expansion of the medium- and low-voltage distribution networks in Siem Reap;
- (v) rehabilitation and expansion of the Phnom Penh distribution system;
- (vi) establishment of a technical training center in Phnom Penh to train EdC staff in all aspects of power generation and distribution; and
- (vii) introduction of a commercially based accounting system at the provincial level.

6. Financing to construct the 1 MW diesel power plant in Siem Reap was later cancelled after it was agreed that this plant would be financed by French grant aid. The unutilized loan amount was reallocated to extend the coverage of the high- and low-voltage distribution systems in Siem Reap. Furthermore, a cheaper skid-mounted power station design was used at Sihanoukville, allowing more funds to be diverted to distribution system rehabilitation.

#### **D. Cost, Financing, and Executing Arrangements**

7. The estimated project cost at appraisal was \$35.3 million equivalent, comprising foreign exchange of \$27 million and local currency of \$8.3 million equivalent. The approved ADB loan of \$28.2 million was to be used to finance the entire foreign exchange cost of the Project and a portion of the local currency cost amounting to \$1.2 million. The Government was to meet the remaining local currency cost of \$7.1 million equivalent. Details of the cost breakdown by project component are in Appendix 1.

8. The Ministry of Industry, Mines, and Energy (MIME) through EdC was the Executing Agency (EA) for the Project. The general manager of EdC was responsible for overall management of project implementation and for liaison between the Government and ADB. Given the limited experience of EdC management in implementing projects of this size, three departments—project implementation, planning, and corporate finance—were initially supported by foreign advisors, funded by the loan. A project management unit within the Project Implementation Department of EdC was responsible for the day-to-day management of procurement contracts. International consultants, financed under the loan, supervised the design, procurement, and implementation of the project contracts.

#### **E. Completion and Self-Evaluation**

9. The project completion report (PCR), circulated in November 2001, rated the Project highly successful because it was implemented almost as conceived in terms of scope, project cost, and implementation schedule. The PCR provided a comprehensive overview of the project scope and implementation. After successful implementation of the Project, significant improvements were achieved in the availability, reliability, and quality of the power supply in the project areas. The technical training center in Phnom Penh was completed although delayed and met the requirements identified in the associated TA (footnote 3). The PCR also considered the TA highly successful in meeting its objectives in developing appropriate training programs for EdC.

10. The main issues identified in the PCR included (i) inadequate fluency in English of EdC staff that reduced the effectiveness of training and increased the cost of operating the technical training center, and (ii) noncompliance with some financial covenants that were deemed too tough for a newly corporatized EdC. The PCR also indicated concerns about future operation and maintenance (O&M) of project facilities in view of the high cost of spares for the generating equipment. Some observations in the PCR relating to the training center and introduction of a commercially based accounting system were inconsistent with the findings of the Operations Evaluation Mission (OEM). The economic analysis in the PCR produced considerably higher economic returns for the project components compared with the appraisal estimates. The OEM did not find sufficient evidence of a larger consumer surplus as claimed in the PCR (para. 57).

## **F. Operations Evaluation**

11. This project performance audit report (PPAR) reviews the findings of the PCR and assesses the Project in terms of relevance, efficacy, efficiency, sustainability, and institutional and other developmental impacts. The assessment is based on a review of ADB documents, discussion with ADB staff, and findings of the OEM. The OEM visited Phnom Penh, Siem Reap, and Sihanoukville during 31 March–16 April 2003 and held discussions with representatives from MIME, Electricity Authority of Cambodia (EAC), and EdC. The views of ADB's concerned departments were taken into account in finalizing the PPAR. Copies of the draft PPAR were forwarded to Ministry of Economy and Finance, MIME, EAC, and EdC on 21 May 2003 with a request that comments be provided within 2 weeks. Although the request was followed up subsequently, no comments were received. It was, therefore, assumed that the Government and EdC endorsed the PPAR.

## **II. PLANNING AND IMPLEMENTATION PERFORMANCE**

### **A. Formulation and Design**

12. The Project was formulated with the objective of rehabilitating the physical electricity supply infrastructure in Phnom Penh, Sihanoukville, and Siem Reap and to strengthen the institutional management and structure of EdC. The Project conformed to the Government strategy for the power sector in the short and medium term and was in line with ADB's interim term strategy<sup>4</sup> for the power sector in Cambodia.

13. Rehabilitation of the distribution system in Phnom Penh was seen as a priority because of Phnom Penh's importance to the national economy as the political and commercial center. This component of the Project was designed to complement similar rehabilitation work in other parts of the city that had been financed by the French and Irish governments and by the World Bank (WB), in addition to work financed by ADB under a previous emergency loan (footnote 2).

14. The rehabilitation of the electricity generation and distribution systems in Sihanoukville was seen as important, as Sihanoukville is Cambodia's only seaport. Similarly, rehabilitation of the distribution system in Siem Reap would support the development of a tourist industry, as Siem Reap is the gateway to the world famous Angkor temple complex.

15. The distribution system design was consistent with the technical standards that had been developed by EdC, with the assistance of advisors funded by the United Nations

<sup>4</sup> ADB's interim term strategy for the power sector in Cambodia was set out in the Economic Review and Bank Operations Paper circulated to the Board in June 1994.

Development Programme (UNDP). These standards set the primary distribution voltage at 22 kilovolts (kV). This voltage is high for the low loads outside Phnom Penh, but provides significant excess capacity at a relatively small additional cost. This capacity will permit the future connection of large industrial loads and the extension of the existing network to outlying areas. The distribution system is designed to minimize maintenance while giving a high level of reliability. High-voltage cabling is underground in urban areas and the low-voltage distribution lines are also underground in built-up commercial areas. All low-voltage overhead distribution uses an aerial bundled conductor, which gives increased safety and reliability and requires a narrow right-of-way. Distribution transformers are generally housed in purposely built substation buildings, although packaged designs are used for smaller capacities.

16. At the time of appraisal, EdC functioned essentially as a government department and was responsible only for the power supply in Phnom Penh. All its significant financial and technical decisions were made by the MIME and it relied on government budget allocations to cover its capital expenditure and budget deficits. The institutional strengthening component of the Project was designed to assist EdC develop into a self-sustaining state-owned corporation, free of direct government control. This objective was supported by the loan conditions, which required EdC to be corporatized and the electricity supply systems in Sihanoukville and Siem Reap to be transferred to EdC on completion of the Project.

17. The associated TA, which reviewed the current skills and training facilities available to EdC and assessed future human resource and training requirements, was consistent with the objectives of the Project. The TA was particularly relevant in that its output could be used as the basis for the design of the new training center.

18. The OEM considers the formulation and design of the Project as appropriate, given the situation that existed at the time of appraisal and subsequent developments. The changes made to the project scope during implementation were minor and were driven by the availability of additional funding or by the use of innovative designs, rather than by changes to the industry or political environment within Cambodia. The changes allowed funds to be diverted to further the achievement of the project objectives.

## **B. Achievement of Outputs**

19. The Project achieved almost all physical outputs as envisaged at appraisal. The completed components for rehabilitation of the physical electricity supply infrastructure included the following:

- (i) acquisition of two new 2.5 MW heavy fuel oil (HFO) generators, and construction of a new administration building in Sihanoukville;
- (ii) rehabilitation of the distribution network in Phnom Penh, including
  - (a) approximately 52 kilometer (km) of underground 22 kV cable,
  - (b) 19 new and 22 fully refurbished distribution substations,
  - (c) approximately 110 km of overhead and 42 km of underground 380 volt (V) low-voltage distribution lines and 17,000 customer meters;
- (iii) rehabilitation of the distribution network in Sihanoukville, including
  - (a) approximately 28 km of overhead and 24 km of underground 22 kV distribution lines,
  - (b) 33 new or fully refurbished distribution substations,
  - (c) approximately 66 km of overhead and 12 km of underground 380 V low-voltage distribution lines and 6,500 customer meters; and

- (iv) rehabilitation of the distribution network in Siem Reap, including
  - (a) approximately 16 km of overhead and 30 km of underground 22 kV distribution lines,
  - (b) 31 new or fully refurbished distribution substations,
  - (c) approximately 67 km of overhead and 20 km of underground 380 V low-voltage distribution lines and 7,500 customer meters.

20. The training center constructed under the Project is on the outskirts of Phnom Penh and comprises a three-story administration and facilities block, three single-storey classrooms and workshop blocks. The buildings are of reinforced concrete with brick and mortar walls and have a total floor area of almost 2,000 square meters. Equipment for the training center procured under the Project included (i) furniture, (ii) computers and software, (iii) audio visual equipment, (iv) pedagogical aids, (v) mechanical and electrical equipment, (vi) machine tools, and (vii) specialized equipment for training students in the maintenance of diesel engines. The training center is well-designed and well-equipped. There is sufficient capacity to accommodate additional training that will be required as EdC integrates the electricity supply systems in other provincial centers.

21. With regard to introduction of a commercially based accounting system at the provincial level, the Project supplied a Novell V4 local area network, five computer workstations complete with 24 pin dot matrix printers, and Microsoft Office software for both Sihanoukville and Siem Reap. The setup at Sihanoukville was less than ideal initially, as temporary connections were necessary since the new administration building, constructed under the Project, was not complete at the time of installation. Additional funds from the Project were allocated in 1999 to upgrade the hardware originally supplied.

22. The integrated accounting software installed at both locations was Accounting Package (ACCPAC) a product used by a number of large companies in Cambodia and that had previously been purchased by EdC for use in Phnom Penh but never successfully installed. The package was chosen on the basis of recommendations from companies that were actively using the software. Accounting modules provided at each location included (i) system manager, (ii) general ledger, (iii) accounts receivable, (iv) accounts payable, and (v) inventory control.

23. The Project included the customization of the ACCPAC software to meet EdC requirements. In particular, a chart of accounts was set up and trial balance, income statement, and balance sheet reports were customized. The system was also set up to produce reports in the Khmer language based on the Ministry of Economy and Finance (MEF) standard chart of accounts, in accordance with MIME requirements. However, it was reported that the reports thus produced were not in the format specifically required by MEF.

### **C. Cost and Scheduling**

24. The actual total project cost was \$31.5 million, compared with an appraisal estimate of \$35.3 million. The actual cost included \$25.9 million in foreign exchange and \$5.6 million equivalent in local currency. The main savings were in local costs, which were \$2.8 million or 34% below the appraisal estimate. All foreign exchange costs were financed from the loan and local costs were fully met by EdC. Actual ADB loan disbursement was \$25.9 million and the balance of \$2.2 million was cancelled.

25. While the savings in foreign exchange costs would appear less significant, there were a number of reallocations of foreign exchange expenditure during project implementation (Appendix 2). They included the following:

- (i) Removal of a 1 MW generator in Siem Reap from the project scope (para. 6) and use of a skid-mounted power station design at Sihanoukville reduced the cost of generation plant by \$3.2 million.
- (ii) The distribution systems in Siem Reap and Sihanoukville were constructed over a larger area than envisaged at appraisal, and these incurred additional expenditure of \$5.0 million.
- (iii) Funds were provided to upgrade the original computer hardware originally acquired under the loan for Siem Reap and Sihanoukville and to support additional training for accountancy staff.
- (iv) Funds from the loan were provided to finance for 6 months, a continuation of the services of an advisor to the deputy managing director (planning) of EdC, formerly funded by WB, for the period from January 2000 until loan closing in June 2000.

26. The project schedule at appraisal is compared with actual project implementation progress in Appendix 3. While loan effectiveness occurred 1 month earlier than anticipated, front-end delays occurred in appointing the project implementation consultant. As a result, the award of construction contracts was not completed until mid-1997, 9 months later than envisaged at appraisal. Nevertheless, physical construction of the Sihanoukville power station was completed on schedule in September 1998, possibly due to the use of a skid-mounted packaged design. Construction of the three distribution networks was not completed until April 1999, 5 months later than the appraisal estimates. The additional scope of work in Sihanoukville and Siem Reap (para. 25) may have been a contributing factor to these delays.

27. The construction of the training center, which was not completed until February 2000, was almost 18 months behind schedule. The initial delay arose from the fact that the site was being used for storage and did not become available to the Project until June 1996. Subsequent geotechnical tests by the project implementation consultant revealed weak soil conditions which required a redesign of the foundations of two of the buildings in order to use pile foundations. Further, the construction was severely hampered by heavy rains and flooding in April/May and November/December 1999. Classes at the training center did not start until 2001. Had the works proceeded on schedule, classes could have begun a year earlier.<sup>5</sup>

#### **D. Procurement and Construction**

28. Goods and services were procured and project facilities constructed in accordance with ADB's *Guidelines for Procurement*. No serious problems in procurement were encountered, and the performance of most suppliers and consultants was satisfactory. However, delays in selecting the project implementation consultants and awarding contracts for the training center were experienced. Some pedagogical and other equipment for the training center could not be fully installed and tested before loan closure and probably contributed to the training center's ongoing inability to utilize the \$30,000 automation simulator.

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<sup>5</sup> The Project did not include the design of courses for the training center. This work was done with the assistance of a consultant funded by a grant from Agence Francaise de Developpement. However, the course design could not be completed until after the pedagogical equipment had been installed and tested under the Project.

29. The 14 months required for selecting the project implementation consultant was well in excess of the 6 months envisaged at appraisal. The negotiated contract submitted to ADB for approval on 27 November 1995 was 35% in excess of the appraisal estimate of \$2.0 million. Therefore, the consultant was requested to reduce the number of visits, reduce the specialist input into the design of the training center, and do other appropriate cost savings. On 7 March 1996, a revised contract for \$2.3 million was signed with the project implementation consultant.

30. In addition to the late issuance of bidding documents for the training center (para. 26), there were further delays in the award of the contracts. After ADB's approval of EdC's recommendation for contract award for civil works on 22 January 1998, EdC advised on 2 March 1998 that MEF could not allocate the full \$1.1 million equivalent of local costs due to budgeting constraints, and requested ADB to review the loan financing. On investigation, it was found that the contractor had misunderstood what items could be classified as foreign or indirect-foreign, and the local portion of the contract price was subsequently revised downwards. This revision brought the contract within the EdC's budget, and it was awarded on 19 May 1998.

## **E. Organization and Management**

31. The performance of MEF was satisfactory. Counterpart funds were made available in a timely manner. The performance of EdC as the EA improved as it became more familiar with ADB procedures. In March 1997, in the course of project implementation, EdC was corporatized. The project implementation and planning departments were merged, but this structural change did not affect the implementation of the Project. Corporatization of EdC allowed it to set salary levels to recruit and retain competent staff, and reduced political interference in day-to-day management decisions.

32. EdC started to produce consolidated accounts only in 1998. A summary of EdC's financial performance over the period 1998–2001 is given in Appendix 4. Despite the fact that EdC's electricity tariffs are the highest in the region (para. 51), its financial position remains weak and the principal financial covenants under this loan were not met. These covenants were (i) 30% minimum level of self-financing of EdC's average annual capital expenditure, (ii) a minimum debt service ratio of 1.3, (iii) a debt-equity ratio not exceeding 60:40, and (iv) accounts receivable not exceeding 3 months electricity sales. EdC's financial difficulties are discussed in more detail later in paras. 52–54.

33. The UNDP-funded management advisors whose contract was extended under the loan and the project implementation consultants were important to the successful project outcome, given MIME and EdC's limited experience with ADB's procurement procedures at the time of loan approval. The management advisors also were important to the corporatization of EdC and to the development of technical standards for electricity distribution. This has ensured the compatibility of work undertaken by different contractors under different funding agencies.

34. The consultants engaged for the associated TA made an important contribution in developing the conceptual design of the training center. This consultancy was provided by one of the partners that undertook the project implementation consultancy and, after completion of the Project, also contributed, under French funding, to the development of detailed training course designs. This has ensured a continuity that has undoubtedly contributed to the success of the training center.

### III. ACHIEVEMENT OF PROJECT PURPOSE

#### A. Operational Performance

35. Two components of the Project are a new 5 MW power station in Sihanoukville and a rehabilitated distribution network in Phnom Penh, Sihanoukville, and Siem Reap. As shown in Table 1, they have resulted in increased electricity sales and reduced electricity losses in each of the three project areas. Average electricity tariffs in the project areas are between \$0.16 and \$0.22 per kilowatt hour (kWh) compared with tariffs of up to \$0.36 per kWh at the time of appraisal. Tariff reductions in Siem Reap, where nearly all generation is currently sourced from privately owned diesel plants, have been particularly significant.

**Table 1: Summary of Network Performance**

| Item                                   | 1994  | 1998   | 1999   | 2000   | 2001    | 2002    |
|--|-------|--------|--------|--------|---------|---------|
| <b>Phnom Penh</b>                      |       |        |        |        |         |         |
| Peak Load (MW)                         | —     | 60     | 64     | 67     | 76      | 92      |
| Electricity Sales (GWh)                | —     | 266    | 264    | 329    | 364     | 418     |
| Number of Customers                    | —     | 35,434 | 85,207 | 95,058 | 111,908 | 133,674 |
| Losses (%)                             | 38    | 20     | 24     | 11     | 15      | 13      |
| Average Consumption per Customer (kWh) | —     | 7,507  | 3,333  | 3,461  | 3,253   | 3,127   |
| Average Tariff (US cents/kWh)          | 14    | 10     | 13     | 14     | 15      | 15      |
| Average Tariff (KR/kWh)                | 350   | 371    | 504    | 530    | 597     | 595     |
| <b>Sihanoukville</b>                   |       |        |        |        |         |         |
| Peak Load (MW)                         | —     | 2.15   | 2.70   | 3.00   | 3.20    | 4.00    |
| Electricity Sales (GWh)                | —     | 8.3    | 10.3   | 12.7   | 14.7    | 16.1    |
| Number of Customers                    | 3,000 | 4,531  | 6,236  | 6,675  | 6,974   | 7,204   |
| Losses (%)                             | 48    | 22     | 19     | 14     | 15      | 16      |
| Average Consumption per Customer (kWh) | —     | 1,910  | 1,644  | 1,905  | 2,110   | 2,233   |
| Average Tariff (US cents/kWh)          | 20    | 16     | 15     | 16     | 15      | 16      |
| Average Tariff (KR/kWh)                | 500   | 597    | 584    | 600    | 601     | 624     |
| <b>Siem Reap</b>                       |       |        |        |        |         |         |
| Peak Load (MW)                         | 1.4   | 2.19   | 1.90   | 2.61   | 3.20    | 4.50    |
| Electricity Sales (GWh)                | —     | 4.8    | 6.3    | 10.1   | 13.5    | 15.9    |
| Number of Customers                    | —     | 5,888  | 7,295  | 7,902  | 8,278   | 8,660   |
| Losses (%)                             | 53    | 45     | 31     | 15     | 16      | 17      |
| Average Consumption per Customer (kWh) | —     | 820    | 860    | 1,298  | 1,625   | 1,841   |
| Average Tariff (US cents/kWh)          | 36    | 28     | 25     | 23     | 22      | 22      |
| Average Tariff (KR/kWh)                | —     | 1,062  | 964    | 872    | 876     | 879     |

— = not available, GWh = gigawatt hour, kWh = kilowatt hour, MW = megawatt.

Source: Data for 1994 were taken from the report and recommendation of the President, and those for other years from Electricité du Cambodge.



36. Over 90% of all EdC customers are residential and these customers use between 50% and 60% of the electricity purchased from EdC in each project area. The balance of the load is broadly classified into commercial, industrial, and government. Over the period 1999–2002, the proportion of electricity sales revenue received from nonresidential customers has remained reasonably constant in Sihanoukville and Siem Reap at about 47% and 42%, respectively. However, the proportion of nonresidential sales from Phnom Penh customers has declined from 66% in 1999 to 51% in 2002. It is not known how much of the additional consumption is new load and how much is load that was previously supplied from private on-site generation. However, industrial and commercial businesses still rely on private on-site generation for the bulk of their electricity requirements and use the EdC supply only when load levels are low. EdC staff told the OEM that the peak load in Phnom Penh and Sihanoukville would increase by 100 MW and 6 MW, respectively, if these customers purchased all their electricity requirements from EdC. Reduced consumption per customer in Phnom Penh (Table 1) indicates increased reliance on private generation as tariffs have increased (in riel). Private generation is also used extensively in Siem Reap, although average consumption per customer is increasing, reflecting decreasing tariff levels (in riel). The capacity of the new distribution networks is more than enough to accommodate the power requirements of existing businesses of all sizes, and better use of the system depends on EdC achieving tariff reductions.

37. Distribution losses are well down from the level of around 50% that was normal before the Project. However, the rehabilitated distribution systems, in Sihanoukville and Siem Reap in particular, have very light loads. The reported losses are still considered high compared with what has been achieved elsewhere with networks of similar design. Many of these losses are likely to be caused by a prevalence of uncompensated low power factor loads and by relatively high transformer no-load losses. It is thought that non-technical losses could be around 5% although a more detailed loss analysis would be needed to verify this.

38. The distribution network is well designed, constructed, operated, and maintained. The primary 22 kV distribution system is operated well below its potential capacity and should provide a sound basis for future growth as economic conditions improve.

39. Another component of the Project was the training center. This is well designed, managed, and equipped. In 2001, 133 courses were run for 902 trainees. In 2002, the number increased to 172 courses for 1,296 trainees. Nevertheless, the center has significant spare capacity and will be used to train staff from the eight provincial towns to be absorbed into EdC's service areas following further network rehabilitation financed by an ongoing ADB loan.<sup>6</sup> The director of the training center envisages that eventually staff from the private sector of the industry will be trained at the center on a fee-paying basis.

40. The PCR expressed concern about the operation of the training center. It noted that operation of the training center is the responsibility of the administration department within EdC. All expenditure, including staff salaries, has to be made by the center director from an annual lump-sum budget, which is proving to be inadequate. Unfortunately, salaries paid to the academic staff from the EdC budget were too low, and a number of trained staff have already left. However, the OEM found that, while the overall budget remains a concern, many of the problems identified in the PCR had been effectively addressed. Staff are being paid a monthly

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<sup>6</sup> Loan 1794-CAM(SF): *Provincial Power Supply*, for \$18.6 million equivalent, approved on 5 December 2000. The eight provincial towns covered under this loan project are Banlung, Kampot, Kompong Speu, Prey Veng, Sisophon, Stung Treng, Svay Rieng, and Takeo.

location allowance to compensate for travel to and from the training center, which is located on the outskirts of Phnom Penh. Up to now, only one trainer has resigned. The issue of inadequate fluency in English (para. 10) became less acute due to the use of teaching materials in French.

41. Nevertheless, the OEM identified other problems in respect of the operation of the center. In particular, no technical books are available in the library and a \$30,000 plant automation simulator, procured under the Project, cannot be used as no manuals or operating instructions were provided. Dormitories for out-of-town students are to be financed under the ongoing ADB Loan 1794 (footnote 6). However, while the design of the dormitories is in hand, there has been no consultation with the director of the training center. Further, development of additional courses and provision of further pedagogical equipment, particularly relating to 115 kV transmission, is urgently needed and is said to be funded through grant aid from the Agence Francaise de Development.

42. The final component of the Project was a modern accounting system, ACCPAC, and associated computer hardware. The accounting software provided under the Project has not been used in either Sihanoukville or Siem Reap since the end of 1997, the year it was supplied. ACCPAC is a general-purpose, integrated accounting package that has not been specifically designed for utility operation. It supports multiuser access, so financial transactions can be entered by a number of authorized personnel connected to a network. It is also designed to be used in an international accounting practice (IAP) environment so that, once posted, a transaction cannot be altered. Any errors therefore need to be corrected by entering reversal transactions or journal adjustments.

43. EdC gave a number of reasons why ACCPAC is no longer used. It argued that (i) the accounts receivable module of ACCPAC could not be used for automating the production of customer bills, which constituted the vast majority of accounting transactions; (ii) conformity with IAP increased the complexity of the accounting process and is not required by either MEF or MIME; and (iii) the reports prepared by ACCPAC did not meet MEF formatting requirements, so that the final MEF accounts still had to be manually prepared. At the time of appraisal, all accounts and invoices in Sihanoukville and Siem Reap were prepared without computers, using manual paper-based processes. Accounts are now kept using Microsoft Excel spreadsheets and staff have become very adept at using this tool. This is a significant advance.

44. The project implementation consultant was not able to customize the ACCPAC accounts receivable module to automatically generate invoices on the basis of meter read data. The consultant therefore developed spreadsheets that, until recently, were used to prepare customer invoices. There were differences in the spreadsheet format used in Sihanoukville and Siem Reap, but the reason for the differences is not clear. In 2002, EdC provided both offices with an access database billing system that it developed in-house. This system automatically calculates invoice amounts on the basis of meter read data and prints the required invoices. It also produces reports on long-standing debts. The system has been well received and is actively used by both offices.

45. EdC staff commented that the introduction of ACCPAC may have been more successful had the customization been done by a representative of the supplier, who could modify the program code. The project implementation consultant was an accountant with no previous experience using the program and who was generally limited to user accessible functions. It was also noted that the consultant was more familiar with French accounting systems than with IAP, but the nature of the difference between the two approaches is not entirely clear.

46. The PCR concluded that the problems encountered in introducing of ACCPAC software were due to a lack of the required staff competence to use the software and recommended further accounting and general management training. The OEM findings do not support this conclusion since, in both offices, the staff seem very competent in the use of spreadsheet-based accounting techniques and have had few problems implementing and using EdC's new billing system. Additional training was provided using project contingency funds in 1999, but it did not result in ACCPAC being reactivated.

47. The complexity of the accounting system, as customized by the implementation consultant, appears to have been a major issue. A full set of accounts for the year 1997 was prepared by the Siem Reap office using ACCPAC. This was a substantial volume containing a large amount of detail and would have been of limited use for management reporting. As audited accounts for the Phnom Penh operation in 2002 were not available, the OEM was given a copy of the unaudited accounts, produced using ACCPAC. The income statement contained almost 50 revenue and 150 expenditure line items, compared with the 15 revenue and 35 expenditure categories currently used in both Sihanoukville and Siem Reap to mirror MEF requirements. The OEM was left with the impression that the implementation consultant could have been better used to customize a simplified system that closely mirrored the standard MIME/MEF chart of accounts.

48. The PCR stated that the level of use of ACCPAC should increase as staff become more familiar with the system. However, an accounting system such as ACCPAC is integral to the management and control of a business operation and must therefore be used to record all transactions relevant to a particular accounting function. It is not practical to record some transactions in ACCPAC and the remaining transactions in some other system.

49. The OEM concludes that what was really required was a billing system, rather than an integrated accounting system, as customer accounts constitute the vast majority of accounting transactions. The provincial offices are not large operations and, if billing is handled by a different system as is now the case, the volume of the remaining accounting transactions is sufficiently low to be effectively managed using spreadsheets. It is noted that the use of spreadsheets does not preclude paper records being kept for audit purposes. On this basis, there needs to be an additional reason to justify the use of ACCPAC or a similar accounting package. One possible reason would be a decision by MEF to require adherence to IAP. Alternatively, the use of an integrated accounting package would be necessary if a decision were to be taken by EdC to centralize its accounting function using a wide area network.

## **B. Performance of the Operating Entity**

50. Summaries of EdC's financial accounts for the consolidated operation and individual provincial operations during 1998–2001 are given in Appendixes 4 and 5. EdC's financial performance continues to be problematic. This is perhaps best illustrated by the cash flow summary in Appendix 4.1, which shows that EdC had a positive income from operating activities only in 2001, and that the net operating income was about 2.8% of total turnover. While the consolidated accounts for 2002 are not yet available, there are some indications of improvement. By the end of 2003, however, EdC will absorb the electricity operations of eight more provincial capitals (footnote 6), and this expanded operation could make improved financial position difficult in the short term.

51. Table 2 shows that EdC's electricity tariffs are the highest in the region, due to an almost exclusive reliance on diesel and HFO generation. In 2001, the cost of fuel and electricity

purchases from independent power producers (IPPs) amounted to over 58% of EdC's total operating costs, including depreciation, and together totaled KR409 or over \$0.10 per kWh sold. This cost alone is significantly higher than the total electricity tariff in many Asian countries. It is clear that EdC's financial problems need to be tackled by reducing costs rather than by increasing tariffs.

**Table 2: Comparative Electricity Retail Tariffs in Selected Asian Economies**  
(US cents/kWh, as of December 2001)

| <b>Economy</b>    | <b>Residential</b> | <b>Commercial</b> | <b>Industrial</b> |
|-------------------|--------------------|-------------------|-------------------|
| Hong Kong, China  | 11.0–13.9          | 12.5              | 8.9               |
| Indonesia         | 3.7                | 6.1               | 4.4               |
| Republic of Korea | 4.8–18.8           | 6.9–8.0           | 2.6–9.1           |
| Malaysia          | 5.7–7.3            | 4.4–7.5           | 3.9–5.0           |
| Philippines       | 10.7               | 10.3              | 10.0              |
| Singapore         | 11.7               | 6.9–8.8           | 6.7–8.2           |
| Thailand          | 1.6–5.5            | 2.3–2.5           | 2.3–2.5           |
| Viet Nam          | 3.2–6.0            | 6.2               | 1.4–3.5           |
| <b>Cambodia</b>   | <b>9.0–21.7</b>    | <b>13.0–21.7</b>  | <b>12.0–21.7</b>  |

Sources: ASEAN Center for Energy; Korea Electric Power Corporation, Republic of Korea; China Light and Power Group, Hong Kong, China; Perusahaan Listrik Negara, Indonesia; Electricité du Cambodge, Cambodia.

52. EdC's costs are impacted significantly by high levels of taxation, particularly on imported fuel. Current taxation on fuel is approximately 70%, excluding the value-added tax (VAT). Hence, in 2001, EdC's tax on direct fuel purchases (excluding fuel purchased directly by IPPs for electricity generation) would have amounted to KR18.5 billion (\$4.6 million) or 7.5% of total costs. EdC is also required to pay VAT on inputs, but is prohibited by Government decree from passing this VAT on to consumers.

53. In recognition of EdC's difficult operating position, ADB replaced the project financial covenants (para. 32) in Section 2.18 of the Project Agreement for Loan 1794 (footnote 6) signed in December 2000. The covenants were replaced by requirements to (i) achieve at least cash breakeven for FY2001 and each FY thereafter, (ii) earn for FY2002 an annual return of at least 5% of the average net revalued value of EdC's fixed assets in operation, and (iii) earn for FY2003 and each FY thereafter an annual return of at least 6% of the average net revalued value of EdC's fixed assets in operation. Furthermore, EdC was required to achieve a debt service coverage ratio of at least 1.2 for FY2002 and each FY thereafter.<sup>7</sup>

54. The heavy tax burden places EdC at a severe disadvantage financially in both Sihanoukville and Siem Reap, which are close to the country's borders. Illegally imported, tax-free fuel is readily available in both cities and is used extensively for private electricity generation. As a result, commercial and industrial customers in both areas generally connect to EdC only at times of low demand and switch to their own generation when demand increases. The situation in Phnom Penh is somewhat better although larger commercial and industrial consumers still tend to use their own in-house generation. This extensive use of private generation has negative impacts on the financial performance of EdC. The rehabilitated primary 22 kV distribution systems have ample capacity to service all loads in their area of coverage. Internationally, utilities find large loads important to their financial viability since

<sup>7</sup> EdC was unable to achieve cash breakeven in FY2001. Compliance with the two other financial covenants remains to be seen when the financial statements of EdC for 2002 become available.

servicing costs are generally low in proportion to the amount of revenue larger customers produce.

55. Historically, revenue collection has been difficult for EdC with collection from government agencies presenting a particular problem. However, a significant amount of the government debt backlog was recovered in 1999 and 2000.

### C. Financial and Economic Reevaluation

56. Financial and economic reevaluations of the Project, undertaken using the latest available information, are discussed in more detail in Appendix 6. The revaluations are based on the overall power supply operation in each of the three project areas. The main difference between the PCR/PPAR and appraisal approach lies in the forecast of the sales. At appraisal, the sales were considered to be limited by the generating capacity installed or committed. Given the recent power demand and forecast growth scenarios, the distribution facilities rehabilitated and expanded under the Project are expected to be loaded to their full capacity in 2010 for Phnom Penh, 2017 for Sihanoukville, and 2013 for Siem Reap. The power supply situation also changed significantly from the appraisal assumptions. Power purchases from IPPs and neighboring countries ignored at appraisal are increasing rapidly. Thus, in the PCR and the PPAR, sales are considered to expand until limited by the capacity of the distribution system installed under the Project. However, unlike the PCR, consumer surplus was not included in the PPAR economic recalculation, given the fact that many businesses are unwilling to buy electricity from EdC at current tariff rates and rely on self-generation for the bulk of their power supply. The results of these analyses are summarized in Table 3.

**Table 3: Summary of Financial and Economic Reevaluations**

| Location      | FIRR (%)  |      |      | EIRR (%)  |      |      |
|---------------|-----------|------|------|-----------|------|------|
|               | Appraisal | PCR  | PPAR | Appraisal | PCR  | PPAR |
| Phnom Penh    | 24.1      | 6.6  | 8.9  | 37.4      | 44.3 | 18.3 |
| Sihanoukville | 9.1       | 13.6 | 15.2 | 15.6      | 24.9 | 16.1 |
| Siem Reap     | 12.9      | 14.9 | 11.9 | 19.8      | 33.2 | 15.5 |

EIRR = economic internal rate of return, FIRR = financial internal rate of return, PCR = project completion report, PPAR = project performance audit report.

57. The more favorable PPAR estimate of financial internal rates of return (FIRR) for project components in Phnom Penh and Sihanoukville were mainly due to stronger demand and larger savings in terms of O&M costs compared with the PCR estimate. The lower recalculated FIRR for Siem Reap was due to the revised rate of increase of electricity sales at 15% per annum compared with the PCR estimate of 21%. The recalculated economic internal rates of return (EIRRs) are much less compared with the PCR estimates for all three components mainly due to the exclusion of consumer surplus from the PPAR recalculation.

### D. Sustainability

58. The distribution networks constructed under the Project now form the basis for the electricity distribution infrastructure in all three project areas. The networks are well-designed and the primary distribution backbone in each project area has ample capacity to accommodate future load growth. It is readily capable of expansion as resources become available to extend the coverage area. In Sihanoukville, this is already being done on an incremental basis as a small number of additional substations are connected to the network. The networks should

therefore prove to be a springboard for continuing expansion and ongoing economic development in each project area.

59. The OEM found the O&M of the equipment provided under the Project to be generally satisfactory. All equipment was operational and the power station at Siem Reap had undergone major services recommended by the supplier. The maintenance requirements of the distribution components of the Project are low, given the absence of moving parts, high reliability built into the design of the network, and the relatively low network loading. However, the poor financial health of EdC (para. 50) raises concerns about the future availability of sufficient funds and other resources for O&M.

60. The failure of medium size and large users to use the networks in Sihanoukville and Siem Reap to their fullest potential is a concern as it reduces the financial and economic return from the investment. This in turn limits EdC's ability to extend the service and provide a supply to consumers outside the present area of coverage. To address this problem, EdC must focus on cost reduction so that it can reduce its tariffs to levels that are comparable with the cost of supply from private generation.

#### **IV. ACHIEVEMENT OF OTHER PROJECT IMPACTS**

##### **A. Socioeconomic Impact**

61. Sihanoukville and Siem Reap were chosen as project areas because of their importance to the national economy (para.14). This would suggest that the primary motivation for the Project was to ensure that businesses and industries in these areas, as distinct from domestic households, had access to a reliable and economic supply of electricity to improve their productivity and economic competitiveness and thereby deliver downstream economic benefits. In both areas, however, many businesses that drive the economy are not using the facilities provided under the Project to source the bulk of their electricity requirements. The main project beneficiaries have therefore been the domestic consumers, who have availed themselves of the 24-hour availability of supply and, in many cases, avoided the need to operate small private generators. On this basis, the downstream economic outcome from the Project resulting from a lower cost, more reliable electricity supply to businesses is less than envisaged at appraisal. Nevertheless, it is estimated that an additional 95,000 domestic households gained access to a reliable 24-hour electricity supply.

62. While the Project now provides a reliable electricity supply in all project areas, it has had little impact on the nominal electricity tariff in Sihanoukville. The average electricity tariff in 2002 was KR624 per kWh compared with KR597 per kWh in 1998 (Table 1). The main reason for this would seem to be that cost savings as a result of the Project have been offset by the depreciation charges on the project facilities. In Siem Reap, however, there has been a tariff reduction of 17% since 1998, due to the implementation of the Project. In this case the depreciation charge is much lower as no new power station has been constructed.<sup>8</sup>

63. It is more difficult to assess the socioeconomic impact of the Phnom Penh component. This is one of a number of projects designed to improve the electricity supply in the capital, and it is not possible to separately analyze the impact of any one individual project. While the average tariff in Phnom Penh remains cheaper than in either Sihanoukville or Siem Reap, it has

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<sup>8</sup> The 1 MW diesel power plant in Siem Reap financed by French grant aid used secondhand equipment and stopped operation in 2000.

increased by more than 60% since 1998. However, the 1998 tariff was unrealistic and resulted in unacceptable losses. Furthermore, electricity purchases from IPPs have increased due to the limited generation capacity of EdC.

## **B. Environmental Impact**

64. The Project has significantly reduced the visual impact of electricity distribution by replacing the proliferation of conductors that existed prior to rehabilitation with a limited number of larger conductors, designed and installed in an aesthetic way. Furthermore, the rehabilitated distribution network is designed to minimize environmental impacts by using (i) underground high-voltage distribution lines in all urban areas, (ii) underground low-voltage distribution lines in commercial areas, and (iii) low-voltage aerial bundled conductor for overhead distribution to minimize right-of-way requirements. The Project was designed around existing development and infrastructure, and no resettlement of project-affected families was required. The new power station at Sihanoukville was constructed on land owned by EdC that was already used for power generation purposes. No significant adverse environmental impacts were anticipated at appraisal and none have occurred.

65. One of the objectives of the Project at appraisal was to reduce the environmental impact of power generation by replacing the large number of small privately owned generators with a single generating station. This has not been achieved to the extent envisaged, as many businesses and industries still rely on private in-house generation to meet the bulk of their electricity requirements.

## **C. Impact on Institutions and Policy**

66. The OEM was impressed by the understanding of the challenges and issues facing EdC by its senior and middle management and by senior officials from both MIME and EAC. Despite the weaknesses identified in this report, EdC is clearly a much stronger organization now than it was at the time of appraisal and is well placed to meet the challenges ahead. While the attempted introduction of the ACCPAC software was a failure, accounting staff in all three project locations came across as competent and well able to perform their duties. Power planning staff were competent, and had a clear vision of how the system needs to develop in the medium term. The training center was well run, with enthusiastic and capable senior management.

67. In February 2001, Cambodia passed the Electricity Law, which provides the blueprint for the ongoing development of the electricity industry. The Law aims to (i) ensure the protection of the right of consumers to receive a reliable and adequate electricity supply at reasonable cost, (ii) promote private ownership of facilities for providing electric power services, (iii) establish competition wherever feasible in the sector, (iv) establish EAC, and (v) create favorable conditions for investment in and the commercial operation of the electric power industry. EAC will issue licenses to both private and public sector industry participants and will regulate both the technical standards and costs of services provided by licensees. Under this model, EdC has no statutory right to supply electricity throughout Cambodia and will operate alongside private sector participants. On 1 February 2002, EAC issued EdC a consolidated electricity license, which included the right to distribute and supply electricity in 15 areas, including the 3 project areas. The Law applies only to electricity generation, transmission, and distribution for sale and does not cover the generation of electricity for internal consumption. At the time of the OEM, EAC's activities were focused on the issue of licenses and little progress had been made in developing procedures for regulating tariffs.

## **V. OVERALL ASSESSMENT**

### **A. Relevance**

68. Under the Project, a well-designed electricity distribution system was installed in the three project areas. In addition, a modern power station, operating on the most cost-effective fuel currently available in Cambodia, was constructed in Sihanoukville. These project outputs constitute essential components of the infrastructure for ongoing economic development. The other project components were designed to ensure that effective systems are put in place to properly operate and maintain this infrastructure over the longer term. Overall, the Project is rated as highly relevant.

### **B. Efficacy**

69. The Project achieved its intended purposes of rehabilitating the physical power supply infrastructure in the three project areas and also develop and construct a training center designed to meet EdC's ongoing staff development requirements. However, it has been less successful in achieving the objective of stimulating economic development in the project areas since many of the target users are boycotting the system.

70. The purpose of the introduction of the ACCPAC software in Sihanoukville and Siem Reap was to introduce modern accounting techniques in the two offices. To a large extent this has been achieved, although not in the manner intended at the time of appraisal and during the course of project implementation. Before the Project began, accounting at either office was undertaken manually, using paper-based systems. While ACCPAC is not used, both offices now keep detailed computer-based records of their operation, using hardware and software (Microsoft Office) supplied under the Project. The account records are used to prepare detailed financial statements of each operation and meet the requirements of EdC, MIME, and MEF. Overall the Project is rated as efficacious.

### **C. Efficiency**

71. The Project was prepared in 6 months without project preparatory TA and implemented with minimum delay and change of scope. It resulted in acceptable economic returns (Table 3), as confirmed by the recalculated EIRRs for each of the Project's physical infrastructure components. FIRR's are somewhat lower due to EdC's high level of taxation. However, the Project would have generated higher FIRR's and EIRRs if businesses and industries purchased their entire power requirement from EdC. Since the rehabilitated distribution systems are lightly loaded particularly in Siem Reap and Sihanoukville, considerable overcapacities exist in the project areas. The other inefficiencies in the Project, including the unsuccessful introduction of ACCPAC software and the procurement of a simulator for the training center that cannot be used, are minor compared with those of the major infrastructure components. Overall, the Project is rated as efficient.

### **D. Sustainability**

72. Over the 4-year period of 1998–2002, electricity sales by EdC increased by 57% in Phnom Penh, 94% in Sihanoukville, and 230% in Siem Reap (Table 1) despite electricity tariffs being the highest in the region (Table 2). While most residential customers in the project areas obtain their supply from EdC, many businesses and industries revert to their own generation to provide the bulk of their requirements. There is therefore significant potential for further growth



even in the areas covered by the Project. Additional growth will also occur as the existing distribution systems are extended to include areas where EdC supply is not available.

73. The main constraint on EdC's ability to service this growth is its ability to provide the power generation required. While generation appears to be readily available from IPPs, it tends to be expensive and EdC will need to look to other generation opportunities if it is to reduce costs and tariffs. In the short term, IPP generation in Siem Reap will be replaced by EdC's own HFO-fueled generation when the power station funded by the Japan Bank for International Cooperation (JBIC) is commissioned.

74. Although the O&M of the equipment provided under the Project are found to be generally satisfactory to date, the poor financial health of EdC raises concerns about the sustainability of the Project. Overall, the Project is rated as likely sustainable.

## **E. Institutional Development and Other Impacts**

75. At appraisal, EdC functioned effectively as a government department and relied on government budget allocations to cover its operating deficits and all capital expenditure. While routine day-to-day technical operations were carried out by EdC, all major decisions involving technical as well as financial matters were handled by MIME. EdC is now corporatized and responsible for managing its own technical and financial affairs. Under the Electricity Law of February 2001, MIME's role is to develop energy policy while EAC has been established as an independent regulator.

76. Given the situation at appraisal, EdC's progress in institutional development has been impressive, notwithstanding its current financial problems. The senior staff interviewed by the OEM had a good understanding of their responsibilities and the challenges ahead. These changes have largely been brought about by the need to comply with ADB's various nonfinancial loan covenants. Of more specific relevance to this Project is the fact that EdC now operates a well-managed training center designed to meet its ongoing staff training requirements and that quality financial accounts are now kept at both Sihanoukville and Siem Reap, although not in the manner intended at the time of appraisal.

77. However, the Project did not achieve the desired environmental impact to the extent envisaged (para. 65), as many businesses and industries still rely on private in-house generation to meet the bulk of their electricity requirements. On this basis, the institutional development and other impacts of the Project are considered significant.

## **F. Overall Project Rating**

78. On the basis of the preceding assessments, the Project is rated successful.

## **G. Assessment of ADB and Borrower Performance**

79. ADB cooperated well with the Government, MIME, and EdC in formulating the Project and processing the loan. During implementation, ADB closely monitored and supported the Project, with six review missions visiting it despite a moratorium on visits to the country between August 1997 and November 1998 due to a political crisis and civil disturbance. The schedule for implementing the revenue-generating components of the Project, prepared at appraisal, was realistic. ADB approved without delay several reallocations of loan proceeds and promptly adjusted the financing plan to accommodate local budget constraints. Unfortunately, ADB did

not react effectively to the implementation problems with ACCPAC, although this is likely due to the timing of the moratorium on visits.<sup>9</sup> While the consultant completed his work in September 1997, action in the form of provision of further training was not taken until 1999. Predictably, given the long time delay, this training was ineffective. Overall, the performance of ADB is considered satisfactory.

80. The performance of MEF was also satisfactory. Counterpart funds were made available in a timely manner. The performance of EdC improved as the Project progressed and as EdC became more familiar with ADB procedures.

## **VI. ISSUES, LESSONS, AND FOLLOW-UP ACTIONS**

### **A. Key Issues for the Future**

81. The key issue facing EdC is the need to improve its financial performance so as to ensure long-term sustainability. As current tariffs are the highest in the region, efforts must focus on reducing costs, particularly the cost of generation, rather than raising revenues by increasing tariffs. Prospects for reducing generation costs are good, particularly over the longer term. EdC has negotiated contracts to purchase electricity from both Viet Nam and Thailand, but transmission facilities need to be constructed to deliver the power to the load centers.<sup>10</sup> It is unlikely that supply from either source can be put in place before 2007.

82. In the shorter term, cost reduction efforts must focus on reducing the cost of fuel and possibly also on further loss reduction initiatives. HFO is significantly cheaper than diesel and efforts to substitute HFO generation for diesel are ongoing. JBIC is currently funding the construction of a new 10 MW HFO generating station in Siem Reap and is likely to fund the conversion to HFO of existing diesel generation in Phnom Penh.

83. Perhaps, the most urgent problem facing EdC is its heavy tax burden. Fuel used for electricity generation is taxed by more than 70%. In addition, EdC must pay import tax on imported inputs and is obliged to pay VAT on inputs, but cannot pass this tax on to customers. Furthermore, EdC receives no protection from private generators, many of whom are able to avoid tax by using illegally imported fuel and equipment. Relief from these taxes would significantly improve EdC's financial viability and could allow tariffs to be reduced to the extent that medium-size and large businesses outside of Phnom Penh would use EdC for the bulk of their electricity requirements.

84. A dilemma for the Government is the impact that reducing the tax burden on EdC would have on government revenues. It is suggested that a study of the impact of reduced electricity tariffs on overall economic activity be undertaken. Such a study could explore whether the increased economic activity resulting from a reduction in electricity tariffs would produce sufficient government revenue to offset the reduced taxation from EdC.

85. Losses remain a significant cost burden on EdC because of the high cost of generation. It is suggested that a loss analysis be undertaken to determine the extent of nontechnical losses

<sup>9</sup> There was a moratorium on visits to Cambodia between August 1997 and November 1998 due to a political crisis and civil disturbance.

<sup>10</sup> Under TA 4078-CAM: Power Distribution and Greater Mekong Subregion Transmission, ADB is currently investigating the feasibility of the construction of a 220 kV transmission line from Viet Nam to supply electricity to Phnom Penh, Takeo, and Sihanoukville. It is anticipated that a loan that will include construction of this line will be approved in November 2004.

and to provide a breakdown of the different causes of the technical loss. Such a study would determine the cost-effectiveness of further loss reduction measures.

## **B. Lessons Identified**

86. The consulting services to support the introduction of a commercially based accounting system in Sihanoukville and Siem Reap were inadequate. At appraisal, accounts kept in these offices were manual and paper based. The transition to the use of a computerized state-of-the-art accounting system required a major cultural shift, which necessarily must take a significant time to implement and establish. Furthermore, the end result is critical to the ongoing management and control of the organization and, once in place, requires the full commitment of staff and management. However, all work to implement the accounting system was done between February and September 1997. It would seem that the consultant set the system up, showed EdC how to use it, and walked away. This level of involvement is inappropriate in circumstances where a major organizational change or cultural shift is required. The consultant should have been required to assist with the preparation of the annual accounts for 1997 and also to be available as required throughout 1998.

87. Questions also arise on the relevance of the accounting system that was implemented to the requirements of EdC's provincial officers. Anecdotal evidence given to the OEM suggests that the primary reasons for selecting ACCPAC were that EdC already had purchased the software for use in its Phnom Penh office and that other companies interviewed had found the package to be satisfactory. There is no evidence of any systematic needs analysis being undertaken. Such an analysis could well have identified the need for a customer billing system, and the requirements of such a system, and eventually could have led to a less complex implementation.

88. EdC's inability to utilize the \$30,000 automatic plant control simulator highlights the lack of involvement of the consultants over the final 2 years of the Project. This is apparent from the utilization summary included in the project implementation consultant's completion report. The simulator was delivered with other pedagogical equipment in mid-1999 but could not be unpacked and installed until after the training center buildings were completed in February 2000. The pedagogical equipment was not inspected until the consultant returned to the site in May 2000, a month before loan closure. While no further information is provided, it is possible that the consultant was unable to verify that the equipment operated correctly since he could not connect it to the power supply.

89. These experiences highlight the importance of providing ongoing consulting support after project completion as well as before and during project implementation. While this can often be difficult due to budgetary and time constraints, failure to provide such support can lead to suboptimal project outcomes.

90. On hindsight, a project design weakness was the absence of policy components that address broader sector issues such as high tariff and reliance on oil-fired power generation, which resulted in the failure of medium-size and large businesses to use the project facilities to the fullest potential.

## **C. Follow-Up Actions**

91. It is recommended that ADB engage the Government in a policy dialogue focusing on whether the current level of taxation on EdC is appropriate. Continuation of the current tax

policy, apart from placing EdC in a difficult trading position, may have detrimental impacts on the national economy. It may also exacerbate inequalities across the country after cheaper power from Viet Nam becomes available in 2007. The OEM understands that the cost of power imported from Viet Nam will be \$0.04–\$0.08 per kWh at the border and that up to 200 MW will be available. This should be sufficient to supply the power requirements of the cities and towns connected to the proposed new transmission system in the south of the country. The tax on this power will be low compared with the current tax on fuel. This could mean a significant difference in the price of electricity sold to customers with access to the transmission network and that sold to those without such access. Since these matters raise important policy issues for the Government, the OEM considers that further study into the downstream implications of different policy options is necessary.

## ESTIMATED AND ACTUAL PROJECT COSTS

| Item                                  | Appraisal Estimates<br>(\$ million) |                   |             | Actual<br>(\$ million) |                   |             |
|---------------------------------------|-------------------------------------|-------------------|-------------|------------------------|-------------------|-------------|
|                                       | Foreign<br>Exchange                 | Local<br>Currency | Total       | Foreign<br>Exchange    | Local<br>Currency | Total       |
| Sihanoukville                         | 8.5                                 | 2.2               | 10.7        | 8.0                    | 1.9               | 9.9         |
| Siem Reap                             | 2.5                                 | 1.2               | 3.7         | 4.0                    | 1.1               | 5.1         |
| Phnom Penh                            | 7.0                                 | 2.4               | 9.4         | 7.8                    | 2.1               | 9.9         |
| Training Center                       | 2.1                                 | 1.4               | 3.5         | 2.2                    | 0.5               | 2.7         |
| Vehicles, Tools and<br>Equipment      | 0.5                                 | —                 | 0.5         | —                      | —                 | —           |
| Consulting Services                   | 3.2                                 | 0.2               | 3.4         | 3.4                    | —                 | 3.4         |
| Contingencies                         | 2.5                                 | 0.9               | 3.4         | —                      | —                 | —           |
| Service Charge<br>During Construction | 0.7                                 | —                 | 0.7         | 0.5                    | —                 | 0.5         |
| <b>Total</b>                          | <b>27.0</b>                         | <b>8.3</b>        | <b>35.3</b> | <b>25.9</b>            | <b>5.6</b>        | <b>31.5</b> |

— = not available.

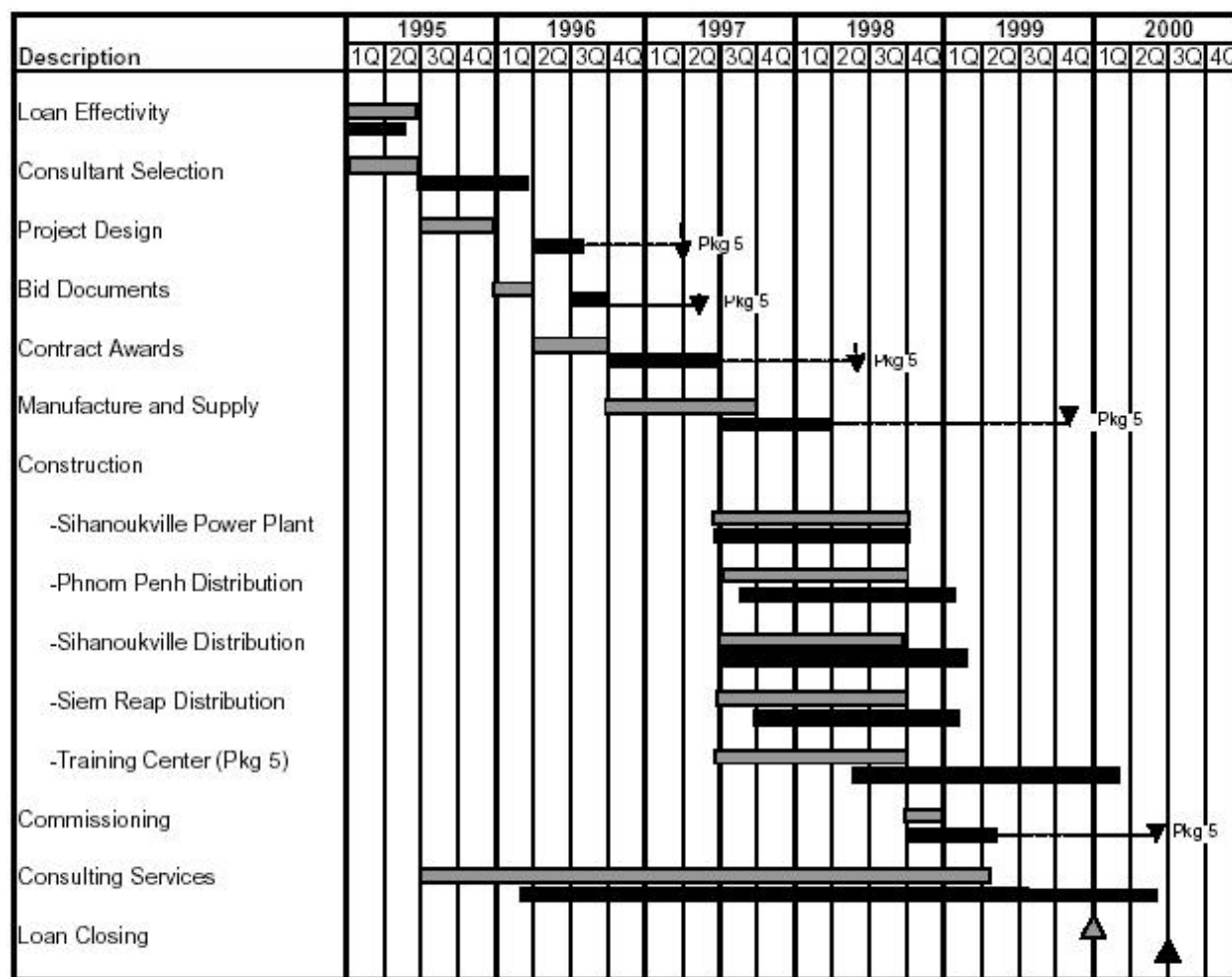
Source: Electricité du Cambodge.

**LOAN DISBURSEMENTS**  
(\$ million)

| <b>Item</b>                    | <b>Original Allocation</b> | <b>Amount Disbursed</b> | <b>Undisbursed Balance</b> |
|--------------------------------|----------------------------|-------------------------|----------------------------|
| Power Stations                 | 7.880                      | 4.685                   | 3.195                      |
| Distribution Network           | 10.080                     | 15.071                  | (4.991)                    |
| Vehicles, Tools, and Equipment | 0.500                      | 0                       | 0.500                      |
| Training Center                | 2.100                      | 2.236                   | (0.136)                    |
| Consulting Services            | 3.200                      | 3.379                   | (0.179)                    |
| Local Currency Expenditure     | 1.223                      | 0                       | 1.223                      |
| Service During Construction    | 0.675                      | 0.565                   | 0.092                      |
| Unallocated                    | 2.539                      | 0                       | 2.539                      |
| <b>Total</b>                   | <b>28.179</b>              | <b>25.936</b>           | <b>2.243</b>               |

Source: Electricité du Cambodge.

## IMPLEMENTATION SCHEDULE



Legend:

Original

Actual

Pkg 5 is construction of Training Center.

## ELECTRICITE DU CAMBODGE FINANCIAL PERFORMANCE

1. A summary of Electricité du Cambodge's recent financial performance is given in the following tables.

**Table A4.1: EdC Consolidated Income Statement Summary**

| <b>Fiscal Year Ending 31 December</b>            | <b>1998</b>    | <b>1999</b>    | <b>2000</b>    | <b>2001</b>   | <b>2002</b> |
|--|----------------|----------------|----------------|---------------|-------------|
| Generation Available for Distribution (GWh)      | 356            | 358            | 407            | 466           | 517         |
| Distribution Losses (%)                          | 22             | 22             | 13             | 16            | 13          |
| Sales (GWh)                                      | 279            | 280            | 355            | 392           | 450         |
| Sales Growth (%)                                 |                | 0.3            | 21.1           | 9.5           | 12.7        |
| Average Tariff (KR/kWh)                          | 407            | 528            | 567            | 640           | —           |
| <b>Operating Revenues (KR billion)</b>           |                |                |                |               |             |
| Electricity Sales                                | 113.50         | 147.90         | 201.20         | 250.90        | —           |
| Connection Fees                                  | 4.20           | 12.50          | 3.20           | 5.60          | —           |
| Other Revenues                                   | 0.70           | 1.10           | 0.40           | 0.50          | —           |
| <b>Total Operating Revenue</b>                   | <b>118.40</b>  | <b>161.60</b>  | <b>204.80</b>  | <b>257.00</b> | —           |
| <b>Operating Costs (KR billion)</b>              |                |                |                |               |             |
| Fuel   | 59.20          | 45.60          | 65.50          | 44.90         | —           |
| IPP Power Purchase                               | 59.50          | 75.80          | 102.80         | 145.90        | —           |
| Operation and Maintenance                        | 15.40          | 14.00          | 18.10          | 19.80         | —           |
| Staff Costs                                      | 5.10           | 6.20           | 7.00           | 8.60          | —           |
| Provision for Maintenance                        | 0.10           | 0.40           | 0.60           | 0.70          | —           |
| Provision for Bad Debts                          | 9.60           | 1.90           | 4.30           | 0.80          | —           |
| Depreciation                                     | 15.40          | 19.00          | 23.30          | 28.90         | —           |
| <b>Total Operating Costs</b>                     | <b>164.30</b>  | <b>162.90</b>  | <b>221.60</b>  | <b>249.60</b> | —           |
| <b>Net Operating Income Expense (KR billion)</b> | <b>(45.9)</b>  | <b>(1.4)</b>   | <b>(16.7)</b>  | <b>7.40</b>   | —           |
| Foreign Exchange Loss (Gain)                     | 4.60           | 0.10           | 6.70           | 1.10          | —           |
| Other Expenses (Income)                          | (0.50)         | (2.30)         | (18.10)        | (1.80)        | —           |
| <b>Profit (Loss) Before Interest and Tax</b>     | <b>(50.00)</b> | <b>(3.70)</b>  | <b>(5.30)</b>  | <b>8.20</b>   | —           |
| Interest Expense (Income)                        | (0.20)         | 5.00           | 12.10          | 13.10         | —           |
| <b>Profit (Loss) Before Tax</b>                  | <b>(49.80)</b> | <b>(8.70)</b>  | <b>(17.40)</b> | <b>(4.90)</b> | —           |
| Tax  | 1.00           | 1.60           | 2.00           | 0.60          | —           |
| <b>Net Income (Loss)</b>                         | <b>(50.80)</b> | <b>(10.30)</b> | <b>(19.40)</b> | <b>(5.50)</b> | —           |

— = not available, EdC = Electricité du Cambodge, GWh = gigawatt-hour, IPP = independent power producer, kWh = kilowatt-hour.

Source: EdC.



**Table A4.2: EdC Consolidated Balance Sheet Summary**  
(KR billion)

| <b>Fiscal Year Ending 31 December</b>       | <b>1998</b>  | <b>1999</b>  | <b>2000</b>  | <b>2001</b>  |
|---|--------------|--------------|--------------|--------------|
| Long-Term Assets                            | 402.0        | 458.8        | 438.7        | 418.9        |
| Current Assets                              | 46.8         | 82.9         | 119.2        | 156.3        |
| <b>Total Assets</b>                         | <b>448.8</b> | <b>541.7</b> | <b>557.9</b> | <b>575.2</b> |
| Long-Term Liabilities                       | 166.9        | 226.4        | 140.0        | 150.7        |
| Current Liabilities                         | 66.2         | 90.6         | 92.7         | 96.6         |
| Owner's Equity                              | 215.7        | 224.8        | 325.3        | 327.9        |
| <b>Total Liabilities and Owner's Equity</b> | <b>448.8</b> | <b>541.7</b> | <b>557.9</b> | <b>575.2</b> |

EdC = Electricité du Cambodge.

Source: EdC.

**Table A4.3: EdC Consolidated Cash Flow Summary**  
(KR billion)

| <b>Fiscal Year Ending 31 December</b>        | <b>1998</b> | <b>1999</b> | <b>2000</b> | <b>2001</b> |
|--|-------------|-------------|-------------|-------------|
| <b>Cash Flows from Operating Activities</b>  | (0.2)       | 4.0         | 0.8         | (7.1)       |
| <b>Cash Flows From Investing Activities</b>  |             |             |             |             |
| Purchase of Long-Term Assets                 | (206.8)     | (76.3)      | (19.1)      | (2.8)       |
| Sale of Property, Plant and Equipment        | 2.3         | 0.4         | 2.4         | 0.0         |
| <b>Cash Flows from Financing Activities</b>  |             |             |             |             |
| Net Increase in Long-Term Loans              | 180.5       | 59.6        | (1.1)       | 14.2        |
| Grant Aid and other Capital Contributions    | 26.7        | 15.0        | 21.4        | 0.0         |
| <b>Increase in Cash and Cash Equivalents</b> | <b>2.5</b>  | <b>2.7</b>  | <b>4.4</b>  | <b>4.3</b>  |

EdC=Electricité du Cambodge.

Source: EdC.

## FINANCIAL PERFORMANCE OF INDIVIDUAL PROJECT AREAS

1. A summary of the financial performance of the individual project areas, over the period 1998-2002, is given in the tables below.

**Table A5.1: EdC Phnom Penh Operation  
Summary of Financial Results**

| Item                                 | 1998          | 1999         | 2000          | 2001         | 2002         |
|--------------------------------------|---------------|--------------|---------------|--------------|--------------|
| <b>Revenue (KR billion)</b>          |               |              |               |              |              |
| Electricity Sales                    | 98.8          | 133.1        | 174.3         | 217.2        | 248.8        |
| Other Revenue                        | 4.8           | 12.6         | 3.2           | 5.6          | 6.4          |
| <b>Total</b>                         | <b>103.6</b>  | <b>145.7</b> | <b>177.5</b>  | <b>222.8</b> | <b>255.2</b> |
| <b>Costs (KR billion)</b>            |               |              |               |              |              |
| Energy Purchased from PPP            | 58.1          | 73.7         | 94.9          | 137.7        | 150.6        |
| Fuel                                 | 46.7          | 33.9         | 49.8          | 27.6         | 36.0         |
| Other Costs of Sales                 | 17.6          | 28.8         | 31.7          | 37.2         | 8.1          |
| Staff Costs                          | 2.8           | 4.2          | 5.0           | 6.3          | 6.7          |
| Other Operating Costs                | 25.3          | 4.9          | 10.9          | 6.8          | 58.4         |
| Other Costs (Income)                 | 2.7           | (2.1)        | (12.5)        | (0.8)        | 0            |
| <b>Total</b>                         | <b>153.2</b>  | <b>145.5</b> | <b>192.2</b>  | <b>215.6</b> | <b>259.8</b> |
| <b>Profit Loss (KR billion)</b>      | <b>(49.6)</b> | <b>0.3</b>   | <b>(14.7)</b> | <b>7.3</b>   | <b>(4.6)</b> |
| Installed Capacity (MW)              | 99            | 99           | 117           | 117          | 129          |
| Total Generation (GWh)               | 336           | 350          | 380           | 433          | 478          |
| Sales (GWh)                          | 266           | 264          | 329           | 364          | 418          |
| Total Costs per kWh Sold (KR)        | 576           | 543          | 546           | 590          | 621          |
| Cost of Sales per kWh Generated (KR) | 364           | 390          | 464           | 468          | 407          |
| Cost of Sales per kWh Sold (KR)      | 460           | 517          | 536           | 556          | 466          |
| Average Tariff per kWh Sold (KR)     | 371           | 504          | 530           | 597          | 595          |
| Profit (Loss) as a % of Revenue      | (47.9)        | 0.2          | (8.3)         | 3.3          | (1.8)        |

EdC = Electricité du Cambodge, GWh = gigawatt-hour, kW = kilowatt-hour, MW = megawatt, PPP = private power producers.

Source: EdC.

**Table A5.2: EdC Sihanoukville Operation  
Summary of Financial Results**

| <b>Item</b>                       | <b>1998</b> | <b>1999</b> | <b>2000</b>  | <b>2001</b>  | <b>2002</b> |
|-----------------------------------|-------------|-------------|--------------|--------------|-------------|
| <b>Revenue (KR billion)</b>       |             |             |              |              |             |
| Electricity Sales                 | 5.0         | 6.0         | 7.6          | 8.8          | 10.0        |
| Other Revenue                     | 0.8         | 0.5         | 0.2          | 0.2          | 0.2         |
| <b>Total</b>                      | <b>5.7</b>  | <b>6.5</b>  | <b>7.8</b>   | <b>9.0</b>   | <b>10.2</b> |
| <b>Costs (KR billion)</b>         |             |             |              |              |             |
| Fuel                              | 2.4         | 2.6         | 4.4          | 4.0          | 4.3         |
| Other Purchases                   | 0.5         | 0.2         | 0.6          | 1.1          | 1.0         |
| Labor                             | 0.3         | 0.0         | 0.0          | 0.4          | 0.5         |
| Overheads                         | 1.1         | 0.0         | 0.0          | 0.7          | 0.6         |
| Depreciation                      | 0.7         | 2.2         | 3.4          | 3.5          | 3.5         |
| Financial Costs                   | 0.0         | 0.0         | 0.0          | 0.1          | 0.1         |
| Taxes                             | 0.1         | 0.0         | 0.0          | 0.0          | 0.0         |
| Other Costs                       | 0.0         | 1.0         | 1.4          | 0.0          | 0.0         |
| <b>Total</b>                      | <b>5.1</b>  | <b>6.0</b>  | <b>9.8</b>   | <b>9.7</b>   | <b>10.0</b> |
| <b>Profit/Loss (KR billion)</b>   | <b>0.7</b>  | <b>0.5</b>  | <b>(2.0)</b> | <b>(0.7)</b> | <b>0.2</b>  |
| Installed Capacity (MW)           | 11          | 10          | 10           | 10           | 10          |
| Total Generation (GWh)            | 11.5        | 14.1        | 16.2         | 18.5         | 20.5        |
| Sales (GWh)                       | 8.3         | 10.3        | 12.7         | 14.7         | 16.1        |
| Total Costs per kWh Sold (KR)     | 609         | 589         | 774          | 660          | 619         |
| Fuel Costs per kWh Generated (KR) | 210         | 185         | 272          | 218          | 210         |
| Fuel Costs per kWh Sold (KR)      | 292         | 254         | 345          | 274          | 267         |
| Average Tariff per kWh Sold (KR)  | 597         | 584         | 600          | 601          | 624         |
| Profit (Loss) as % of Revenue     | 11.7        | 7.4         | (25.6)       | (7.8)        | 2.4         |

EdC = Electricité du Cambodge, GWh = gigawatt-hour, kWh = kilowatt-hour, MW = megawatt.

Source: EdC.

**Table A5.3: EdC Siem Reap Operation  
Summary of Financial Results**

| <b>Item</b>                       | <b>1998</b> | <b>1999</b> | <b>2000</b> | <b>2001</b> | <b>2002</b> |
|-----------------------------------|-------------|-------------|-------------|-------------|-------------|
| <b>Revenue (KR billion)</b>       |             |             |             |             |             |
| Electricity Sales                 | 5.1         | 6.0         | 8.9         | 11.8        | 14.0        |
| Other Revenue                     | 0.7         | 0.9         | 0.9         | 0.6         | 1.0         |
| <b>Total</b>                      | <b>5.8</b>  | <b>7.0</b>  | <b>9.8</b>  | <b>12.3</b> | <b>15.0</b> |
| <b>Costs (KR billion)</b>         |             |             |             |             |             |
| Fuel                              | 3.1         | 3.2         | 4.4         | 5.6         | 7.6         |
| Other Purchases                   | 0.5         | 0.0         | 0.1         | 0.6         | 0.0         |
| Outside Services                  | 0.0         | 1.8         | 2.5         | 2.9         | 2.7         |
| Labour                            | 0.0         | 0.3         | 0.4         | 0.4         | 0.5         |
| Depreciation                      | 0.0         | 1.1         | 1.1         | 1.2         | 1.2         |
| Other Costs                       | 1.6         | 0.2         | 0.4         | 0.4         | 0.7         |
| <b>Total</b>                      | <b>5.2</b>  | <b>6.6</b>  | <b>8.9</b>  | <b>11.2</b> | <b>12.7</b> |
| <b>Profit (KR billion)</b>        | <b>0.6</b>  | <b>0.4</b>  | <b>0.9</b>  | <b>1.2</b>  | <b>2.4</b>  |
| Installed Capacity (MW)           | 3.6         | 4.6         | 5.4         | 5.4         | 7.4         |
| Total Generation (GWh)            | 9.7         | 9.4         | 12.3        | 16.2        | 19.4        |
| Sales (GWh)                       | 4.8         | 6.3         | 10.3        | 13.5        | 15.9        |
| Total Costs per kWh Sold (KR)     | 1,072       | 1,050       | 869         | 830         | 794         |
| Fuel Costs per kWh Generated (KR) | 321         | 338         | 358         | 348         | 389         |
| Fuel Costs per kWh Sold (KR)      | 643         | 505         | 429         | 419         | 474         |
| Average Tariff per kWh Sold (KR)  | 1062        | 964         | 872         | 876         | 879         |
| Profit as % of Revenue            | 10.5        | 5.3         | 9.3         | 9.6         | 15.8        |

EdC = Electricité du Cambodge, GWh = gigawatt-hour, kWh = kilowatt-hour, MW = megawatt.

Source: EdC.

## **FINANCIAL AND ECONOMIC REVALUATION**

### **A. Methodology of the Appraisal Report**

1. The financial and economic evaluations of the Project at appraisal were carried out separately for individual project components, viz., Phnom Penh, Sihanoukville, and Siem Reap. For Phnom Penh, rehabilitation of the entire distribution system, financed by several aid agencies including the Asian Development Bank, was considered. Generation and sales for the three cities were assumed to be limited to what could be generated from projects already implemented or committed. System losses were assumed to decrease to 20% by 2001 for Sihanoukville and Siem Reap, and 23% by 1999 for Phnom Penh. The period of analysis was over 27 years, including a 4-year construction period. All costs and benefits were expressed in constant 1994 dollars.

2. For financial analysis, capital costs were net of interest during construction but included physical contingencies. For economic analysis, taxes and duties were excluded and local costs were converted to border price using a standard conversion factor (SCF) of 0.8. Incremental operation and maintenance (O&M) costs were estimated annually at 3% of capital costs for Sihanoukville and Siem Reap, and 2% for Phnom Penh. Estimates of generation costs assumed that all generation would be based on diesel fuel.

3. Financial benefits were calculated on revenues valued at annual average tariffs and incremental sales. Economic benefits were assumed to be derived mainly from resource cost savings and did not include consumer surplus.

### **B. Approach and Methodology of the PCR/PPAR**

4. The project performance audit report (PPAR) largely followed the approach adopted in the project completion report (PCR). The main difference in the approach between the PCR/PPAR and appraisal lies in the forecast of the sales. At appraisal, the sales were considered to be limited by the generating capacity installed or committed. Given the recent power demand and forecast growth scenarios, the distribution facilities rehabilitated and expanded under the Project are expected to be loaded to full capacity in 2010 for Phnom Penh, 2017 for Sihanoukville, and 2013 for Siem Reap. Further, the power supply situation also changed significantly from the appraisal assumptions. Power purchases from independent power producers (IPPs) and neighboring countries ignored at appraisal are increasing rapidly. Cheaper power purchased from neighboring countries is expected after 2005. Thus, in the PCR and PPAR, sales are considered to expand until limited by the capacity of the distribution system installed under the Project. All costs and benefits are expressed in constant 2000 dollars and a SCF of 0.935 is applied to convert the local cost to border prices.

5. The main assumptions used in PPAR to recalculate the financial rate of return (FIRR) and economic rate of return (EIRR) are given below:

- (i) All costs and benefits are expressed in constant 2000 dollars.
- (ii) Actual electricity sales for Electricité du Cambodge (EdC) up to 2002 are used. After 2002, total sales are projected to increase at 10% per annum up to 2010 for Phnom Penh and up to 2017 for Sihanoukville, and 15% per annum up to 2013 for Siem Reap. Maximum sales occur when the distribution systems in the project area reach their full load capacity, and then remain constant thereafter.

- (iii) The period of analysis is 25 years plus the construction period before commissioning. The capital cost for additional and replacement generators in Siem Reap are included in the cost streams as appropriate.
- (iv) Costs of power purchases from independent power producers (IPPs) and fuel are included in the generation costs. The generation costs are assumed to increase at the same rate as the total sales. For economic analysis, the generation costs are net of the value added tax (VAT), import tax, and social fund charges levied on fuels. (With the introduction of VAT in 1998, the overall rate of tax deduction for economic generation cost became 67% against 80% at appraisal).
- (v) Based on the 2002 data for the three cities, O&M costs are estimated annually at 10% of total energy sales for Phnom Penh, 15% for Sihanoukville, and 20% for Siem Reap.
- (vi) The financial tariffs after 2005 are \$0.12/kWh for Phnom Penh, \$0.16/kWh for Sihanoukville, and 0.17/kWh for Siem Reap.
- (vii) Economic benefits are assumed to be derived from resource cost savings only since consumer surplus is expected to be rather small, given the high level of financial tariffs and business consumers' unwillingness to connect to EdC supply. Economic benefits are expressed by economic tariffs derived from resource cost savings from alternative self-generation costs. It is further assumed that the proportion of nonincremental to incremental use of the additional electricity is 70:30.
- (viii) A SCF of 0.935 is applied to convert the local cost to border prices.

6. Table A6.1 summarizes the results obtained from both financial and economic reevaluation. Details of the cash flows for FIRR and EIRR recalculations are in Tables A6.2–A6.4.

**Table A6.1: Summary of Financial and Economic Reevaluations**

| Location      | FIRR (%)  |      |      | EIRR (%)  |      |      |
|---------------|-----------|------|------|-----------|------|------|
|               | Appraisal | PCR  | PPAR | Appraisal | PCR  | PPAR |
| Phnom Penh    | 24.1      | 6.6  | 8.9  | 37.4      | 44.3 | 18.3 |
| Sihanoukville | 9.1       | 13.6 | 15.2 | 15.6      | 24.9 | 16.1 |
| Siem Reap     | 12.9      | 14.9 | 11.9 | 19.8      | 33.2 | 15.5 |

EIRR = economic internal rate of return, FIRR = financial internal rate of return, PCR = project completion report, PPAR = project performance audit report.

7. The more favorable PPAR estimate of FIRRs for project components in Phnom Penh and Sihanoukville were mainly due to stronger demand and larger savings in terms of O&M costs compared with the PCR estimate. The lower recalculated FIRR for the project component in Siem Reap was due to the revised rate of increase of electricity sales at 15% per annum compared with the PCR estimate of 21%. The recalculated EIRRs are much less compared with the PCR estimates for all three components because, unlike in the PCR, consumer surplus was not included in the PPAR recalculation, given the fact that many businesses are not willing to buy electricity from EdC at current tariff and are relying on self-generation for the bulk of their power supply.

**Table A6.2: Recalculated Financial and Economic Internal Rates of Return–Phnom Penh**

(in constant 2000 prices)

| Item                                    | 1996        | 1997     | 1998     | 1999     | 2000     | 2001     | 2002     | 2003     | 2004     | 2005     | 2010      | 2022      |
|---|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|
| <b>Generation, Sales and Benefit</b>    |             |          |          |          |          |          |          |          |          |          |           |           |
| Total Energy Sales (GWh)                | 0           | 218.4    | 266.0    | 264.0    | 329.0    | 364.0    | 418.0    | 459.8    | 505.8    | 556.4    | 896.0     | 896.0     |
| Total Energy Sales (\$'000)             | 0           | 0        | 31,875.5 | 39,157.8 | 45,867.4 | 56,274.7 | 62,989.3 | 64,372.0 | 70,809.2 | 72,326.5 | 107,522.4 | 107,522.4 |
| Incremental Sales(GWh)                  | 0           | 0        | 47.6     | 45.6     | 110.6    | 145.6    | 199.6    | 241.4    | 287.4    | 338.0    | 677.6     | 677.6     |
| Average Financial Tariff (\$/kWh)       | 0           | 0        | 0.12     | 0.15     | 0.14     | 0.15     | 0.15     | 0.14     | 0.14     | 0.13     | 0.12      | 0.12      |
| Average Economic Tariff (\$/kWh)        | 0           | 0        | 0.24     | 0.24     | 0.22     | 0.22     | 0.20     | 0.20     | 0.18     | 0.18     | 0.18      | 0.18      |
| <b>Gross Financial Benefit (\$'000)</b> | 0           | 0        | 5,704    | 6,764    | 15,419   | 22,510   | 30,078   | 33,796   | 40,233   | 43,935   | 81,314    | 81,314    |
| <b>Gross Economic Benefit (\$'000)</b>  | 0           | 0        | 7,997    | 7,661    | 17,032   | 22,422   | 27,944   | 33,796   | 36,210   | 42,583   | 85,380    | 85,380    |
| <b>Financial Cost (\$'000)</b>          |             |          |          |          |          |          |          |          |          |          |           |           |
| Capital Cost                            | 908         | 11,856   | 17,497   | 15,139   | 19,526   | 14,389   | 22,127   | 24,580   | 0        | 0        | 0         | 0         |
| Generation Cost (IPP and Fuel)          | 0           | 0        | 8,551    | 6,387    | 12,822   | 17,571   | 21,975   | 24,173   | 26,590   | 29,249   | 47,106    | 47,106    |
| O&M and Others                          | 0           | 0        | 1,364    | (2,253)  | 2,717    | 1,891    | 6,871    | 6,437    | 7,081    | 7,233    | 10,752    | 10,752    |
| <b>Total Financial Cost</b>             | 908         | 11,856   | 27,412   | 19,273   | 35,065   | 33,851   | 50,973   | 55,190   | 33,671   | 36,482   | 57,858    | 57,858    |
| <b>Economic Cost (\$'000)</b>           |             |          |          |          |          |          |          |          |          |          |           |           |
| Capital Cost                            | 899         | 11,740   | 17,326   | 14,991   | 19,336   | 14,249   | 21,911   | 24,340   | 0        | 0        | 0         | 0         |
| Generation Cost (IPP and Fuel)          | 0           | 0        | 5,729    | 4,280    | 8,591    | 11,772   | 14,724   | 16,196   | 17,816   | 19,597   | 31,561    | 31,561    |
| O&M and Others                          | 0           | 0        | 1,275    | (2,107)  | 2,540    | 1,768    | 6,425    | 6,019    | 6,621    | 6,763    | 10,053    | 10,053    |
| <b>Total Economic Cost</b>              | 899         | 11,740   | 24,330   | 17,164   | 30,467   | 27,789   | 43,060   | 46,555   | 24,437   | 26,360   | 41,614    | 41,614    |
| <b>Net Financial Benefit (\$'000)</b>   | (908)       | (11,856) | (21,708) | (12,509) | (19,646) | (11,341) | (20,895) | (21,394) | 6,562    | 7,453    | 23,456    | 23,456    |
| <b>Net Economic Benefit (\$'000)</b>    | (899)       | (11,740) | (16,333) | (9,503)  | (13,435) | (5,367)  | (15,116) | (12,759) | 11,773   | 16,223   | 43,766    | 43,766    |
| <b>EIRR(%)</b>                          | <b>18.3</b> |          |          |          |          |          |          |          |          |          |           |           |
| <b>FIRR (%)</b>                         | <b>8.9</b>  |          |          |          |          |          |          |          |          |          |           |           |

EIRR= economic internal rate of return, FIRR = financial internal rate of return, GWh = gigawatt-hour, IPP = independent power producer, kWh = kilowatt-hour, O&M = operation and maintenance.

**Table A6.3: Recalculated Financial and Economic Internal Rates of Return–Sihanoukville**  
(In constant 2000 prices)

| Item                                    | 1997    | 1998    | 1999    | 2000    | 2001    | 2002    | 2003    | 2004    | 2005    | 2017     | 2023     |
|---|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|
| <b>Generation, Sales and Benefit</b>    |         |         |         |         |         |         |         |         |         |          |          |
| Total Energy Sales (GWh)                | 8.0     | 8.3     | 10.3    | 12.7    | 14.7    | 16.1    | 17.7    | 19.5    | 21.4    | 67.2     | 67.2     |
| Total Energy Sales (\$'000)             | 0       | 1,599.6 | 1,760.5 | 2,008.7 | 2,290.1 | 2,540.4 | 2,794.4 | 3,073.8 | 3,381.2 | 10,611.7 | 10,611.7 |
| Incremental Sales(GWh)                  | 0       | 0       | 1.9     | 4.4     | 6.4     | 7.8     | 9.4     | 11.2    | 13.1    | 59.2     | 59.2     |
| Average Financial Tariff (\$/kWh)       | 0       | 0.19    | 0.17    | 0.16    | 0.16    | 0.16    | 0.16    | 0.16    | 0.16    | 0.16     | 0.16     |
| Average Economic Tariff (\$/kWh)        | 0       | 0.25    | 0.24    | 0.24    | 0.24    | 0.22    | 0.22    | 0.22    | 0.22    | 0.22     | 0.22     |
| <b>Gross Financial Benefit (\$'000)</b> | 0       | 0       | 333.6   | 696.5   | 996.7   | 1,228.5 | 1,502.4 | 1,785.6 | 2,097.1 | 9,473.9  | 9,473.9  |
| <b>Gross Economic Benefit (\$'000)</b>  | 0       | 0       | 323.7   | 734.7   | 1,066.8 | 1,198.3 | 1,446.0 | 1,718.6 | 2,018.4 | 9,118.6  | 9,118.6  |
| <b>Financial Cost (\$'000)</b>          |         |         |         |         |         |         |         |         |         |          |          |
| Capital Cost                            | 1,057   | 7,587   | 1,329   | 0       | 0       | 0       | 0       | 0       | 0       | 0        | 0        |
| Generation Cost (IPP and Fuel)          | 0       | 0       | (103)   | 387     | 387     | 406     | 446     | 491     | 540     | 1,695    | 1,695    |
| O&M and Others                          | 0       | 0       | (177)   | (100)   | (191)   | (185)   | 419     | 461     | 507     | 1,592    | 1,592    |
| <b>Total Financial Cost</b>             | 1,057   | 7,587   | 1,049   | 287     | 196     | 221     | 865     | 952     | 1,047   | 3,287    | 3,287    |
| <b>Economic Cost (\$'000)</b>           |         |         |         |         |         |         |         |         |         |          |          |
| Capital Cost                            | 1,047   | 7,513   | 1,316   | 0       | 0       | 0       | 0       | 0       | 0       | 0        | 0        |
| Generation Cost (IPP and Fuel)          | 0       | 0       | (69)    | 259     | 260     | 272     | 299     | 329     | 362     | 1136     | 1136     |
| O&M and Others                          | 0       | 0       | (166)   | (93)    | (179)   | (173)   | 392     | 431     | 474     | 1488     | 1488     |
| <b>Total Economic Cost (\$'000)</b>     | 1,047   | 7,513   | 1,081   | 166     | 81      | 99      | 691     | 760     | 836     | 2624     | 2624     |
| <b>Net Financial Benefit (\$'000)</b>   | (1,057) | (7,587) | (715)   | 409     | 801     | 1008    | 637     | 833     | 1,050   | 6,187    | 6,187    |
| <b>Net Economic Benefit (\$'000)</b>    | (1,047) | (7,513) | (758)   | 569     | 986     | 1099    | 755     | 959     | 1,182   | 6,495    | 6,495    |
| <b>EIRR%</b>                            | 16.1    |         |         |         |         |         |         |         |         |          |          |
| <b>FIRR%</b>                            | 15.2    |         |         |         |         |         |         |         |         |          |          |

EIRR = economic internal rate of return, FIRR = financial internal rate of return, GWh = gigawatt-hour, IPP = independent power producer, kWh - kilowatt-hour, O&M = operation and maintenance.



**Table A6.4: Recalculated Financial and Economic Internal Rates of Return–Siem Reap**  
(In constant 2000 prices)

| Item                                    | 1996        | 1997  | 1998    | 1999    | 2000    | 2001    | 2002    | 2003    | 2004    | 2005    | 2010    | 2022     |
|---|-------------|-------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|
| <b>Generation, Sales and Benefit</b>    |             |       |         |         |         |         |         |         |         |         |         |          |
| Total Energy Sales (GWh)                | 0           | 3.6   | 4.8     | 6.3     | 10.3    | 13.5    | 15.9    | 18.3    | 21.1    | 24.3    | 48.8    | 74.2     |
| Total Energy Sales (\$'000)             | 0           | 0     | 1,654.5 | 1,778.3 | 2,353.4 | 3,054.2 | 3,548.2 | 4,080.5 | 4,217.9 | 4,850.5 | 8,292.8 | 12,612.2 |
| Incremental Sales(GWh)                  | 0           | 0     | 1.2     | 2.7     | 6.7     | 9.9     | 12.3    | 14.7    | 17.5    | 20.7    | 45.2    | 70.59    |
| Average Financial Tariff (\$/kWh)       | 0           | 0     | 0.34    | 0.28    | 0.23    | 0.23    | 0.22    | 0.22    | 0.20    | 0.20    | 0.17    | 0.17     |
| Average Economic Tariff (\$/kWh)        | 0           | 0     | 0.29    | 0.29    | 0.26    | 0.26    | 0.25    | 0.25    | 0.25    | 0.25    | 0.25    | 0.25     |
| <b>Gross Financial Benefit (\$'000)</b> | 0           | 0     | 422     | 758     | 1,527   | 2,237   | 2,747   | 3,279   | 3,498   | 4,131   | 7,681   | 12,000   |
| <b>Gross Economic Benefit (\$'000)</b>  | 0           | 0     | 250     | 543     | 1,211   | 1,793   | 2,161   | 2,579   | 3,061   | 3,614   | 7,907   | 12,353   |
| <b>Financial Cost (\$'000)</b>          |             |       |         |         |         |         |         |         |         |         |         |          |
| Capital Cost                            | 309         | 490   | 3,736   | 880     | 0       | 0       | 0       | 579     | 4,593   | 3,500   | 0       | 0        |
| Generation Cost (IPP and Fuel)          |             |       | 272     | 55      | 285     | 729     | 1,030   | 1,184   | 1,362   | 1,566   | 3,150   | 4,790    |
| O&M and Others                          |             |       | 137     | 292     | 504     | 601     | 620     | 816     | 844     | 970     | 1,659   | 2,522    |
| <b>Total Financial Cost</b>             | 309         | 490   | 4,145   | 1,227   | 789     | 1,330   | 1,650   | 2,579   | 6,799   | 6,036   | 4,809   | 7,312    |
| <b>Economic Cost (\$'000)</b>           |             |       |         |         |         |         |         |         |         |         |         |          |
| Capital Cost                            | 306         | 485   | 3,700   | 871     | 0       | 0       | 0       | 573     | 4,548   | 3,466   | 0       | 0        |
| Generation Cost (IPP and Fuel)          |             |       | 182     | 37      | 191     | 489     | 690     | 793     | 912     | 1,049   | 2,110   | 3,209    |
| O&M and Others                          |             |       | 128     | 273     | 471     | 562     | 579     | 763     | 789     | 907     | 1,551   | 2,358    |
| <b>Total Economic Cost</b>              | 306         | 485   | 4,010   | 1,181   | 662     | 1,051   | 1,269   | 2,129   | 6,249   | 5,422   | 3,661   | 5,567    |
| <b>Net Financial Benefit (\$'000)</b>   | (309)       | (490) | (3,723) | (469)   | 738     | 907     | 1,097   | 700     | (3,301) | (1,905) | 2,872   | 4,688    |
| <b>Net Economic Benefit (\$'000)</b>    | (306)       | (485) | (3,760) | (639)   | 549     | 742     | 892     | 450     | (3,188) | (1,808) | 4,246   | 6,786    |
| <b>EIRR (%)</b>                         | <b>15.5</b> |       |         |         |         |         |         |         |         |         |         |          |
| <b>FIRR (%)</b>                         | <b>11.9</b> |       |         |         |         |         |         |         |         |         |         |          |

EIRR = economic internal rate of return, FIRR = financial internal rate of return, GWh = gigawatt-hour, IPP = independent power producer, kWh = kilowatt-hour, O&M = operation and maintenance.