

**ASIAN DEVELOPMENT BANK**

**PPA: IND 23706**

**PROJECT PERFORMANCE AUDIT REPORT**

**ON THE**

**CESC LIMITED PROJECT  
(Investment 7058/Loan 1036-IND)**

**IN**

**INDIA**

**December 2002**

## CURRENCY EQUIVALENTS

Currency Unit – Indian rupee/s (Re/Rs)

	<b>At Appraisal</b> (July 1990)	<b>At Project Completion</b> (October 1998)	<b>At Operations Evaluation</b> (November 2002)
Re1.00	= \$0.0575	\$0.0280	\$0.0208
\$1.00	= Rs17.40	Rs35.70	Rs48.10

## ABBREVIATIONS

ADB	–	Asian Development Bank
CESC	–	Calcutta Electric Supply Company
EIRR	–	economic internal rate of return
FIRR	–	financial internal rate of return
IFC	–	International Finance Corporation
OEM	–	Operations Evaluation Mission
PCR	–	project completion report
PPAR	–	project performance audit report
WBSEB	–	West Bengal State Electricity Board
WBSG	–	West Bengal State Government

## WEIGHTS AND MEASURES

kV (kilovolt)	–	1,000 volts
km	–	kilometer
kWh (kilowatt-hour)	–	1,000 watt-hours
MVA (megavolt-ampere)	–	1,000 kilovolt-amperes
MVA <sub>r</sub>	–	megavolt-ampere reactive
MW (megawatt)	–	1,000 kilowatts

## NOTES

- (i) The fiscal year (FY) of CESC ends on 31 March (e.g., FY 1995 is the 12-month period ending 31 March 1995).
- (ii) In this report, "\$" refers to US dollars.

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**BASIC DATA**  
**Investment 7058/Loan 1036-IND: CESC Limited Project**

<b>Key Project Data</b>	<b>As per ADB Loan Documents</b>		<b>Actual<sup>1</sup></b>	
	Rs million	\$ million	Rs million	\$ million
Total Project Cost	1,575	91.6	2,312	75.0
Foreign Exchange Cost	504	29.2	774	27.7
Local Currency Cost	1,071	62.4	1,538	47.3
ADB Loan Amount/Utilization	306	17.8	579	18.8
Cofinancing	954	55.5	1,292	41.8

<b>Key Dates</b>	<b>Expected</b>	<b>Actual</b>
Fact-Finding		2–15 May 1990
Appraisal		20–27 Jul 1990
Loan Negotiations		30–31 Jul 1990
Board Approval		4 Oct 1990
Loan Agreement		8 May 1991
Loan Effectiveness	8 May 1991	8 May 1991
First Disbursement		6 Nov 1992
Project Completion	31 Mar 1995	30 Jun 1996
Loan Closing	31 Dec 1995	10 Sep 1996
Months (effectiveness to completion)	47	62

<b>Internal Rates of Return (%)</b>	<b>Appraisal</b>	<b>PCR</b>	<b>PPAR</b>
Economic Internal Rate of Return	15.9	15.8	12.1
Financial Internal Rate of Return	8.9	9.2	6.3

**Borrower** CESC Limited

<b>Mission Data</b>	<b>No. of Missions</b>	<b>No. of Person-Days</b>
<b>Type of Mission</b>		
Fact-Finding	1	28
Appraisal	1	16
Meeting (IFC)	1	2
Loan Negotiations (Calcutta)	1	4
Loan Signing (Calcutta)	1	1
Project Completion	1	6
Operations Evaluation <sup>2</sup>	1	16

ADB = Asian Development Bank, CESC = Calcutta Electric Supply Company, IFC = International Finance Corporation, PCR = project completion report, PPAR = project performance audit report.

<sup>1</sup> The dollar equivalent values reflect exchange rates applicable to the rupee cost at the time of expense.

<sup>2</sup> The Operations Evaluation Mission, which visited Calcutta during 12–20 November 2002, comprised T.M. Hutton (Senior Evaluation Specialist/Mission Leader) and Haraprasad Biswas (Staff Consultant).

## EXECUTIVE SUMMARY

The investment loan approved by the Asian Development Bank (ADB) in 1990 to the Calcutta Electric Supply Company (CESC) Limited was for a transmission project that aimed to achieve a more integrated system linking the power plants and substations in CESC's network. The original project scope was limited to augmenting CESC's 132/33 kilovolt (kV) transmission system. During implementation, an unexpected increase in the demand for electricity justified expanding the project scope to also strengthen some of CESC's transmission and distribution at lower voltage levels. The Project's rationale to help meet the increasing demand for electricity in Calcutta (renamed Kolkata in 2001) was consistent with the Government's Eighth Plan (FY1991–FY1995) to spur industrial growth across India and ADB's assistance strategy for promoting and sustaining economic growth.

Outputs under the original scope included (i) laying of four 132 kV underground transmission cables, (ii) construction of two new 132 kV substations, and (iii) upgrading of four existing 132 kV substations. Outputs for the expanded scope included (i) construction of an additional 132 kV underground transmission cable, (ii) construction of nine new 33 kV substations, and (iii) installation of a 33 kV power capacitor. The Project was formulated and designed by CESC's in-house engineers and approved by India's Central Electric Authority.

ADB's appraisal was completed in July 1990, and Investment 7058/Loan 1036-IND: CESC Limited, for \$17.8 million equivalent, in support of a total project cost of \$91.6 million, was approved on 4 October 1990. The ADB loan was to finance 61% of the estimated foreign exchange cost. A loan for \$20.0 million equivalent from the International Finance Corporation (IFC) was to be used to finance the balance of the foreign exchange cost (\$11.4 million) of imported equipment and \$8.6 million of the local currency cost. Expansion to the project scope was approved in May 1994, and the total project cost was reestimated at \$74.1 million. The major reduction in US dollar terms was mainly attributable to favorable currency variations and concessional import duties. CESC assumed responsibility for project implementation and for the foreign exchange risk on its ADB and IFC loans.

The Project was completed in June 1996, 15 months later than envisaged at appraisal. The longer time taken was due entirely to the expansion in project scope. The original project components were completed in December 1994, 3 months ahead of schedule. At \$75.0 million, the actual project cost was only 1% above the revised estimate.

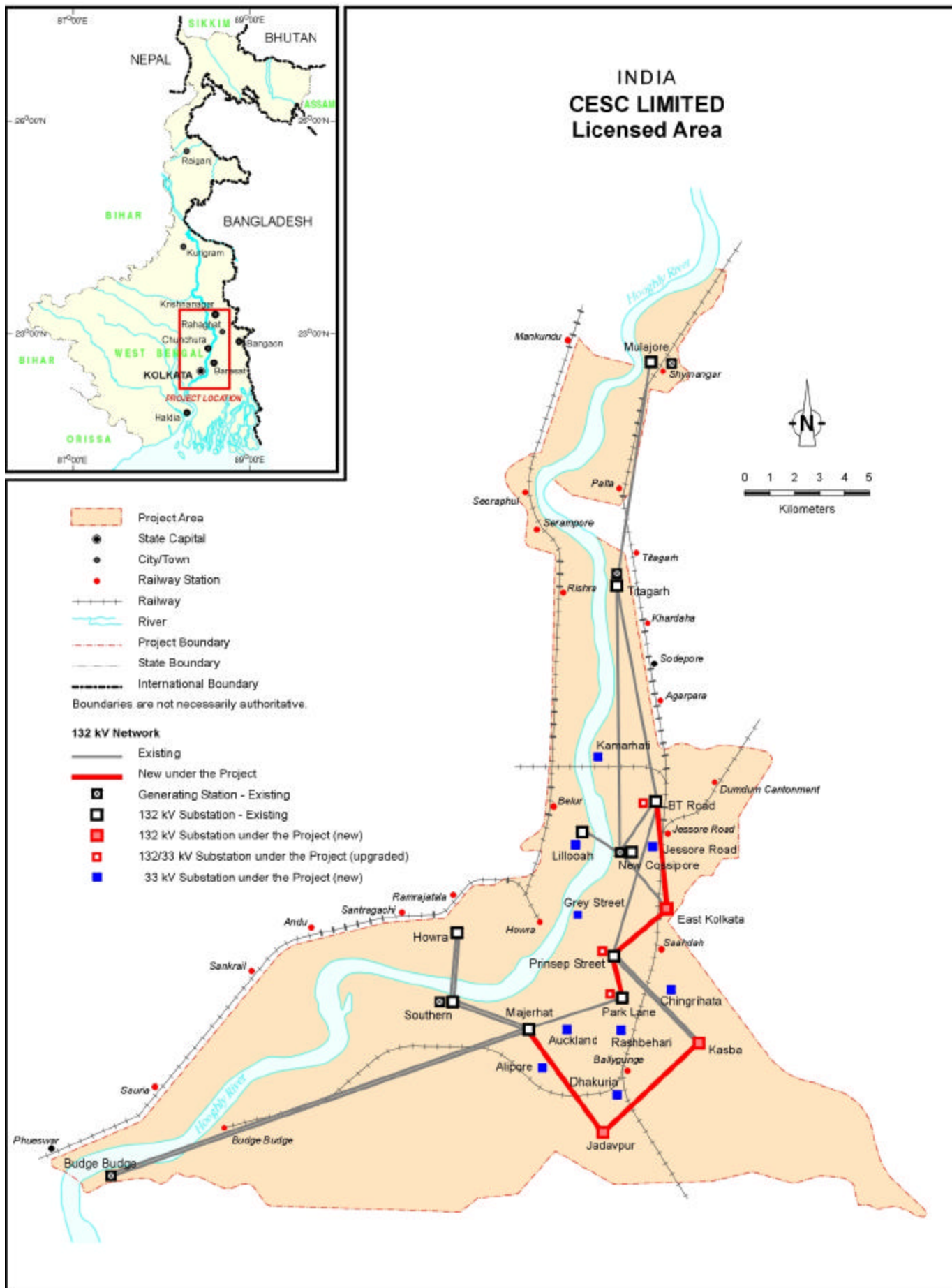
Construction of the new transmission lines and substations increased CESC's transmission capacity by 423 megawatt. Without the Project, CESC's transmission and distribution losses would have been about 4% higher. Voltage reliability across the 33 kV and lower voltage transmission lines would have also been impaired, and CESC's capacity to switch power sources to offset overloading and meet maintenance requirements would have been inadequate.

The Project is rated successful. Its rationale was relevant, and technical design appropriate. Implementation was efficient, and the overall cost in US dollar terms was 18% less than envisaged at appraisal, despite the major expansion in project scope. The Project enabled CESC to meet transmission requirements for new generation units at the Southern and Budge Budge power stations, thus helping eliminate a 15.0% supply deficit. The time-slice economic internal rate of return of 12.1% attests to the economic viability of CESC's investments from FY1990 to FY1996. The financial internal rate of return of 6.3% is close to the real weighted average of capital.

Detracting from a higher rating assessment, the financial statements of CESC reveal a weakening financial status associated with high financial gearing and insufficient infusions of equity capital. Delays since FY1995 in approving increases to the electricity tariff, and rising transmission and distribution losses have also undermined CESC's financial performance. In January 2002, CESC was forced to default on fully servicing its debt obligations to lenders. Nevertheless, positive steps have been taken that collectively provide some optimism that CESC can overcome its financial difficulties. A decision by the Supreme Court on 3 October 2002 to allow CESC to increase its electricity tariff has enabled CESC to recommence loan servicing. A world-renowned investment bank has been engaged to advise on financial restructuring. Issues surrounding the principles for approving electricity tariff adjustments were clarified under the Supreme Court's judgment; this should lead to more timely future adjustments. To reduce its transmission and distribution losses, CESC is implementing a program for upgrading meters, installing capacitors, and taking legal action against electricity theft. Complementing CESC's measures, the West Bengal Government has introduced harsh penalties for theft, and improved court processing for enforcement. As a result of these efforts, CESC's transmission and distribution losses decreased from 23.9% in FY2001 to 21.9% in FY2002, and are expected to fall significantly in FY2003.

The key lesson learned from the Project is that with a more comprehensive technical evaluation and credit assessment at appraisal, the project scope necessary to achieve CESC's performance targets could have been more reliably identified. This lesson and a few others from the Operations Evaluation Mission's observations of CESC's operations are reflected in the following recommendations:

- (i) **ADB** should ensure more comprehensive appraisal when processing future private sector projects.
- (ii) **CESC** should (a) consider restructuring and corporatizing its generation, transmission, and distribution so that the operations of each entity are independent with separate pricing and accountability for expenditures and revenues; and (b) make more use of bond and equity markets to meet investment requirements.
- (iii) The **West Bengal State Government** should (a) restructure the power sector and introduce competition in the provision of power in Kolkata so that the role of the regulator is shifted away from price setting, and (b) provide CESC with legislative support and recovery mechanisms for dealing with outstanding customer accounts.



## I. BACKGROUND

### A. Rationale

1. At the time of project conception, Calcutta<sup>1</sup> was experiencing shortfalls in the supply of electricity. The Calcutta Electric Supply Company (CESC) Limited, which was licensed to operate and expand the transmission and distribution network in the city, was finding it difficult to raise funds in the domestic market to meet its growing investment needs.<sup>2</sup> The transmission network required higher voltages, additional lines from CESC's generation sources, and new substations in areas with high load growth. The Project's rationale of helping meet the increasing demand for electricity in Kolkata was consistent with the Government's Eighth Plan (FY1991–FY1995) that supported industrial growth across India and the Asian Development Bank's (ADB's) assistance strategy for promoting and sustaining economic growth. Prior to release of the Eighth Plan, the Government of India, in recognition that economic growth was being impeded by shortages of electricity supplied from public power utilities, encouraged the private sector to undertake a more significant role in new investments.<sup>3</sup>

### B. Formulation

2. The Project was formulated by CESC with a request to ADB in August 1989 for financial assistance. ADB considered the Project to have merit. Following its approval by the Central Electric Authority, fact-finding was undertaken in May 1990, followed by appraisal in July 1990. ADB's loan of \$17.8 million equivalent (drawn in various currencies) was approved on 4 October 1990.<sup>4</sup> The Borrower was CESC Limited, a public-listed company registered on the India and London stock exchanges, in which 53% of the shares were owned by the private sector.<sup>5</sup> ADB's loan was secured by way of a shared mortgage over CESC's fixed assets.<sup>6</sup> There was no government guarantee.

3. During construction of the Project in FY1993, there was an unexpected increase in the demand for electricity from 881 megawatts (MW) to 967 MW.<sup>7</sup> The increase justified an expansion to the project scope to strengthen CESC's network at lower voltage levels (para. 6). In addition to financing CESC's transmission and distribution network development, ADB supported also CESC's generation program, through a second loan for 2 x 250 MW generator

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<sup>1</sup> Capital city of the West Bengal State, India. Officially renamed Kolkata in FY2001, and hereafter referenced as Kolkata in this report, except in relation to the still legal title of CESC. Kolkata has a population of 10.6 million.

<sup>2</sup> Because of the already high exposure of local finance institutions to CESC (47% of equity and 90% of outstanding debt), a policy was introduced by the Government of India restricting new lending by local finance institutions to a maximum of 40% of investment cost.

<sup>3</sup> With approval of the West Bengal State Government, CESC was permitted to augment the supply of power to its transmission and distribution network, in addition to power supplied from the West Bengal State Electricity Board. Approval was given for CESC to install (i) 2 x 67.5 megawatts (MW) new generator units at the Southern power station for commissioning in FY1991 and FY1992, and (ii) 2 x 250 MW new generator units at Budge Budge for commissioning from FY1995 in two phases.

<sup>4</sup> Investment 7058/Loan 1036-IND: *CESC Limited Project*.

<sup>5</sup> The largest private shareholder in CESC is an industrial investment group—R.P. Goenka Group—with around 20%. Approximately 33% of the shares are owned by 13,000 other private shareholders, and 47% by nine public sector financial institutions.

<sup>6</sup> The mortgage ranked *pari passu* with other lending institutions.

<sup>7</sup> Arising from the Government's relaxation of regulatory rules governing the uses to which electricity could be applied.

units at Budge Budge in December 1991, and a third loan for a new power plant at Balagarh in December 1996.<sup>8</sup>

### C. Purpose and Outputs

4. The project purpose was to augment CESC's transmission capacity so as to achieve a more integrated system linking the power plants and substations in CESC's system. The initial project scope was limited to augmenting CESC's 132 kilovolts (kV) transmission network with links to two new substations and four existing load centers. With the surge in load demand in FY1993, it became necessary to expand further CESC's 132 kV transmission network and strengthen CESC's transmission and distribution at 33 kV, 11 kV, and 6 kV levels.

5. The project outputs for the original scope included (i) laying four 132 kV underground transmission cables between New Cossipore and East Kolkata, East Kolkata and Prinsep Street, Prinsep Street and Park Lane, and Majerhat and Jadavpur substations; (ii) construction of two new 132 kV substations at East Kolkata and Jadavpur; and (iii) upgrading of four existing substations at Majerhat, New Cossipore, Park Lane, and Prinsep Street.

6. The project outputs for the extended scope included (i) laying an additional 132 kV underground transmission cable between Jadavpur and Kasba substations; (ii) transformers, relay, and switchgear equipment for nine new 33/11/6 kV distribution stations<sup>9</sup> to cater for the additional load demand; and (iii) installation of one 33 kV power capacitor at Kasba substation to improve voltage reliability. Further details of the project outputs and expected impacts are in Appendix 1.

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

7. As shown in Appendix 2, the total project cost was estimated at appraisal at Rs1,575 million (\$91.6 million), including a foreign exchange cost of Rs504 million (\$29.2 million) and a local currency cost of Rs1,071 million (\$62.4 million). ADB's loan of \$17.8 million equivalent was to be used to finance 61% of the foreign exchange cost related to imported equipment, engineering services, and interest during construction. A loan for \$20.0 million equivalent from the International Finance Corporation (IFC) was to be used to finance the balance of the foreign exchange cost (\$11.4 million) for imported equipment and \$8.6 million of the local currency cost. The remaining part of the local currency cost was to be funded by local finance institutions (Rs610 million, or \$35.5 million) and CESC (Rs315 million, or \$18.3 million).

8. In February 1994, when the need to extend the project scope became evident, the revised estimate for the original scope was Rs1,528 million (\$50.1 million). The major reduction in US dollar terms was mainly attributable to favorable currency variations and concessional import duties. The project scope expansion increased the estimated overall project cost to Rs2,284 million (\$74.1 million), which could still be financed within the funding arrangements

<sup>8</sup> Investment 7082/Loan 1142-IND: *CESC II Limited Project*, for \$32 million, approved on 13 December 1991; and Investment 7130/Loan 1499-IND: *Balagarh Power Company Limited Project*, for \$40 million, approved on 6 December 1996. Following protracted delays in the adjustment of electricity tariffs, the validity period of the latter expired and the loan was subsequently cancelled on 31 October 2001.

<sup>9</sup> At Alipore, Auckland, Bally, Chingrihata, Dhakuria, Dumdum, Kamarhati, Grey Street, and Park Circus. Following detailed assessment of load requirements, the proposed substations at Bally, Dumdum, and Park Circus were replaced by new substations at Jessore Road, Lillooah, and Rashbehari.

envisaged at appraisal. CESC assumed the foreign exchange risk and responsibility for project implementation.<sup>10</sup>

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

9. ADB's Project Completion Review Mission inspected the Project in October 1998. Although no explicit rating was given, an assessment of generally successful<sup>11</sup> could be inferred from the project completion report (PCR) as all project components were found to have been implemented satisfactorily and within budget. The performance of contractors was considered good, and the Project was seen to have (i) enhanced load management and operating efficiencies; (ii) reduced the risks of outages; and (iii) enabled power to be transferred from the Southern and Budge Budge power stations which, in turn, reduced CESC's reliance on power purchases from the West Bengal State Electricity Board (WBSEB). The Project's financial internal rate of return (FIRR) and economic internal rate of return (EIRR) were recalculated at 9.2% and 15.8%, respectively, close to the appraisal estimates of 8.9% and 15.9%. Against these success factors, some deterioration in CESC's financial strength was observed, and attributed to a dispute with the West Bengal State Government (WBSG), which had not approved CESC's application to increase tariffs. The dispute was resolved in October 1998. With a 25.4% approved tariff increase, the financial strength of CESC was expected to be restored.

10. The PCR identified several positive lessons learned as reasons for the satisfactory implementation of the Project: (i) the role of ADB in working closely with CESC, (ii) the competence of CESC as an experienced operator, and (iii) the satisfactory legal and regulatory framework under which CESC operated. Attention was drawn to the need to look seriously at the inefficiencies in transmission and distribution due to high power losses, which were affecting the creditworthiness and the capacity of private sector projects to raise commercial finance.

11. The PCR reliably evaluated project implementation, but in the absence of a technical advisor, could not provide an assessment of the technical effectiveness of the Project. The broader development impacts of the Project were also not assessed, and evaluation of CESC's financial performance and outlook for the future proved unrealistic.

## **F. Operations Evaluation**

12. This project performance audit report (PPAR) examines the findings of the PCR and reassesses the economic, financial, and operating performance of the Project. Special attention is given to assessing the achievement of project purpose, intended developments from the Project, sufficiency of technical design for meeting load growth, financial performance of CESC, and sufficiency of its initiatives to contain system losses. Also assessed are recovery mechanisms on loan and customer debt, planning, environmental issues, and the capacity for private sector participation to meet Kolkata's future power expansion needs. The PPAR reflects the findings of an Operations Evaluation Mission (OEM) that visited Kolkata in November 2002; a review of the PCR, appraisal report, material in ADB files, and 3 years of additional operational data; CESC's responses to the OEM's questionnaire; and discussions with ADB staff, CESC's senior management, and electricity consumers at Jadavpur. Copies of the draft PPAR were provided to WBSG, CESC, and ADB departments concerned for review, and their comments were considered in finalizing the PPAR.

<sup>10</sup> At appraisal, CESC's exposure to foreign exchange risk on its foreign loans was reported as negligible. CESC's foreign exchange risk on the ADB and IFC loans was considered manageable and within acceptable bounds for recovery through the electricity tariff.

<sup>11</sup> Under the previous three-category rating system (generally successful, partly successful, and unsuccessful).

## II. PLANNING AND IMPLEMENTATION PERFORMANCE

### A. Formulation and Design

13. Formulation of the Project was influenced by (i) the need for additional power to support industrial growth, (ii) ADB's assistance strategy for promoting and sustaining economic growth, (iii) the viability of CESC's proposal for achieving a cost-effective and technically efficient transmission network, and (iv) the apparent shortage of financing options available to CESC. At appraisal, ADB accepted CESC's technical proposal and reassessed the financial and economic viability of the Project based on CESC's aggregate investment program for the period FY1991–FY1995. Final technical specifications and costings were subject to detailed design during implementation, using CESC's in-house technical expertise and experience.

14. The appraisal followed ADB's general approach for public sector projects, but with less comprehensiveness. The time taken from CESC's request for assistance to ADB loan approval was approximately 13 months, which compared favorably with the time taken by commercial banks to approve industrial loans. The overall approach proved satisfactory, but inadequate attention was given to evaluating the Project's credit risk. The technical viability of improvements and impact on load growth in the absence of reinforcement and upgrading of the CESC system were not evaluated. If the Project's credit risk and technical inputs had been more comprehensively assessed, the potential for deterioration in CESC's financial performance might have become evident, and a sounder basis for ADB's involvement, and for CESC to meet its loan obligations, might have emerged (para. 54).

### B. Achievement of Outputs

15. Actual outputs were as envisaged at appraisal and subsequently revised with hardly any variation (Table 1). Minor amendments followed detailed engineering assessments of the system, e.g., the envisaged 132 kV underground cable between New Cossipore and East Kolkata was replaced by the 132 kV underground cable between Barrackpur Trunk Road and East Kolkata; the power capacitor envisaged at Kasba was replaced by a capacitor at Mulajore; and the envisaged upgrading of Majerhat substation was transferred to another project (see Map).

**Table 1: Achievement of Outputs**

Item	Envisaged	Actual
<b>At Appraisal</b>		
Transmission Lines	76 km of 630 mm <sup>2</sup> 132 kV underground cable: New Cossipore-East Kolkata (21 km) East Kolkata-Prinsep Street (21 km) Prinsep Street-Park Lane (12 km) Majerhat-Jadavpur (22 km)	73 km of 630 mm <sup>2</sup> 132 kV underground cable: BT Road-East Kolkata (29 km) East Kolkata-Prinsep Street (20 km) Prinsep Street-Park Lane (7 km) Majerhat-Jadavpur (17 km)
New Substations <sup>a</sup>	132/33 kV East Kolkata 132/33 kV Jadavpur	132/33 kV East Kolkata 132/33 kV Jadavpur
Upgraded Substations <sup>b</sup>	132/33 kV Park Lane, Prinsep Street, New Cossipore, and Majerhat	132/33 kV Park Lane, Prinsep Street, and BT Road
<b>Added with Extended Scope</b>		
Transmission Line	34 km of 630 mm <sup>2</sup> 132 kV underground cable: Jadavpur-Kasba	34 km of 630 mm <sup>2</sup> 132 kV underground cable: Jadavpur-Kasba
New Substations <sup>b</sup>	Nine Distribution Substations	Nine Distribution Substations
Power Capacitor	15 MVA 33 kV at Kasba	20 MVA 33 kV at Mulajore

BT = Barrackpur Trunk, km = kilometer, kV = kilovolt, mm<sup>2</sup> = square millimeter, MVA = megavolt-ampere.

<sup>a</sup> With outdoor equipment that included 132 kV circuit breakers, 132 kV isolators, 50 MVA 132/33 kV transformers; and indoor equipment for switchgear, panel, and metering.

<sup>b</sup> Including transformers, cabling, metering, and connecting equipment.

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

16. At Rs2,312 million (\$75.0 million), the actual total project cost was only 1% above the revised estimate of February 1994. Financing was provided by IFC (\$26.5 million), ADB (\$18.8 million), local finance institutions (\$15.3 million), and CESC (\$14.4 million). The increases in the US dollar equivalents of the ADB and IFC loans were attributable to favorable currency variations against the US dollar in the pool of currencies borrowed by CESC. ADB's loan financed 25% of the total project cost and 68% of the foreign exchange cost. IFC financed the balance of the foreign exchange cost and 37% of the local currency cost. The remaining local currency requirements were met by local finance institutions (32%) and CESC (31%) (Appendix 2).

17. The components of the original project scope were completed in December 1994, 3 months ahead of appraisal schedule. The additional components were completed in June 1996. To allow their financing, the closing date for ADB's loan was extended from 31 December 1995 to 10 September 1996.

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

18. At appraisal, it was agreed that procurement would be undertaken in accordance with CESC's standard procedures. The award of contracts for civil works and cable laying was to be based on a minimum of three competitive bids. Procurement within India was to be based on local competitive bidding, and major equipment items imported were to be procured through international competitive bidding. These procedures were generally followed. The procurement process involved multitier reviews within CESC before approval by the Central Electric Authority. Documentation relating to items procured with ADB funding was forwarded to ADB for review and approval. A summary of contract awards under ADB's loan is in Appendix 3.

19. CESC reported that the international and domestic contractors and suppliers for the Project had performed satisfactorily. All equipment inspected at the sites visited by the OEM was functioning satisfactorily with no significant defects.

### **E. Organization and Management**

20. Organization and management for implementation were consistent with arrangements agreed at appraisal. Responsibility was totally vested with CESC, which had long experience with implementing such transmission reinforcement and upgrading. Documentation and inspection evidence available to the OEM and discussions with implementation personnel and senior management confirmed that implementation had been satisfactory with respect to the awarding of procurement and construction contracts, contracting of technical experts for training the operators of new equipment, and in-house management covering detailed design and construction supervision. ADB held coordination meetings with IFC at appraisal, and in 1994 when considering the project scope expansion.

21. Apart from a loan review associated with the change in scope, ADB did not field any review missions to monitor project implementation. This was consistent with the private investment banking practice that provides for review only under special circumstances when the interests of the bank and its investment are at stake. Monitoring relied on the submission of bidding documents for equipment financed under ADB's loan, and reporting requirements as covenanted under ADB's loan. The OEM found that CESC kept good records of project accounts, and all documentation and reporting requirements were met satisfactorily.

### III. ACHIEVEMENT OF PROJECT PURPOSE

#### A. Operational Performance

22. Operational performance is measured in terms of the Project's achievements in (i) extending and augmenting the 132 kV grid to transfer power between power plants and substations, (ii) reinforcing overloaded 33 kV systems, (iii) reducing system losses on the 11/6 kV distribution systems, and (iv) improving system reliability. The adequacy of maintenance is also reviewed.

23. The improved 132 kV transmission links to alternative generating sources enabled CESC to reduce its dependence on power supply from WBSEB that was impaired by frequent outages, and improve the availability of power in the southern distribution area of CESC's license. CESC's own generation as a proportion of total energy transmitted increased from 51% at appraisal to 62% in FY1995, and 82% by FY2001. The reliability of CESC's system to meet load demand variations was also improved.

24. With the two-stage commissioning of the 135 MW Southern power station in FY1990 and FY1991, CESC's power supply deficit, estimated at around 15%, was eliminated. Responding to the increased availability of power and improvement in transmission capacity, the average growth in CESC's energy sales accelerated from 1.8% per annum between FY1987 and FY1990 to 3.8% per annum between FY1990 and FY1995, but did not reach the 5.6% appraisal forecast.

25. The addition of nine new 33 kV substations preempted distribution losses that would have otherwise occurred with further load growth.<sup>12</sup> Without this expansion of the project scope and augmentation of the 132 kV grid, CESC's transmission and distribution losses would have been at least 4% higher. Table 2 gives performance indicators before and after the Project. Detailed discussion of the operational and technical performance of the Project and CESC system is in Appendix 4.

**Table 2: Operational Performance Indicators**

Indicator	Before Project	After Project
132/33 kV Load Capacity (MVA)	980	1,280
Distribution Load Capacity (MVA)	1,400	1,894
System Voltage Across 33 kV	32–33	32–33 <sup>a</sup>
System Loss Across 33 kV (%)	2.0–2.4	1.8–2.0 <sup>b</sup>
Distribution Loss Savings (%)	nil	0.8–2.4 <sup>c</sup>

kV = kilovolt, MVA = megavolt-ampere.

<sup>a</sup> The system ideally should be operating at 33 kV.

<sup>b</sup> The 33 kV losses ideally should be around 1.8%.

<sup>c</sup> Over the lower voltage network and arising from 132 kV augmentation only.

26. Adequate general maintenance, including checks and monitoring of technical performance at substations, is undertaken by CESC. Because the transmission lines implemented under the Project were all laid underground, regular maintenance is not required. The substations and the distribution equipment appear in good order and are operating at their

<sup>12</sup> During FY1994, WBSG relaxed some of its regulatory measures on the use of electricity. As a consequence, the growth in CESC's energy sales increased from 4.2% in FY1995 to 6.6% in FY1996. The unanticipated increase would, with further load growth, have led to overloading and a drop in voltage below the system design of 33 kV.

optimum design. General maintenance to meet safety standards at substation yards is variable. Discussions with CESC engineers confirmed their understanding of transformer maintenance and gas circuit-breaker handling requirements.

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

### **1. Financial Performance**

27. CESC's financial performance over the period FY1987–FY1990 was characterized by slow growth amidst persistent power shortages during evenings. While the number of customers increased at 4.9% per annum during that period, the supply constraints kept the energy sales growth at only 1.8% per annum. Net operating income (profit) before tax as a proportion of equity and operating revenues averaged a moderate 11.8% and 2.7%, respectively. At 14.9%, equity as a proportion of total assets was well below the commercial norm for ensuring financial sustainability. Appraisal projections to FY2000 took into account the project implementation schedule and the expected increase in generation from the Southern and Budge Budge power stations. Electricity sales were expected to increase at an overall rate of around 5.6% per annum. Consistent with CESC's past performance, profit before tax was projected to grow at 12.9% per annum and to be sufficient to maintain a rate of return on equity of around 12%, on operating revenues of around 3%, and on net fixed assets of around 4%. The principle established under the Sixth Schedule of the Electricity Supply Act (1948) for approving electricity tariff adjustments to allow an after tax return on net fixed assets of 3% provided confidence in these projections.

28. The Project's investment in transmission and distribution equipment, spread over 6 years, represented 45% of CESC's net fixed assets at appraisal, and 3% in FY2002. Although the Project was a relatively small component of CESC's growing operations, it was essential for improving these operations and avoiding inefficiencies that would have otherwise occurred with continued load growth. CESC's financial viability was premised on CESC's capacity to meet its debt servicing requirements. Critical to the financial projections at appraisal were underlying assumptions relating to load growth, system losses, and tariff adjustments.

29. Appendix 5 summarizes CESC's financial statements pertaining to its operations from FY1988 to FY2002. The performance trend of CESC was one of solid improvement followed by a rapid decline in profitability. Profit before tax increased from Rs129 million in FY1990 (2.6% of revenues) to a maximum Rs896 million in FY1996 (7.5% of revenues), to turn into growing losses from FY1998 onwards. Total assets grew by 33.0% per annum to Rs47.9 billion in FY1996, and to a maximum Rs62.4 billion in FY1999, before easing to Rs58.9 billion in FY2001. Equity to total assets strengthened from 17.9% to 53.3% in FY1994, before sliding to 34.7% in FY2001. Significantly, and representing improved operational efficiencies, CESC's operating expenditures before depreciation and interest declined from 85.9% of operating revenues in FY1990 to 76.9% in FY2002.<sup>13</sup> During the same period, the average tariff increased from Rs1.34 per kilowatt-hour (kWh) to Rs3.89 per kWh.<sup>14</sup> This was equivalent to 9.3% per annum, as against the average inflation rate of 7.3% per annum, and an increase in average operating cost (excluding depreciation and interest) of 6.8% per annum. However, there was a significant difference in the average tariff increase between FY1990 and FY1996 (10.6% per annum) and that between FY1996 and FY2002 (8.0% per annum). As a result of this slowdown, the average

<sup>13</sup> The ratio fell to its lowest of 70.3% in FY2001.

<sup>14</sup> Still to be confirmed by the regulator. The electricity tariff is adjusted annually based on guidelines set under the India Electricity Supply Act (1948) and CESC's proposal. The system of adjustment worked satisfactorily until FY1995 when WBSG disagreed with CESC's proposed increase to recover fuel increases affecting operating costs in FY1994. Although the increase was forthcoming, approval was not ratified until December 1996. Thereafter, continuing disputes and claims arose, which led to further delays that accentuated CESC's financial losses.

tariff could not keep pace with the average operating cost (Appendix 5, Figure A5) and CESC started incurring losses.

30. Contributing to these overall trends were accounting treatments for the revaluation of assets in FY1994, inadequate adjustments of electricity tariffs from FY1995 onwards, increased interest on borrowings associated with an overreliance on loans to meet capital requirements, and growing system losses.<sup>15</sup> Table 3 provides a summary of the key financial performance indicators between FY1989 and FY2002. ADB's loan covenant of a long-term debt to equity ratio of no more than 3 was complied with only in FY1995 and FY 1996, while the debt service ratio covenant of at least 1.1 times was complied with in every year except FY1998 and FY2002. The covenants were intended as triggers for maintaining electricity tariffs so as to ensure that revenues covered all operating expenses and taxes, loan interest and other charges, and repayment of debts when due; and that a reasonable return on CESC's capital base was generated, as defined in the Electricity Supply Act (1948).

**Table 3: Financial Performance of the Calcutta Electric Supply Company**

Fiscal Year Ending	1989	1990	1993	1995	1996	1997	1998	1999	2001	2002
Debt Service Ratio <sup>a</sup>	1.7	1.6	1.6	2.7	2.4	1.6	0.8	1.2	1.3	1.0
Long-Term Debt to Equity Ratio <sup>b</sup>	3.5	3.5	3.9	2.4	2.7	3.1	4.3	4.6	4.7	<sup>c</sup>
Operating Expenditure/ Revenue (%)	86.4	85.9	80.9	79.3	77.9	85.3	87.1	78.8	70.3.	76.9
Return on Operating Revenue (%) <sup>d</sup>	2.9	2.6	3.1	7.1	7.3	0.3	(7.6)	(7.5)	(9.1)	(16.2)
Return on Equity (%)	13.4	12.5	12.9	3.4	4.2	0.2	(5.5)	(6.2)	(8.4)	<sup>c</sup>
Equity to Total Assets (%)	15.9	14.9	15.2	51.7	44.8	39.8	34.6	33.0	34.7	<sup>c</sup>
Average Revenue Tariff (Rs per kWh)	1.20	1.34	1.69	2.10	2.45	2.77	2.89	3.21	3.51	3.89 <sup>e</sup>

kWh = kilowatt-hour.

<sup>a</sup> Profit before depreciation, interest, and tax less dividends, all divided by interest plus loan repayments.

<sup>b</sup> Equity for this ratio in calculation excluding the effect of asset revaluations.

<sup>c</sup> Dependent on the regulator's tariff determination.

<sup>d</sup> Profit before tax divided by operating revenue.

<sup>e</sup> Subject to final determination and dependent on claw-back provisions awarded by the West Bengal State Electricity Board. The actual average operating tariff before award was Rs3.38 per kWh.

31. In January 2002, CESC defaulted on servicing its debt obligations to several lenders, including ADB and IFC. This precipitated litigation from lenders through the Kolkata High Court for recovery of interest and loan principal. ADB abstained as a participant to the injunction, preferring to work with the Steering Committee<sup>16</sup> to evolve a satisfactory restructuring of CESC's loans. In a separate appeal for tariff relief, the Supreme Court's decision of 3 October 2002 (para. 37) to approve a tariff increase of 16.5% with adjustment for transmission and distribution losses, allowed CESC to resume its loan-servicing obligations.<sup>17</sup>

<sup>15</sup> Among these, the one-off revaluation of assets led to a substantial increase in shareholders' funds and, therefore, increase in equity to total assets. Similarly, the decline in long-term borrowings to total assets occurred not because the former declined, but because the revaluation and growth in assets was large relative to the growth in borrowings.

<sup>16</sup> Formed by the lenders to negotiate loan restructuring with CESC.

<sup>17</sup> The adjustment was expected to result in a net effective tariff increase of about 12.3%.

## 2. Auditing Arrangements

32. Local chartered accountants are reappointed on a yearly basis for an external audit of CESC's accounts. The same firm of auditors has been reappointed since at least FY1987, and the same format for presenting CESC's accounts has been followed. While auditing procedures are believed to comply with the Government's requirements and standards, and generally open disclosure exists for all accounting items, CESC's presentation of accounts and disclosure details are not fully consistent with accepted international practice. Important areas requiring more transparency include disclosure in the income statement covering provisions on the profit and loss account and unpaid consumer bills, and provision for exchange rate changes on foreign currency liabilities and extraordinary items. Important areas requiring more transparency and alignment in the balance of accounts statement include the treatment and extent of unpaid receivables, and the treatment of consumer deposits. Presentation in the standard balance sheet format would help make the accounts of CESC more transparent and easier to interpret.

### C. Financial and Economic Reevaluation

33. At appraisal, the financial and economic analysis covered benefits from all of CESC's power investments planned for commissioning during the time-slice FY1991–FY1995.<sup>18</sup> The base-case benefits assessed were considered conservative in terms of pricing and incremental output, and implementation arrangements sufficient to enable project completion as scheduled and within the estimated cost. Because the Project was to be implemented using proven technology and methods, no major implementation risks were anticipated. The same time-slice methodology was used in the PCR.

34. The OEM has reestimated the EIRR and FIRR based on more detailed information than was available at the time of the PCR. Differences between the appraisal, PCR, and OEM estimates (Table 4) are explained by differences in the load and tariff levels. The EIRR reestimate of 12.1% confirms the economic viability of CESC's investments, of which technical improvements under the Project were a part, but are not fully captured in terms of avoided outages and distribution losses, and improved voltage reliability. The FIRR of 6.3%, which assumes transmission sufficiency to meet load growth up to FY2008 and takes into account the cost of investments with taxes and duties, confirms the financial viability of CESC's investments between FY1990 and FY1996. The FIRR is close to the average real weighted cost of capital estimated at 6.7%, which takes into account the nominal lending rates on foreign and local loans, together with a premium for the foreign exchange risk, an adjustment for corporate tax, and an adjustment for inflation. A detailed account of the methodology and assumptions underlying the FIRR and EIRR reestimates is in Appendix 6.

**Table 4: FIRR/EIRR Estimates**  
(%)

Item	Appraisal	PCR	PPAR
FIRR	8.9	9.2	6.3
EIRR	15.9	15.8	12.1

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

<sup>18</sup> Benefits expected from other projects included additional revenue benefits derived from the commissioning of Southern power station (135 MW), other upgrading, distribution, and miscellaneous projects commissioned during the period.

35. A 10% increase in the average tariff in FY1997 would have improved the FIRR to 8.6%, and the EIRR to 14.2%. Similarly, if a 10% tariff increase is assumed for FY2003, an FIRR of 7.9% is obtained. Such an increase has some bearing on future tariff adjustments to be sought from the regulator. Should the load growth during FY2003–FY2008 be 10% higher than the OEM's projection, the FIRR and EIRR will improve to 6.9% and 12.9%, respectively.

#### **D. Sustainability**

36. The sustainability of project benefits depends on planning, the timely matching of capacity with growth in load demand, optimal system management, and maintenance. Planning follows CESC's master plan, last prepared in FY1994, for operations improvement. Generation sufficiency is being met together with back-up generation capacity available from WBSEB.<sup>19</sup> The additional transmission capacity installed under the Project will not reach its maximum for many years so that in the unlikely event of a shutdown in generation, technical sustainability is reasonably assured. However, transformer capacity across CESC's network is sufficient only for the next 3 years, and higher transformer capacities will be needed to avoid load shedding.<sup>20</sup> System management is conducted satisfactorily and attention is being paid to further upgrading of CESC's network. Maintenance requirements are being met satisfactorily.

37. The timely matching of technical improvements with load growth is dependent on CESC's capacity to meet its investment requirements. Since FY1995, adjustments in the electricity tariff have been irregular, and distribution losses have climbed with an adverse impact on CESC's profits, dividends, and share price. To avoid performance failure in the future, these issues need to be addressed, together with financial restructuring and a change in management modus operandi toward meeting future investment needs. The OEM's discussions with CESC management showed that there was awareness of the situation and constructive steps were being taken. A world-renowned investment bank was engaged to advise on financial restructuring. Issues surrounding the principles for approving electricity tariff adjustments were clarified under the Supreme Court's judgment of 3 October 2002, which should lead to more timely future adjustments. CESC was taking measures to reduce its transmission and distribution losses (Appendix 4), and WBSG introduced harsh penalties for electricity theft, and improved court processing for enforcement. After having steadily increased from 14.6% in FY1991 to 23.7% in FY2001, the transmission and distribution losses decreased for the first time in FY2002, to 21.8%, and a further significant decline is expected in FY2003. These efforts provide ground for some optimism that CESC can overcome its financial difficulties. However, the basis for adjusting tariffs is still likely to require review (para. 51). Regular injections of equity capital are also needed, which to date has not been seen as necessary, or providing a sufficient commercial return.<sup>21</sup> In the absence of more definitive planning and commitment from the major shareholder, the financial viability of CESC's operations is uncertain. This uncertainty applies to the total operations of CESC, as opposed to the sustainability of project benefits, which are reasonably assured.

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

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

38. The socioeconomic situation in the project areas was not assessed at appraisal or during implementation. The OEM also could not reliably measure social benefits derived from the

<sup>19</sup> CESC's transmission network is connected to WBSEB at Howrah, Kasba, Lillooah, and Titagarh substations.

<sup>20</sup> Provision for upgrading is currently planned at Auckland and Park Lane substations.

<sup>21</sup> In the short term, it may be necessary to first divest some of CESC's operations in order to normalize its financial gearing.

Project, but CESC operators and users in the project areas visited reported that the reliability of supply improved and there were fewer outages during evenings. These improvements were seen to have widened the scope of commercial activities, enhanced the quality of life, and improved the environments in which people worked.

39. One of the factors taken into account for approval of ADB's loan was the expected stimulus to industrial growth that the improved availability and reliability of power would provide. Acceleration in industrial growth was expected to spur economic activity and, in turn, lead to increased electricity demand from households and small businesses. This expected outcome does not appear to have occurred. At appraisal, energy consumption by industry was growing at about 2.4% per annum. Between FY1990 and FY1996, the growth slowed to 2.1% per annum, despite the increased availability of power. From FY1996 to FY2002, there was zero growth in energy sales to industry. The OEM was unable to establish the reasons for the lack of industrial growth despite the improved availability and reliability of power.

40. The Project was gender neutral with no stated objective to assist women during or after implementation. Project benefits for women accrued largely in the form of improved availability of electricity, in particular less outages during evenings, in their homes.

## **B. Environmental Impact**

41. Environmental aspects relating to the Project were not specifically addressed at appraisal, except for ADB's loan covenants requiring CESC to ensure that the Project was implemented with due regard to environmental and pollution control laws. The Project had no significant adverse impact on the environment. The 132 kV transmission lines were laid underground consistent with established practice, which avoided concerns relating to tower construction, minimum height clearance, and safety. The new substations are fenced off, and noise pollution from transformers is not audible outside the fence boundaries. Personnel safety measures against accidental high-voltage electrocution were built into the design and ground cover of the substations. For some substations, more diligent attention to controlling weed growth around the equipment is warranted. Procedures against the accidental operation of switchgear at the new and upgraded substations are appropriate.

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

42. Appraisal included a review of CESC's organization, management, and operations. CESC was found to have the relevant experience to satisfactorily implement the Project. Suboptimal features associated with aged equipment, obsolete technologies, and multiple voltage distribution systems were noted, and it was recognized that CESC was taking measures to address the need for modernizing. Procedures for and experience in procurement were considered appropriate. Consequently, a specific provision for institutional strengthening was not considered necessary.

# **V. OVERALL ASSESSMENT**

## **A. Relevance**

43. The Project's rationale to help meet the suppressed demand for electricity in Kolkata, and in so doing assist industrialization, was consistent with the Government's Eighth Plan (FY1991–FY1995) and ADB's assistance strategy to facilitate economic growth. Significant in ADB's decision to support the Project was the private sector status of CESC; the already high exposure of the local finance institutions and a new law restricting their lending to a maximum of 40% of the investment cost; and power shortages in Kolkata that were impeding industry and

economic growth. The Project improved the availability, reliability, and security of power supply to consumers by enhancing CESC's transmission and load management capacity. The nine new substations were important for containing downstream distribution losses. In consideration of these factors, the Project's rationale, purpose and outputs are assessed as relevant.

## **B. Efficacy**

44. The expansion of the project scope and the redesign of some components following detailed engineering were appropriate. Civil works for the 132 kV transmission underground cable were completed satisfactorily and in accord with established practice. Installation of equipment for the two new 132/33 kV substations and nine new 33 kV substations was of a high order. The project outputs achieved their design purpose of expanding CESC's transmission capacity and avoiding transmission and distribution losses that would have otherwise occurred, but were not of a sufficient scale to achieve a reduction in CESC's overall losses. Although the Project helped remove power constraints on industrial growth, it was insufficient on its own to effect such growth. The Project, in achieving its stated purpose and principal targets, is assessed as efficacious.

## **C. Efficiency**

45. Implementation efficiency in terms of cost and schedule was satisfactory. The expansion of the project scope required installation of additional equipment and was responsible for the additional time needed for project completion. System management at generation and transmission is satisfactory. The reestimated EIRR of 12.1% attests to the economic viability of CESC's investments made over the period FY1990–FY1996. The reestimate exceeds ADB's efficiency benchmark, but is significantly lower than the appraisal figure. Overall, the Project's implementation and performance are assessed as efficient.

## **D. Sustainability**

46. CESC's capacity to meet Kolkata's growing electricity needs is strongly dependent on timely injections of equity capital matched with loan support. To date, CESC has relied largely on borrowings to meet its capital requirements, and the interest cost has impaired the financial viability of its operations. CESC's financial capacity to meet expansion requirements, contain transmission and distribution losses, and also meet loan-servicing obligations is uncertain. While this uncertainty applies to CESC's total operations, the additional transmission capacity installed under the Project will not reach its maximum for many years and maintenance of the equipment is sound so that technical sustainability is reasonably assured. Accordingly, the sustainability of benefits generated by the Project per se is assessed as likely.

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

47. Project support for institutional strengthening was limited to ADB's loan covenants that were aimed at providing early signals for adjusting tariffs and at ensuring observance of reporting requirements on project implementation and CESC's financial operations. The Project, while improving the availability of electricity for industry, was not sufficient to spur industrial growth, which actually slowed. However, it allowed expansion in new connections for commercial and domestic consumers that widened the scope for commercial activities, and improved their home and work environment. Overall, institutional, economic, and other impacts of the Project are judged moderate.

## F. Overall Project Rating

48. The Project is rated successful.<sup>22</sup> It enabled CESC to meet transmission requirements for the new generation units at the Southern and Budge Budge power stations, thus helping eliminate a 15% supply deficit. Detracting from a higher rating is the FIRR of 6.3%, which although close to the average real weighted cost of capital, reflects CESC's weakening financial performance that renders uncertain its capacity to fully meet future investment requirements and financial obligations.

## G. Assessment of ADB and Borrower Performance

49. ADB's overall performance is assessed as partly satisfactory. ADB's appraisal was inadequate in evaluation of technical inputs and credit assessment. With a more comprehensive evaluation, ADB could have been instrumental in achieving a fuller project impact, and helping CESC secure a better basis for meeting its future capital requirements. A sounder basis for ADB's involvement and management of its loan investment would have been provided. Since the July 1990 appraisal, loan processing procedures for ADB's private sector operations have been strengthened.<sup>23</sup>

50. CESC's performance is assessed as satisfactory, notwithstanding the weaknesses in its financial management. CESC competently managed project implementation. Procurement was carried out in accordance with competitive bidding procedures, and the original scope completed within the appraised cost and schedule. Cooperation with ADB was good, and adequate records of every detail of project implementation were kept. Detracting from a higher assessment are financial difficulties experienced by CESC due to delayed tariff increases, an overreliance on meeting capital requirements from borrowed funds, and rising distribution losses.

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

### A. Key Issues for the Future

51. **Privatization and Regulatory Failure.** CESC's license passes responsibility for meeting investment requirements to the private sector. Up to the present, CESC has viewed solutions to its expansion needs as a function of the availability of loan support. The public shareholding base of CESC is not used to raise equity for the purpose of partly funding CESC's investment needs.<sup>24</sup> The underlying principle of the Electricity Supply Act (1948) whereby the Government undertakes to approve an adjustment to the electricity tariff to meet the full cost of supply is a disincentive to do so. A review of CESC's financial management strategy and of the principle for adjusting CESC's electricity tariff as provided under the Act is warranted.

52. The monopoly development of CESC under regulatory control<sup>25</sup> has contributed to its declining financial performance. Generation, transmission, and distribution operations remain

<sup>22</sup> Using the revised four-category rating system (highly successful, successful, partly successful, and unsuccessful).

<sup>23</sup> ADB. 2001. *Private Sector Operations Strategic Direction and Review*. Manila.

<sup>24</sup> Limited rights issues attached to nonconvertible redeemable debentures were offered.

<sup>25</sup> While CESC is a public company whose shares are majority owned by a private investor group and listed on the London and India stock exchanges, its license to supply and distribute power is in reality permission to operate at intervals (of about 10 years), after which WBSG has a "deferred option to purchase the undertaking." In effect, the Government can nationalize the operations of CESC if the benefits of privatizing the supply and distribution of electricity are not in the public interest. To ensure that the public interest is not exploited by the monopoly operations of CESC, WBSEB is the appointed regulator responsible, among other matters, for reviewing and approving (or otherwise) adjustments to the electricity tariff. CESC must also obtain approval for additional investments, which until FY1988 precluded CESC from investing in generation.

bundled and without legal independence and accountability. The lack of legal entities under which the key operational areas are structured presents difficulties for lenders to collateralize their loan investments and offer more favorable lending terms. The lack of corporatization of CESC's operations also means that expenditures and revenues between generation and distribution are not legally separable. The need for internal restructuring of CESC's operations is evident, as is the need to restructure the Kolkata power sector so that competition is introduced and regulatory intervention minimized. New entrants should be encouraged in generation, and responsibility for expanding distribution extended to additional operators. Divestment of CESC's Budge Budge power station and the involvement of a strategic investor in CESC also merit consideration.

53. **Value Added by ADB.** ADB's financing followed appraisal procedures commonly practiced in commercial banks. There was a minimum of project administration, except for monitoring compliance with loan covenants related to reporting and loan servicing, and extending approval for CESC to utilize loan savings for an expansion in project scope. Such minimum involvement is consistent with global investment banking practice. The issue, therefore, arises as to how ADB can provide added value in its development role for private sector lending, and whether ADB's appraisal and administration of private sector proposals are appropriate.

54. One weakness evident at project formulation was the lack of technical verification by ADB that the project design would achieve its stated purpose and performance targets. Even the expanded scope, although beneficial, was of insufficient scale to contain CESC's overall transmission and distribution losses. Another weakness was the lack of credit assessment on CESC and its principal shareholder, despite ADB's loan being without government guarantee and independent security. The lack of standalone collateral and practical difficulties associated with legal recourse in the event of default meant that ADB was lending on a promissory basis—a feature that was later repeated for ADB's second loan to CESC (footnote 8). Loan security could have been strengthened with more attention to loan structuring, and ADB's exposure lessened through sell-down arrangements. Long-term investment lending to the private sector would normally entail (i) identifying the risks, (ii) setting an interest rate commensurate with the long-term risk and security, and (iii) underwriting or selling down the lead lender's loan to other international investors. ADB's private sector operations arm would add value to its impact if it looked to increase the volume of its lending through an increased involvement in underwriting, and selling down. Essential to that process is a comprehensive and high-quality credit assessment at appraisal that is also made available to other underwriters and potential fund investors.

## **B. Lessons Identified**

55. The key lesson is that with a more comprehensive technical evaluation and credit assessment at appraisal, the project scope necessary to achieve CESC's performance targets could have been more reliably identified. This lesson and a few others from the OEM's observations of CESC's operations are reflected in the recommended follow-up actions below.

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

56. **ADB** should ensure more comprehensive appraisal when processing future private sector projects.

57. **CESC** should (i) consider restructuring and corporatizing its generation, transmission, and distribution so that the operations of each entity are independent with separate pricing and

accountability for expenditures and revenues; and (ii) make more use of bond and equity markets to meet its investment requirements.

58. **WBSG** should (i) restructure the power sector and introduce competition in the provision of power in Kolkata so that the role of the regulator is shifted away from price setting, and (ii) provide CESC with legislative support and recovery mechanisms for dealing with outstanding customer accounts.

## GOALS, TARGETS, INPUTS, AND RESULTS<sup>a</sup>

Goals	Targets	Expected Outcomes and Impacts	Actual Outcomes and Impacts
<b>Sector</b>			
<ul style="list-style-type: none"> <li>• Reduce resource constraints on lending to the private sector for power projects</li> <li>• Help expand the role of the private sector to improve overall efficiencies in the power sector</li> <li>• Promote economic development</li> </ul>	<ul style="list-style-type: none"> <li>• Calcutta Electric Supply Company (CESC) Limited, a public listed company in which 53% of the shares are privately owned</li> <li>• Improved transmission and distribution efficiency in the Kolkata licensed area</li> <li>• Meeting industry power needs and enhancing system reliability</li> </ul>	<ul style="list-style-type: none"> <li>• Increased funding leading to progressive expansion of power generation and transmission to the Kolkata licensed area</li> <li>• Increased generation output, transmission, and distribution sales</li> <li>• Higher production levels and faster economic growth</li> </ul>	<ul style="list-style-type: none"> <li>• Loan funding constraints overcome; generation and transmission requirements met</li> <li>• Power deficit offset; transmission and distribution losses reduced specific to the Project but not CESC</li> <li>• Industry growth sales sustained at 2.2% per annum to 1996, thereafter zero growth</li> </ul>
<b>For the Project As Appraised</b>			
<ul style="list-style-type: none"> <li>• Reduce transmission constraints preventing the transfer of power between area systems that make up the Kolkata network</li> </ul>	<ul style="list-style-type: none"> <li>• Construction of new 132-kilovolt (kV) substations at East Kolkata and Jadavpur</li> <li>• Upgrading of existing 132 kV substations at New Cossipore, Majerhat, Prinsep Street, and Park Lane</li> <li>• Laying of new 132 kV interconnections by underground cable between substations (i) New Cossipore-East Kolkata, (ii) East Kolkata-Prinsep, (iii) Park Lane-Prinsep, and (iv) Majerhat-Jadavpur</li> </ul>	<ul style="list-style-type: none"> <li>• Increased transmission network capacity</li> <li>• Reduced transmission and distribution losses across the CESC network from 16.3% to 15.0%</li> <li>• Sustained voltage reliability with increased load demand</li> <li>• Limited outages associated with overloading</li> </ul>	<ul style="list-style-type: none"> <li>• Transmission capacity increased by 423 megawatts (MW)</li> <li>• Transmission distribution losses increased to 19.9% in FY1996 and 23.7% by FY2001</li> <li>• Voltage reliability sustained</li> <li>• Anticipated outages in project area avoided</li> </ul>

<sup>a</sup> Although some similarity in format exists, this comparison is not intended to develop a project framework that was not prepared at appraisal or reappraisal.

Goals	Targets	Expected Outcomes and Impacts	Actual Outcomes and Impacts
<b>For the Additional Scope</b>			
<ul style="list-style-type: none"> <li>Counter the instability of power distribution arising from the unanticipated jump in power demand from 881 MW in FY1993 to 967 MW in FY1994</li> </ul>	<ul style="list-style-type: none"> <li>Construction of new 132 kV interconnection by underground cable between Jadavpur and Kasba substations</li> <li>Construction of nine new 33/11/6 kV substations</li> <li>Installation of one 15 megavolt-ampere reactive (MVAr) 33 kV power capacitor at Kasba substation</li> <li>Supply of power equipment to improve reliability</li> </ul>	<ul style="list-style-type: none"> <li>Increased transformer capacity by about 135 megavolt-ampere (MVA)</li> <li>Sustained voltage performance and reduce outages</li> <li>Increased capacity to expand number of consumer connections</li> </ul>	<ul style="list-style-type: none"> <li>Transformer capacity increased to 148 MVA</li> <li>Voltage output to households/commercial consumers regularized at 220 volts <math>\pm</math> 5%</li> <li>20 MVAr capacitor at Mulajore substituted for 15 MVAr capacitor at Kasba</li> <li>New connections across Kolkata increased by 91% (873,000) to end of FY2002</li> </ul>
<b>Project Inputs</b>			
<ul style="list-style-type: none"> <li>Procurement and installation of cables, switchgear, transformers, jointing kits, and accessories</li> </ul>	<ul style="list-style-type: none"> <li>Project costs (at appraisal) Rs1,575 million (\$91.6 million)</li> <li>Project financing plan <ul style="list-style-type: none"> <li>— ADB \$17.8 million</li> <li>— IFC: \$20.0 million</li> <li>— LFI: \$35.5 million</li> <li>— CESC: \$18.3 million</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Original project completion by 31 March 1995</li> <li>Expanded project completion by 31 March 1995</li> </ul>	<ul style="list-style-type: none"> <li>Original project components completed on 31 December 1994</li> <li>Overall project completed on 6 September 1996</li> <li>Project costs Rs2,312 million (\$75.0 million)</li> <li>Project financing <ul style="list-style-type: none"> <li>— ADB: \$18.8 million</li> <li>— IFC: \$26.5 million</li> <li>— LFI: \$15.3 million</li> <li>— CESC: \$14.4 million</li> </ul> </li> </ul>

ADB = Asian Development Bank, IFC = International Finance Corporation, LFI = local finance institution.

## PROJECT COSTS

Item	Estimated (Rs million)			Estimated (\$ million)			Actual (Rs million)			Actual (\$ million) <sup>a</sup>		
	Foreign Exchange	Local Currency	Total Cost	Foreign Exchange	Local Currency	Total Cost	Foreign Exchange	Local Currency	Total Cost	Foreign Exchange	Local Currency	Total Cost
<b>Original Project<sup>b</sup></b>												
Land	0	17	17	0.0	1.0	1.0	0	21	21	0.0	0.6	0.6
Civil Works	0	7	7	0.0	0.4	0.4	0	25	25	0.0	0.8	0.8
Cable, Equipment, and Spares	307	638	945	17.8	37.1	54.9	296	712	1,008	10.6	21.9	32.5
Engineering Services	2	89	91	0.1	5.2	5.3	1	220	221	0.0	6.8	6.8
IDC	76	107	183	4.4	6.2	10.6	209	119	328	7.5	3.7	11.2
Contingencies	119	213	332	6.9	12.5	19.4	0	0	0	0.0	0.0	0.0
<b>Subtotal</b>	<b>504</b>	<b>1,071</b>	<b>1,575</b>	<b>29.2</b>	<b>62.4</b>	<b>91.6</b>	<b>506</b>	<b>1,097</b>	<b>1,603</b>	<b>18.1</b>	<b>33.8</b>	<b>51.9</b>
<b>Revised Original Project<sup>c</sup></b>												
	<b>572</b>	<b>956</b>	<b>1,528</b>	<b>18.7</b>	<b>31.4</b>	<b>50.1</b>	<b>506</b>	<b>1,097</b>	<b>1,603</b>	<b>18.1</b>	<b>33.8</b>	<b>51.9</b>
<b>Expanded Project<sup>c</sup></b>												
Civil Works	0	9	9	0.0	0.3	0.3	0	9	9	0.0	0.3	0.3
Cable, Equipment, and Spares	153	277	430	4.9	8.8	13.7	165	294	459	5.9	9.0	14.9
Engineering Services	11	10	21	0.3	0.3	0.6	12	10	21	0.4	0.3	0.7
IDC	85	119	204	2.8	3.7	6.5	92	128	220	3.3	3.9	7.2
Contingencies	33	59	92	1.0	1.9	2.9	0	0	0	0.0	0.0	0.0
<b>Subtotal</b>	<b>282</b>	<b>474</b>	<b>756</b>	<b>9.0</b>	<b>15.0</b>	<b>24.0</b>	<b>269</b>	<b>441</b>	<b>709</b>	<b>9.6</b>	<b>13.5</b>	<b>23.1</b>
<b>Revised Original and Expanded Project</b>												
Land	0	23	23	0.0	0.8	0.8	0	21	21	0.0	0.6	0.6
Civil Works	0	42	42	0.1	4.9	5.0	0	34	34	0.0	1.1	1.1
Cable, Equipment, and Spares	534	911	1,445	20.6	27.7	48.3	461	1,006	1,467	16.5	30.9	47.4
Engineering Services	13	236	249	0.1	2.9	3.0	12	230	242	0.4	7.1	7.5
IDC	222	182	404	5.5	7.6	13.1	301	247	548	10.8	7.6	18.4
Contingencies	85	36	121	1.4	2.5	3.9	0	0	0	0.0	0.0	0.0
<b>Total</b>	<b>854</b>	<b>1,430</b>	<b>2,284</b>	<b>27.7</b>	<b>46.4</b>	<b>74.1</b>	<b>774</b>	<b>1,538</b>	<b>2,312</b>	<b>27.7</b>	<b>47.3</b>	<b>75.0</b>
<b>Funding Source</b>												
ADB	556	0	556	18.0	0.0	18.0	579	0	579	18.8	0.0	18.8
IFC	298	412	710	9.7	13.4	23.1	195	624	819	8.9	17.6	26.5
LFI		473	473	0.0	15.3	15.3	0	473	473	0.0	15.3	15.3
CESC		545	545	0.0	17.7	17.7	0	441	441	0.0	14.4	14.4
<b>Total</b>	<b>854</b>	<b>1,430</b>	<b>2,284</b>	<b>27.7</b>	<b>46.4</b>	<b>74.1</b>	<b>774</b>	<b>1,538</b>	<b>2,312</b>	<b>27.7</b>	<b>47.3</b>	<b>75.0</b>

ADB = Asian Development Bank, CESC = Calcutta Electric Supply Company, IDC = interest and other charges during construction, IFC = International Finance Corporation, LFI = local finance institution.

<sup>a</sup> The dollar equivalent values reflect exchange rates applicable on the rupee cost at the time of expense.

<sup>b</sup> As appraised in July 1990.

<sup>c</sup> As approved in February 1994.

Sources: ADB and CESC.

**SUMMARY OF CONTRACT AWARDS UNDER ADB LOAN<sup>a</sup>**

<b>Description</b>	<b>Currency</b>	<b>Contract Amount</b>
Procurement of 132 kV Gas-Insulated Switchgear from Germany	DM	13,699,267
Erection Supervision of 132 kV Gas-Insulated Switchgear from Germany	DM	3,483,618
Procurement of 132 kV Jointing Kits and Accessories from Sweden	\$	3,185,450
Procurement of 132 kV Jointing Kits and Accessories from Japan	\$	589,356
Procurement of Disturbance Recorder from Germany	\$	9,050

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ADB = Asian Development Bank, DM = deutsche mark, kV = kilovolt.

<sup>a</sup> The balance of ADB funds was used to meet interest during construction.

Source: ADB disbursement records and Calcutta Electric Supply Company.

## OPERATIONAL AND TECHNICAL PERFORMANCE<sup>1</sup>

### A. Design

1. The 132 kilovolt (kV) transmission lines installed under the Project used 132 kV crosslinked polyethylene (XLPE) insulated copper cables laid underground, which are appropriate for a densely populated city area. The lines are not visible except where cables are connected with overground equipment. The termination points appeared well built, and there were no reports of problems with them.
2. The 132 kV substations erected at Jadavpur and East Kolkata were of conventional outdoor design with main and transfer bus configuration. The 132 kV substations at Prinsep Street and Park Lane, where land was the main constraint, included gas-insulated switchgear (GIS) with double bus bar configuration. For stepping down 132 kV transmission voltage to 33 kV distribution voltage, 50 megavolt-ampere transformers were installed at Jadavpur and East Kolkata substations, and a 75 megavolt-ampere transformer installed at Park Lane substation.
3. The design of the 132 kV and 33 kV substations and transformers was in accord with national and international design standards. The main and transfer bus configuration for outdoor substations, and double bus bar configuration for GIS, provided flexibility in operation and enhanced power availability. At Jadavpur and East Kolkata, space was kept for future expansion of the substation capacity for one 132 kV/33 kV transformer. Most other substations in the Calcutta Electric Supply Company's (CESC's) network are similarly planned.
4. The functional design of substations was appropriate. A minor improvement in design for the better storage of spares was possible at Jadavpur.

### B. Operation and Maintenance

5. The main equipment items at substations are summarized in Table A4.1, and power loads carried by the 132 kV and 33 kV transformers at each substation are summarized in Table A4.2.
6. During discussions, operation staff indicated there were no major operating problems for the 132 kV and 33 kV substations, transformers, and other equipment. No abnormal leakage of sulfur hexafluoride gas from circuit breakers and GIS were reported or observed during site inspections. Oil seepage from the two transformers of Auckland Square was scheduled for repair. No abnormal leakage from transformers was observed in other substations inspected.
7. As GIS was used for the first time in CESC's system, key operation and maintenance staff of CESC took training in the manufacturer's works in Germany. Maintenance of transformers and other equipment is carried out regularly. Stocks of spare parts required for maintenance of equipment are also maintained.
8. Equipment at the 132 kV and 33 kV substations is maintained satisfactorily. At Jadavpur, grass and weeds around the transformers and bus plant had grown through the graveled ground cover and were jeopardizing the safety features in the substation design. More diligence should be applied to maintaining safety design features.

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<sup>1</sup> Additional summary findings of the staff consultant.

Table A4.1: Locations and Scope of the Project

Item	Result	
<b>At Appraisal</b>		
	<b>Length (km)</b>	
<b>A. 132 kV Transmission Line<sup>a</sup></b>	<b>At Appraisal</b>	<b>Actual</b>
Majerhat-Jadavpur	7.2	5.6
Prinsep Street-Park Lane	4.0	2.2
Prinsep Street-East Kolkata	7.0	6.6
East Kolkata-Barrackpur Trunk (BT) Road	7.0	9.6
<b>Subtotal</b>	<b>25.2</b>	<b>24.0</b>
<b>B. New 132 kV and 33 kV Substations</b>	<b>Construction for each new stations generally included</b>	
Jadavpur	* 132 kV (main and transfer bus) outdoor switchyard, 6 bays	
East Kolkata	* 132 kV circuit breaker, 6 sets	
	* 132 kV isolator, 20 sets	
	* 132 kV instrument transformers and other accessories	
	* 50 MVA, 132 kV and 33 kV transformers, 2 sets	
	* Control panel and relay panels 132 kV system	
	* 33 kV, single busbar, air insulated, indoor switchgear, 12 panels	
	* Control panel and relay panels 33 kV system	
	* Miscellaneous hardware and equipment	
	* Station building, one	
<b>C. Extension to 132 kV and 33 kV Substations<sup>b</sup></b>	<b>Extension for each substation generally included</b>	
BT Road	* 132 kV (Main and transfer bus) outdoor switchyard, 1 bay	
	* 132 kV circuit breaker, isolators, and other accessories	
	* Control panel and relay panels 132 kV bay	
Prinsep Street	* Double bus bar 132 kV indoor GIS switchgear, 10 bays	
	* Control panel and relay panels 132 kV system	
	* Miscellaneous plant and equipment	
	* Modification of existing building	
Park Lane	* Double bus bar 132 kV indoor GIS switchgear, 5 bays	
	* Double bus bar 33 kV indoor GIS switchgear, 15 bays	
	* 75 MVA, 132 kV and 33 kV transformers, 1 set	
	* Control panel and relay panels 132 kV and 33 kV system	
	* Miscellaneous plant and equipment	
	* Modification of existing building	

GIS = gas-insulated switchgear, km = kilometer, kV = kilovolt, MVA = megavolt-ampere.

<sup>a</sup> All lines were laid underground. The lines were of copper cable construction, single core, 630 square millimeters, and insulated with crosslinked polyethylene (XLPE). Because transmission is carried out in three phases, and cable is required for each phase, the actual length of cable is three times the length of the line specified.

<sup>b</sup> Extension and upgrading of Majerhat substation was transferred from the original scope to another Calcutta Electric Supply Company project.

**Table A4.1: Locations and Scope of the Project—Continued**

Item	Result	
<b>Extended Scope</b>		
	<b>Length (km)</b>	
<b>D. 132 kV Transmission Line<sup>a</sup></b>	<b>At Appraisal</b>	<b>Actual</b>
Jadavpur-Kasba	10.5	10.6
<b>E. 33/11/6 kV Distribution Substation<sup>c</sup></b>	<b>Construction and extension of substation generally included</b>	
Alipore	* 16 MVA transformer along with associated plant and equipment, 1 set	
Auckland Square	* 20 MVA transformer along with associated plant and equipment, 1 set	
Chingrihatta	* 16 MVA transformer along with associated plant and equipment, 1 set	
Dhakuria	* 16 MVA transformer along with associated plant and equipment, 1 set	
Grey Street	* 16 MVA transformer along with associated plant and equipment, 1 set	
Jessore Road <sup>d</sup>	* 16 MVA transformer along with associated plant and equipment, 1 set	
Kamarhati	* 16 MVA transformer along with associated plant and equipment, 1 set	
Rashbehari <sup>e</sup>	* 16 MVA transformer along with associated plant and equipment, 1 set	
Lillooah <sup>f</sup>	* 16 MVA transformer along with associated plant and equipment, 1 set	
<b>F. 33 kV Capacitor Bank</b>		
Mulajore Generating Station <sup>g</sup>	* 33 kV, 20 MVA capacitor bank along with plant and equipment, 1 set	

MVA = megavolt-ampere reactive.

<sup>c</sup> Except Lillooah, all are new substations.

<sup>d</sup> Instead of Dumdum identified at appraisal.

<sup>e</sup> Instead of Park Circus identified at appraisal.

<sup>f</sup> Instead of Bally identified at appraisal.

<sup>g</sup> Instead of 15 MVA at Kasba.

Source: Calcutta Electric Supply Company Limited.

Table A4.2: Power Loading of Substation Transformers

Item	Transformers Installed		Power Loading Before (MW)		Power Loading After (MW)			
	Transformer Capacity (MVA)	Number of Transformers	1994–1995	1997–1998	1998–1999	1999–2000	2000–2001	2001–2002
<b>A. 132/33 kV Substations</b>								
1. Jadavpur Substation	50	2 <sup>a</sup>	0	64	65	64	74	74
2. East Kolkata Substation	50	2 <sup>a</sup>	0	33	35	43	52	60
3. Park Lane Substation	75	2 <sup>b</sup>	35	43	44	55	56	56
<b>B. 33/11/6 kV Substations</b>								
1. Alipore	16	2 <sup>c</sup>	0	14	14	14	17	17
2. Auckland Square	20	2 <sup>c</sup>	0	9	9	18	18	18
3. Chingrihatta	16	1	0	9	9	9	12	11
4. Dhakuria	16	2 <sup>c</sup>	0	9	9	8	13	13
5. Grey Street <sup>d</sup>	16	1	0	13	13	11	10	10
6. Jessore Road <sup>d</sup>	16	1	0	15	16	17	15	17
7. Kamarhati <sup>d</sup>	16	2 <sup>c</sup>	0	12	13	13	15	13
8. Lillooah <sup>d</sup>	16	2 <sup>c</sup>	14	23	23	24	24	21
9. Rashbehari <sup>d</sup>	16	2 <sup>b</sup>	0	7	7	13	14	12

kV = kilovolt, MVA = megavolt-ampere, MW = megawatt.

<sup>a</sup> Both transformers installed under 132 kV augmentation project.

<sup>b</sup> Second transformer installed under 132 kV augmentation project.

<sup>c</sup> First transformer installed under 132 kV augmentation project.

<sup>d</sup> Decrease in substation load after FY1999 is due to redistribution of load from nearby substations.

Source: Calcutta Electric Supply Company Limited.

### C. System Losses

9. CESC's system losses (auxiliary losses and transmission and distribution [T&D] losses), along with other operation performance indicators, are shown in Table A4.3. There was a steady increase on T&D losses from FY1991 to FY1997 (from 14.6% to 20.0%). T&D losses decreased to 19.3% in FY1998 and thereafter increased to 23.7% in FY2001. Upgrading of CESC's transmission system to a higher voltage, and addition of distribution substations, prevented T&D losses across CESC's total system from being at least 4% higher.

10. Not unrelated to the increase in CESC's T&D losses is the increase in new connections by 873,000 or 91% between FY1990 and FY2002, representing 48% of CESC's total consumer connections. Most of the increase was for small business and domestic connections. At least one third of CESC's increase in T&D losses is attributable to increased technical losses.

11. T&D losses of CESC are lower than those of most other areas in India. In FY1998, CESC's T&D losses were 19.3% compared with national average of 23.7%, Delhi's 48.1%, Haryana's 35.2%, Andhra Pradesh's 34.1%, and Chandigarh's 29.7%.<sup>1</sup> CESC's T&D losses of 19.3% were also lower than those of the Ahmedabad Electric Company Limited (20.1%) but higher than those of Bombay Suburban Electric Supply Limited (16.8%). Technical losses of CESC are estimated to be below 12%, with the balance attributed to pilferage and inaccurate meters. CESC is taking aggressive steps to reduce its losses and has introduced a program for upgrading meters, installing capacitors, upgrading its transmission system to higher voltages, and taking legal action against pilferage. The West Bengal State Government has introduced harsh penalties for theft and improved court processing for enforcement. T&D losses decreased from 23.7% in FY2001 to 21.8% in FY2002, and are expected to fall significantly in FY2003.

### D. System Voltages

12. At all the substations inspected, the system voltages were observed to be normal. The 132 kV system was operating at about 131 kV–132 kV, and the 33 kV at 31 kV–33 kV. All transformers were provided with an on-load tap changer, which helps maintain optimal voltage with changing load conditions.

### E. System Control

13. All the five generating stations of CESC are interconnected and synchronized with the West Bengal State Electricity Board.<sup>2</sup> Total system demand and availability of power from own generation determine the necessary quantum of imported power. Presently, CESC's load management and system control are managed using a supervisory control and data acquisition (SCADA) system introduced in 1996. The SCADA system, although technically obsolete, is operated effectively. Data monitoring is automatic, control is manual, and communication is by telephone. A modern SCADA system would allow the system operators to schedule generation more efficiently and achieve a further saving in T&D losses. CESC's future development plans include provisions for upgrading the SCADA system.

<sup>1</sup> Source: Sixteenth Electric Power Survey of India, in which actual losses are available up to FY1998.

<sup>2</sup> Public power utility owned by the West Bengal State Government.

**Table A4.3: Operating Performance Indicators**

Item	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Energy from Generation (GWh)	4,139	4,295	4,335	4,446	4,710	4,852	5,173	5,421	5,832	5,991	6,206	6,386	6,421	6,765	6,824
Energy Sold (GWh)	3,513	3,589	3,639	3,795	3,902	4,035	4,202	4,380	4,670	4,794	5,010	5,071	4,937	5,165	5,333
Energy Sold in Revenues (Rs million)	3,588	4,298	4,872	5,144	5,979	6,823	7,890	9,177	11,453	13,286	14,497	16,254	17,040	18,146	18,020
Energy Cost Excluding Depreciation and Interest (Rs million)	3,211	3,867	4,400	4,618	5,194	5,851	6,923	7,684	9,340	12,005	13,200	13,399	12,696	13,350	14,440
<b>Total Energy Cost (Rs million)</b>	<b>3,636</b>	<b>4,347</b>	<b>4,992</b>	<b>5,341</b>	<b>6,085</b>	<b>7,011</b>	<b>7,968</b>	<b>8,999</b>	<b>11,100</b>	<b>14,028</b>	<b>16,306</b>	<b>18,294</b>	<b>18,523</b>	<b>20,713</b>	<b>21,810</b>
Auxiliary Losses (%)	8.7	8.6	9.0	9.6	9.7	9.6	9.4	9.1	9.1	9.6	10.3	10.0	9.9	10.0	9.8
Transmission and Distribution Losses (%)	15.1	16.4	16.1	14.6	17.2	16.8	18.8	19.2	19.9	20.0	19.3	20.6	23.1	23.7	21.8
<b>Total System Losses (%)</b>	<b>23.8</b>	<b>25.0</b>	<b>25.0</b>	<b>24.2</b>	<b>26.8</b>	<b>26.4</b>	<b>28.2</b>	<b>28.3</b>	<b>29.1</b>	<b>29.5</b>	<b>29.6</b>	<b>30.6</b>	<b>33.0</b>	<b>33.7</b>	<b>31.6</b>
Energy Purchased (GWh)	2,043	2,111	1,997	1,997	1,911	1,743	1,993	2,046	2,355	2,680	2,631	2,135	1,576	1,196	1,323
Energy from Own-Generation (GWh)	2,096	2,184	2,220	2,449	2,799	3,109	3,180	3,375	3,477	3,311	3,575	4,251	4,845	5,569	5,601
<b>Own-Generation/Total Energy Transmitted (%)</b>	<b>50.6</b>	<b>50.8</b>	<b>51.2</b>	<b>55.1</b>	<b>59.4</b>	<b>64.1</b>	<b>61.5</b>	<b>62.3</b>	<b>59.6</b>	<b>55.3</b>	<b>57.6</b>	<b>66.6</b>	<b>75.5</b>	<b>82.3</b>	<b>82.1</b>
System Maximum Demand (MW)	708	738	773	774	840	873	952	956	1,043	1,138	1,160	1,183	1,195	1,238	1,290
Average Load Demand (MW)	401	410	415	433	445	461	480	500	533	547	572	579	564	590	609
<b>Average Load Demand/System Maximum Demand (%)</b>	<b>56.6</b>	<b>55.5</b>	<b>53.7</b>	<b>56.0</b>	<b>53.0</b>	<b>52.8</b>	<b>50.4</b>	<b>52.3</b>	<b>51.1</b>	<b>48.1</b>	<b>49.3</b>	<b>48.9</b>	<b>47.2</b>	<b>47.6</b>	<b>47.2</b>
<b>Total Connections ('000)</b>	<b>866</b>	<b>911</b>	<b>955</b>	<b>1,010</b>	<b>1,073</b>	<b>1,146</b>	<b>1,208</b>	<b>1,266</b>	<b>1,346</b>	<b>1,448</b>	<b>1,552</b>	<b>1,646</b>	<b>1,721</b>	<b>1,789</b>	<b>1,828</b>
Domestic Energy Sales (GWh)	1,089	1,064	1,090	1,140	1,280	1,340	1,400	1,520	1,660	1,740	1,830	1,980	1,930	2,040	2,180
Commercial Energy Sales (GWh)	537	612	620	630	670	680	720	760	810	840	880	920	910	950	990
Industrial Energy Sales (GWh)	1,907	1,913	1,930	2,030	1,950	2,010	2,080	2,100	2,200	2,210	2,310	2,160	2,100	2,170	2,160
<b>Total Energy Sold (GWh)</b>	<b>3,513</b>	<b>3,589</b>	<b>3,639</b>	<b>3,795</b>	<b>3,902</b>	<b>4,035</b>	<b>4,202</b>	<b>4,380</b>	<b>4,670</b>	<b>4,794</b>	<b>5,010</b>	<b>5,071</b>	<b>4,937</b>	<b>5,165</b>	<b>5,333</b>
Exchange Rate (Rs = \$1.00)	12.9	15.0	17.0	18.1	25.8	26.2	31.4	31.4	35.2	35.9	39.3	42.5	43.5	46.8	48.2
Implicit Gross Domestic Deflator (1994 = 100)	61.5	66.7	73.7	83.9	91.2	100.0	109.4	119.3	128.2	136.8	147.6	152.9	158.8	165.3	172.3
<b>Average Revenue Tariff (Rs/kWh)</b>															
Nominal	1.02	1.20	1.34	1.36	1.53	1.69	1.88	2.10	2.45	2.77	2.89	3.21	3.45	3.51	3.38
Nominal from 1990 = Rs1.34/kWh Adjusted for Inflation	1.12	1.21	1.34	1.53	1.66	1.82	1.99	2.17	2.33	2.49	2.68	2.78	2.89	3.01	3.13
<b>Average Operating Cost (Rs/kWh)</b>															
Without Depreciation and Interest (A)	0.9	1.1	1.2	1.2	1.3	1.5	1.6	1.8	2.0	2.5	2.6	2.6	2.6	2.6	2.7
With Depreciation and Interest (B)	1.0	1.2	1.4	1.4	1.6	1.7	1.9	2.1	2.4	2.9	3.3	3.6	3.8	4.0	4.1
<b>B/A</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.2</b>	<b>1.2</b>	<b>1.2</b>	<b>1.2</b>	<b>1.2</b>	<b>1.2</b>	<b>1.2</b>	<b>1.2</b>	<b>1.4</b>	<b>1.5</b>	<b>1.6</b>	<b>1.5</b>

GWh = gigawatt-hour, kWh = kilowatt-hour, MW = megawatt, Rs = Indian rupees.

Sources: Calcutta Electric Supply Company Limited and Operations Evaluation Mission estimates.

## FINANCIAL RESULTS

**Table A5.1: Calcutta Electric Supply Company Summary Income Statement, 1988–2002**  
(Rs million)

Item	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002 (p)
Energy Sales	3,588	4,298	4,872	5,144	5,979	6,823	7,890	9,177	11,453	13,286	14,497	16,254	17,040	18,146	18,020
Other Income	133	179	249	242	254	413	480	509	543	783	661	759	768	846	750
<b>Total Operating Revenue</b>	<b>3,721</b>	<b>4,477</b>	<b>5,121</b>	<b>5,386</b>	<b>6,233</b>	<b>7,235</b>	<b>8,370</b>	<b>9,686</b>	<b>11,996</b>	<b>14,069</b>	<b>15,158</b>	<b>17,013</b>	<b>17,808</b>	<b>18,992</b>	<b>18,770</b>
Fuel Costs	832	1,032	1,281	1,526	1,829	2,334	2,577	2,722	3,018	3,789	4,256	4,839	5,011	5,709	6,110
Purchased Power	1,632	1,938	2,131	1,968	2,033	1,996	2,545	2,847	3,795	4,705	5,168	4,639	3,470	3,050	3,340
Salaries and Wages	399	484	528	575	640	698	866	1,006	1,111	1,382	1,559	1,669	1,758	1,824	} 4,990
Repairs	302	398	452	514	665	732	797	918	1,127	1,156	1,035	1,004	1,214	1,191	
Other	46	17	7	34	27	91	138	191	289	973	1,182	1,248	1,243	1,576	
<b>Total Operating Expenses</b>	<b>3,211</b>	<b>3,867</b>	<b>4,400</b>	<b>4,618</b>	<b>5,194</b>	<b>5,851</b>	<b>6,923</b>	<b>7,684</b>	<b>9,340</b>	<b>12,005</b>	<b>13,200</b>	<b>13,399</b>	<b>12,696</b>	<b>13,350</b>	<b>14,440</b>
<b>Total Net Operating Income</b>	<b>510</b>	<b>610</b>	<b>721</b>	<b>768</b>	<b>1,039</b>	<b>1,384</b>	<b>1,448</b>	<b>2,001</b>	<b>2,656</b>	<b>2,064</b>	<b>1,958</b>	<b>3,614</b>	<b>5,112</b>	<b>5,643</b>	<b>4,330</b>
Depreciation	115	121	127	136	178	318	335	573	657	701	784	1,933	1,980	3,084	3,200
Interest	310	359	465	587	713	842	710	742	1,103	1,322	2,322	2,962	3,847	4,279	4,170
<b>Net Income Before Tax</b>	<b>85</b>	<b>130</b>	<b>129</b>	<b>45</b>	<b>148</b>	<b>225</b>	<b>403</b>	<b>686</b>	<b>896</b>	<b>41</b>	<b>(1,148)</b>	<b>(1,281)</b>	<b>(715)</b>	<b>(1,720)</b>	<b>(3,040)</b>
Income Tax	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Net Income After Tax</b>	<b>85</b>	<b>117</b>	<b>129</b>	<b>45</b>	<b>148</b>	<b>225</b>	<b>403</b>	<b>686</b>	<b>896</b>	<b>41</b>	<b>(1,148)</b>	<b>(1,281)</b>	<b>(715)</b>	<b>(1,720)</b>	<b>(3,040)</b>
Provision for Dividends	29	33	36	36	41	61	89	133	152	124	0	0	0	0	0
Provision for Exchange Rates	0	0	0	0	0	0	0	0	0	0	0	0	415	201	0
Provision for Other	43	60	69	(19)	79	85	221	432	505	(298)	1,148	(22)	1,415	3,065	4,584
<b>Surplus Carried to Capital Reserves</b>	<b>13</b>	<b>14</b>	<b>24</b>	<b>28</b>	<b>28</b>	<b>79</b>	<b>93</b>	<b>121</b>	<b>239</b>	<b>215</b>	<b>0</b>	<b>(1,303)</b>	<b>(2,545)</b>	<b>(4,584)</b>	<b>(7,624)</b>

p = provisional estimate.

Sources: Calcutta Electric Supply Company Limited and Operations Evaluation Mission estimates.

**Table A5.2: Calcutta Electric Supply Company Summary Balance Sheet, 1988–2001**  
(Rs million)

Item	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Gross Fixed Assets	4,185	4,424	4,759	6,061	7,308	7,741	23,335 <sup>a</sup>	24,597	25,399	26,912	42,133	43,002	58,599	60,756
Accumulated Depreciation	1,051	1,165	1,287	1,421	1,590	1,895	2,223	2,845	3,553	4,313	5,157	7,157	9,215	12,418
<b>Total Net Fixed Assets</b>	<b>3,134</b>	<b>3,259</b>	<b>3,472</b>	<b>4,640</b>	<b>5,718</b>	<b>5,846</b>	<b>21,112</b>	<b>21,752</b>	<b>21,846</b>	<b>22,599</b>	<b>36,976</b>	<b>35,845</b>	<b>49,384</b>	<b>48,338</b>
<b>Work-in-Progress</b>	<b>612</b>	<b>1,339</b>	<b>2,052</b>	<b>1,623</b>	<b>1,038</b>	<b>2,867</b>	<b>7,483</b>	<b>12,724</b>	<b>20,108</b>	<b>24,640</b>	<b>12,872</b>	<b>15,453</b>	<b>1,890</b>	<b>1,078</b>
Receivables	852	886	968	1,308	1,557	1,481	1,409	1,825	3,323	5,223	5,534	6,385	5,996	3,761
Cash Balance	79	75	117	60	81	211	183	212	594	423	357	386	271	703
Other	217	478	486	553	720	910	998	1,903	1,958	2,612	4,089	4,189	4,338	4,897
<b>Total Current Assets</b>	<b>1,148</b>	<b>1,439</b>	<b>1,571</b>	<b>1,921</b>	<b>2,358</b>	<b>2,602</b>	<b>2,590</b>	<b>3,940</b>	<b>5,875</b>	<b>8,258</b>	<b>9,980</b>	<b>10,960</b>	<b>10,605</b>	<b>9,361</b>
Investments <sup>b</sup>	0	0	0	2	11	54	57	175	112	115	120	133	133	133
<b>Total Assets</b>	<b>4,894</b>	<b>6,037</b>	<b>7,095</b>	<b>8,186</b>	<b>9,125</b>	<b>11,369</b>	<b>31,242</b>	<b>38,591</b>	<b>47,941</b>	<b>55,612</b>	<b>59,948</b>	<b>62,391</b>	<b>62,012</b>	<b>58,910</b>
Paid-Up Capital	202	202	202	202	241	330	300	384	592	700	603	634	634	621
Reserves/Grants	675	757	853	921	1,087	1,402	16,349	19,552	20,864	21,447	20,168	19,953	19,916	19,813
<b>Total Equity</b>	<b>877</b>	<b>959</b>	<b>1,055</b>	<b>1,123</b>	<b>1,328</b>	<b>1,732</b>	<b>16,649</b>	<b>19,936</b>	<b>21,456</b>	<b>22,147</b>	<b>20,771</b>	<b>20,587</b>	<b>20,550</b>	<b>20,434</b>
Local Finance Institution Loans	1,287	1,569	1,946	2,208	2,383	2,441	3,626	4,378	5,648	6,817	8,000	9,153	9,200	10,960
Foreign Loans	0	0	0	0	0	928	2,591	4,530	7,317	9,442	8,097	7,077	6,575	6,064
Debentures	184	194	202	193	411	1,071	2,114	2,212	2,203	2,221	2,213	2,046	2,235	2,032
Other	1,298	1,614	1,591	2,283	2,297	2,279	2,652	2,806	4,920	6,715	10,397	11,385	10,801	10,813
<b>Total Long-Term Liabilities</b>	<b>2,769</b>	<b>3,377</b>	<b>3,739</b>	<b>4,684</b>	<b>5,091</b>	<b>6,719</b>	<b>10,985</b>	<b>13,926</b>	<b>20,088</b>	<b>25,195</b>	<b>28,709</b>	<b>29,661</b>	<b>28,811</b>	<b>29,869</b>
Sundry Creditors	430	561	645	835	1,099	896	907	1,146	1,697	3,365	3,653	5,703	6,385	6,848
Loan Maturities	157	187	110	127	136	186	276	338	490	552	689	724	780	706
Other	536	692	395	465	395	624	1,153	1,263	2,404	2,291	3,643	4,358	4,892	2,066
<b>Total Current Liabilities</b>	<b>1,123</b>	<b>1,440</b>	<b>1,150</b>	<b>1,427</b>	<b>1,630</b>	<b>1,706</b>	<b>2,336</b>	<b>2,747</b>	<b>4,589</b>	<b>6,208</b>	<b>7,985</b>	<b>10,785</b>	<b>12,057</b>	<b>9,620</b>
Other Funds <sup>c</sup>	650	738	838	961	1,111	1,248	1,500	1,711	1,958	2,209	2,508	2,800	3,272	3,697
Balancing Item	(525)	(477)	312	(9)	(35)	(37)	(229)	271	(150)	(146)	(25)	(1,443)	(2,677)	(4,710)
<b>Total Liabilities</b>	<b>4,894</b>	<b>6,037</b>	<b>7,095</b>	<b>8,186</b>	<b>9,125</b>	<b>11,369</b>	<b>31,242</b>	<b>38,591</b>	<b>47,941</b>	<b>55,612</b>	<b>59,948</b>	<b>62,391</b>	<b>62,012</b>	<b>58,910</b>

<sup>a</sup> Increase on 1993 follows from a revaluation of assets. There were no further revaluations.

<sup>b</sup> Includes subsidiary and small bond investments.

<sup>c</sup> Includes capital contributions from consumers and consumer security deposits.

Source: Calcutta Electric Supply Company Limited and Operations Evaluation Mission estimates.

Table A5.3: Financial Performance Indicators

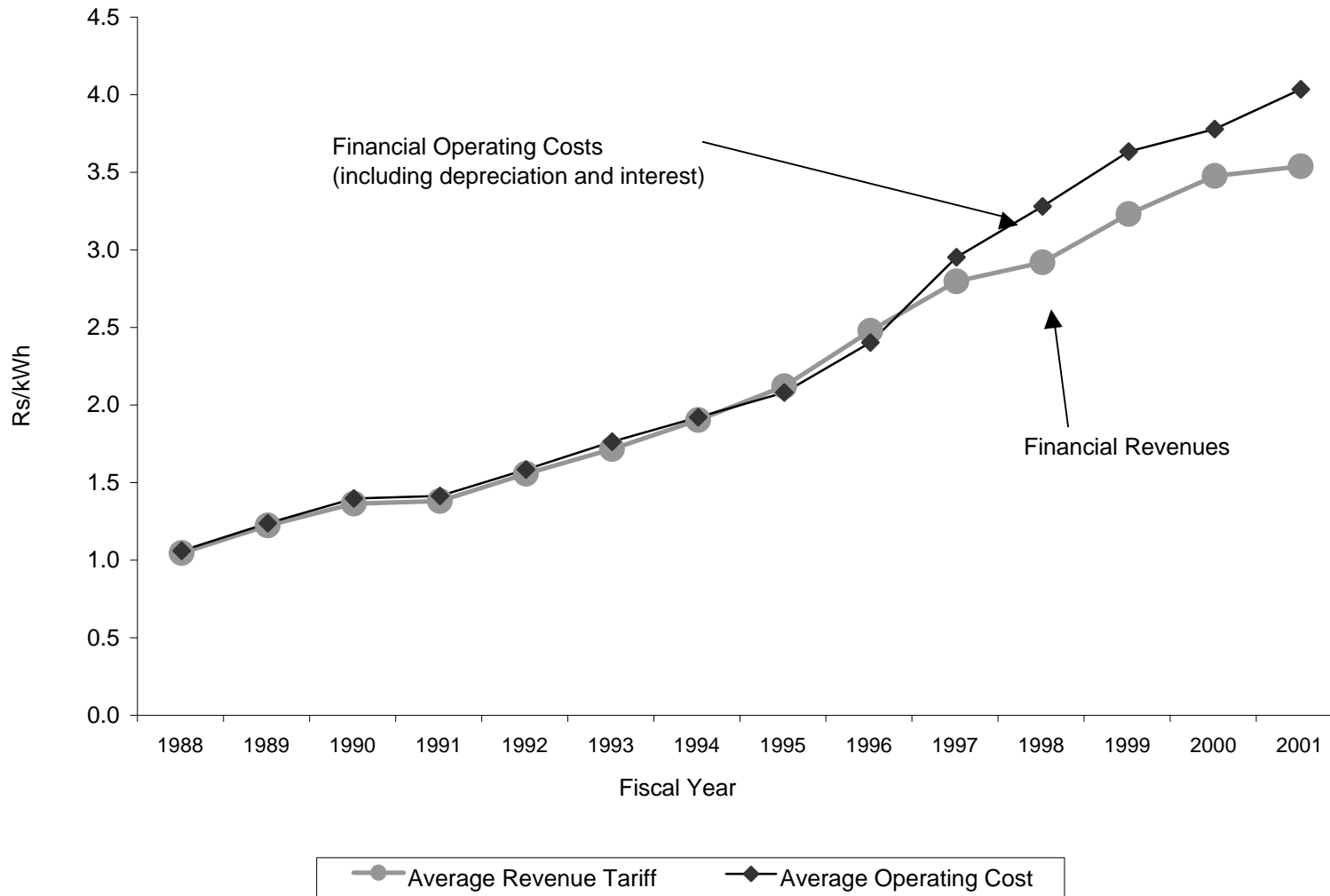
Fiscal Year Ending	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Exchange Rate (Rs per \$1.00)	12.88	14.95	17.04	18.07	25.83	26.20	31.38	31.38	35.18	35.93	39.28	42.48	43.49	46.75	48.18
Additions to Fixed Assets (Rs million)	135	240	338	470	1,259	501	15,609	1,283	847	1,570	15,326	1,027	15,675	2,266	<sup>a</sup>
Operating Revenue (Rs million)	3,721	4,477	5,121	5,386	6,233	7,235	8,370	9,686	11,996	14,069	15,158	17,013	17,808	18,992	18,770
Gross Operating Profit (Rs million)	510	610	721	768	1,039	1,384	1,448	2,001	2,656	2,064	1,958	3,614	5,112	5,643	4,330
Cost of Fuel (Rs million)	832	1,032	1,281	1,526	1,829	2,334	2,577	2,722	3,018	3,789	4,256	4,839	5,011	5,709	6,110
Cost of Power Purchases (Rs million)	1,632	1,938	2,131	1,968	2,033	1,996	2,545	2,847	3,795	4,705	5,168	4,639	3,470	3,050	3,340
Repairs and Maintenance (Rs million)	302	398	452	514	665	732	797	918	1,127	1,156	1,035	1,004	1,214	1,191	4,990
Salaries and Wages (Rs million)	399	484	528	575	640	698	866	1,006	1,111	1,382	1,559	1,669	1,758	1,824	}
Other Operating Costs (Rs million)	46	17	7	34	27	91	138	191	289	973	1,182	1,248	1,243	1,576	
Depreciation (Rs million)	115	121	127	136	178	318	335	573	657	701	784	1,933	1,980	3,084	3,200
Interest (Rs million)	310	359	465	587	713	842	710	742	1,103	1322	2,322	2,962	3,847	4,279	4,170
Profit Before Tax (Rs million) <sup>b</sup>	85	130	129	45	148	225	403	686	896	41	(1,148)	(1,281)	(715)	(1,720)	(3,040)
Profit After Tax (Rs million)	85	117	129	45	148	225	403	686	896	41	(1,148)	(1,281)	(715)	(1,720)	(3,040)
Total Equity (Rs million)	877	959	1,055	1,123	1,328	1,732	16,649	19,936	21,456	22,147	20,771	20,587	20,550	20,434	<sup>a</sup>
Net Fixed Assets (Rs million)	3,134	3,259	3,472	4,640	5,718	5,846	21,112	21,752	21,846	22,599	36,976	35,845	49,384	48,338	<sup>a</sup>
Current Assets (Rs million)	1,148	1,439	1,571	1,921	2,358	2,602	2,590	3,940	5,875	8,258	9,980	10,960	10,605	9,361	<sup>a</sup>
Total Assets (Rs million)	4,894	6,037	7,095	8,186	9,125	11,369	31,242	38,591	47,941	55,612	59,948	62,391	62,012	58,910	<sup>a</sup>
Current Liabilities (Rs million)	1,123	1,440	1,150	1,427	1,630	1,706	2,336	2,747	4,589	6,208	7,985	10,785	12,057	9,620	<sup>a</sup>
Long-Term Liabilities (Rs million)	2,769	3,377	3,739	4,684	5,091	6,719	10,985	13,926	20,088	25,195	28,709	29,661	28,811	29,869	<sup>a</sup>
Operating Expenditure/Operating Revenue (%)	86.3	86.4	85.9	85.7	83.3	80.9	82.7	79.3	77.9	85.3	87.1	78.8	71.3	70.3	76.9
Depreciation and Interest/Operating Revenue (%)	11.4	10.7	11.6	13.4	14.3	16.0	12.5	13.6	14.7	14.4	20.5	28.8	32.7	38.8	39.3
Profit Before Tax/Equity (%)	9.7	13.5	12.3	4.0	11.1	13.0	2.4	3.4	4.2	0.2	(5.5)	(6.2)	(3.5)	(8.4)	<sup>a</sup>
Profit Before Tax/Operating Revenue (%)	2.3	2.9	2.5	0.8	2.4	3.1	4.8	7.1	7.5	0.3	(7.6)	(7.5)	(4.0)	(9.1)	(16.2)
Long-Term Liabilities/Equity (ratio)	3.2	3.5	3.5	4.2	3.8	3.9	0.7	0.7	0.9	1.1	1.4	1.4	1.4	1.5	<sup>a</sup>
Equity/Total Assets (%)	17.9	15.9	14.9	13.7	14.6	15.2	53.3	51.7	44.8	39.8	34.6	33.0	33.1	34.7	<sup>a</sup>
Current Assets/Current Liabilities (ratio)	1.0	1.0	1.4	1.3	1.4	1.5	1.1	1.4	1.3	1.3	1.2	1.0	0.9	1.0	<sup>a</sup>
Current Liabilities/Total Liabilities (%)	22.9	23.9	16.2	17.4	17.9	15.0	7.5	7.1	9.6	11.2	13.3	17.3	19.4	16.3	<sup>a</sup>
Long-Term Liabilities/Total Assets (%)	56.6	55.9	52.7	57.2	55.8	59.1	35.2	36.1	41.9	45.3	47.9	47.5	46.5	50.7	<sup>a</sup>
Debt Service Ratio <sup>c</sup>	1.6	1.7	1.6	1.3	1.5	1.6	2.0	2.7	2.4	1.6	0.8	1.2	1.3	1.3	1.0
Self-Financing Ratio <sup>d</sup>	3.9	3.1	4.4	1.6	1.6	0.3	0.3	0.4	2.7	0.5	0.5	0.5	1.1	1.3	<sup>a</sup>
Long-Term/Equity (ratio) <sup>e</sup>	3.2	3.5	3.5	4.2	3.8	3.9	4.3	2.4	2.7	3.1	4.3	4.6	4.5	4.7	<sup>a</sup>

Rs = Indian rupees.

<sup>a</sup> Results are dependent on the outcome of determinations for that portion of the tariff increase approved on 3 October 2002 that can be applied to FY2002.<sup>b</sup> After depreciation and interest.<sup>c</sup> Profit before depreciation, interest, and tax less dividends, all divided by interest plus loan repayments.<sup>d</sup> Net funds from internal sources (return plus depreciation less dividends) divided by the average capital expenditure calculated over 3 years for the current fiscal year, previous fiscal year, and next fiscal year.<sup>e</sup> Excluding the effect of asset revaluations on equity.

Sources: Calcutta Electric Supply Company Limited and Operations Evaluation Mission estimates.

**Figure A5: Financial Revenues versus Operation Costs**  
(including depreciation and interest)



kWh = kilowatt-hour, Rs = rupees.

## FINANCIAL AND ECONOMIC REEVALUATION

### A. Methodology at Appraisal

1. The financial internal rate of return (FIRR) and economic internal rate of return (EIRR) were calculated on the basis of all project additions (planned and under construction) to the Calcutta Electric Supply Company (CESC) Limited power system for the time-slice FY1987–FY1995.<sup>1</sup> The time-slice took into account (i) all investment expenditure from FY1987, including that for the Southern power station, which was expected to be commissioned in two phases over FY1991 and FY1992; and (ii) all expected incremental operating and maintenance costs and incremental energy revenue from FY1990 onwards. A 25-year period, FY1990–FY2015, was used for the calculation.

2. The FIRR calculation included expected direct taxes and duties on capital items, which the EIRR calculation excluded. Operation and maintenance costs were calculated based on separate assessments for fuel requirements (namely, the cost of coal); power purchased; and other costs covering salaries and wages, repairs and maintenance, and administration. All costs and benefits were valued at constant 1990 prices. Costs excluded financial charges, depreciation, and indirect taxes. An average tariff of Rs1.31 per kilowatt-hour (kWh) was used in FY1991 and FY1992 to value incremental energy sales, Rs1.30/kWh in FY1993 and FY1994, and Rs1.29/kWh from FY1995 onwards. For the EIRR calculation, a standard conversion factor of 0.8 was used to convert domestic prices (applied to the local currency component of capital costs and the whole of operation and maintenance costs) into economic equivalent prices. The economic tariff was assumed equivalent to the financial tariff on the basis of consumers' willingness to pay at least 100% of the tariff billed. The FIRR and EIRR so obtained were 8.9% and 15.9%, respectively.

### B. Methodology at Evaluation

3. The Asian Development Bank's project completion report (PCR) and Operations Evaluation Mission (OEM) independently reestimated the FIRR and EIRR following the same time-slice approach, but based on more factual information relating to investment costs, operating expenditures, and revenues. The OEM reestimates are based on actual operating expenditures and revenues up to FY2002.

4. Tables A6.1 and A6.2 show the FIRR and EIRR benefit and cost streams calculated by the OEM. The load increase represents the load taken up as a result of increased generation and improved transmission capacity under the Project. Differences between the appraisal, PCR, and OEM estimates are largely explained by the underlying assumptions for load forecasts and tariff level. These differences are summarized in Table A6.3.

5. For the FIRR, investment costs take into account the capital expenditures associated with technical services, equipment purchases, civil construction, and taxes and duties paid on equipment items, less income taxes. The EIRR investment costs are calculated similarly, but exclude duties and taxes paid. The tradeables portion of investment and operating costs is multiplied by the domestic numeraire of 1.1 to arrive at the economic equivalence value.

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<sup>1</sup> It was felt that the nature of the transmission line projects was such that a meaningful FIRR and EIRR could not be calculated for the Project alone.

**Table A6.1: FIRR Cost and Benefit Stream**  
(Constant 2002 Prices—Rs million)

<b>Year</b>	<b>Load Increase With Project (GWh)</b>	<b>Investment Cost With Project<sup>a</sup></b>	<b>Increased Operating Costs<sup>b</sup></b>	<b>Increased Revenue Benefits<sup>c</sup></b>	<b>Total Net Benefits</b>
1988		1,523			(1,523)
1989		2,046			(2,046)
1990		2,051			(2,051)
1991	156	1,525	384	455	(1,454)
1992	263	1,096	661	794	(964)
1993	396	1,654	989	1,223	(1,420)
1994	563	2,846	1,461	1,766	(2,540)
1995	741	1,191	1,878	2,367	(702)
1996	1,031	2,891	2,771	3,559	(2,103)
1997	1,155		3,643	4,269	626
1998	1,371		4,217	4,842	625
1999	1,298		3,865	4,907	1,042
2000	1,526		4,258	5,972	1,714
2001	1,629		4,390	6,245	1,855
2002	1,735		4,778	6,211	1,433
2003	1,864		5,133	6,672	1,539
2004	1,996		5,497	7,145	1,648
2005	2,131		5,869	7,630	1,760
2006	2,269		6,251	8,125	1,874
2007	2,411		6,641	8,633	1,992
2008	2,556		7,041	9,153	2,111
2009	2,556		7,041	9,153	2,111
2010	2,556		7,041	9,153	2,111
2011	2,556		7,041	9,153	2,111
2012	2,556		7,041	9,153	2,111
2013	2,556		7,041	9,153	2,111
2014	2,556		7,041	9,153	2,111
2015	2,556	(5,375)	7,041	9,153	7,486
				<b>FIRR</b>	<b>6.3%</b>

FIRR = financial internal rate of return, GWh = gigawatt-hour, kWh = kilowatt-hour.

<sup>a</sup> Excluding capital investment expenditure on Budge Budge station.

<sup>b</sup> Total load (GWh) increase with Project, multiplied by the operating cost per kWh of electricity sold before depreciation and interest.

<sup>c</sup> Total load (GWh) increase with Project, multiplied by the average revenue per kWh for electricity sold.

**Table A6.2: EIRR Cost and Benefit Stream**  
(Constant 2002 prices—Rs million)

Year	Load Increase With Project (GWh)	Investment Cost With Project	Operating Costs	Resource Cost Savings <sup>a</sup>	Incremental Revenue Benefits <sup>b</sup>	Total Net Benefits
1988		1,474				(1,474)
1989		1,979				(1,979)
1990		1,986				(1,986)
1991	156	1,479	388	85	384	(1,398)
1992	263	1,064	669	198	563	(972)
1993	396	1,606	1,000	246	995	(1,366)
1994	563	2,769	1,477	313	1,527	(2,406)
1995	741	1,160	1,898	422	2,040	(596)
1996	1,031	2,816	2,802	589	3,168	(1,860)
1997	1,155		3,683	713	3,786	815
1998	1,371		4,263	774	4,369	880
1999	1,298		3,907	974	4,019	1,085
2000	1,526		4,305	960	5,376	2,032
2001	1,629		4,438	1,057	5,508	2,126
2002	1,735		4,831	1,117	5,334	1,621
2003	1,864		5,190	1,200	8,447	4,457
2004	1,996		5,557	1,286	9,039	4,767
2005	2,131		5,934	1,373	9,646	5,084
2006	2,269		6,320	1,462	10,267	5,409
2007	2,411		6,715	1,553	10,903	5,742
2008	2,556		7,119	1,647	11,555	6,082
2009	2,556		7,119	1,647	11,418	5,946
2010	2,556		7,119	1,647	11,418	5,946
2011	2,556		7,119	1,647	11,418	5,946
2012	2,556		7,119	1,647	11,418	5,946
2013	2,556		7,119	1,647	11,418	5,946
2014	2,556		7,119	1,647	11,418	5,946
2015	2,556	(5,267)	7,119	1,647	11,418	11,213
					<b>EIRR</b>	<b>12.1%</b>

EIRR = economic internal rate of return, GWh = gigawatt-hour.

<sup>a</sup> From new connections, and representing the saving on alternative energy sources using kerosene and diesel fuel

<sup>b</sup> Incremental load increase valued at "willingness to pay."

**Table A6.3: Key Assumptions and Data Inputs**

Item	Appraisal	PCR	PPAR
Methodology Approach	time-slice (all CESC)	time-slice (all CESC)	time-slice (all CESC)
Project Period	1987–2015	1987–2015	1988–2015
Total Investment Cost (\$ million) Nominal	90.6	74.1	75.0
First Year of Revenues	FY1990	FY1991	FY1991
<b>Valuation of Benefits</b>			
Energy Volume	load increase (consumer sales)	load increase (consumer sales)	load increase <sup>a</sup> (consumer sales)
Financial Tariff (Rs/kWh)	3.29 (2002 prices)	3.45 (2002 prices)	3.58 (2002 prices)
Economic Tariff (Rs/kWh)	3.29 (2002 prices)	3.45 (2002 prices)	na (2002 prices)
Willingness to Pay (Rs/kWh)	financial tariff	financial tariff	4.76
Economic Benefits	load x tariff	load x tariff	resource savings incremental sales at willingness to pay
Financial Benefits	load x tariff	load x tariff	load x tariff
Energy Savings (GWh/year)	nil <sup>b</sup>	nil <sup>b</sup>	160 <sup>c</sup>
<b>Valuation of Operating Costs</b>			
Financial (Rs/kWh)	2.82 (2002 prices)	2.69 (2002 prices)	3.44 (2002 prices)
Economic (Rs/kWh)	2.36 (2002 prices)	2.15 (2002 prices)	2.20 (2002 prices)
Exchange Rate (Rs = \$1.00)	17.04	35.70	48.10
MUV Index (1990 = 100)	68.60	110.20	107.70
GDP Deflator (1994 = 100)	73.70	128.20	172.30

CESC = Calcutta Electric Supply Company, GDP = gross domestic product, GWh = gigawatt-hour, kWh = kilowatt-hour, MUV = manufacturer's unit value, na = not applicable to calculations, PCR = project completion report, PPAR = project performance audit report.

<sup>a</sup> The PPAR load increase is disaggregated into that for (i) new consumers switching from alternative energy sources, and (ii) incremental sales from increased consumption.

<sup>b</sup> Assumed fully captured in consumer sales volumes.

<sup>c</sup> Representing energy losses avoided. Measuring limitations without the aid of a computer simulation model did not enable the energy savings from avoided losses to be estimated. They are not included in the financial internal rate of return (FIRR) or economic internal rate of return (EIRR) estimates. Approximate savings of 160 GWh per year were realized. If these savings were included in the reestimates, the FIRR would increase from 6.3% to 9.6% and the EIRR from 12.1% to 14.2%.

6. The load increase was measured in terms of the actual increase in energy sales from FY1990 to FY2002, and projected to reach 80% of the design limit for CESC's transmission equipment in FY2008.<sup>2</sup> Thereafter, the load increase was held constant. The financial revenue benefits were derived from the load increase and the actual average tariff (revalued in constant 2002 prices) applicable from FY1990 to FY2002. No change in the FY2002 average tariff was assumed thereafter, implying constant tariffs in real terms. Similarly, the associated financial operating cost was derived from the load increase and the sum of CESC's unit operating costs revalued in constant 2002 prices. The economic benefits equal the sum of (i) resource cost savings arising from new consumers switching from kerosene or diesel fuel, (ii) willingness to pay benefits, and (iii) increment in operating revenues generated associated with increased electricity consumption per consumer. Not taken into account for the EIRR reestimate is the incremental energy savings from avoided losses as a result of technical improvements (Table A6.3, footnote c).

7. Table A6.4 shows the sensitivity to changes in the main underlying parameters.

**Table A6.4: FIRR/EIRR Sensitivity to Parameter Changes**  
(%)

Item	FIRR	EIRR
<b>A. Base Case</b>	<b>6.3</b>	<b>12.1</b>
<b>B. With the Following Changes</b>		
10% Increase in the Average Tariff in FY1997	8.6	13.9
<b>Both Changes Combined</b>	<b>9.5</b>	<b>15.1</b>
<b>C. With the Following Changes</b>		
10% Increase in the Average Tariff in FY2003	7.9	12.9
10% Increase in Energy Sales Between FY2003 and FY2008	6.9	12.9
<b>Both Changes Combined</b>	<b>8.6</b>	<b>14.3</b>

EIRR = economic internal rate of return, FIRR = financial internal rate of return.

<sup>2</sup> A higher projection would require additional investments in transformer capacity and upgrading of the distribution network.