

RRP-IND 24273

ASIAN DEVELOPMENT BANK

REPORT AND RECOMMENDATION

OF THE

PRESIDENT

TO THE

BOARD OF DIRECTORS

ON A

PROPOSED LOAN

TO THE

POWER GRID CORPORATION OF INDIA LIMITED

FOR THE

POWER TRANSMISSION (SECTOR) PROJECT

IN THE

REPUBLIC OF INDIA

October 1995

CURRENCY EQUIVALENTS

(as of 30 September 1995)

Currency Unit	Rupees (Rs)
Rs1	\$0.0299
\$1	Rs33.45

For the purpose of calculations in this Report, an exchange rate of \$1.00 = Rs31.4 has been used.

ABBREVIATIONS

APSEB	Andhra Pradesh State Electricity Board
CEA	Central Electricity Authority
ED	Electricity Department
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
FIRR	Financial Internal Rate of Return
ICE	International Competitive Bidding
IDC	Interest During Construction
IEE	Initial Environmental Examination
IPP	Independent Power Producer
MOF	Ministry of Finance
MOE	Ministry of Power
MOU	Memorandum of Understanding
NHPC	National Hydropower Corporation
NDC	National Development Council
NIT	National Task Force
NTPC	National Thermal Power Corporation
ODA	Overseas Development Administration
OFAP	Operational and Financial Action Plan
O&M	Operation and Maintenance
QSEB	Qasse Sale Electricity Board
REC	Power Finance Corporation
POWERGRID	Power Grid Corporation of India Limited
PPA	Purchase Power Agreement
RSCC	Regional System Coordination Centre
ROR	Rate of Return
RTE	Regional Task Force
SCADA	System Control and Data Acquisition
SEB	State Electricity Board
SEIA	Summary Environmental Impact Assessment
SIEE	Summary Initial Environmental Examination
SFR	Self-financing Ratio

ABBREVIATIONS

TA	Technical Assistance
TNEB	Tamil Nadu Electricity Board
UPRVUN	Uttar Pradesh Rajya Vidyut Utpadam Nigam
UPSEB	Uttar Pradesh State Electricity Board
USAID	United States Agency for International Development
WBSEB	West Bengal State Electricity Board

WEIGHTS AND MEASURES

V	(volt)	-	Unit of voltage
kV	(kilovolt)	-	1,000 volts
W	(watt)	-	Unit of active power
kW	(kilowatt)	-	1,000 W
MW	(megawatt)	-	1,000 kW
Wh	(watt-hour)	-	Unit of energy
kWh	(kilowatt-hour)	-	1,000 Wh
MWh	(megawatt-hour)	-	1,000,000 Wh
GWh	(gigawatt-hour)	-	1,000,000 kWh
cct km	Circuit kilometer		

NOTES

- i) The fiscal year of POWERGRID and the Government ends on 31 March. In this report, "FY" before a calendar year denotes the year in which the fiscal year ends, e.g. FY1995 ends on 31 March 1995.
- ii) In this report, "\$" refers to the US dollar.

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LOAN AND PROJECT SUMMARY

Borrower	:	Power Grid Corporation of India Limited (POWERGRID), with the Government of India as Guarantor.		
The Project	:	The Project represents a five-year time-slice of POWERGRID's investment plan for transmission of electricity in India.		
Classification	:	Primary Classification	:	Economic growth
		Environment Category	:	B
Rationale	:	The Project is part of the Bank's strategy for the power sector that links support of critical investments of the more efficient central power sector agencies to the implementation of important reforms by the Government.		
Objectives and Scope	:	<p>The objectives of the Project are to strengthen POWERGRID's transmission systems to reduce system losses and allow efficient utilization of existing and planned power plants by (i) supporting development of the Northeastern regional power grid, (ii) interconnecting the Southern and Eastern regional power grids, (iii) constructing transmission facilities for power evacuation from new and expanded power plants, and (iv) providing consulting services to assist in Project implementation. The major subprojects identified for financing under the sector loan are:</p> <ul style="list-style-type: none"> (i) eight 132-kilovolt (kV) transmission lines comprising 675 circuit kilometers (cct km) and substation extensions in Assam, Mizoram, and Tripura in the Northeastern Region; (ii) a 132-kV transmission line of 195 cct km and substation extension to evacuate power from the 84-megawatt (MW) Agartala gas-fired power plant being constructed in Tripura; (iii) a 220-kV transmission line of 85 cct km and substation extension to evacuate power from the 100-MW extension of the Kopili hydropower plant in Southern Assam; (iv) a regional system coordination center (RSCC) for all states in the Northeastern Region; (v) a 400-kV transmission line of 550 cct km and substation facilities to interconnect the Eastern and Southern Regions; 		

- (vi) six 400-kV transmission lines comprising 890 cct km and substation facilities to evacuate power from the 1000-MW Stage-II of the Vindhyachal coal-fired thermal power plant;
- (vii) a 220-kV transmission line of 600 cct km and substation extension to evacuate power from the 420-MW Stage-II of the Unchahar coal-fired thermal power plant; and
- (viii) consulting services for (a) implementation of the RSCC, (b) implementation of bulk supply and transmission tariffs, and (c) development of the related regulatory framework.

Cost Estimates	:	The total Project cost is estimated at \$527.4 million, of which the foreign exchange component is \$300.8 million, or 57 percent.
Financing Plan	:	The Project will be financed by the proposed Bank loan of \$275 million, local borrowing of \$146.9 million, and POWERGRID's internal resources of \$105.5 million.
Loan Amount and Terms	:	\$275 million from the Bank's ordinary capital resources over 20 years, including a grace period of 4 years. Interest will be at the Bank's variable rate for the US dollar fund pool. POWERGRID will bear the foreign exchange risk.
Period of Utilization	:	September 1995 to March 2001.
Implementation Arrangements	:	POWERGRID's Projects Department, which reports to the Director of Projects, will be responsible for planning, designing, contracting, testing, and implementing the subprojects. POWERGRID will provide the Bank with quarterly progress reports.
Executing Agency	:	POWERGRID
Procurement	:	All goods and services for the Project to be financed under the Bank loan will be procured in accordance with the Bank's <i>Guidelines for Procurement</i> . Standard materials and equipment required for the Project may be estimated and procured in bulk prior to approval of all the subprojects concerned. POWERGRID may award contracts with <i>post facto</i> Bank approval for contracts up to \$3 million where the lowest bid is also the lowest evaluated bid. The Bank has approved advance procurement action for five subprojects and retroactive financing of \$27.5 million for disbursements made between 19 April 1995 and loan effectiveness.

**Consulting
Services**

: In view of POWERGRID's technical capability and its implementation record for similar projects, consultants will only be required to supervise implementation of the Northeast Region RSCC and to advise the Government in areas requiring special expertise during the implementation of the recommendations of the Bank-financed Study of Bulk Power and Transmission Tariffs and Transmission Regulations. The consultants will be recruited in accordance with the Bank's *Guidelines on the Use of Consultants*.

**Estimated Project
Completion Date**

: 30 June 2000.

**Project Benefits
and Beneficiaries**

: The main benefits of the Project will be (i) introduction of tariffs for bulk supply and transmission that reflect the economic costs, (ii) development and introduction of a regulatory framework for operating the national power grid, (iii) additional and more reliable power available in the Northeastern Region, (iv) ability to interchange power between the Eastern and Southern regions, and (v) the evacuation of power from a number of new and expanded generation facilities to load centers. All consumers will benefit from the increased availability of power supply. The Project will be particularly beneficial for industrial and commercial consumers that are currently subject to load restrictions and load shedding.

I. THE PROPOSAL

I submit for your approval the following Report and Recommendation on a proposed loan to Power Grid Corporation of India Limited (POWERGRID) for the Power Transmission (Sector) Project.

II. INTRODUCTION

1. The Government of India (the Government) and POWERGRID have requested a sector loan from the Bank to finance part of the foreign exchange cost of a group of transmission subprojects to be undertaken during a five-year time-slice commencing in FY1996, which are accorded high priority by the Government and POWERGRID and are an integral part of POWERGRID's Transmission Development Plan. The loan would be the Bank's first to India's power sector since 1992.

2. Fact-finding was carried out in May 1993, when the Project's geographical coverage was limited to the Northeastern Region. In May 1994, the Project was reformulated to widen its geographical coverage and now includes most of the transmission facilities previously considered for the Northeastern Region plus critical transmission subprojects in the other regions for which POWERGRID requires financing.¹

3. The Preappraisal Mission visited India in September 1994. It was upgraded to an Appraisal Mission in April 1995, after POWERGRID had demonstrated that its accounts receivable could be maintained at two months or less of equivalent sales.² This Report is based on the findings of the Appraisal Mission and subsequent sector review missions.

III. BACKGROUND

A. The Power Sector

1. Overview

4. Although India's power sector has expanded rapidly, power shortages and poor quality of supply severely constrain economic development in almost all parts of the country. This deficiency reflects, in part, attempts to centrally manage such a large and complex system and the limited autonomy under which many of the power utilities operate. Financing capacity expansion is a major challenge, and lack of capital arising from inadequate tariffs, often reflecting noncommercial objectives imposed on power suppliers, is a central problem. The chronic financial difficulties of most state electricity boards (SEBs) underpin much of the sector's difficulties. Collectively, SEBs have a high level of accounts payable to central power agencies, whose own financial viability is threatened.

¹ The five power regions in India are the Northern, Northeastern, Eastern, Southern, and Western.

² The Appraisal Mission comprised E. Hourihan, Senior Financial Analyst as Mission Leader; J. Kuiper, Project Engineer; J. Fyfe, Financial Analyst; A. Iorio, Counsel; and R. Dobias, Environment Specialist.

5. Experience indicates that ad hoc, incremental efforts to improve the sector's performance have not worked, and the need for a radical restructuring is recognized by the Government. The Committee on Power, which was established in mid-1993 (see para. 26), provides a focus for forging consensus on needed fundamental change and has set the agenda for sectoral reform. The Committee has submitted its report to the Government, with recommendations relating to commercialization and privatization; separation of generation, transmission, and distribution functions; greater cooperation with the private sector, including joint ventures and independent operation of power facilities by private investors; depoliticizing tariff setting; and greater operational autonomy. The incentive for reform at the state level is being provided by the Government's resolve to reduce support for power sector development in states that are not moving forward with needed restructuring, an approach that private financiers and aid agencies, including the Bank, are following. Several states have shown eagerness to implement reforms and, at the central level, some important institutional and policy reforms have taken place.

6. POWERGRID, the national power transmission company, is an important part of the strategy to improve the power sector's efficiency. Because of the critical service it provides, it is a significant agent for change. For example, pressure has been applied to SEBs to improve their performance by the threat of reduced access to power if they do not reduce their accounts payable to POWERGRID. In the context of the proposed sector loan, subprojects will be considered for financing only in states that comply with their commercial contracts with POWERGRID. Also, the Bank has concluded dialogue with the Government on introducing economically sound bulk power and transmission tariffs and the related regulations.

7. To move more rapidly toward establishing a national power transmission grid and facilities for interregional coordination, with the concomitant reduction in the cost of power supply, POWERGRID needs assistance for financing its capacity expansion. POWERGRID's investment program is well conceived and meets priority needs, and POWERGRID is a competent executing agency. Taking also into account the progress made on sector reforms, a sector loan is therefore considered appropriate to finance a portion of POWERGRID's investments over the next five years. The sector loan approach will enable flexibility in choosing subprojects that meet technical, financial, economic, and environmental criteria for support from the Bank.

2. Organization

8. India consists of 25 states and 7 union territories with a total population of almost 900 million. Accordingly, its power sector is vast. Installed generation capacity grew at an average annual rate of 8.6 percent, from about 2,000 megawatts (MW) in 1950 to 81,174 MW by 31 March 1995. There are more than 77 million electricity consumers and 85 percent of villages have been electrified. However, the annual per capita consumption is only about 270 kilowatt-hours (kWh), which is lower than the consumption levels in many other developing countries.¹ Per capita consumption ranges from about 90 kWh in the Northeastern Region, where a significant part of the transmission facilities are to be constructed under the Project, to almost

¹ Philippines - 433 kWh, People's Republic of China - 688 kWh, Thailand - 1,070 kWh, and Malaysia - 1,384 kWh.

400 kWh in the Western Region, thus showing a strong correlation with regional disparities in economic development.

9. The organization of the power sector is determined by India's federal structure. The Government's Ministry of Power (MOP) provides regulation for the entire sector, mainly through the Central Electricity Authority (CEA), and controls the central power sector agencies such as the National Thermal Power Corporation (NTPC), National Hydropower Corporation (NHPC) and POWERGRID. State governments control the rest of the sector through 17 SEBs and 12 electricity departments (EDs). These SEBs and EDs provide distribution facilities and set retail tariffs. Power generation and transmission are split between the central power sector agencies and SEBs. As of 31 March 1995, the central agencies operated 24,776 MW of installed capacity and accounted for 33 percent of the country's total generation, while SEBs and EDs had 52,854 MW of installed capacity generating 62 percent of the total. In addition, five private power utilities in urban agglomerations have an installed capacity of 3,544 MW and a share of 5 percent in power generation.

10. As a result of the federal structure, all major issues affecting the power sector require concurrent action by the Government and state governments. This shared responsibility limits the Government's ability to influence the power sector policies of state governments, especially with respect to retail tariffs.

3. State Electricity Boards

11. While the Electricity Act (1956) and other legislation allows a certain degree of managerial and financial autonomy for SEBs, this autonomy is often nominal as most state governments use SEBs to pursue noncommercial objectives, and particularly provide low priced or free electricity to the agriculture sector to attract financial and political support. State governments also tend to intervene with SEBs' day-to-day operations, thus complicating the task of SEB management. These interventions have led to the SEBs' deteriorating financial health, which has become the central problem of India's power sector. An analysis of the SEBs' actual operational data for FY1993¹ (see Appendix 1), and partial estimates for FY1994 and FY1995 indicates the following:

- (i) The estimated average cost of power supply for 17 major SEBs in FY1993, including fuel, operations and maintenance, depreciation on historical cost, and interest and administration cost was \$0.043 (Rs1.33)/kWh, compared with an average tariff revenue of \$0.034 (Rs1.06)/kWh. The cost recovery of only 79.7 percent resulted in aggregate financial losses for the 17 SEBs of \$1.4 billion (Rs43.6 billion), which were reduced to \$0.8 billion (Rs24.4 billion) by subsidies from state governments. Although the cost recovery slightly improved in FY1995 (to 80.8 percent),² the projected financial losses in absolute terms further

¹ Data on the SEBs is collected and published by the Power and Energy Division of the Planning Commission. Their most recent publication, for FY1993, was published in February 1994.

² The average cost in FY1995 was \$0.052 per kWh, and the average tariff \$0.042 per kWh. The latter was significantly below the tariff levels in other countries in the region (US cents per kWh): Bangladesh -7.2, Indonesia - 7.6, Malaysia - 8.8, Philippines (Meralco) - 11.4, Sri Lanka - 7.6.

increased to \$2.0 billion (Rs61.6 billion) before subsidies and \$1.3 billion (Rs41.3 billion) after subsidies.

- (ii) The statutory requirement that SEBs should not only fully recover their costs but also generate a minimum of 3 percent rate of return (ROR) on their fixed assets after interest expense¹ and receipt of subsidies from state governments was met by only four SEBs in FY1993 (Karnataka, Maharashtra, Rajasthan, and Tamil Nadu).
- (iii) Total internal cash generation of the 17 SEBs was projected to have declined further, from a negative \$149 million (Rs4.7 billion) in FY1993 to a negative \$509 million (Rs1.6 billion) in FY1995.
- (iv) Although operational inefficiencies resulting in low power plant load factors (57 percent in FY1993) and excessive transmission and distribution losses (over 22 percent in FY1993) play a major role, given the generally satisfactory level of industrial tariffs (increased from Rs1.60 in FY1993 to Rs2.02 in FY1995), the single most important reason for the dismal financial performance of most SEBs has been the heavy subsidization of agricultural consumers, who accounted for 27.8 percent of total consumption in FY1995, down from 30 percent in FY1993. The average agricultural tariff has been projected to be only Rs0.22/kWh in FY1995 (up from Rs0.16 in FY1993), and a number of SEBs are providing free electricity to such consumers. The resulting commercial losses could be reduced only partly through cross-subsidization by other consumers.
- (v) Had the agricultural tariff been increased countrywide to Rs0.50 per kWh, which the State Power Ministers had agreed to pursue as a matter of policy, the aggregate financial losses before subsidies would have been reduced by 49 percent in FY1993 and virtually eliminated in FY1995.

12. The negative internal cash generation at the state level has impoverished the SEBs, impeded construction of new power facilities, and restricted the funds available for maintenance and rehabilitation of existing assets, thus making it impossible to close the demand-supply gap. This gap in peak demand, estimated to be in the order of 10 percent in FY1994, is projected to increase to about 20 percent by FY1997. Chronic power shortages and poor quality of power supply continue to plague the economy in almost all parts of the country. If not remedied, the nonavailability of sufficient power will be the single most important constraint to economic development in the coming years and will thwart the Government's efforts to attract domestic and foreign investment.

13. In view of the above facts, a reform of the power sector at the state level is urgently needed to reduce the need for subsidies and public spending on the sector. As financial losses of SEBs, state power subsidies, and investments of SEBs together account for about 4 percent of gross domestic product and are almost entirely financed through central and

¹ Depending on the level of debt service, this would generally correspond to about 8-9 percent ROR on assets at historical cost.

state budgetary resources, such a reform would significantly reduce claims on the country's fiscal resources and allow additional spending on other priority sectors.

4. National Thermal Power Corporation

14. Until 1982, SEBs had been almost solely responsible for development of power generation and transmission within their own states. In view of SEBs' poor performance in meeting the rapidly increasing demand for electricity, and in order to improve the efficiency of generation, two central sector agencies, NTPC and NHPC, were established to generate bulk power for sale to SEBs.

15. NTPC has the best operational performance of all public power generating entities in India and is considered to meet international standards. Since commencing commercial operations, NTPC's installed capacity has grown from 800 MW to 15,625 MW (as of 31 March 1995), i.e., at an average annual rate of 26 percent, which allowed NTPC to reach a share of 19 percent in the country's total capacity. NTPC has been consistently profitable, with a ROR on assets at historical cost in excess of 10 percent (estimated to be 11.4 percent in FY1995). NTPC has 25 bulk customers, consisting of 15 SEBs and 10 EDs.

16. NTPC's capital structure has not been highly leveraged, and its current debt/equity ratio of 45:55 reflects fairly well the historical average. NTPC is wholly owned by the Government, which in the past has contributed about 60 percent of total equity (largely a pass-through of World Bank loans) while the balance is from retained earnings. To finance its investment program, NTPC has outstanding debt of about \$1.4 billion in foreign loans and \$1.8 billion in local loans. The largest single lender has been the World Bank, with 16 loans totaling \$3.4 billion over a 12-year period. NTPC has also been a major borrower from bilateral sources such as the former Soviet Union and Japan, as well as from international commercial banks. NTPC no longer receives budgetary support from the Government.

17. The central agencies, including NTPC, are seriously affected by the poor financial health of most SEBs, as evidenced several times in the past when excessive accounts receivable from the SEBs seriously impaired the central agencies' liquidity. To resolve this problem, NTPC has, in addition to restricting supply and obtaining Government appropriation to settle debts of SEBs, even resorted to taking over generation facilities of SEBs in settlement of accounts receivable.¹ Nevertheless, the case of NTPC indicates that a central agency can thrive, with some temporary setbacks, even under the generally adverse conditions of the country's power sector, provided it has efficient management, sound commercial policies, and Government support.

5. POWERGRID

18. Prior to the establishment of POWERGRID, NTPC and NHPC constructed and operated the transmission facilities required to evacuate power from their power plants and transmit it to client SEBs. As the transmission system grew, it was recognized that it would be

¹ As part of the agreement to change the executing agency for Loan No. 907-IND: Unchahar Thermal Power Project to NTPC, the Bank, the Government, the government of Uttar Pradesh, and NTPC agreed to transfer title to the 420-MW Stage-I to NTPC.

more efficient to have a national transmission utility that would (i) be responsible for the transmission systems required to evacuate power from central sector power plants, and (ii) construct and operate transmission facilities required for power interchange among SEBs within a region and for interchanges between regions.

19. To serve the above purpose, POWERGRID was established in October 1989 as a Government corporation and commenced operations in late 1991. It has been profitable since its first full year of operations, FY1993, and is forecast to remain so. Its ROR was 12 percent in FY1993 and 10 percent in FY1994, and is projected to remain in this range in FY1995. Disputes with SEBs arising from interpretation of the tariff notifications and dating back to the start of commercial operations in 1992 are still outstanding in the Northern Region, and some write-offs may be required in FY1996 when these disputes are expected to be settled. However, this should not materially affect POWERGRID's profitability and would clear up all items that have been disputed since its creation.

20. The development of POWERGRID has been planned in three phases. The first phase, which was completed in 1991, involved the transfer of transmission facilities and associated staff from the other central sector utilities to POWERGRID.

21. The second phase of development, which is under way, includes the transfer from CEA of the regional system coordination centers (RSCCs) and associated communication facilities in each region. This has been accomplished recently in the Southern, Eastern, and Northeastern Regions and is scheduled to be completed in the Northern and Western Regions in December 1995. POWERGRID will construct and operate new RSCC facilities, which will improve the coordination of regional grids and facilitate bulk power trading between SEBs. Development of additional transmission facilities for new central sector power plants and for power trading between SEBs within a region will also continue in the second phase.

22. The third phase will be the development of a national transmission grid and facilities for intensified interregional cooperation and coordination. Transmission links between the five power regions are very limited, and the different regions are not synchronized in frequency. The development of a national grid will enhance operational efficiency by sharing of reserve margins, trading of surplus generation between regions, and long-term power exports from regions with low-cost hydropower or coal resources.

23. Collection of accounts receivable from SEBs was a major problem for POWERGRID in the past. On several occasions, poor collections tied up its working capital and led to delays in arranging financing for new projects because of noncompliance with accounts receivable covenants. To resolve the problem, the Government reached an agreement with state governments for SEBs that were seriously delinquent, whereby the Government would pay their overdue accounts receivable over a period of four years and offset these payments against the affected states' share of centrally collected taxes. Both the World Bank and the Bank have informed the Government and POWERGRID that this method of central appropriations is unsustainable in the longer term, as it reduces funding available for other sectors.

24. In reaction to this, a set of new commercial and investment policies that have been put in place aim to improve financial discipline of SEBs and allow NTPC and POWERGRID to curtail or shut off power to defaulting SEBs, as well as to defer investments that would benefit

defaulting SEBs in such states. These policies, which include appropriate payment coverage by letters of credit attached to the bulk power supply agreements with SEBs, have been applied since October 1993, with some success. POWERGRID's accounts receivable stood at 1.8 months of sales as of 31 March 1995, below the covenanted 2 months, and collections have averaged more than 100 percent of billings since November 1994 (see Appendix 2).

25. As in the case of NTPC, POWERGRID is not highly leveraged; its current debt/equity ratio is about 45:55. With its ambitious expansion program and the associated borrowing, this ratio is expected to increase to about 65:35 and stabilize at that level. POWERGRID is wholly owned by the Government, which has contributed about 85 percent of its equity (largely in the form of fixed assets transferred from NTPC) while the balance is from retained earnings. POWERGRID has borrowed locally about Rs29 billion (\$0.9 billion), of which 94 percent is outstanding. Its largest single source of foreign funds is the World Bank, followed by the Overseas Economic Cooperation Fund of Japan and the European Investment Bank. POWERGRID does not receive any Government budgetary support for operations but still receives from the Government equity injections that are based on bilateral assistance agreements for completed projects.

B. Government Policies and Plans

1. Overall Power Sector Reform

26. In view of the dualistic structure of the power sector in India, a political consensus is essential to ensure that measures necessary to improve sector performance are taken concurrently by the Government and state governments. Experience shows that the traditional gradual approach of seeking marginal improvements in operational efficiencies and tariffs does not work in the present institutional setup. The need for radical restructuring has been widely recognized but the practical steps towards achieving this goal are emerging only now. To strengthen the momentum, the National Development Council (NDC)¹ constituted in June 1993 the Committee on Power under the chairmanship of the Chief Minister of Maharashtra, with the Union Ministers of Finance and Power and the Chief Ministers of Assam, Karnataka, Punjab, Uttar Pradesh, and West Bengal as members. In October 1993, a high-level conference was held in Jaipur, during which power sector reforms were discussed by senior Government officials, representatives from virtually all states and SEBs, and representatives of major external funding agencies, including the Bank.

27. In October 1994, the Committee on Power forwarded its final report to the Prime Minister for consideration by NDC. The final report recommended (i) organizational reforms at the state level, consisting of commercialization, and unbundling of generation, transmission, and distribution; (ii) organizational reforms at the regional and national level aiming at strengthening the role of central agencies such as NTPC and POWERGRID, freeing them from the Government's control, allowing them to implement new projects on a joint venture basis with the private sector, and ultimately reducing the Government equity in them to not more than 26 percent; (iii) large-scale involvement of the private sector in generation and distribution, with the

¹ NDC is India's highest political body. It is chaired by the Prime Minister and comprises Chief Ministers of all States.

sponsors selected through transparent and competitive bidding procedures; (iv) depoliticizing tariff setting by creating a national tariff board for regulating bulk tariffs at the national level and regional tariff boards for regulating bulk and retail tariffs for both public and private utilities at the state level; and (v) progressive phasing out of subsidies to agricultural consumers, with a minimum tariff of not less than 50 percent of the average cost of supply to be introduced in the first phase.

28. It was anticipated that the publication and implementation of these recommendations would start in mid-1995 after a series of state elections were finished, but this has been delayed as the Chairman of the Committee and a member representing an important constituency were not returned to power. The Government is now trying to rebuild the consensus to implement the recommendations, quite a difficult task in view of the forthcoming national elections. Nevertheless, many of the reforms have gained their own momentum, with investment in new facilities being dictated by availability of private capital, as well as of multilateral and bilateral assistance. Support for public sector power development in states not moving toward restructuring of their power sector is being withheld by the aid agencies, and private sector investors have tended to follow suit as many state governments that are not restructuring their power sectors also have poor credit ratings.

29. At the national level, the Government's commitment to power sector reforms, which are regarded as an integral part of the general economic liberalization, has been demonstrated by (i) the initiative taken under the NDC framework to establish the necessary political consensus; (ii) the introduction of legislation to allow private sector participation; (iii) the provision of Government counter-guarantees to state government guarantees of performance obligations of their SEBs related to power purchase agreements (PPAs) for a limited number of private power projects, provided the SEBs concerned meet certain financial performance criteria; (iv) the establishment between the central power sector agencies and SEBs of commercial relationships allowing a flexible allocation of power; and (v) the cessation of intermediary activities between lenders and the central power sector agencies, i.e., allowing the latter to borrow directly, albeit with a Government guarantee, and to bear the interest rate and foreign exchange risks. The Government has also agreed to completely revise the structure of tariffs for supply of bulk electricity from the large central sector power plants and of transmission tariffs for the use of POWERGRID's transmission facilities. The revision will be based on the recommendations arising from the Bank-financed Tariff Study¹ and will also reduce Government intervention in the sector by building a new regulatory framework. These efforts are discussed in detail in paras. 40-46.

2. Restructuring of State Power Sectors

30. Some states have started to restructure their power sector. The most advanced is Orissa, where with World Bank financing, the state government (i) created commercially oriented generation, transmission, and distribution companies to replace the Orissa State Electricity Board (OSEB); (ii) is proceeding to privatize some of these companies (those involved in thermal generation) and allow private sector participation in others (those involved in

¹

TA 1756-IND: *Study of Bulk Supply and Transmission Tariffs and Transmission Regulations*, for \$600,000, approved on 29 September 1992.

hydropower generation and distribution); (iii) converted OSEB into a regulatory agency; and (iv) introduced annual tariff adjustments starting with 15 percent in July 1994.

31. Four other states (Bihar, Haryana, Rajasthan, and Uttar Pradesh) have also initiated World Bank-financed studies on (i) restructuring options, including the necessary legal and regulatory framework; (ii) medium- and long-term investment programs; and (iii) emergency investment needs to stop power supply deterioration (capacitors and distribution transformers, and power plant rehabilitation, but no new major projects). Maharashtra is starting a program of restructuring using its own funds, and Andhra Pradesh is negotiating financing from the Overseas Development Administration (ODA) of the United Kingdom for restructuring its SEB. Tamil Nadu and Gujarat have recently approached the Bank for similar assistance. Despite these encouraging signs, it is too early to assess the state governments' commitment to reform, as painful measures such as reducing state control and revising retail tariffs are still pending. Orissa plus the above eight states consume two thirds of the country's power. They are expected to be joined by a few more states but others may be unable in the near future to create the broad political consensus needed even to commit to the studies. The *status quo* and the resulting deterioration of power supply will continue in the states that do not reform, with adverse consequences for economic growth.

32. There has been some progress on the tariff issue, which is a critical part of the reform process. Since April 1994, 13 SEBs and EDs have increased tariffs, including the largest SEB in Uttar Pradesh. The increases were substantial in the commercial and industrial sectors, and relatively modest in the residential and agriculture sectors. There have been some notable exceptions: residential tariffs have been raised by at least 25 percent in six states while agricultural tariffs have been increased by similar margins in nine states. The latter have reached or exceeded the interim target level of Rs0.50/kWh in five states, compared with only one state in FY1993. On the negative side, there have been tariff reductions for residential use in Kerala (22 percent) and for agricultural use in Andhra Pradesh (14 percent). Details of the consumption pattern by tariff category for FY1993 are given in Appendix 3.

3. Commercialization and Privatization

33. Since 1991, the Government has been encouraging participation of private investors in the power sector. Under amended legislation, the private sector can now undertake generation projects of any type or size to generate and sell bulk power to SEBs or directly to large consumers, or to distribute power in a licensed area from its own generation or purchases. Captive power plants set up to serve an industry are also permitted to sell surplus power to SEBs. The eligible projects are generally for sites that NTPC, NHPC or SEBs have already obtained technical, economic, and environmental clearances for, but have been unable to develop because of lack of funds. These projects are included in CEA's generation development plan, and MOP's Investment Promotion Cell maintains a list of the projects with their development status.

34. Policy changes have resulted in wide international and domestic interest in investing in the power sector. The incentives and promotional efforts of the Government have attracted private interest in a number of projects. Many of the project sponsors have concluded memorandums of understanding (MOUs) with SEBs, which generally give the sponsors exclusive

rights for specific project sites.¹ Eight projects are at an advanced stage of negotiations and are regarded as fast-track projects (see Table 1) for which the Government will give a limited counter-guarantee to the state guarantee of the obligations of the SEB under the PPA.² Three or four of the fast-track projects, including one supported by the Bank,³ will probably be finalized in 1995 or early 1996. Many of the other MOUs may not be followed through because of sponsors' inexperience, lack of adequate guarantees for the revenue streams, or serious difficulties in arranging financing.

Table 1. List of Fast-Track Projects

Project and State	Type	Size (MW)	Sponsors	Country
Jegurupadu, Andhra Pradesh	Gas CC	235	GVK Industries CMS Generation	US/India US
Kakinada, Andhra Pradesh	Gas CC	208	Spectrum Technologies Jaya Foods NTPC	US/India India India
Visakhapatnam, Andhra Pradesh	Coal	1,000	Ashok Leyland National Power	India UK
Mangalore, Karnataka	Coal	1,000	Cogentrix Inc	US
Dabhol, Maharashtra	LNG CC	2,015	Enron Development Corp GE Capital Bechtel Corp	US US US
Ib Valley, Orissa	Coal	420	AES Corporation GE Capital	US US
Zero Unit, Tamil Nadu	Lignite	210	ST Power Systems	US/India
Paguthan, Gujarat	Gas CC	655	Gujarat Torrent Energy	India

CC = Combined Cycle
Source: Ministry of Power

¹ As of May 1995, about 180 MOUs have been signed for more than 60,000 MW.

² The main criterion for the selection of these eight fast-track projects has been a successful conclusion of negotiations between the sponsors and SEBs on preliminary PPAs. The projects represent a wide spectrum of financially capable foreign and local sponsors backed by strategic partners with the relevant implementation and operation experience.

³ The Bank is processing a loan and an equity contribution totaling \$50 million from its private sector window for the 420-MW Ib Valley Thermal Power Project in Orissa, which is likely to be among the first fast-track projects to be implemented. In addition, the Bank is processing a Government-guaranteed loan of \$120 million and an equity investment of \$15 million for the 500-MW Balagarh Thermal Power Project in West Bengal, which does not belong to the fast-track group but is quite advanced.

35. Implementation of private power projects has been delayed by various unresolved policy and regulatory issues, protracted administrative processes, and, in some cases, the complicated financing structure of the projects and lack of commercial funding caused by the perceived high risk of dealing with SEBs that have a questionable credit rating. In the absence of financially viable SEBs, sponsors are requiring state government guarantees and Government counter-guarantees. However, the Government's capacity to provide such counter-guarantees is limited and the desirability of providing them is questionable, unless steps are taken to improve the credit worthiness of SEBs. Of the eight fast-track projects, Government counter-guarantees have been issued for only two projects, and only one, Enron's Dabhol project in Maharashtra, has reached financial closing. Even after commencing construction, new delays have been experienced because of the change in the state government. Maharashtra has recently abrogated the contract for Phase-I of the project and cancelled Phase-II; Enron and the government of Maharashtra are now renegotiating the project.

36. Another issue that must be resolved soon is the current practice of negotiated deals with project sponsors, on a cost-plus based tariff, rather than procurement of private power on a competitive bidding basis. In January 1995, the Government issued guidelines for bidding on new power projects and stated that it would not allow further projects to be allocated by signing of an MOU, and that MOUs already signed would expire by 30 April 1996 unless a PPA has been approved. In future, CEA will only sanction projects awarded on the basis of competitive bidding. Detailed bidding documents are being developed by the Power Finance Corporation (PFC) with financing from the World Bank.

4. POWERGRID's Role

37. The three-phase development of transmission systems and operations, described in paras. 20 to 22, will facilitate the restructuring of the power sector into separate and more efficient generation and distribution companies. The development of the regional and national transmission grids and control centers will also improve the coordination and efficiency of power sector operations on a regional and national basis. The World Bank's study "India: Long Term Issues in the Power Sector," prepared in 1991, concluded that improved coordination in system operations, through such measures as effective operation of RSCCs and improved bulk power tariffs, could reduce total unserved electric energy by half from its then prevailing level of about 9 percent of total energy demand. Potential savings through improved coordination in operations were estimated at \$5 billion to \$10 billion by the year 2001. The study further estimated that unserved energy demand could be reduced by an additional 30 percent, and fuel costs could also be reduced, if interregional transmission facilities were developed for national power trading. The combined savings were found to be equivalent to about 10 percent of the total capital investment required in the power sector over this period. Clearly, POWERGRID has a major role to play in improving the efficiency and productivity of India's power sector.

38. POWERGRID was created to provide transmission service as a common carrier, which is required to transmit electricity for a fee and construct additional transmission facilities if the existing system is inadequate. However, financial constraints may impede POWERGRID from fully assuming the obligation to expand its transmission systems and, therefore, its role may be better characterized as a contract carrier. In this context, quite a difficult regulatory issue arises, namely, how to determine access conditions and priorities when the transmission system is not adequate. These limitations and other relevant issues were analyzed and

recommendations made in the Bank-financed Tariff Study. Part of the answer to the shortage of investment funds for new capacity may be for POWERGRID to find joint venture partners. In accordance with the recommendations submitted to NDC, POWERGRID has entered into discussions with potential joint venture partners to finance a number of major projects.

39. Other features of power sector restructuring will also affect POWERGRID. While building national and regional electricity grids, regulation of its activities will change significantly with the implementation of the Tariff Study's recommendations, introduction of competition among generating companies, and the planned move toward privatizing POWERGRID's own activities through joint ventures with private investors and major international transmission companies, followed by a partial sale of its equity to the public.

5. Implementation of the Recommendations of the Tariff Study

a. General

40. The Bank-financed Tariff Study that was completed in February 1994 addressed several important problems. Tariffs for power transmission by POWERGRID are currently based on simple cost-sharing formulas. However, the Study concluded that a more refined tariff structure would be required for POWERGRID's operations, together with a regulatory framework to define POWERGRID's responsibilities and its relationship to other power utilities, as well as with a regulatory process for establishing access, resolving conflicts, and approving transmission tariffs. The system of tariffs for bulk supply from central sector power companies and new independent power producers, and for bulk power interchanges between states also needs improvements, to promote economic efficiency and to coordinate operation of the numerous power companies. Improved bulk power supply tariffs are essential because POWERGRID will not be responsible for a command style for dispatching generation, but will rely on commercial incentives and disincentives to promote economically efficient plant dispatch and operation. The Tariff Study recommendations for improvements in tariff structure and regulatory principles are summarized in Appendix 4. The Government approved the Study's recommendations on bulk supply and transmission tariffs, and constituted in February 1995 the National Task Force (NTF) to manage the reform process in this area. This was followed by the formation of Regional Task Forces (RTFs). The major tasks of the NTF and RTFs have been to (i) prepare the implementation plan for tariff reform, and (ii) design detailed tariffs in accordance with the approved general principles. The time-bound implementation plan is shown in Appendix 5. The implementation of the new bulk supply and transmission tariffs will be a covenant of the proposed loan.¹ On the technical side, the preparation of a grid code,² which is required for operation of the transmission system, is well under way with World Bank assistance. The implementation of metering and other technical arrangements needed for POWERGRID to operate the transmission system in accordance with the new tariff structures has also started and is scheduled for completion by March 1996.

¹ The World Bank has also made satisfactory progress on the implementation of the recommendations of the Tariff Study a condition of further assistance to central sector agencies such as NTPC and POWERGRID.

² The grid code is the set of rules for operation of and access to the transmission system.

41. Originally, the Tariff Study implementation plan was to cover not only the bulk supply and transmission tariffs but also major reforms to regulatory procedures at the national level. After dialogue with the Government and discussions with the World Bank, it has been recognized that substantial additional work is required in the latter area before implementation can take place. The Tariff Study analyzed regulation requirements and recommended the broad scope and direction of the regulations, but the evolution of a regulatory authority, a role now played by CEA, needs further discussion and consensus among the Government, central power sector agencies and SEBs. It has been agreed that MOP will prepare the framework for regulation and the related implementation plan, and will be responsible for the implementation.

42. The Project includes provision of services, in areas requiring special expertise, for implementation of the bulk supply and transmission tariffs, and if required, advisory services may also be provided to MOP for development of the regulatory framework and its implementation. The approach to these tasks is described in Appendix 6.

b. Bulk Supply Tariffs

43. Tariffs for bulk power supplied by central sector utilities and by independent private power producers are currently based on PPAs for specific power plants operated by these entities. They consist of two parts, with a fixed capacity charge that covers all fixed costs at a normative level of availability and an energy charge based on (i) fuel cost, (ii) incentive for generation above the normative availability, and (iii) other variable operation costs. This tariff structure encourages plants to generate if available, rather than in accordance with a plant merit order based on the least-cost principle.

44. Under the proposed structure, the tariffs will be distinguished by scheduled and unscheduled interchange rather than by power plants. Tariffs for scheduled interchange, where amounts and schedules of power trades are agreed in advance, will include a capacity component and an energy component. If SEB draws more than its entitlement under the scheduled interchange agreement, the excess consumption will be deemed unscheduled interchange and will be priced at a different tariff. Unscheduled interchange will be monitored hourly, and there will be a high enough penalty during peak load periods or periods of low frequency to discourage SEBs from drawing beyond their entitlement from the power pool. During off-peak periods, the tariff will be lower than the scheduled interchange tariff to discourage generation that is not least cost. Each regional electricity board, comprising the SEBs in that region, will determine the appropriate tariff levels for scheduled and unscheduled interchanges.

c. Transmission Tariffs

45. NTPC and NHPC formerly combined generation and transmission charges in their billings. As part of the process of splitting off POWERGRID from these central generation utilities, POWERGRID's billing now separates transmission charges. These charges are currently based on the historical cost of the assets, using approved parameters for (i) return on equity in nominal terms, which is currently fixed at 12 percent but is covenanted under the proposed loan to increase to 16 percent for all assets brought into service after 31 March 1997, (ii) depreciation, (iii) operation and maintenance, and (iv) debt service. The current transmission tariffs in each

region consist of a single rate per kWh of energy transmitted, which is uniform for all client SEBs in that region. Under the proposed structure, the following major changes will be introduced: (i) two-part transmission tariffs will be established for each region, with a fixed capacity cost component and an energy cost component; (ii) access to the transmission grid will be available to any qualified entity; and (iii) separate tariff designs will be used for fundamentally different transmission services, such as evacuation of power from central sector plants, intraregional power transfers between SEBs, interregional power transfers between regional electricity boards, and operation of RSCCs. With this structure, the transmission tariffs will closely reflect the actual costs in the various regions at different times of day, thus helping reduce energy losses and enhancing efficient use of electricity.

d. Power Sector Regulation

46. CEA currently has the responsibility to (i) operate the RSCCs, (ii) develop national power policy, (iii) advise the Government, state governments and agencies involved in supply of electricity, (iv) act as an arbitrator in disputes among the various agencies, and (v) issue regulations. Under the Electricity (Supply) Act, operation of the RSCCs implies that licensees and generating companies have to conduct their operations in accordance with the instructions of CEA. The anomaly of CEA being both operator of the RSCCs and their regulator will be removed with the ongoing takeover of the RSCCs by POWERGRID. Pending development of detailed recommendations on power system regulation, CEA will continue its regulatory role over power sector agencies, including POWERGRID, but may require reorganization to do so.

C. External Assistance to the Sector

47. Between 1986 and 1992, the Bank made five loans totaling \$990 million to assist the public power sector and two loans with a combined amount of \$49.8 million for private power projects, and arranged cofinancing under its complementary cofinancing scheme for \$110.8 million for the public sector. In addition, the Bank gave seven technical assistance (TA) grants totaling \$4.1 million (see Appendix 7). Most of the assistance was for power generation. The Bank's lending was based on the strategy of assisting only efficient central sector utilities and SEBs that met minimum performance criteria and agreed to implement satisfactory operational and financial action plans. This strategy, developed in coordination with the World Bank and other aid agencies in the second half of the 1980s, resulted in some improvement in the sector but has not brought about major changes needed to put the power sector at the state level on a sustainable basis.

48. During 1993, the multilateral and bilateral aid agencies involved in India's power sector changed their approach, with some of them reducing their commitment or even starting to withdraw from the sector because of general disappointment with the lack of significant improvement. The Government's recent support for sector restructuring and private sector involvement has encouraged aid agencies, which now insist on a total reform of the SEBs, increased transmission and distribution investment, and major private sector participation in generation and distribution.

49. The World Bank is the largest external funding source for the power sector. It has committed 54 loans totaling \$9.2 billion, including 7 loans to the private sector totaling \$577.4

million and 19 International Development Association credits amounting to \$2.4 billion. About \$4.2 billion of the World Bank's loans have been for NTPC projects with the rest spread among the other central sector utilities such as POWERGRID and PFC, as well as among a number of SEBs. Germany, Japan, and Sweden are other major contributors. The role of Canada and the UK used to be important but is now declining while the United States has largely withdrawn from the sector, except for a TA for private sector participation provided by the United States Agency for International Development (USAID).

D. Lessons Learned

50. No project completion reports or project performance audit reports have been prepared for the Bank-financed power projects in India, all of which are still under implementation. Portfolio performance has been mixed, with some projects more or less on schedule and long delays experienced with others. Recent contract award and disbursement performance for power sector projects has been generally good compared with other sectors.

51. In the first phase of its operations in India's power sector, between 1986 and 1990, the Bank made four major loans for generation facilities for selected SEBs. In doing so, the Bank used its leverage to (i) raise environmental standards for generation (this generally only resolved project-specific problems); (ii) improve tariffs at the SEB level (this was a temporary solution as control remained with the state governments); and (iii) improve the performance of SEBs (this was undertaken with TAs attached to loans, and had some success but did not address the underlying need for sector reform). Technical problems were encountered with (i) land acquisition not being sufficiently advanced when loans were approved, causing long delays before construction could start; (ii) procurement packaging sometimes resulting in contracts that were too small to attract adequate international competition; and (iii) cumbersome procurement procedures and approvals also causing front-end implementation delays. Some of these problems were caused by over reliance on project preparation by SEBs' planning departments and by local consultants who did not fully understand or investigate these issues.

52. Two loans for the North Madras Thermal Power Project and associated transmission facilities¹ had initial delays of about one year because of difficulties with land acquisition. The main contracts for the power plants were generally implemented on time after significant delay in contract awards. In 1992, it was established that there would be substantial loan savings as the main contracts were denominated in local currency and there had been substantial devaluations of the rupee against the US dollar. Board approval was obtained to use these savings to construct port coal handling facilities that were part of the Coal Ports Project.² The Bank is reviewing the use of these loan savings because of inordinate delays in (i) engaging consultants, (ii) finalizing the consultants' recommendations on the port coal handling facilities, (iii) undertaking procurement for the coal handling facilities and transmission components of the original scope of work, and (iv) making contract awards. Future loans to unproven executing

¹ Loan No. 798-IND: *North Madras Thermal Power Project*, for \$150 million, approved on 18 November 1986; and Loan No. 1029-IND: *Second North Madras Thermal Power Project*, for \$200 million, approved on 30 August 1990.

² Loan No. 1181-IND: *Coal Ports Project*, for \$285 million, approved on 27 October 1992.

agencies should include a thorough investigation of their procurement procedures, and consideration should be given to imposing deadlines on procurement activities.

53. The Bank's second loan to the Indian power sector, Loan No. 907-IND: Unchahar Thermal Power Project, for \$160 million, was approved on 29 September 1988. The executing agency was Uttar Pradesh Rajya Vidyut Utpadan Nigam (UPRVUN), a state corporation owned by the government of Uttar Pradesh. The project aimed at expanding the Unchahar Power Station by two additional 210-MW units. However, as a result of financial and management problems, UPRVUN was unable to implement the project and ceased operating. The Bank suspended contract awards and disbursements under the loan. Then, in 1993, the Government and the government of Uttar Pradesh, with support from the Bank, agreed to sell the Unchahar Power Station and to transfer the Bank loan to NTPC so that its implementation could be resumed. The loan transfer was approved by the Bank's Board in October 1994 with the executing agency changed from UPRVUN to NTPC. Loan performance is expected to improve substantially in the coming months, as NTPC has awarded two major contracts for the project and has expedited other procurement.

54. Loan No. 988-IND: Rayalaseema Thermal Power Project, for \$230 million, approved in November 1989, has been satisfactorily implemented by the executing agency, the Andhra Pradesh State Electricity Board (APSEB). One 210-MW coal-fired generating unit has been in commercial operation since February 1995, and the other is expected to be re-commissioned in November 1995.¹ The satisfactory performance can be attributed to APSEB's management and staff, as well as to nonintervention in its procurement activities by the state government.

55. In 1992, under its most recent loan to the power sector, the Bank shifted its focus from new generation facilities to power plant rehabilitation, transmission, and distribution by providing a loan to PFC.² By restricting the subborrowers to SEBs, which have been willing to prepare Operational and Financial Action Plans and able to meet the performance criteria specified therein,³ this sector loan has supported the reform efforts in the power sector. The selection and appraisal of subprojects for Bank financing were completed in January 1995, six months later than originally envisaged. Contract awards and disbursements have started, albeit slowly. These delays have been attributable to management problems within PFC, which have largely been rectified in the meantime. The Bank and the Government have had intense dialogue with PFC over its implementation performance and if new conditionalities that have been imposed are not met, the loan amount will be reduced.

56. The lessons learned to date highlight the need to ensure that project preparation is at a very advanced stage before approving a loan. This will require advance recruitment of consultants and advance procurement action, substantial completion of Government approvals, and guaranteed availability of land and counterpart funds. Most of the portfolio problems have been related to SEB issues. Accordingly, with more stringent constraints on lending to SEBs,

¹ This unit was put into operation in March 1994 but had to be repaired by the manufacturer because of fire damage during the warranty period.

² Loan No. 1161-IND: *Power Efficiency (Sector) Project*, for \$250 million, approved on 26 March 1992.

³ The SEBs in Andhra Pradesh, Orissa, Maharashtra and Karnataka have qualified for borrowing from this sector loan.

including the need for restructuring, the power sector reform is expected to make a positive contribution to portfolio performance.

57. The Bank's TA program has generally been effective. The recent Tariff Study has given direction to revising the tariff structure at the bulk supply and transmission level and to designing the regulatory function for the central sector, while another TA,¹ is part of the underlying work to restructure the power sector in Orissa. As Orissa is the most advanced in restructuring efforts, and its efforts appear to be succeeding, this involvement will provide the Bank with experience for participation in the reform of the power sector in other states.

E. The Bank's Sectoral Strategy

58. Power shortages remain a key constraint to overall economic growth in India. Energy intensity of the economy is high because of the low cost of electricity, predominance of heavy industries, and very intensive agricultural irrigation. Much of the technology used is considered energy-inefficient by today's standards. On the supply side, the poor financial and operational performance of most SEBs is the predominant issue. The main reason for the poor performance is the pervasive influence of state governments, which use SEBs to implement populist policies, particularly in the agriculture sector, and interfere in their day-to-day operations.

59. The Government, a number of state governments, and all aid agencies agree that only a radical reform of the SEBs will improve the critical situation in the power sector. It is essential that the Bank support these initiatives. To this end, the Bank has financed the Tariff Study and has conducted, in close coordination with the World Bank, intensive policy dialogue with Government authorities on the key issues. A number of further studies are proposed for the next few years to establish a basis for the power sector reform, including studies on SEB restructuring, integrated resource management for power, policy framework for SEB tariffs, and transmission and distribution expansion. The Bank will encourage and support power sector reform with loans and TAs to states that are committed to making the necessary reform efforts.

60. The Bank's operational program focuses on (i) rehabilitating existing and constructing new generation facilities where significant policy reform is undertaken; (ii) reinforcing and expanding existing transmission and distribution systems relating to existing and new generation, and establishing regional and national grids; (iii) promoting domestic and foreign private investments, particularly in generation and distribution; (iv) reforming state power sectors with particular emphasis on SEB restructuring and commercialization; (v) rationalizing power tariffs, both at the bulk and retail level; (vi) reforming the regulatory framework; and (vii) improving demand management and energy efficiency.

F. Policy Dialogue

61. POWERGRID, together with NTPC, will have an important role in the restructured, commercially oriented power sector. The overall sector reform, and particularly the implementation of the recommendations of the Tariff Study, have therefore played the central role

¹ TA No. 2116-IND: *Power System Planning in Orissa*, for \$600,000, approved on 28 June 1994.

in the policy dialogue held with the Government and POWERGRID since early 1993, parallel to processing of the Project. In addition, this policy dialogue, which has been conducted in close coordination with the World Bank, has aimed at (i) ensuring POWERGRID's profitability and liquidity by increasing its minimum ROR on equity and insisting that POWERGRID enforce its commercial terms of business; and (ii) putting all bulk power supply and power transmission transactions on a sound economic and commercial basis.

1. Restructuring of the Power Sector at the State Level

62. All reports and studies conclude that restructuring the power sector at the national and, more important, state level is essential to any progress. There is also a consensus that although the approach will be slightly different in each state, the common principles are (i) unbundling of the SEBs' generation, transmission, and distribution activities; (ii) privatization of generation and distribution; and (iii) independent regulation of the sector and tariffs. The Bank supports these principles and is prepared to assist states attempting to reform their power sectors. A number of states have already identified the need for external assistance for such restructuring. However, in view of the poor success rate with reform efforts in the past, the Bank is conducting a dialogue with states where it has an ongoing relationship in the context of its loan and TA operations, to understand their problems and to induce them to start the process by taking some of the most obvious steps, such as increasing tariffs, which in turn demonstrates their commitment to the process. In other states, where the Bank has not yet been involved, preliminary discussions have been held, with a view to coordinating their requests with the Ministry of Finance (MOF). The current status in five states, in which the Bank has been active, is described below.

a. Andhra Pradesh

63. The APSEB, which is just about to complete implementation of the Bank-financed 420-MW Rayalaseema Thermal Power Project is one of the better performing SEBs (para. 54). In the past, it has broken even and currently does not receive Government subsidy. On the negative side, APSEB has a very low agricultural tariff (\$0.004/kWh or Rs0.12/kWh) combined with an increasing agricultural demand. The agriculture sector is cross-subsidized by the industrial sector to the point that APSEB has one of the highest industrial tariffs in India, which is above long-run marginal cost. During loan and TA reviews and programming missions, staff have had lengthy dialogue with APSEB and the state government concerning tariff issues. In view of the general sentiment in India favoring low agricultural tariffs and the perceived need of the state government to not increase them as long as other states do not do so, the state government has consistently refused to consider tariff reform. In return, the Bank has stated unequivocally that it would not support any further public sector projects until the tariffs are brought on a sound economic basis and the sector is reformed. Andhra Pradesh is now pursuing a grant from ODA to finance restructuring activities. The Bank also has agreed to provide a TA for development of a framework for tariff policy in Andhra Pradesh and has completed fact-finding. Both APSEB and the state government have confirmed their participation in the study and have agreed to the terms of reference. ODA and the World Bank have made satisfactory progress on implementing this TA a condition for their assistance to Andhra Pradesh.

64. In addition, APSEB is negotiating the privatization of large parts of its distribution system and is considering a proposal from a private power utility from Canada to invest in

distribution facilities on a build-and-transfer basis. As the Canadian utility does not intend to act as an operator, a framework is needed to undertake the Project. APSEB has recently requested the Bank to use savings under an ongoing TA to develop such a framework for private sector investment in distribution in Andhra Pradesh. The Bank's activities in the Andhra Pradesh power sector are thus contributing to its basic reform.

b. Gujarat

65. Although the Bank has not been involved previously in the power sector in Gujarat, the state government has requested Bank assistance to restructure its power sector as well as its manufacturing and financial sectors. A mission recently visited Gujarat to review this request and the Bank, subject to MOF's concurrence, has now agreed to study the options for restructuring the power sector as well as providing a TA for restructuring other parts of the state's infrastructure. In the power sector, which is run by one of the better performing SEBs, a more detailed analysis of its performance and an assessment of the state's commitment to reform will be required before the Bank can provide a definitive response. A fact-finding mission is scheduled to undertake this work before the end of 1995.

c. Orissa

66. In late 1993, a dialogue was initiated between the Bank and World Bank on the reform of the power sector in Orissa. Both agencies were reviewing their policies for assistance to the power sector in India and had concluded that restructuring the SEBs was an essential part of this reform. The World Bank proposed using about \$2 million from one of its credits to provide TA to Orissa to prepare the reform. It was recognized that this amount would be inadequate to undertake the whole task and that the chances of success would be higher if both agencies were involved in this state that was the first in India to express willingness to reform its power sector. It was agreed that the Bank would provide a project-preparatory TA to prepare the investment plan for transmission and distribution facilities that are critical to support independent power producers (IPPs) and the privatization of the distribution system. This TA is under way and a final report will be published later this year.¹

67. The state government of Orissa changed in the recent elections but the new government remains committed to reforming the power sector. A shadow regulatory agency has been in operation since January 1995, new legal structures have been incorporated and await concurrence of the state government, and negotiations are ongoing to privatize major parts of Orissa's power distribution system. Processing of a Bank loan ensuing from the above mentioned TA will depend on further progress in implementing the reforms, including an increase in tariffs and removal of tariffs from the direct control of the state government.

d. Tamil Nadu

68. The Bank has provided two loans totaling \$350 million for the Tamil Nadu Electricity Board (TNEB) to construct the 630-MW North Madras Thermal Power Project (para

¹ TA 2116-IND: *Power System Planning in Orissa*, for \$600,000, approved 28 June 1994.

52). Although TNEB is able to achieve the statutory 3 percent ROR after government subsidy,¹ it has not performed well as an executing agency. There have been lengthy procurement delays and frequent criticisms of its bid evaluation process. Due to this poor performance, the Bank has not agreed to use loan savings estimated at \$10 million for additional transmission facilities. Although the state government and TNEB were of the view that the state power sector did not need a full restructuring, the former requested the Bank to finance studies for (i) development of a framework for power tariff policy, and (ii) integrated resource planning for power. As these two areas were important to the reform and efficiency of the sector, and further dialogue was needed, the Bank undertook fact-finding for the TA in February 1995. Given the mixed views on the need for a full reform, the Bank requested that the state government and TNEB confirm the terms of reference for the tariff study as it would specifically aim at the agriculture sector, which currently receives free power. Since no confirmation of the aide memoire and terms of reference has been received to date, the TA may be dropped.

e. West Bengal

69. The West Bengal State Electricity Board (WBSEB) has requested Bank assistance for two projects. WBSEB is a poorly performing SEB and does not appear committed to reform. Its requests will be refused unless WBSEB demonstrates a strong commitment to reform. However, the Bank is supporting the 500-MW Balagarh Thermal Power Project in West Bengal, which is sponsored by a private utility that generates and distributes electricity in metropolitan Calcutta. That utility is the best performing private utility in the country, and the Bank's support for the project is promoting it as a role model for other private sector transactions.

2. Privatization

70. Initially there was limited interest from IPPs to invest in India's power sector. However, with the aggressive stance taken, and additional security provided by the Government, and the support offered by the multilateral institutions, including the Bank, to IPPs willing to invest, over 180 MOUs have been signed for more than 60,000 MW of generation as of May 1995. It remains to be seen how many of these private power projects will materialize as the MOUs become null and void after a certain period unless financial closing is reached.

71. The Bank has been facilitating the introduction of private investment to the power sector by direct assistance from its own private sector window and is now moving to add additional funds from its public sector window to accelerate the pace of private sector involvement and help build model projects. In view of the long gestation period for power projects, the Bank has agreed to the limited selection procedures for IPPs during the initial stage, but only on the understanding that competitive bidding procedures would be developed as soon as possible. This process has now commenced in a number of states.

72. Discussions among the World Bank, USAID, the Bank, and the Government have emphasized the need for transparency in selecting sponsors and determining the cost of private power. This need was underlined when a number of new state governments (in Andhra Pradesh, Karnataka, Maharashtra, and Orissa) reopened PPAs thought long closed. In response

¹ The subsidy is paid to TNEB to compensate for agricultural consumers, which do not pay for electricity.

to these discussions and events, the Government issued new guidelines for private power projects in January 1995. The World Bank is funding a TA through PFC for drawing up competitive bidding procedures. Pending development of the detailed bidding documents, Andhra Pradesh has started using limited bidding procedures to introduce competition to the process. The first projects to be selected with full competitive bidding are not expected to be closed for at least 18 months.

3. Reform of Tariffs and Regulation

73. The final report for the Bank-financed Tariff Study was submitted by the consultants to the Government in February 1994. A major part of the work before and after the completion of the Tariff Study consisted of building a consensus for its recommendations and overcoming opposition in some agencies to (i) changing tariffs prior to expiration of the current tariff notifications in March 1997, (ii) allowing POWERGRID an increase of its return on equity from 12 percent to 16 percent in line with that of NTPC, and (iii) introducing a two-part transmission tariff which also distinguishes between scheduled and unscheduled interchanges, and (iv) introducing a regulatory reform.

74. As a condition of further processing of the Project, the Bank required that the recommendations of the Tariff Study be formally considered and approved by the Government and that an acceptable time-bound phased action plan for their implementation be provided to the Bank. The Government initially submitted a plan that envisaged putting the new tariffs in place in April 1997. After further discussions, the Government agreed to a phased implementation of the recommendations for bulk supply and transmission tariffs starting in March 1995 and ending in August 1996. During these discussions, the Government also emphasized the need for additional work before undertaking implementation of power sector regulation as substantial further effort would be required to obtain a consensus among the Government and SEBs on the division of the regulatory powers. A compromise was reached on this issue, with further work to be undertaken under the Project on developing the regulatory framework at the national level (para. 41). In addition, the Government agreed to increase the allowed ROR on POWERGRID's equity investments commissioned from 1 April 1997 onwards from 12 percent to 16 percent.

4. POWERGRID's Accounts Receivable

75. Collection of accounts receivable from its client SEBs has been a major problem for POWERGRID since it began commercial operations. A large part of the problem arose from disputes on transmission tariffs, which only emerged when POWERGRID started billing separately from NTPC and NHPC. The situation became untenable in late 1993 when the accounts receivable reached seven months of sales, thus impairing POWERGRID's liquidity. The World Bank reacted by informally suspending disbursements from its ongoing loan, while the Bank rejected repeated requests to proceed with appraisal of the Project. This firm stance resulted in the Government and POWERGRID finally taking the necessary measures such as (i) writing off some disputed billings made prior to POWERGRID's establishment, (ii) eliminating the remaining part by appropriating from the Government allocations to the states owing the money, and (iii) setting up letters of credit by SEBs with a poor past record. These measures have brought POWERGRID's accounts receivable to less than two months, and POWERGRID reports that it has collected more than 100 percent of its current billings over the past six months. The

World Bank has consequently lifted its informal suspension of disbursements and the Bank has completed processing of the Project.

76. However, not all problems have been resolved and there could be setbacks in the payment discipline of some SEBs. There is still a major dispute on billings with Uttar Pradesh State Electricity Board (UPSEB), dating back to POWERGRID's establishment. This case has been referred to binding arbitration and a decision is expected shortly. UPSEB has been paying for the undisputed current amounts by revolving letter of credit. APSEB, which used to have a good payment record for its undisputed accounts, has recently been delaying payments on its current accounts. POWERGRID is examining its option of restricting power supply to APSEB. This option is relatively new but was applied on two occasions to UPSEB, in November 1994 and April 1995, with the desired results. Since APSEB has a serious supply deficit at the moment, such power supply restriction is expected to bring APSEB back into line.

77. In view of the risk of a SEB or a region defaulting on POWERGRID's commercial conditions for payment of its bills, no subprojects will be approved for financing under the proposed sector loan unless the beneficiary SEBs or region (i) maintain accounts payable to POWERGRID at two months or less of equivalent sales during the six-month period prior to the subproject approval; or (ii) bring accounts payable down to the level of two months at the time of submission of the subproject appraisal report and provide a revolving letter of credit for POWERGRID's estimate of its monthly billing. In addition, POWERGRID will increase the penal rate it charges on overdue accounts from 1.5 percent to 2 percent per month. POWERGRID welcomes these conditions, which give it additional leverage in maintaining its accounts receivable at sustainable levels.

III. THE PROJECT

A. Rationale

78. POWERGRID has a well-formulated detailed long-term Transmission Development Plan, which is outlined in Appendix 8. From FY1996 to FY2000, the capital requirements of this Plan are estimated at about \$4.2 billion, of which \$1.6 billion, or 38 percent, is foreign currency. The World Bank has contributed \$350 million under its ongoing loan¹ towards meeting these requirements, and is considering another loan of a similar size for FY1997. To narrow the foreign exchange gap, the Government and POWERGRID requested the Bank in May 1994 to formulate the Project as a countrywide transmission sector loan of \$275 million. This loan will account for about 7 percent of the investment program to be undertaken by POWERGRID during the five-year time slice, and will be the Bank's first loan to POWERGRID.

¹ Power System Development Project, Loan 3677-IN, approved in March 1993. The World Bank has reported that implementation of this loan has progressed satisfactorily and time originally lost because of problems with bidding documents had been made up. POWERGRID also borrowed indirectly on a sector basis from the World Bank before POWERGRID was made a separate entity. Part of the Northern Region Transmission Project (Loan 3237-IN for \$485 million) to NHPC in June 1990 and part of the Rihand Power Transmission Project (Loan 2555-IN for \$202 million) in 1985 to NTPC were for transmission projects now operated by POWERGRID.

79. POWERGRID is a suitable agency for a major sector loan as the relevant criteria for providing a sector loan are met: (i) power transmission (a) has been identified as a crucial element of overall power development, (b) has been neglected in the past, and (c) can contribute significantly to higher efficiency in the power sector; (ii) POWERGRID's investment program is well conceived and appropriately formulated to meet its priority needs; (iii) POWERGRID is capable of implementing the investment program by using the sector loan approach; and (iv) the recently formulated policies for the sector are appropriate.

B. Objectives and Scope

80. The direct objective of the Project is to strengthen POWERGRID's transmission systems in order to reduce system losses and allow efficient utilization of existing and planned generation plants in India, thus supporting economic growth. The indirect broader objectives, pursued in the policy dialogue with the Government, are to (i) support the restructuring of India's power sector by facilitating the unbundling of generation, transmission, and distribution, and the entry of IPPs; (ii) put all bulk power supply and power transmission on a sound economic basis through appropriate pricing; and (iii) put all transmission transactions on a sound commercial basis, thus ensuring POWERGRID's profitability and liquidity.

81. The Project comprises several groups of subprojects. The subprojects currently identified include (i) transmission system reinforcement and expansion in the Northeastern Region (Mizoram, South Assam, and Tripura); (ii) power evacuation from the 84-MW gas-fired Agartala power plant in Tripura, which is scheduled for commissioning in 1998; (iii) power evacuation from the planned 100-MW extension of the Kopili hydropower plant in Southern Assam, which is scheduled for commissioning in 1997; (iv) a RSCC in the Northeastern Region to be constructed and operated by POWERGRID, including load dispatch centers for each state in the region; (v) the alternating current portion of the East-South interconnector; (vi) power evacuation from the planned 1,000-MW Stage II expansion of the Vindhyachal coal-fired power plant scheduled for commissioning in 1999, and reinforcement of the power evacuation from the existing 1,260-MW Stage I; (vii) power evacuation from the Bank-financed 420-MW Unchahar coal-fired power plant extension in Uttar Pradesh; and (viii) consulting services for the implementation of the recommendations of the Tariff Study. A brief description of the identified subprojects is in Appendix 9.

C. Technical Justification

82. The Mission has reviewed the planning and implementation capability of POWERGRID's Projects Department and found it to be satisfactory. POWERGRID has started submitting detailed subproject appraisal reports to the Bank in the format outlined in Appendix 10. The justification of each subproject is supported by load flow diagrams, evaluation of alternatives, and a detailed cost estimate and implementation schedule. On this basis, only technically viable and least-cost subprojects are being selected. As all of the subprojects identified to date are based on well proven technology and are within POWERGRID's implementation capability, there are no significant technical or institutional risks.

D. Cost Estimates

83. The total cost of the subprojects identified is estimated at \$527.4 million, comprising \$300.8 million in foreign currency¹ and \$226.6 million in local currency equivalent (see Table 2 and Appendix 11). The estimates are based on 1995 price levels and an exchange rate of \$1 = Rs31.4, and include physical contingencies of 10 percent and price escalation of 2.5 percent per annum on foreign currency cost and 6 percent on local currency cost for FY1995, 9 percent for FY1996, 7 percent for FY1997, 6 percent for FY1998, and 5 percent per annum thereafter.

**Table 2. Summary Cost Estimate
(\$ million)**

Subproject		Region	Foreign Exchange	Local Currency	Total
i.	NE Transmission Augmentation	NE	19.7	14.7	34.4
ii.	Agartala Power Evacuation	NE	3.0	2.3	5.3
iii.	Kopili Power Evacuation	NE	3.6	2.7	6.3
iv.	Northeastern RSCC	NE	41.5	20.6	62.1
v.	East-South Interconnector	ES	35.4	27.5	62.9
vi.	Vindhyachal Power Evacuation	W	132.2	104.3	236.5
vii.	Unchahar Power Evacuation	N	22.4	16.8	39.2
viii.	Consulting Services	All	2.0	—	2.0
Subtotal: Base Cost Plus Contingencies			259.8	188.9	448.7
Interest during construction			41.0	37.7	78.7
Total			300.8	226.6	527.4
Percent			57	43	100

ES = Eastern and Southern ; N = Northern; NE = Northeastern; W = Western; All = All regions
Source: POWERGRID

E. Financing Plan

84. The financing plan for the Project is given in Table 3. The proposed Bank loan of \$275 million, or 52.1 percent of the total Project cost, will finance a major part of the foreign currency costs, including the related interest and other charges during construction. The loan will be drawn from the Bank's ordinary capital resources and will have a repayment period of 20 years, including a grace period of 4 years. POWERGRID will be the borrower, with a guarantee

¹ The foreign exchange content of the Project is larger than usual for Indian power projects because of the RSCC and 400-kV subprojects, which include a high proportion of imported materials and equipment.

from the Government, and will bear the foreign exchange risk. POWERGRID will meet at least 20 percent of the total Project cost from its internal cash generation and will finance the balance by domestic borrowing.

**Table 3: Financing Plan
(\$ million)**

Source	Foreign Exchange	Local Currency	Total	Percent
Bank Loan	275.0	-	275.0	52.1
POWERGRID	25.8	79.7	105.5	20.0
Domestic Borrowing	-	146.9	146.9	27.9
Total	300.8	226.6	527.4	100.0

F. Implementation Arrangements

1. Implementation Schedule

85. In accordance with the implementation schedule given in Appendix 12, procurement activities have already commenced for some subprojects, and all subprojects will be completed in the year 2000. POWERGRID will provide quarterly progress reports to the Bank, within 30 days after the end of each quarter. The Bank will review the implementation of the subprojects and meet with POWERGRID semiannually to discuss Project progress. The Bank will also monitor POWERGRID's overall performance. In view of the long lead time for implementation of major transmission projects, POWERGRID has agreed to submit for approval by the Bank, the appraisal reports for the last subprojects to be financed under the proposed loan, by June 1996.

2. Procurement of Equipment and Materials

86. Goods and services financed by the Bank will be procured in accordance with the Bank's *Guidelines on Procurement*. Great care has been taken in the preparation of the bidding packages, and POWERGRID sent a high-level mission to the Bank to ensure that their procedures would meet Bank requirements. Contract packages, which are detailed in Appendix 13, and bid specifications have been prepared in a manner to ensure maximum competition under international competitive bidding (ICB). Prequalification and bid documents for the RSCC have been prepared under a World Bank TA, in accordance with the Bank's *Guidelines on Procurement*, and tender documents will be sold to the prequalified bidders. Bulk purchase of common standard equipment and materials may proceed prior to subproject approvals. POWERGRID will provide a procurement notice for inclusion in the *ADB Business Opportunities* four weeks prior to issuance of bid documents for all contracts awarded under ICB. Local manufacturers may participate in ICB and be accorded the 15 percent domestic preference margin.

87. The Bank has approved advance procurement action for five critical subprojects¹ to expedite their implementation. The Bank has also agreed to retroactive financing of up to 10 percent of the loan amount for contracts awarded between appraisal and the date of loan effectiveness. POWERGRID has been informed that approval of advance procurement action and retroactive financing does not commit the Bank to subsequently approve the loan. POWERGRID has also been authorized to award contracts on a *post-facto* approval basis up to \$3 million where the lowest priced bid is also the lowest evaluated bid.²

88. POWERGRID has provided to the Bank detailed information on the implementation schedules and proposed contract packages for most subprojects. Procurement action started in June 1995 for the five critical subprojects and will start by February 1996 for the rest.

3. Consulting Services and Training

89. Among the identified subprojects, only the implementation of the Northeastern RSCC, as well as the recommendations of the Tariff Study will require assistance from consultants. These consulting services will be financed from the proposed sector loan, and the consultants will be recruited in accordance with the Bank's *Guidelines on the Use of Consultants*. Should consulting services be needed for any additional subproject, they will be financed from POWERGRID's own resources in accordance with its rules and procedures. In view of POWERGRID's experience with the engagement and control of consultants for its projects, this arrangement is considered to be satisfactory.

90. The Bank's procurement experience in some other countries in the region with the system control and data acquisition (SCADA) technology needed for the RSCC subproject has not been encouraging. Consequently, the approach has been modified to provide specifications that will allow manufacturers to compete on the basis of system performance, rather than for specific hardware that is being upgraded so rapidly that it is virtually impossible to provide technical specifications that can be used as a measure of performance. Experienced consultants completed the feasibility study for this subproject; detailed design and bid documents are being prepared by another consulting firm under World Bank financing, and international consultants to be financed under the Project will supervise implementation and training. The Mission believes that this approach will help avoid problems suffered in other SCADA projects.

G. Executing Agency

1. General

91. The Executing Agency will be POWERGRID. Planning, design, and procurement will be coordinated by its Projects Department at the corporate center in Delhi. POWERGRID's

¹ Advance procurement action has been approved for (i) system augmentation in Mizoram, Southern Assam, and Tripura; (ii) Agartala power evacuation; (iii) Kopili power evacuation; (iv) alternating current portion of the East-South interconnector; and (v) Vindhyachal power evacuation.

² Under the ongoing World Bank project, POWERGRID may award contracts up to \$3.5 million without prior review.

regional offices will be responsible for construction supervision, commissioning, and operation. POWERGRID will submit for Bank review an appraisal report for each subproject prior to any procurement action for the subproject, except for common materials bought in bulk for a number of subprojects. The appraisal reports will contain a technical description, detailed cost estimates, and an implementation schedule, and will provide technical and economic justification, and an environmental assessment for the subprojects. Much of the basic information, including a sample appraisal report, has been provided to the Bank during appraisal.

92. When completed, the subprojects will be operated and maintained by POWERGRID staff, who have the necessary experience. Staff for maintenance of the RSCC will be trained by the consultants and the contractor as part of the installation contract.

93. POWERGRID's revenues amounted to Rs8.4 billion (\$257 million) in FY1995 and are expected to increase sixfold by FY2000. POWERGRID has transactions with all 17 SEBs and 12 EDs, as well as with a few other entities. Its largest customer, UPSEB, is also the largest customer of NTPC. Ten SEBs account for 75 percent of POWERGRID's revenues and, consequently, have a major impact on its financial viability. Four of these large customers, (Karnataka, Maharashtra, Rajasthan and Tamil Nadu) achieved in FY1993 the stipulated 3 percent ROR, two (Andhra Pradesh and Orissa) broke even, and two (Delhi and Haryana) have since increased their tariffs by 43 percent and 33 percent, respectively. More important, seven of the large customers (Andhra Pradesh, Bihar, Haryana, Maharashtra, Orissa, Rajasthan, and Uttar Pradesh) have started the process of restructuring. It is also important to note that POWERGRID's billings are equivalent to less than 2 percent of the annual revenues of the SEBs and EDs. In view of the importance of the central power supply for their economy, the states are likely to give priority to settling the bills of their SEBs with POWERGRID to avoid curtailment or shut-off of an important part of their power supply.

2. Organization, Management, and Staff

94. POWERGRID was incorporated in October 1989 under the Companies Act of 1956 as the National Power Transmission Corporation, and commenced commercial operations in August 1991. In October 1992, it changed its name to Power Grid Corporation of India Limited. POWERGRID is managed by a Board of Directors consisting of a full-time Chairman/Managing Director, three full-time Directors (one each for finance, projects, and personnel) and three part-time Directors, two representing MOP and one representing CEA (see Appendix 14). The Board's power is largely confined to POWERGRID's day-to-day operations and administration. Government approval is required for POWERGRID's annual budget, capital investment program, borrowing, tariffs, salary structure, and the appointment of key personnel. Similar to other Government-owned enterprises, POWERGRID signed with MOP a MOU that sets operational and financial performance targets, delegates authority to POWERGRID for certain capital- and revenue-related expenditures, and sets out the Government's other obligations towards POWERGRID.

95. POWERGRID's organizational structure consists of (i) a corporate center in New Delhi, responsible for overall corporate planning, system planning and engineering, management of transmission system operations and projects, finance, commercial matters, and personnel; and (ii) regional headquarters, each of which manages several group headquarters. POWERGRID designs and manages its projects with only limited use of external consultants,

and, while contractors are used for erection work, POWERGRID usually retains the responsibility for implementation coordination. POWERGRID has strengthened its management procedures and field organization, and a separate Project Coordination Office has been established in the Projects Department at the corporate center. Site supervisors report to the General Managers of their regions. The regional General Managers chair monthly review meetings to review progress, address implementation issues, and authorize payments to suppliers and contractors. POWERGRID management receives monthly progress reports and reviews each project in quarterly Management Committee meetings. POWERGRID introduced computerized project management systems to help plan and monitor project implementation and facilitate comprehensive and timely progress reporting.

3. Actual and Projected Financial Performance

96. Since the commencement of its commercial operations, POWERGRID had acquired by the end of FY1994, Rs50 billion of transmission assets, which were financed by 56 percent equity and 44 percent debt. Of the debt, about Rs16 billion is in short- and medium-term domestic debt and about Rs10 billion is in foreign currencies. In FY1992, POWERGRID made a small operating loss, as it was only receiving a management fee on the assets being operated. Since FY1993, it has been profitable based on the return-on-equity formula used to calculate its transmission charges. Excluding the write-off of disputed receivables taken over from its predecessor companies, POWERGRID is projected to have an average ROR of over 10 percent on net fixed assets at historical cost, a self-financing ratio of more than 20 percent, a debt-service coverage of more than 1.2 times, and a debt-equity ratio of less than 65:35. As these ratios are achievable based on the assumptions used for the financial projections, POWERGRID will be covenanted to maintain a minimum self-financing ratio of 20 percent on a three-year running average basis and not to incur any debt if a ratio of debt to equity of less than 80/20 would result. POWERGRID's audited results to FY1994 and projected performance are summarized in Table 4 and detailed in Appendix 15.

Table 4: Actual and Projected Performance
(Rs million)

FY ended 31 March	1992	1993	1994	1995	1996	1997	1998	1999
Operating Revenue	217	6,341	6,488	9,031	10,816	13,300	17,901	25,094
Depreciation	—	1,388	1,678	2,680	3,131	4,115	4,761	7,069
Operating Expenses	233	923	1,036	1,208	1,361	1,582	2,048	2,770
Interest Expense	2	1,659	1,505	2,160	2,505	3,121	4,971	7,802
Net Profit	(18)	2,371	1,879	3,037	3,819	4,482	6,121	7,453
ROR on Historical Cost (%)	na	12	10	13	13	13	14	13
SFR 3-Year Average (%)	na	20	20	20	21	24	27	26
Debt-Service Ratio	na	1.7	1.7	1.8	2.0	1.8	1.5	1.5
Debt-Equity Ratio	80:20	56:44	56:44	56:44	52:48	57:43	60:40	60:40

na = not applicable, ROR = Rate of Return; SFR = Self-financing ratio

Note: 1992-1994 is actual; 1995-1999 is projected.

Source: POWERGRID

97. POWERGRID's main financial problem has been collection of its accounts receivable, which increased from over five months of equivalent sales in 1991 to seven months in late 1993.

This level was in violation of the World Bank loan covenant of two months and a serious impediment to processing the proposed Bank loan. As a large amount of the total accounts receivables (about four months) was related to billing disputes and billing practices arising before POWERGRID commenced operations, the Government requested CEA to arbitrate the disputed amounts. Based on the arbitration, certain amounts were written off¹ and the undisputed overdue balances were appropriated from Government allocations to the states owing the money. The level of accounts receivable was thus reduced to 1.6 months. While this one-time settlement of accounts receivable by appropriations from Government allocations was necessary under the given circumstances, the Bank advised the Government and POWERGRID that it would be difficult to support such an approach in the future.

98. As POWERGRID's revenues consist of cost-based charges, its main financial risks concern its liquidity, such as (i) collection of accounts receivable, (ii) delays in project completion, and (iii) financing local costs of its investment program with short- and medium-term domestic debt. POWERGRID has taken steps to resolve its accounts receivable problems and to reduce risk in this area by requiring letters of credit from SEBs that have a poor payment record, and curtailing their power supply if defaults in payment occur. As far as project delays are concerned, the actual costs of any delay are included in POWERGRID's asset base and passed on through its charges. However, no charges are passed on until the asset is completed. POWERGRID's project management performance is, therefore, critical to its overall results. Based on the performance of the project management staff in the predecessor companies and in POWERGRID, this risk is considered to be minor.

99. POWERGRID has already arranged most of its funding requirements for its Eighth Plan investments (FY1993-97). However, the limited availability of long-term domestic debt could be a serious problem. Although experience in the market indicates that short- and medium-term debt can be readily rolled over and it is expected that this will continue, POWERGRID and other public sector entities in India will need to develop a strategy to reduce this risk. One obvious solution that is market-driven in most countries is for the Government to require that pension funds maintain a portion of their investments in longer term blue chip investments. Other possibilities are to maximize borrowing from multilateral and foreign financial institutions and for the Government to actively develop and market longer term borrowing instruments. Following the Government's decision to make the rupee freely convertible, borrowing overseas in foreign currency is now a viable option for commercially sound Indian public sector companies. To this end, POWERGRID has appointed an international merchant bank to advise on funding options, particularly on the requirements and costs of borrowing on international markets.

H. Environmental and Social Measures

1. Environment

100. Initial environmental examination reports for the transmission lines that have been prepared by POWERGRID and submitted to the Bank indicate that the environmental impact of

¹ There is still an amount due from UPSEB that is under arbitration. It is anticipated that this dispute will be resolved by November 1995.

the proposed subprojects is minor or negligible, and that mitigating measures can be readily prescribed. The summary initial environmental examination (SIEE) report on environmental considerations for each subproject will be included in the subproject appraisal report¹ and necessary environmental clearances will be provided before approval of the subprojects. It is considered unlikely that the subprojects considered for financing by the Bank will have major adverse environmental impacts or resettlement implications, although some mitigating measures may have to be undertaken. POWERGRID will have to finance tree plantations to compensate for clearance of trees in the acquired rights-of-way and will provide the Bank with annual monitoring reports for five years after establishing the plantations. Bank staff have visited a number of the subproject sites that are likely to experience an unfavorable environmental impact. Because of the proximity to environmentally sensitive areas, two proposed subprojects were not included in the Project pending additional environmental studies to determine the appropriate mitigating measures. POWERGRID will place at each regional office, an environment officer who will be responsible for monitoring the subprojects from an environmental standpoint at the field level, and, in the future, will assist with environmental assessments at new sites. Based on the evaluated subprojects, the Project has been rated as Category B.

2. Social Analysis

101. The proposed subprojects have no direct effect on the population. Some land is required for substations but acquisition of this land has not displaced any people and the rights-of-way for new transmission lines are generally over farmland or scrub land in remote areas. POWERGRID buys the land, on which substations and tower footings are placed, based on the market value. In addition, it pays the market value for crops destroyed during construction, and farmers are allowed to continue using the land under the transmission lines after they are built. Traditionally, no payment is made for rights-of-way.

V. PROJECT JUSTIFICATION

A. Financial and Economic Analysis

102. POWERGRID charges SEBs a regulated tariff for transmission services that is based on the cost of service and allowed ROR on equity. An average transmission tariff is charged for each region, based on the total cost of fixed charges and operating costs of all POWERGRID's transmission facilities in that region, divided by the total central sector energy generation transmitted by POWERGRID in that region. Although POWERGRID will not charge a separate tariff for each new subproject to be financed under the Bank loan, POWERGRID's average tariff will be adjusted so that the total revenue increases to cover the costs and allowed 16 percent nominal ROR on equity for each new subproject. The incremental tariff revenue allowed for this purpose can be considered as the financial revenue attributable to a particular subproject. A financial evaluation has been made on this basis for the Vindhyachal Stage-II 400 KV

¹ The SIEE report for the Northeastern transmission augmentation subproject in Mizoram-South Assam-Tripura is shown in Appendix 16.

transmission project, which is the largest subproject to be financed under the Bank loan. The financial internal rate of return (FIRR) is 8.4 percent, which is above the average real weighted cost of capital of 7.4 percent (see Appendix 17). The FIRRs for other subprojects are expected to be similar.

103. The proposed sector loan will finance a number of different subprojects, each of which will be evaluated separately before final approval by the Bank to ensure that it is (i) technically feasible, (ii) part of the least-cost plan for power system expansion, and (iii) economically viable with an economic internal rate of return (EIRR) of at least 12 percent. A preliminary economic analysis of the major subprojects has been undertaken and the results are described in detail in Appendix 17 and summarized in Table 5.

Table 5: Economic Evaluation of Major Subprojects

Subproject	EIRR (%)	Capital Cost (\$ million)
Vindhyachal Power Evacuation	19.7	283.6
Northeastern Transmission Augmentation	18.2	38.8
Northeastern RSCC	22.5	73.9
Unchahar Power Evacuation	13.6	46.8
East-South Interconnector	21.3	70.4

104. The Vindhyachal Stage-II 400 kV subproject, with a total cost of about \$284 million, is required to evacuate power from the 1,000-MW mine-mouth power plant in the northeast corner of Madhya Pradesh. NTPC awarded the construction contracts for the Stage-II power plant in March 1995, and POWERGRID will develop facilities required to transmit power to the load centers in central Madhya Pradesh, and to Maharashtra and Gujarat, the other states in the Western Region. The alternative would be to transport coal by rail from mines in the Vindhyachal region to power plant sites closer to the load centers. Based on alternative costs of coal transport by rail, the EIRR is estimated at 19.7 percent.

105. An economic analysis has also been conducted of the complete integrated power system expansion plan for Maharashtra, which is the largest state in the Western Region and will use almost half of the output from Vindhyachal Stage-II. The analysis of the 1991-1997 time-slice compares the total economic costs of incremental generation, transmission, and distribution during the period with the incremental economic benefits of power consumption to final consumers and indicates an EIRR of 15.1 percent, thus demonstrating that additional power supply is economically justified.

106. The economic benefits of the transmission augmentation in the Northeastern Region, which shows an EIRR of 18.2 percent, have been estimated on the basis of the incremental load to be served to meet normal load growth, loss reduction on transmission lines, and improved reliability of power supply. The economic benefits of the Northeastern RSCC, with an EIRR of 22.5 percent, have been estimated on the basis of increased effective use of generation and

transmission capacity, a reduction in average annual power outages, and more efficient coordination and utilization of thermal power plants in the region.

107. For the transmission system strengthening in Uttar Pradesh to evacuate power from NTPC's 420-MW Unchahar Stage-II Power Project, which is being financed by the Bank under Loan No. 907-IND, the EIRR is estimated to be 13.6 percent, based on the economic value of power supply to the ultimate consumers.

108. The East-South interconnector will enable power transfers between the Eastern and Southern Regions, which are not interconnected at present. An agreement has been made to export 500 MW of power from NTPC's Talcher mine-mouth power plant in the Eastern Region to the Southern Region, which currently imports coal from Orissa for power generation. However, future generation at mine-mouth power plants in Orissa and transmission to the south will be much more economical. The economic benefits have been evaluated on the basis of alternative coal transport costs from Talcher to the south, which result in an estimated EIRR of 21.3 percent.

109. Sensitivity analysis has been conducted to evaluate the impact on the major subprojects of (i) a 20 percent increase in subproject costs, (ii) a 20 percent reduction in subproject benefits, and (iii) a one-year implementation delay. All the major subprojects continue to be economically viable under these adverse scenarios.

B. Environment

110. The transmission subprojects and the implementation of the new bulk power supply and transmission tariffs will reduce the total output of pollutants from power plants by encouraging the optimal use of generation facilities through (i) a tariff structure that ensures that least-cost hydro and efficient thermal plants have the highest position in the merit order for dispatching for operation; (ii) bringing electricity into the system from new efficient coal-fired power plants, as well as from clean hydro and natural gas power plants; (iii) transferring electricity from one regional grid to another to benefit from the diversity in peak demand hours, and ensuring the optimal interregional use of power plants; and (iv) reducing demands to transport coal with a very high ash content on the overcrowded rail and road systems. The optimization of the use of power plants and the reduction of system losses by the RSCCs and through strengthening transmission lines will also improve frequency and voltage levels, which will reduce wear on electrical equipment, leading to more efficient use of resources and lower energy requirements.

C. Social Dimensions

111. The Project will be gender-neutral in regard to beneficiaries. Industrial, commercial, residential, and agricultural consumers will be the primary beneficiaries of the power supply provided by the various subprojects. Other benefits include employment opportunities during construction, and reduced load shedding and a more reliable power supply with less interruptions. Three subprojects are for transmission facilities that will increase the availability and security of supply in the Northeastern Region, which is the most disadvantaged area in

India. Additional power supply will create more jobs and improve productivity in the manufacturing sector.

VI. ASSURANCES

112. The Government and POWERGRID have given the following assurances, in addition to the standard assurances, which have been incorporated into the legal documents:

- (i) The Government will by 31 March 1997, approve setting POWERGRID's transmission tariffs at a level that will enable POWERGRID to recover full costs of service and earn a 16 percent ROR on its equity investments in transmission projects commissioned after 1 April 1997.
- (ii) Prior to 1 April 1997, POWERGRID will enter into commercial contracts for transmission services with its customers on terms and conditions satisfactory to the Bank and in accordance with the commercial conditions to be designed as part of the implementation of the recommendations of the Tariff Study.
- (iii) POWERGRID will exercise its rights under the commercial contracts with SEBs, particularly the right to suspend service to a SEB that is delinquent in its payments to POWERGRID.
- (iv) Prior to 31 August 1996, POWERGRID will increase the service charge on overdue accounts to a penal rate of not less than 2 percent per month.
- (v) POWERGRID will (a) take all necessary measures to produce, starting from FY1996, funds from internal sources equivalent to not less than 20 percent of its capital expenditures (on a three-year moving average); and (b) not incur any debt that will cause the ratio of debt to equity to exceed 80:20.
- (vi) POWERGRID will take all necessary steps to maintain its accounts receivable at a level not exceeding the total billings for its transmission services for the preceding two months.
- (vii) POWERGRID will furnish to the Bank, not later than seven months after the close of each financial year, its audited financial statements.
- (viii) Starting 31 December 1995, POWERGRID will furnish to the Bank, for the Bank's review and comments, not later than 31 December of each year, its financial projections, including its investment program, financing plan and financial statements for at least ten succeeding years.

- (ix) POWERGRID will, by 30 June 1996, place at each regional office an environment officer who will be responsible for monitoring the Project components from an environmental standpoint and for assisting with environmental assessments at new sites.
- (x) POWERGRID will arrange to provide the Bank with annual monitoring reports on a compensatory forests' status for five years after establishing the plantation.

VII. RECOMMENDATION

113. I am satisfied that the proposed loan would comply with the Articles of Agreement of the Bank and recommend that the Board approve the loan of \$275 million to Power Grid Corporation of India Limited for the Power Transmission (Sector) Project from the Bank's ordinary capital resources, with interest to be determined in accordance with the Bank's pool-based variable lending rate system for US dollar loans and with an amortization of 20 years, including a grace period of 4 years and such other terms and conditions as are substantially in accordance with those set forth in the draft Loan and Guarantee Agreements presented to the Board.

MITSUO SATO
President

23 October 1995

APPENDIXES

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SUPPLEMENTARY APPENDIXES

(available on request)

- A. Appraisal Report for a Sample Subproject
- B. Summary of Report of the National Development Committee on Power

PERFORMANCE OF STATE POWER SECTORS (FY1993)

State Electricity Board	Profit / (Loss)		Rate of Return w/o Subsidy (%)	Internal Cash Generation (Rs million)	Average Tariff		Cost of Supply (Rs/kWh)	Cost Recovery (%)	Increased Agriculture Tariff * (Rs million)
	Without Subsidy	With Subsidy			All Consumers (Rs/kWh)	Agriculture (Rs/kWh)			
1 Andhra Pradesh	(2)	(2)	0	1,030	0.94	0.08	1.00	94	3,308
2 Assam	(3,422)	(3,422)	-47	(672)	1.17	0.50	2.73	43	0
3 Bihar	(2,795)	(2,796)	-20	(2,016)	1.18	0.10	1.86	64	208
4 Gujarat	(7,700)	(7,700)	-25	(5,960)	1.05	0.11	1.49	71	3,008
5 Haryana	(4,022)	(3,670)	-26	(2,716)	0.73	0.26	1.36	54	1,025
6 Himachel Pradesh	(409)	(409)	-13	(68)	1.01	0.33	1.31	77	2
7 Karnataka	(194)	322	-2	3,848	0.93	0.04	1.00	93	2,466
8 Kerala	(619)	(619)	-11	1,125	0.75	0.25	0.86	87	59
9 Madhya Pradesh	(2,107)	(16)	-6	(1,525)	1.21	0.25	1.40	86	918
10 Maharashtra	1,616	1,616	3	2,524	1.37	0.15	1.39	99	2,898
11 Meghalaya	(122)	(57)	-12	(32)	0.90	0.43	1.19	75	0
12 Orissa	(498)	260	-5	410	0.81	0.42	0.92	88	26
13 Punjab	(6,265)	(6,265)	-20	(1,328)	0.70	0.11	1.22	58	2,422
14 Rajasthan	(2,088)	735	-9	(298)	1.07	0.31	1.33	81	662
15 Tamil Nadu	(2,576)	924	-9	2,536	1.07	0.00	1.25	86	2,580
16 Uttar Pradesh	(9,689)	(1,199)	-20	(294)	1.08	0.32	1.56	69	1,563
17 West Bengal	(2,736)	(2,056)	-37	(1,231)	1.15	0.19	1.64	70	225
Total / Average	(43,628)	(24,352)		(4,667)	1.06	0.16	1.33	80	21,371

* Additional revenue that would be generated by increasing agriculture tariff to Rs0.50/kWh.

Source: Annual Report on the Working of SEBs and EDs, Planning Commission, February 1994.

Region and State		Revenue FY1993	Revenue FY1994	Accts. Rec. Gross	Central Approp.	Net A/R 31 Mar 94	Accts. Rec. 30 Jun 94 Amount	Months	Amount	Months
1	Northern Region									
2	Jammu & Kashmir	114.5	109.9	149.4	110.0	39.4	16.6		(24.3)	(2.1)
3	Himachal Pradesh	28.6	26.7	23.9	13.4	10.5	8.3		(9.2)	(3.2)
4	Punjab	279.4	257.8	178.4	134.1	44.3	3.5		(67.2)	(4.2)
5	Haryana	273.5	330.4	324.9	262.0	62.9	10.0		50.4	2.2
6	Rajasthan	406.0	433.2	383.1	275.8	107.3	56.8		62.9	1.2
7	Uttar Pradesh	970.6	852.9	1,128.3	987.5	140.8	214.7		506.7	9.7
8	Delhi Electric Supply Union Territory of Chandigarh	297.0	345.5	279.9	237.3	42.6	8.4		1.2	0.0
	Subtotal	2,384.7	2,369.6	2,471.5	2,020.1	451.4	313.7	1.5	(0.7)	(1.1)
9	Western Region									
10	Madhya Pradesh	464.1	487.3	(103.4)		(103.4)	(165.4)		(141.6)	(3.0)
11	Gujarat	217.1	277.2	(20.5)		(20.5)	(57.8)		(75.6)	(2.9)
12	Maharashtra	300.5	288.8	(18.7)		(18.7)	(67.1)		(74.1)	(4.7)
13	Goa	28.2	32.1	(6.5)		(6.5)	(11.8)		(9.7)	(4.6)
14	Daman & Diu	6.5	7.9	(0.6)		(0.6)	(1.7)		(2.3)	(2.4)
	Dadra & Naga Haveli	10.6	12.0	(1.4)		(1.4)	(2.8)		(3.5)	(2.9)
	Subtotal	1,027.1	1,105.2	(151.1)	0.0	(151.1)	(306.5)	(3.3)	(306.6)	(3.2)
15	Southern Region									
16	Andhra Pradesh	359.5	535.3	283.1	150.6	132.5	139.0		351.7	6.9
17	Karnataka	193.2	249.5	150.0	85.9	64.1	(5.4)		30.2	1.2
18	Kerala	62.8	151.0	62.0	28.3	33.7	30.5		72.5	4.4
19	Tamil Nadu	271.3	444.2	282.3	153.0	129.3	72.8		184.4	4.6
20	Pondicherry	35.1	47.4	5.2		5.2	(0.1)		(4.4)	(1.2)
	Goa	19.0	25.5	0.2		0.0	(3.7)		-3.74	(1.7)
	Subtotal	940.8	1,427.3	782.6	417.8	364.8	233.0	1.9	634.4	4.5
21	Eastern Region									
22	Bihar	199.0	596.2	198.4	238.5	(40.1)	(104.0)		(81.8)	(2.9)
23	Orissa	330.6	334.3	186.2	157.2	29.0	14.5		(57.0)	(3.9)
24	West Bengal	184.5	47.7	36.6	42.2	(5.6)	(5.0)		2.6	0.6
25	Sikkim	214.2	7.5	131.8	1.7	130.1	130.5		3.0	13.6
	Danodur Valley Corporation	11.1	221.2	(38.8)		(38.8)	(91.5)		77.5	8.0
	Subtotal	939.4	1,207.0	514.2	439.6	74.6	(55.6)	(0.8)	(55.7)	(1.0)
26	Northeastern Region									
27	Assam	78.2	75.4	94.6	98.0	(3.5)	(11.7)		2.8	(1.9)
28	Meghalaya	2.7	4.7	7.4	7.3	0.1	0.9		0.2	0.3
29	Tripura	9.2	14.2	2.1	3.7	(1.7)	(0.7)		(3.6)	(4.8)
30	Mizoram	9.7	13.2	3.7		3.7	3.7		(1.8)	(2.4)
31	Manipur	15.7	16.9	32.8	29.7	3.1	5.7		13.1	11.4
32	Nagaland	7.8								

Total

STATE POWER SECTORS' GENERATION AND CONSUMPTION (FY1993)

	Installed Capacity (MW)	Gross Generation (GWh)	Purchased Power		Available for Sales (GWh)	System Losses (%)	Sales (GWh)	Sales by Consumer Category				Agri-culture (%)	
			Central (GWh)	Other (GWh)				Residential (GWh)	Commercial (GWh)	Agri-culture (GWh)	Industry (GWh)		Other (GWh)
State Electricity Board													
1 Andhra Pradesh	4,173	17,872	6,039	1,155	25,066	23%	19,386	2,825	610	7,894	5,688	2,369	40.7%
2 Assam	537	1,068	772	270	2,111	25%	1,590	232	110	30	588	630	1.9%
3 Bihar	1,554	2,967	4,398	79	7,444	25%	5,614	506	322	1,527	2,673	585	27.2%
4 Delhi Electric Supply	614	2,432	7,265	486	10,183	23%	7,802	3,244	1,120	43	2,087	1,308	0.6%
5 Gujarat	4,312	20,303	4,759	683	25,745	28%	18,571	1,612	423	7,713	6,629	2,194	41.5%
6 Haryana	882	7,741	3,085	358	11,184	24%	8,474	1,486	227	4,182	1,915	664	49.4%
7 Himachal Pradesh	274	1,087	425	588	2,100	21%	1,665	283	88	14	633	647	0.8%
8 Karnataka	3,035	13,231	3,628	11,474	28,333	54%	12,963	2,054	307	5,340	4,479	783	41.2%
9 Kerala	1,468	6,189	1,232	0	7,421	21%	5,838	1,841	706	235	2,617	439	4.0%
10 Madhya Pradesh	3,618	13,259	9,084	469	22,812	26%	16,783	2,730	570	3,601	7,215	2,668	21.5%
11 Maharashtra	7,557	31,033	6,500	2,536	40,069	22%	31,454	3,549	851	8,331	11,707	7,016	26.5%
12 Meghalaya	194	430	0	0	430	1%	426	36	44	2	85	260	0.4%
13 Orissa	1,708	5,184	944	1,135	7,263	25%	5,435	1,118	210	328	3,026	753	6.0%
14 Punjab	2,245	14,700	3,428	63	18,192	19%	14,788	1,795	387	6,179	4,869	1,558	41.8%
15 Tamil Nadu	4,309	16,981	7,248	11	24,240	21%	19,130	2,975	1,029	5,160	7,999	1,967	27.0%
16 Uttar Pradesh	5,599	18,167	12,786	38	30,991	28%	22,318	4,577	1,435	8,498	5,941	1,867	38.1%
17 West Bengal	2,278	7,156	773	4,787	12,717	51%	6,225	1,003	474	732	1,924	2,093	11.8%
Subtotal	44,356	179,802	72,365	24,133	276,300	28%	198,462	31,867	8,913	59,808	70,074	27,800	30.1%
Electricity Department *													
1 Arunachal Pradesh	28	54	25	0	79	23%	61	32	8	6	4	12	9.0%
2 Goa	0	0	517	0	517	-25%	647	152	44	9	350	92	1.4%
3 Danodar Valley Corporation	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4 Jammu & Kashmir	262	801	1,838	145	2,784	45%	1,520	273	133	157	335	622	10.3%
5 Manipur	12	4	253	0	256	20%	205	88	12	4	41	60	1.9%
6 Mizoram	29	19	70	2	92	29%	65	46	6	0	1	13	0.0%
7 Nagaland	6	4	103	26	132	33%	89	52	8	0	7	22	0.0%
8 Pondicherry	0	0	647	178	826	16%	694	67	22	85	507	13	12.3%
9 Sikkim	30	43	24	0	67	31%	46	23	10	0	8	5	0.0%
10 Tripura	55	173	49	22	244	31%	168	44	20	28	33	44	16.5%
11 Union Territory of Chandigarh	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12 Danan & Diu	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13 Dadra & Naga Haveli	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Subtotal	422	1,098	3,527	373	4,997	30%	3,495	777	262	289	1,285	882	8.3%
Total	44,779	180,900	75,892	24,506	281,297	28%	201,957	32,644	9,175	60,097	71,360	28,681	29.8%
							100.0%	16.2%	4.5%	29.8%	35.3%	14.2%	

* Except for Jammu & Kashmir and Delhi Electric Supply, accounts for Electricity Departments are merged with those of state or local governments.

b Includes purchases from all central sector utilities.

c System losses include own consumption.

Source: Annual Report on the Working of State Electricity Boards and Electricity Departments - Planning Commission, February 1994.

SUMMARY OF TARIFF STUDY RECOMMENDATIONS

A. Background

1. The study was financed by the Bank under TA 1756-IND, for \$600,000, approved on 29 September 1992. The consultants commenced work in February 1993 and completed the final report in February 1994. The purpose of the study was to review existing power sector operations and tariffs for bulk power supply and transmission in India, and to develop (i) a framework for improved bulk power tariffs that would promote more economic and efficient dispatching of generation and improve the quality of public power supply in terms of frequency variations and power outages; (ii) an economically efficient yet practical and fair system of transmission tariffs for the new bulk transmission services provided by Power Grid Corporation of India (POWERGRID); and (iii) recommendations for suitable regulatory controls of POWERGRID's transmission operations as well as for regulation and approval of specific bulk power and transmission tariffs. The study covered a broad range of difficult problems and issues, but an impressive degree of dialogue and consensus was nevertheless achieved through the establishment of a senior level steering committee, a technical level working group, and several task forces, to represent all central and regional power agencies and state electricity boards (SEBs). The principal recommendations of the study are summarized below.

B. Bulk Supply Tariffs

2. Tariffs for bulk power supplied by central sector utilities (such as the National Thermal Power Corporation and National Hydro Power Corporation) and by independent private power producers are currently based on agreed tariffs for specific power plants operated by these entities. These agreements allocate a certain share of the output from the power plant to subscribing state electricity boards (SEBs). The bulk supply tariffs currently consist of two parts, with a fixed capacity charge that covers all fixed charges at a normative level of availability, and an energy charge based on fuel and variable operation costs. In addition, the energy charge contains a bonus for generation above the normative availability. This structure encourages producers to generate as much as possible in each of their power plants, rather than following the plant merit order that reflects the cost of generation. To rectify this deficiency, the fixed capacity charge should be calculated on the basis of actual plant availability and the entitlement of each purchaser to this project under the power purchase agreement, regardless of whether the purchaser actually draws its full allowed entitlement. This will provide the incentive for producers to make their power plants available, but they would not actually generate power if it is not requested by purchasing SEBs. Achievement of availability rates higher than the norm would result in incentive payments.

3. Bulk power trading between SEBs should be governed by a system of tariffs for scheduled and unscheduled interchange. Tariffs for scheduled interchange, where amounts and schedules of power trades are agreed in advance, should include a capacity component and an energy component. A regional (pool) tariff could be agreed for a particular region, or a specific tariff could be negotiated between two SEBs for power trading between them.

4. If a SEB draws more than its entitlement under the scheduled interchange agreement, the excess consumption will be deemed unscheduled interchange (UI), which should be priced at a specified tariff. UI should be monitored on an hourly basis, and the UI tariff should be high enough during peak load periods or periods of low frequency to discourage

SEBs from drawing beyond their entitlement from the power pool. During off-peak periods, the UI tariff should be lower than the scheduled interchange tariff to discourage excessive generation and forced export to other members of the pool. A three-part tariff is recommended, based on the two-part scheduled interchange tariff plus a third part, which would be a penalty (or bonus) linked to deviations in system frequency from the norm of 50 hertz. SEBs that over-consume would have to pay compensation, based on the UI tariff, to SEBs that are deprived of their entitled consumption, and net payments would balance out within the pool. Each regional electricity board, comprising the SEBs in that region, should determine its own appropriate UI tariff.

C. Transmission Tariffs

5. Current POWERGRID transmission tariffs in each region are based on a uniform single part tariff per kilowatt-hour of energy transmitted from central sector generating projects to the various client SEBs in that region. The tariff study recommended that (i) two-part transmission tariffs should be established, with a fixed capacity cost component and an energy cost component to account for losses; (ii) access to the transmission grid should be available to any qualified entity; and (iii) separate tariff designs should be used for fundamentally different transmission services, such as evacuation of power from central sector plants, intraregional power transfers between SEBs, interregional power transfers between regional electricity boards, and operation of the regional system coordination centers.

D. Regulation

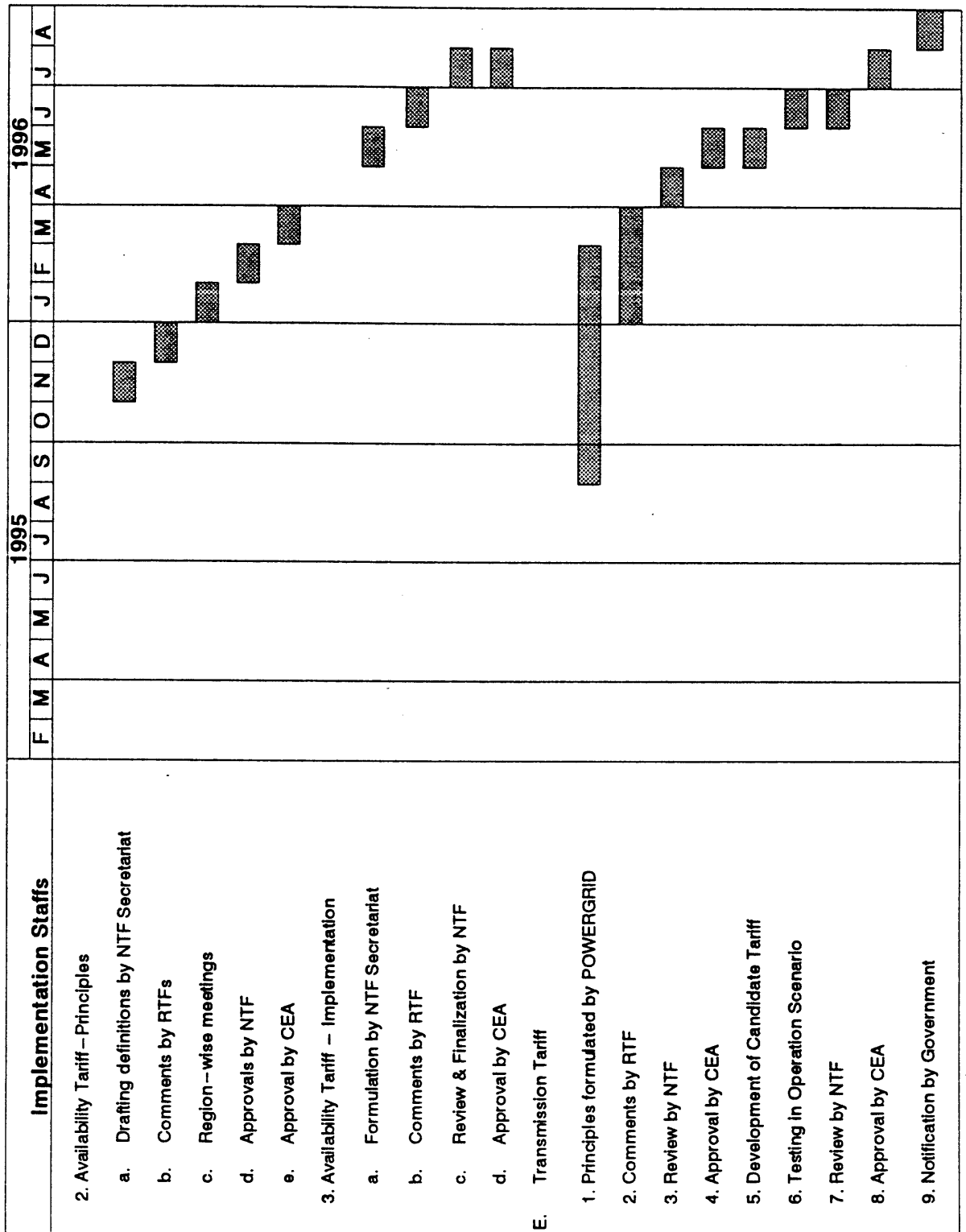
6. The study report also contains many general recommendations on the regulation of the power sector, which are too numerous to summarize briefly. The report recommends that the Central Electricity Authority (CEA) retain its current role in the central sector planning structure, which includes coordinating the planning proposals of the state governments, central sector power entities, and regional bodies. As private generators emerge under the Government's new policies, CEA should adapt its supply planning review function to accommodate the efficient development of this sector and the possible development of competition in bulk power supply by independent power producers. CEA should, however, avoid micro managing independent power producers' project developments by detailed review of project plans and costs. CEA should exercise exclusive jurisdiction over, and act independently to develop detailed tariff policies; and formulate, review, and approve, disapprove, or modify bulk power and transmission tariffs filed by national power entities according to general tariff principles prescribed by Government statute. These principles should be elaborated in more detailed regulatory standards and policies by CEA for each area of tariffs under its jurisdiction. Once these standards and policies are sufficiently developed, they should replace Ministry of Power notifications that directly prescribe tariff standards.

E. Implementation

7. The purpose of the tariff study was to develop basic principles for tariff setting and regulation. In many cases, these basic principles still allow considerable latitude for detailed tariff design. The tariff study report has been reviewed by the Government of India, which has approved all recommendations related to bulk power supply tariffs and transmission tariffs. The recommendations related to the regulatory reform need further analysis.

Implementation Staffs	1995												1996											
	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A					
Acceptance of the Report																								
Constitution of NTF																								
Constitution of RTFs																								
A. Market Mechanism (by RTFs) (separately for each region)																								
1. Options – Review & Choices																								
2. Model Agreements (Discussion by RTFs)																								
a. Development of Model Agreements by RTF Secretariat																								
b. Debate on Agreements by RTFs																								
c. Finalization by RTF																								
B. Operational Principles																								
1. Guidelines by NTF																								
2. Development by RTFs' Secretariat																								
3. Review by RTF																								
4. Review by NTF																								
5. Review by CEA																								
6. Adoption in the Regions																								

	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A
	1995									1996									
Implementation Staffs																			
C.																			
Interchange Tariffs (Development by RTF Secretariat & Review by RTF)																			
1. Bilateral Trading Principles																			
2. Establish Candidate Tariffs																			
3. Testing the Tariffs Against Operation Scenarios																			
4. Formulation of Recommendations by RTF																			
5. Circulation to All Pool Participants																			
6. Analysis of Comments by NTF Secretariat																			
7. Transmission to NTF																			
8. Review and Finalization																			
9. Approval by CEA																			
D.																			
Generation Tariffs																			
1. Modified Rao Tariff																			
a. Development by NTF Secretariat																			
b. Comments of RTFs																			
c. Approval by NTF																			
d. Approval by CEA																			
e. Notification by the Government																			



CEA = Central Electricity Authority; NTF = National Task Force; RTF = Regional Task Force

APPROACH FOR IMPLEMENTATION OF BULK SUPPLY AND TRANSMISSION TARIFFS AND RELATED REGULATION

A. Background

1. In February 1995, the Ministry of Power constituted a national task force (NTF) and regional task forces (RTFs) in the five power regions to implement recommendations arising from TA No. 1756-IND: Study of Bulk Power and Transmission Tariffs and Transmission Regulations (the Tariff Study). The document establishing the NTF also contained brief terms of reference for these task forces, which will supervise the design of detailed tariffs for bulk power supply and interchange. The Power Grid Corporation of India Limited (POWERGRID) is proceeding with the design of tariffs for power transmission, which will be discussed and agreed with the RTFs and the NTF. Advisory support needed by NTF and the RTFs in areas requiring special expertise, will be provided by consultants experienced with this work. The development of a regulatory framework will be initiated on the basis of a proposal by the Ministry of Power (MOP). This proposal will be provided to the Bank for review and comment before implementation. If required, MOP will engage consultants for development of the proposal for the regulatory framework and for its implementation, as part of the Project. Based on preliminary estimates, about 25 person-months of international consulting services will be required to assist MOP, NTF and RTFs. The consulting services will be financed from the proposed Bank loan to POWERGRID.

2. The success of the implementation efforts will depend on the degree of support of the agencies involved. POWERGRID has already started, with assistance from two firms from the United Kingdom, to develop grid codes and operating procedures in the Southern and Eastern Regions and work is now beginning in the Northeastern Region.

3. The Government has not yet decided upon the most suitable form of regulatory administration. The basic principles for the regulation of tariffs and bulk power supply were analyzed and recommendations were made in the Tariff Study. More detailed analysis is needed of the requirements for national regulation of power sector operations, and the interactions between national- and state-level regulation. Further discussions are also required to agree upon the most suitable regulatory organization. The Tariff Study recommended that the Central Electricity Authority should become the basic regulatory agency for the power sector, but there is not yet a clear consensus on this issue.

B. Objectives

4. The NTF, RTFs and POWERGRID will prepare the detailed design and undertake implementation of bulk power supply and transmission tariffs while MOP will develop a regulatory framework and related institutional support for administration of the regulations, and implement the regulatory regime.

C. Scope of Work

1. Bulk Supply and Interchange Tariffs

5. Based on the principles for the design of bulk supply and interchange tariffs, as described in the Tariff Study and approved by the Government,

- (i) the NTF will review the components of fixed charges and develop a detailed generation tariff design, including the set of general data definitions (availability target, mechanical availability target, basic availability credit, basic incentive credit), and data collection requirements needed to implement the generation tariffs;
- (ii) the RTFs will
 - (a) review the available range of modes of operation for bulk power supply and interchange that are within the limits permitted by the approved tariff principles, and select the one to be adopted by each region;
 - (b) review recommended bilateral and pool tariffs for scheduled and unscheduled interchange and develop detailed designs;
 - (c) develop a transition plan to implement the recommended generation tariffs;
 - (d) develop detailed procedures for design and calculation of bulk supply tariffs, and develop computer-based models to calculate bulk supply tariffs for specific power plants (at least one of each type of power plant) as examples to validate the tariff design and for development of tariffs for other power plants;
 - (e) develop draft unit-by-unit availability tariff and hydro generation tariff designs for submission to the central tariff regulator;
 - (f) develop an operating agreement that includes regional operational planning and scheduling and dispatch procedures;
 - (g) develop detailed procedures and computer models to calculate the payments due for bulk power consumption by typical State Electricity Boards and other typical consumers; and prepare examples to illustrate the application of each procedure for each type of bulk consumer;
 - (h) develop functional requirements, implementation options, and a detailed plan for a settlement system for bilateral and pool, scheduled and unscheduled interchange tariffs and central sector generation tariffs; and
 - (i) develop payment procedures for interchange and central sector generation; and
 - (j) develop interim and final requirements for billing and control metering for each Region.

2. Transmission Tariffs

6. The NTF, RTFs, and POWERGRID will develop a detailed transmission tariff design based on the Tariff Study recommendations, including:

- (i) for reactive power, based on agreed thresholds for voltage deviations from nominal values, develop appropriate incentives/disincentives for controlling reactive power flows;
- (ii) for capacity additions, determine minimally adequate regional transfer capability and the level and form of incentives/disincentives;
- (iii) determine appropriate capacity, discount, and carrying charges;
- (iv) develop a methodology for determining power flows of individual transactions for specific transmission facilities;
- (v) develop a method for evaluation and standards of performance for grid operation;
- (vi) develop a methodology for setting cost responsibility for incremental capacity and the allocation of revenue responsibility; and
- (vii) develop a flow-based pricing methodology; and
- (viii) develop transmission tariffs which incorporate the above features, and submit them for final approval.

3. Power Sector Regulation at the National Level

7. The MOP is currently reviewing objectives and requirements of power sector regulation at the national level, and the interactions between national- and state-level regulation. MOP will identify alternative options for regulatory organization at the national level, and select the most suitable framework for regulation. Thereafter, MOP will prepare a framework proposal for implementation of the selected system of regulation of the power sector at the national level. Subsequently, MOP will:

- (i) prepare detailed plans and organizational procedures for the selected regulatory framework. These will cover proposed statutory and administrative changes, as necessary, to grant a central regulatory agency exclusive jurisdictional authority, and independence from the Government, over bulk power and transmission tariffs, including the power to require provision of books and records and to render final and binding decisions; and
- (ii) develop and publish regulatory standards and dispute resolution processes that are related to interchange and generation tariffs and propose statutory changes to establish charters of responsibilities for central power sector agencies.

D. Progress Reviews

8. For the implementation of the bulk supply and transmission tariffs, the NTF will prepare quarterly reports describing progress against the implementation schedule agreed by the Government. These reports will highlight (i) accomplishments against the schedule, (ii) problems and proposed solutions, and (iii) agreed changes in schedules. Other outputs will consist of technical papers, recommended operating procedures, and tariff structures. The NTF will also organize quarterly meetings, commencing in January 1996, to review overall implementation progress with the Bank.

9. For the work on power sector regulation at the national level, MOP will provide its proposal for implementation of the framework to the Bank for review and discussion by 31 October 1996. Thereafter, MOP will host regular consultation meetings with the Bank to review progress in the work.

PREVIOUS BANK ASSISTANCE TO THE POWER SECTOR IN INDIA

Loan No.	Project	Amount (\$ million)	Date Approved
1. Public Sector			
798-IND:	North Madras Thermal Power Plant	150.0	18 Nov 1986
907-IND:	Unchahar Thermal Power Project	160.0	29 Sep 1988
988-IND:	Rayalaseema Thermal Power Plant	230.0	21 Nov 1989
1029-IND:	Second North Madras Thermal Power Plant	200.0	30 Aug 1990
1161-IND:	Power Efficiency (Sector) Project	<u>250.0</u>	26 Mar 1992
	Subtotal	990.0	
2. Private Sector			
7058/1036:	CESC Transmission Project	17.8	04 Oct 1990
7082/1142:	CESC Thermal Power Plant	<u>32.0</u>	13 Dec 1991
	Subtotal	49.8	
Complementary Cofinancing to			
C-19-IND:	Power Finance Corp for TNEB and APSEB	<u>110.8</u>	13 Nov 1990
	Total	1,149.8	
TA No.	Project	Amount (\$'000)	Date Approved
1119-IND:	Power Sector Loan	50	06 Feb 1989
1228-IND:	APSEB Operational Improvement Support	1,000	21 Nov 1989
1229-IND:	National Program for Environmental Management for Coal-Fired Generation	664	21 Nov 1989
1365-IND:	TNEB Operational Improvement	740	30 Aug 1990
1366-IND:	Environmental Monitoring and Pollution Control	490	30 Aug 1990
1756-IND:	Study of Bulk Power and Transmission Tariffs and Transmission Regulations	600	29 Sep 1992
2116-IND	Power System Planning in Orissa	<u>600</u>	28 Jun 1994
	Total	4,144	

POWERGRID'S TRANSMISSION DEVELOPMENT PLAN

Region	Type	Project	Scheduled Date		Base Cost (Rs million)
			Start	Completion	
Eastern Region	Central Facilities	RSCC	1994	1999	4030
		Additional Tfrs and Reactors	2001	2004	600
		SVCs in the grid	1998	2005	1,080
		Takeover TL/S station	2002	2004	960
		Install capacitors	2001	2007	1,440
		High capacity North-East link	1999	2007	13,330
	NTPC power evacuation	Jeypore HVDC link	1995	1999	3,250 ^a
		West-East HVDC link	2002	2007	1,210
		North-East HVDC link	1995	2001	2,750
		Farakka II	1994	1995	2,670
		Kahaigaon I	1994	1997	2,180
		Talcher I	1993	1996	1,320
		Talcher II	1997	2006	10,000
		North Karanpura	1997	2007	4,000
		Kahaigaon II	1997	2007	2,500
		Ib Valley I	1997	2007	12,000
	NHPC power evacuation	Koelkara-Jamshedpur	1996	2003	1,850
		Teesta III	1997	2007	15,000
Northern Region	Central facilities	RSCC	1994	2004	4,030
		Additional Tfrs and Reactors	2001	2004	600
		SVCs in the grid	1998	2005	1,080
		Takeover TL/S station	2002	2004	960
		Install capacitors	2001	2007	1,440
		North-West HVDC	2002	2007	3,120
	NTPC power evacuation	North-East HVDC link	1995	2001	2,750
		Faridabad Gas I	1994	1999	1,970
		Anta Gas II	1997	2004	990
	NHPC power evacuation	<i>Unchahar II</i>	<i>1994</i>	<i>1999</i>	<i>1,124</i>
		Rihand II	1994	2002	2,000
		Yarmuna Nagar I	1995	2000	750
		Rihand III	1997	2005	8,000
		Charma-Moga	1992	1997	3,800
		Moga-Bhawani	1992	1997	1,310
		Uri-Srinagar	1994	1998	2,420
		Nathpa-Jhakari	1992	2001	16,870
		Kishenpur-Moga	1993	2000	5,250
		Dulhasti contingency	1992	1996	2,040
		Teri-Meerut	1995	2001	5,550
		Chamera-Kishanpur	1994	1998	800
		Bagihar-Kishenpur	2000	2006	760
		Dhaulganga-Bareilly	1997	2001	2,150
		Baspa	1998	2003	2,500
		Sawallot-Kisherpur	1998	2002	580
		Teri II	1998	2002	1,200
		Koteshwar	1998	2002	1,400
	Navelli Lignite Corporation NPC	Baira Siul	1995	1997	240
		Rajasthan APP 3-6	1996	2007	4,970

POWERGRID'S TRANSMISSION DEVELOPMENT PLAN

Region	Type	Project	Scheduled Date		Base Cost (Rs million)
			Start	Completion	
Southern Region	Central facilities	RSCC	1995	2002	4,030
		Additional Tfrs and Reactors	2001	2004	600
		SVCs in the grid	1999	2004	1,080
		Takeover TL/S station	2002	2004	960
		Install capacitors	2002	2007	1,440
		Chandrapur HVDC	1994	1998	4,000
	NTPC power evacuation	Jeypore HVDC	1995	1999	3,250^a
		West-South HVDC	2005	2007	4,150
		Godavari I	1998	2001	390
		Ramagundam III	1999	2007	2,500
		Mangalore I	1999	2003	1,310
		Kayakulam I	1998	2000	880
	NHPC power evacuation	Hibra	2000	2006	1,000
	Navelli Lignite Corporation	TS Expansion	1996	2001	5,780
Western Region	Central facilities	RSCC	1995	2002	4,030
		Additional Tfrs and Reactors	2001	2994	600
		SVCs in the grid	1998	2004	1,080
		Takeover TL/S station	2002	2004	960
		Install capacitors	2002	2007	1,440
		North-West HVDC link	2003	2007	3,130
		Chandrapur HVDC	1994	1998	4,000
		West-East HVDC Link	1997	2001	1,210
	NTPC power evacuation	West-South HVDC II	2002	2006	4,150
		Kishenganga	1998	2003	2,500
		Gandhar Gas	1992	1997	2,880
		Vindhyachal Dhule	1994	1999	4,470
	NPC power evacuation	Vindhyachal II	1995	1999	6,745
		Kawas II	1999	2001	1,000
		Tarapur	2001	2005	1,000
Northeastern Region	Central facilities	RSCC	1995	2000	1,784
		System reinforcement	1994	1998	988
		Additional Tfrs and Reactors	2001	2004	600
		SVCs in the grid	1998	2004	1,080
		Takeover TL/S station	2002	2004	960
		Install capacitors	2002	2007	1,444
	NEEPCO power evacuation	North-East HVDC link	1998	2006	13,330
		Doyang	1992	1996	1,150
		Ranganadi	1993	1997	1,360
		Kopili Ext	1994	1997	189
		Kathalgudi	1992	2001	6,790
		Balipara-Tnnga	1996	1998	240
		Agartala	1995	1998	160
		Kameng	1998	2002	650
		Assam Gas I	2002	2006	2000

HVDC - High voltage direct current; NEEPCO - Northeast Electric Power Corporation; NHPC - National Hydropower Corporation; NPC - Navelli Power Corporation; NTPC - National Thermal Power Corporation; RSCC - Regional System Coordination Center; SVC - Static Voltage Compensator; TL/S - Transmission Line Substation; Tfrs - transformers; TS - Transmission System Subprojects included under the loan are in bold italics.

^a Only alternating current portion included as subproject.

Source: Development Plan and Financial Projections, POWERGRID, December 1994.

DESCRIPTION OF THE PROPOSED SUBPROJECTS

1. **Augmentation of Transmission Systems in South Assam, Mizoram, and Tripura.** Additional 132-kilovolt (kV) transmission lines will be constructed in the southern part of the Northeastern Region in order to improve the capacity, reliability, and quality (voltage) of the power system. This subproject includes eight components comprising 675 circuit-km (cct-km) of single-circuit 132-kV transmission lines, two new substations (Khleihriat and Badarpur) and eight substation extensions (two of which include installation of a 20 megavolt ampere reactive bus reactor). The commissioning year of all components is 1998.
2. **Agartala Transmission System.** This subproject is to evacuate power from the 84-megawatt (MW) Agartala gas-fired thermal power plant that the Northeast Electric Power Company will be constructing in Tripura for commissioning in 1998. The scope comprises 195 cct-km of single-circuit 132-kV transmission line from Agartala to Kumarghat and a 132-kV bay extension of Kumarghat substation.
3. **Kopili Stage-I Extension Transmission System.** This subproject is to evacuate power from additional 100-MW (2 x 50-MW) Kopili Stage-I hydropower plant that the Northeast Electric Power Company will be constructing in South Assam and commissioning in 1997. The scope comprises 85 cct-km of single-circuit 220-kV transmission line from Kopili to Misa via Khandong and extension of the 400/220-kV substation at Misa.
4. **Northeastern Regional System Coordination Center.** This subproject will enhance the capability and reliability of power system operation and load dispatching in the Northeastern Region by introducing System Control and Data Acquisition (SCADA) capability in the Regional System Coordination Center (RSCC) of the Power Grid Corporation of India Limited (POWERGRID), which will be commissioned in 2000. The scope comprises computer systems (hardware and software) for the RSCC, communication systems, and remote terminal units for substations and power plants. This subproject also includes SCADA systems for each state in the Northeastern Region that will be operated by the State Electricity Boards after training from POWERGRID. Finally, the subproject includes consulting services required for its implementation.
5. **Unchahar Stage-II Transmission System.** This subproject will evacuate power from additional 420-MW (2 x 210-MW) Unchahar Stage-II coal-fired thermal units that the National Thermal Power Corporation will be constructing in Uttar Pradesh in the Northern Region under the Bank's loan. The power plant will be commissioned in 1999. Contracts for the main power plant components such as boilers and turbines were awarded in early 1995. The scope comprises a 600 cct-km of double-circuit 220-kV transmission line from Unchahar to Kanpur, other associated transmission lines, and extension of the 400/220-kV substation at Kanpur. The substation extension includes installation of two, 315-megavoltampere transformers.
6. **Vindhyachal Stage-II Transmission System.** This subproject will evacuate power from the 1,000-MW (2 x 500-MW) Vindhyachal Stage-II coal-fired thermal units that the National Thermal Power Corporation will be constructing in Madhya Pradesh in the Western Region. The power plant is to be commissioned in 1999. Contracts for the main components were awarded

in early 1995. The scope comprises 270 cct-km of double-circuit 400-kV transmission line from Vindhyachal to Satna, 270 cct-km of double-circuit 400-kV transmission line from Satna to Bina, and 350 cct-km of other associated 400-kV transmission lines. This subproject includes two new 400/220-kV substations at Satna and Raipur with installation of two, 315-megavoltampere transformers for each, and three substation extensions (at Bhilai, Bina, and Korba).

7. **East-South Interconnector.** This subproject will transfer power from the Eastern Region to the Southern Region through the Gazuwaka 500-MW high voltage direct current (HVDC) back-to-back station. Power transfer through the inter-tie will improve the reliability and efficiency of the power system of both regions because of the load diversity and the generation mix differences between two regions. The subproject is to be commissioned in 1999. The scope comprises 550 cct-km of double circuit alternating current 400-kV transmission line from Jeypore substation in Orissa, Eastern Region, to Gazuwaka 500-MW HVDC back-to-back station in Andhra Pradesh, Southern Region. The portion of the subproject to be financed by the loan includes the 400-kV alternating current facilities at Gazuwaka station and extension of the Jeypore substation.

8. **Consulting Services for Implementation of the Tariff Study.** This subproject will provide specialist advisory assistance to the National and Regional Task Forces to develop and implement the recommendations for bulk supply and transmission tariffs under the Bank-financed TA No. 1756-IND: Study of Bulk Supply and Transmission Tariffs and Transmission Regulation. In addition, advisory services may also be utilized to assist the Ministry of Power to develop and implement a regulatory framework for the central power sector. Preliminary estimates indicate that about 25 person-months of international consulting services will be needed.

SUBPROJECT APPRAISAL REPORT FORMAT

The Power Grid Corporation of India (POWERGRID) will prepare an appraisal report for each subproject to be financed under the proposed loan, for review and approval of the Bank. The appraisal report and application for approval should contain the following information and documents:

- (i) confirmation that the beneficiary states of the subproject are in full compliance with their commercial contracts with POWERGRID and the current notified tariff;
- (ii) objective, scope, and description of the subproject;
- (iii) confirmation that the subproject is part of POWERGRID's least-cost development plan, and identification of the subproject in the development plan;
- (iv) a feasibility study demonstrating that the subproject is technically the best alternative (subject to environmental concerns) for solution of the problem, among all reasonable alternatives;
- (v) economic analysis consisting of the calculation of an economic internal rate of return (EIRR) to demonstrate the viability of the subproject (all assumptions used in the analysis should be described; economic feasibility requires that the subproject EIRR should be greater than 12 percent, and, for a subproject with a variable in-service date, the annual benefits must exceed the annual costs, calculated with a 12 percent interest rate, in the first full year of operation);
- (vi) an initial environmental examination (IEE), and, if necessary, an environmental impact assessment (EIA) and summary environmental impact assessment (SEIA) (the EIA and SEIA will be provided if the subproject meets the Bank's environmental criteria for Category "A;" the IEE should include the alternatives considered and reasons given for rejection of viable alternatives);
- (vii) copies of the Public Investment Board approval by the central Government, and, if necessary, approval in principle by the Ministry of Environment and Forests;
- (viii) detailed route and/or location map and single line diagram;
- (ix) list of main components in each package and mode of procurement;
- (x) implementation schedule;

- (xi) cost estimate subdivided into foreign exchange, local currency, and total costs and as set out in the following format:

	Foreign Exchange	Local Currency	Total Costs
Base Cost			
Physical contingencies			
Price contingencies			
Interest during Construction			
Total			
Funding Plan			
Bank			
POWERGRID			
Other			

- (xii) contract awards and disbursement schedule by currency by quarter.

DETAILED COST ESTIMATES
(\$ million)

Table 1: Summary Subproject Cost Estimates

	Foreign Exchange	Local Currency	Total
1. Augmentation of Northeastern Transmission System*			
Base Cost	17.02	11.57	28.59
Physical Contingencies	1.70	1.16	2.86
Price Contingencies	0.98	1.93	2.91
Subtotal	19.70	14.68	34.46
Interest During Construction	2.54	1.94	4.48
Total	22.24	16.60	36.84
2. Agartala Transmission System			
Base Cost	2.65	1.98	4.63
Physical Contingencies	0.27	0.20	0.47
Price Contingencies	0.08	0.15	0.23
Subtotal	3.00	2.33	5.33
Interest During Construction	0.37	0.33	0.71
Total	3.37	2.68	6.04
3. Kopili Stage-I Extension Transmission System			
Base Cost	3.17	2.28	5.45
Physical Contingencies	0.32	0.23	0.55
Price Contingencies	0.08	0.18	0.26
Subtotal	3.57	2.69	6.26
Interest During Construction	0.25	0.20	0.46
Total	3.82	2.89	6.72
4. Northeastern Regional System Coordination Center			
Base Cost	35.52	16.33	51.65
Physical Contingencies	3.53	1.63	5.16
Price Contingencies	2.61	2.64	5.25
Subtotal	41.46	20.60	62.06
Interest During Construction	7.86	3.94	11.80
Total	49.32	24.54	73.86

	Foreign Exchange	Local Currency	Total
5. Unchahar Stage-II Transmission System			
Base Cost	19.28	13.25	32.53
Physical Contingencies	1.93	1.33	3.25
Price Contingencies	1.19	2.26	3.45
Subtotal	22.40	16.84	39.23
Interest During Construction	3.94	3.62	7.56
Total	26.34	20.45	46.79
6. Vindhyachal Stage-II Transmission System			
Base Cost	113.76	81.50	195.26
Physical Contingencies	11.38	8.15	19.53
Price Contingencies	8.07	14.68	22.75
Subtotal	132.21	104.33	237.54
Interest During Construction	22.09	23.95	46.05
Total	155.30	128.28	283.58
7. East-South Interconnector			
Base Cost	30.45	21.60	52.05
Physical Contingencies	3.04	2.16	5.20
Price Contingencies	1.90	3.70	5.60
Subtotal	35.39	27.46	62.85
Interest During Construction	3.91	3.67	7.58
Total	39.30	31.13	70.43

* Details as provided in subproject appraisal are in Table 2.

Source: POWERGRID

Table 2: Augmentation of Northeastern Transmission System
 (\$ million)

Item	1995	1996	1997	1998	Total
A. Preliminary and Civil Works	0.01	0.01	0.04	0.03	0.10
B. Land and Compensation	0.04	0.07	0.18	0.15	0.44
C. Civil Works	0.15	0.23	0.60	0.53	1.51
D. Establishment	0.26	0.39	1.05	0.92	2.62
E. Tower Package					
Towers, including Nuts and Bolts	0.00	3.45	2.71	0.00	6.17
Erection and Civil Works	<u>0.00</u>	<u>1.09</u>	<u>1.55</u>	<u>1.55</u>	<u>4.19</u>
Subtotal	0.00	4.54	4.26	1.55	10.36
F. Conductor Package	0.00	1.39	2.18	0.40	3.97
G. Hardware and Accessories	0.00	0.05	0.24	0.03	0.31
H. Insulators	0.00	0.14	0.26	0.04	0.44
I. Shunt Reactors					
Supply	0.00	0.11	0.56	0.07	0.75
Erection	<u>0.00</u>	<u>0.00</u>	<u>0.03</u>	<u>0.00</u>	<u>0.04</u>
Subtotal	0.00	0.12	0.59	0.08	0.78
J. Substation Group A					
Equipment Supply	0.00	0.68	3.41	0.45	4.55
Erection	<u>0.00</u>	<u>0.11</u>	<u>0.29</u>	<u>0.17</u>	<u>0.57</u>
Subtotal	0.00	0.80	3.70	0.63	5.12
K. Substation Group B					
Equipment supply	0.00	0.39	1.84	0.39	2.63
Erection	<u>0.00</u>	<u>0.03</u>	<u>0.00</u>	<u>0.28</u>	<u>0.31</u>
Subtotal	<u>0.00</u>	<u>0.43</u>	<u>1.84</u>	<u>0.67</u>	<u>2.94</u>
Total Base Cost	0.47	8.15	14.94	5.03	28.59

Source: POWERGRID

PROJECT IMPLEMENTATION SCHEDULE

Item Description	Region	1994				1995				1996				1997				1998				1999				2000			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1 Northeastern Transmission System Augmentation	NE						n	o			a										c								
2 Agartala Transmission System	NE							n	o		a										c								
3 Kopill Stage – I Extension Transmission System	NE							n	o		a						c												
4 Northeastern Regional System Coordination Center	NE							n	o				a																c
5 Unchahar Stage – II Transmission System	N								n	o		a																	
6 Vindhyachal Stage – II Transmission System	W								n	o		a																	c
7 East – South Interconnector	E – S								n	o		a																	c
8 Consulting Services	All							n	o		a																		c

a = Letter of Award; AC = alternating current; c = Project Completion; E = Eastern; n = Notice Inviting Tenders; N = Northern; NE = Northeastern; o = Opening of Bid Documents; S = Southern; W = Western
Source: POWERGRID

TENTATIVE LIST OF CONTRACT PACKAGES

**Table 1: Augmentation of Northeastern Transmission System
Kopili Stage-I Extension Transmission System
Agartala Transmission System**

Package	Cost of Package	
	\$ million	Scope
Bid Document No. 1		
(a) Package A – Kopili–Misa 220–kV Tower	2.12	S+E
(b) Package B – Agartala–Kumarghat 132–kV Tower	2.12	S+E
(c) Package C – Augmentation of 132–kV Transmission System Tower	10.35	S+E
Bid Document No. 2		
(a) Package A – 220–kV and 132–kV Conductor and Earthwire	5.92	S
(b) Package B – 220–kV and 132–kV Insulator	0.63	S
(c) Package C – 220–kV and 132–kV Hardware and Accessories	0.47	S
Bid Document No. 3		
(a)* Package A – Substations of Badarpur (new), Badarpur (extension), and Khleihriat	4.94	S+E
(b)* Package B – Substations of Kumarghat, Jiribam, Aizwal, Khandong, Balrabi, and Misa	4.57	S+E
Total	31.12	

* The provision of the line protection and PLCC shall be made in the turnkey contract to avoid coordination problems.

S = Supply; E = Erection and commissioning

Table 2 : East – South Interconnector

Package	Cost of Package	
	\$ million	Scope
Bid Document No. 1		
(a) Package A – AAAC Conductor and Earthwire	18.21	S
(b) Package B – Insulators	3.29	S
(c) Package C – Hardware and Fittings	1.35	S
Bid Document No. 2		
(a) Package A – Gazuwaka Substation	27.01	S+E
(b) Package B – Jeypore Substation including Line Protection Relay and and PLCC for Gazuwaka end		S+E
Total	49.86	

Table 3 : Vindhyachal Stage-II Transmission System

Package	Cost of Package	
	\$ million	Scope
Bid Document No. 1		
(a) Package A – Vindhyachal–Satna 400–kV Double–circuit Tower	18.08	S+E
(b) Package B – Satna–Bina 400–kV Double–circuit Tower	18.08	S+E
(c) Package C – Korba–Raipur 400–kV Single–circuit, plus LLO of Korba–Bhilai 2 x Single–circuit Line at Raipur plus Reorientation of other lines in the Bhilai–Raipur area	15.15	S+E
Bid Document No. 2		
(a) Package A – Conductor + Earthwire of 400–kV Vindhyachal–Satna	14.18	S
(b) Package B – Conductor + Earthwire of 400–kV Satna–Bina	14.18	S
(c) Package C – Conductor + Earthwire Korba–Raipur 400–kV Single–circuit plus LLO of Korba–Bhilai 2xSingle–circuit Line at Raipur plus Reorientation of 400–kV Lines in the Bhilai–Raipur Area	12.12	S
(d) Package D – OPGW, Korba–Raipur	2.78	S+SU
Bid Document No. 3		
(a) Package A – Insulator	6.09	S
(b) Package B – Hardware and Fittings	4.16	S
Bid Document No. 4		
(a) Package A – Satna Substation – Bina Substation	36.19	S+E
(b) Package B – Raipur Substation – Bhilai Substation – Korba Substation		S+E
Total	141.01	

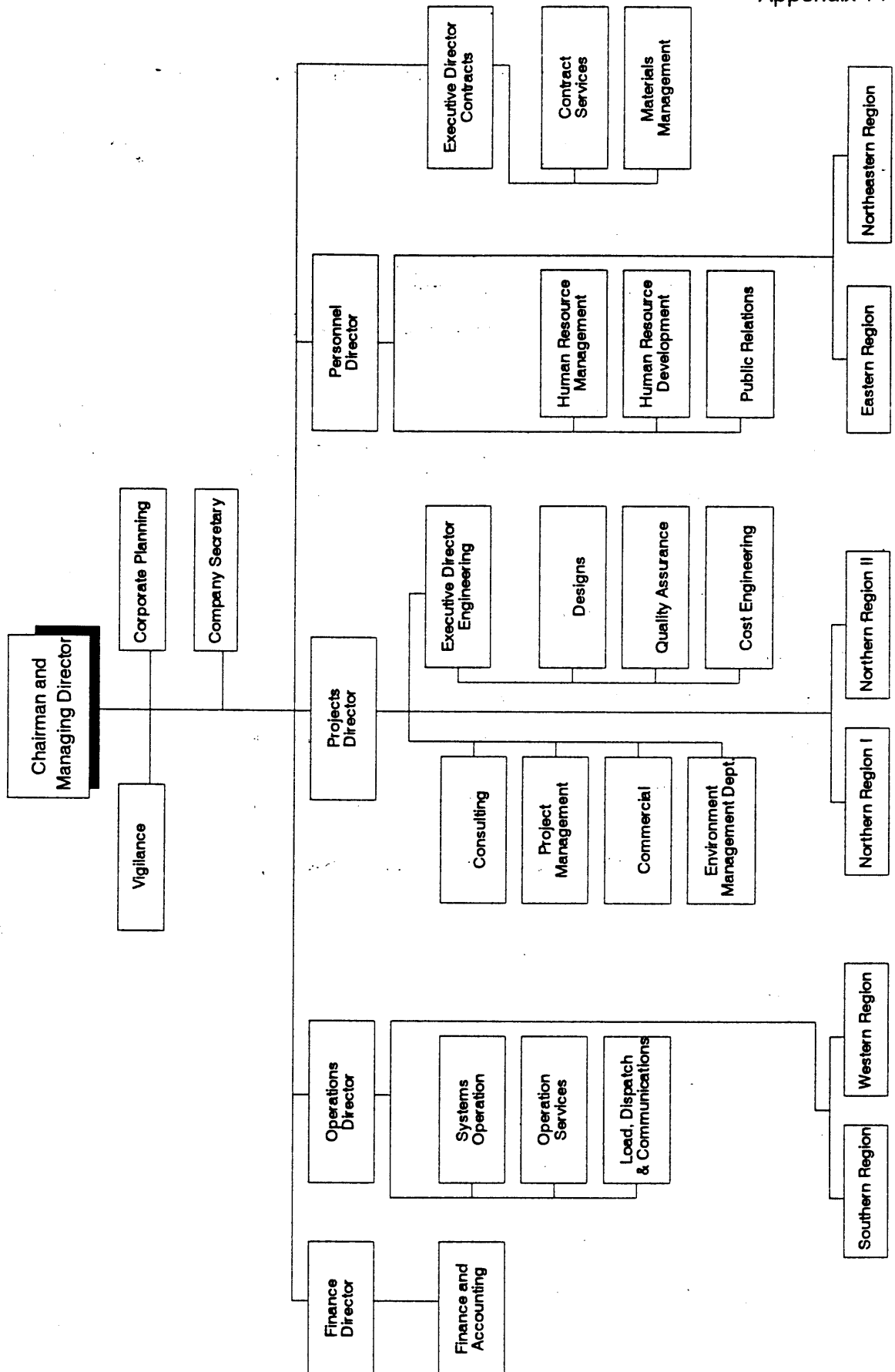
S = Supply; E = Erection and commissioning; SU = Supervision during erection

Table 4 : Unchahar Stage-II Transmission System

Package	Cost of Package	
	\$ million	Scope
Bid Document No. 1		
220–kV Tower Package	10.76	S+E
Bid Document No. 2		
(a) Package A – Conductor and Earthwire	5.96	S
(b) Package B – Insulator Package	0.75	S
(c) Package C – Hardware and Accessories	0.36	S
Bid Document No. 3		
Package A – Kanpur S/S Package	18.64	S+E
Total	36.47	

Source: POWERGRID

POWERGRID ORGANIZATION CHART



FINANCIAL PROJECTIONS

A. Assumptions

1. Price Escalation and Exchange Rates

Year	<---Inflation Rate (%)--->		Exchange Rate \$1 =
	Local	Foreign	
1993/94			Rs32.10
1994/95	6.9	2.5	Rs34.48
1995/96	9.0	2.5	Rs36.66
1996/97	7.0	2.5	Rs38.27
1997/98	6.0	2.5	Rs39.58
1998/99	5.0	2.5	Rs40.54
1999/00	5.0	2.5	Rs41.53
2000/01	5.0	2.5	Rs42.55
2001/02	5.0	2.5	Rs43.58

2. Income Statement

a. Revenues and Tariffs.

1. The Power Grid Corporation of India Limited (POWERGRID) is a service organization. Its projected revenues are not derived, as in most power utilities, from demand for electricity in a specific market, but are a function of the assets it operates. POWERGRID's transmission charges are the sum of the operating costs, which include normative operation and maintenance expenses, actual interest on loan funds, depreciation on capitalized assets, and a return on the equity portion of its average net fixed assets in operation. The present authorized return on equity for existing assets is 12 percent, but taking into account the increase in return on equity from 12 percent to 16 percent for new power generation projects, the same rate has been assumed for new transmission projects.

b. Operation and Maintenance.

2. Operation and Maintenance (O&M) is projected on a predefined norm of 1 percent of the capitalized cost of the assets in operation. Revaluation of assets is not allowed, but the value of the assets, on which O&M costs are calculated, is adjusted from time-to-time by decision of the Government to account for inflation and devaluation of the rupee. A 10 percent annual escalation as allowed under the existing contracts has been assumed. In line with current budget estimates, O&M cost are assumed to comprise salaries and wages (46 percent), operational spares (19 percent), and administration and other expenses (35 percent).

c. Depreciation.

3. According to Government guidelines, depreciation is 4 percent per annum of gross assets for the years up to FY1994 and 6 percent per annum from FY1995, up to 90 percent of

the cost. Depreciation of increased project cost due to foreign exchange rate variation is calculated at the same rates of 4 percent and 6 percent per annum, as the case may be, over the remaining depreciable life of the asset. Depreciation starts from the beginning of the financial year after the year in which the assets are commissioned.

d. Dividend on Share Capital.

4. An initial dividend of \$1.6 million (Rs50.0 million) was approved in FY1994. A dividend rate of 4 percent has been assumed for FY1995-1997, and 7 percent for FY1998-2002.

e. Interest on Loans.

5. Interest rates applicable to the sources of borrowing for the existing and new loans are given in Table 1.

Table 1: Interest Rates by Borrowing Source

Source		Interest Rate (%)
1. Existing		
a.	IBRD/IDA loans through the Government	15
b.	Bonds - Tax free	9 to 10.5
	- Taxable	13 to 17
c.	ECB - IBJ Japan	(average) 5.7
	- EXIM Japan	6
	- SEB Sweden	3
	- EDC Canada	9.5
d.	Other loans through the Government	15
e.	Domestic loans	15
2. New		
a.	ADB/IBRD/IDA direct loans	9
b.	Bonds	15
c.	ECB direct loans	10
d.	Other loans through the Government	15
e.	Domestic loans	15

ECB = external commercial borrowing; EDC = Export Development Corporation, Canada ; EXIM = Export-Import Bank of Japan; IBJ = Industrial Bank of Japan; IBRD = International Bank for Reconstruction and Development; IDA = International Development Association (World Bank); SEB = Skandinaviska Enskilda Banken II
Source: POWERGRID

3. Balance Sheet

a. Commissioned Cost/Gross Fixed Assets:

6. Up to FY1994 actual values from POWERGRID's annual audited Financial Statements/Balance Sheets are used. Subsequent years are based on the projected commissioning date of the projects and the escalated cost at the time of commissioning. Asset values denominated in foreign currency are revalued annually to reflect yearend exchange rates.

Projects are included up to the amount POWERGRID is authorized to commit to under the Eighth Plan and based on provisional estimates for Ninth Plan expenditure.

b. Work-in-Progress.

7. Capital work-in-progress balances are calculated as the difference between investment during the year and transfer of completed projects to fixed assets at the end of the fiscal year. The total capital work-in-progress has been indicated under two headings (i) Capital Works-in-Progress, which is estimated at 80 percent of the total; and (ii) Stores and Advances, estimated at 20 percent of the total.

c. Cash and Bank Balances.

8. Minimum cash of at least \$6.4 million (Rs200 million) is maintained assuming a minimum cash of \$0.6 million (Rs20 million) in each of the six regions and \$2.5 million (Rs80 million) at the Corporate Center.

d. Short-term deposits.

9. These are created out of unutilized bond money.

e. Receivables.

10. Receivables are projected as equivalent to 3 months of revenue outstanding.

f. Inventories.

11. Inventories are projected as 62.5 percent (about 7 months) of the operational spares component of O&M costs.

g. Loans and advances.

12. These are projected as 25 percent (3 months) of total O&M costs.

h. Other Current Assets.

13. Other current assets are projected to increase by 10 percent per annum.

i. Short-term Liabilities.

14. These liabilities are estimated as 4.1 percent (15 days) of total investment, 1.9 percent (7 days) of O&M costs, and 25.3 percent (3 months) of interest chargeable to revenue.

j. Current Maturities of Long-term Debt.

15. A year before long-term debts are due for repayment, they are transferred to current/short-term liabilities; however, they are not treated as part of working capital.

k. Cash Credit (Bank Overdraft).

16. A credit of 75 percent of current assets minus 100 percent of current liabilities is considered as per Government norms.

l. Long-term Debt

17. An annual bond raising target of \$79.6 million (Rs2,500 million) for FY1995 onwards FY1997 has been established. Bonds are repaid in full after 7 years. Foreign borrowings are based on preliminary estimates of the foreign currency component of various projects up to a maximum of 60 percent of project cost. Repayment terms are forecast generally as a 5 to 6-year moratorium and 15 years repayment. Foreign currency borrowings are revalued at each fiscal year and to reflect their current exchange rates. Local borrowings are included to the extent that there is projected to be a funding gap.

m. Equity.

18. The Government's financial support is projected to decline sharply after FY1996 — no new equity contributions beyond those to which the Government is already committed are forecast. Retained earnings will be the main contribution to increases in equity over the forecast period.

4. Sources and Application of Funds

a. Internal Sources.

19. These include net profit after tax and noncash items such as depreciation and provisions for future costs.

b. Debt Service.

20. Debt service is based on existing commitments and anticipated commitments from new borrowings, assumed to follow a five-year grace period. Bonds are forecast to be repaid in full after seven years and a bond redemption reserve of 50 percent of repayments (spread over seven years) has been created.

B. Projections

21. Tables 1-3 give the projections based on the preceding assumptions.

Table 1: Power Grid Corporation of India Ltd. – Income Statement
(Rs million)

FY Ending 31 March	<----- Actual ----->	<----- Projected ----->	1992	1993 ^a	1994	1995	1996	1997	1998	1999	2000	2001	2002
Operating Revenue	217	6,341	6,488	9,031	10,816	13,300	17,901	25,094	31,238	36,482	42,475		
Operating Expenses													
Operations & Maintenance	233	554	466	661	814	1,035	1,501	2,223	2,792	3,315	3,871		
Depreciation	0	1,388	1,678	2,680	3,131	4,115	4,761	7,069	9,325	10,642	12,813		
Other ^b	0	370	570	547	547	547	547	547	547	547	547		
Total	233	2,311	2,714	3,888	4,492	5,697	6,809	9,839	12,664	14,504	17,231		
Operating Profit	(16)	4,030	3,774	5,143	6,324	7,603	11,092	15,255	18,574	21,978	25,244		
Interest Expense	(2)	(1,659)	(1,505)	(2,160)	(2,505)	(3,121)	(4,971)	(7,802)	(9,999)	(12,208)	(14,763)		
Prior Period Adjustments^c	0	(5)	(390)	54	0	0	0	0	0	0	0		
Profit Before Tax	(18)	2,366	1,879	3,037	3,819	4,482	6,121	7,453	8,575	9,770	10,481		
Provision for Tax	0	0	0	0	0	0	0	0	0	0	0		
Net Profit Before Appropriations	(18)	2,366	1,879	3,037	3,819	4,482	6,121	7,453	8,575	9,770	10,481		
Appropriations													
Bond Redemption Reserve	0	(130)	0	(258)	(475)	(653)	(832)	430	(912)	(1,091)	(179)		
General Reserve	0	(2,000)	(2,000)	0	0	0	0	0	0	0	0		
Dividend	0	0	(50)	(1,156)	(1,203)	(1,240)	(2,180)	(2,187)	(2,245)	(2,248)	(2,249)		
Retained Earnings	(18)	236	(171)	1,623	2,141	2,589	3,109	5,696	5,418	6,431	8,053		
Ratios :													
Rate of Return on Historical Cost Assets	(%)	NA	12	10	13	13	14	13	14	14	15		
Operating Ratio	(%)	NA	36	42	43	42	38	39	41	40	41		

^a Includes transfer values of assets from NTPC, NHPC, and NEEPCO as of 1 April 1993.

^b Includes preliminary expenses, bonds expenses, rebates to customers and contingencies.

^c Result for FY1994 includes income from NLC TL assets (Rs150 million), interest saving due to capital restructuring (Rs700 million), reduction in income due to retroactive adjustments to tariffs (Rs900 million) and return on equity reduced to 10% from 12%.

Source : POWERGRID

Table 2: Power Grid Corporation of India Ltd. – Balance Sheet
(Rs million)

FY Ending 31 March	<----->	Actual	<----->	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
ASSETS														
Fixed Assets														
Fixed Assets in Service	84	35,206	42,287	48,474	65,642	76,906	116,271	154,516	176,554	212,939	234,701			
Less: Depreciation	28	1,416	3,215	5,895	9,026	13,141	17,902	24,971	34,296	44,938	57,751			
Net Fixed Assets in Service	56	33,790	39,072	42,579	56,616	63,765	98,369	129,545	142,258	168,001	176,950			
Capital Works-in-Progress	640	7,541	13,071	16,751	17,966	28,205	17,302	9,462	15,071	9,214	16,863			
Stores & Advances	100	2,941	3,945	4,865	5,169	7,728	5,003	2,418	3,820	2,356	4,268			
Miscellaneous Assets	177	155	83	83	83	83	83	83	83	83	83			
Total	973	44,427	56,171	64,278	79,834	99,781	120,757	141,508	161,232	179,654	198,164			
Current Assets														
Cash and Bank Balances	22	159	1,425	1,500	1,600	1,700	1,100	200	500	2,000	2,100			
Short-term Deposits	2,000	949	1,949	2,600	3,300	1,100	0	0	0	2,200	3,250			
Trade Debtors	0	3,365	1,191	2,258	2,704	3,325	4,475	6,274	7,810	9,121	10,619			
Inventories	8	498	609	609	609	647	938	1,389	1,745	2,072	2,419			
Loans & Advances	506	1,763	3,890	4,247	3,689	3,151	2,636	2,899	3,189	3,508	3,859			
Other Current Debtors/Accruals	21	47	70	77	85	95	102	113	124	136	152			
Total	2,557	6,781	9,134	11,291	11,987	10,018	9,251	10,875	13,368	19,037	22,399			
Total Assets	3,530	51,207	65,305	75,568	91,821	109,799	130,008	152,382	174,599	198,690	220,562			
EQUITY AND LIABILITIES														
Shareholders' Equity														
Share Capital Issued	511	711	2,881	30,081	30,989	31,148	31,244	32,071	32,114	32,132	32,138			
Share Deposit	100	17,781	26,010	0	0	0	0	0	0	0	0			
Retained Earnings and General Reserve	(18)	2,218	4,850	7,340	9,887	12,704	16,706	22,541	27,959	34,390	42,443			
Bond Redemption Reserve	0	130	130	388	863	1,516	2,348	1,918	2,830	3,921	4,100			
Total	593	20,840	33,871	37,809	41,739	45,368	50,298	56,530	62,903	70,443	78,681			
Long-term Debt														
Loans Contracted	377	18,193	17,070	19,932	26,976	32,431	34,672	37,836	37,084	33,691	27,226			
Bonds	2,000	8,666	9,661	11,791	14,261	15,121	16,296	14,925	15,668	17,825	17,337			
Loans to be Contracted	0	0	0	729	3,632	11,592	22,797	35,322	49,591	65,949	84,933			
Total	2,377	26,859	26,731	32,452	44,869	59,144	73,765	88,083	102,343	117,465	129,496			
Less: Current Maturities	0	0	0	(1,347)	(3,190)	(3,425)	(6,206)	(5,496)	(4,865)	(9,821)	(9,821)			
Total Long-term Debt	2,377	26,859	26,731	31,105	41,679	55,719	67,559	82,587	97,478	107,644	119,675			
Current Liabilities														
Short-term Loans	0	110	63	342	325	525	646	1,666	2,655	3,516	4,385			
Creditors & Provisions	560	3,398	4,640	4,965	4,888	4,762	5,299	6,103	6,598	7,266	8,000			
Current Maturities of Long-term Debt	0	0	0	1,347	3,190	3,425	6,206	5,496	4,865	9,821	9,821			
Total	560	3,508	4,703	6,654	8,403	8,712	12,151	13,265	14,218	20,603	22,206			
Total Equity and Liabilities	3,530	51,207	65,305	75,568	91,821	109,799	130,008	152,382	174,599	198,690	220,562			
Ratios :														
Debt-Equity Ratio	80:20	56:44	44:56	46:54	52:48	57:43	60:40	60:40	62:38	62:38	62:38			
Current Ratio	4.6	1.9	1.9	1.7	1.4	1.1	0.8	0.8	0.9	0.9	1.0			
Accounts Receivable (No. of months)	0.0	6.4	2.2	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0			

Source : POWERGRID

Table 3: Power Grid Corporation of India Ltd. – Sources and Applications of Funds Statement
(Rs million)

FY Ending 31 March	<----- Actual ----->			<----- Projected ----->							>
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
SOURCES OF FUNDS											
Operating Profit	(16)	4,025	3,384	5,197	6,324	7,603	11,092	15,255	18,574	21,978	25,244
Depreciation	0	1,388	1,678	2,680	3,131	4,115	4,761	7,069	9,325	10,642	12,813
Total Internal Cash Generation	(16)	5,413	5,062	7,877	9,455	11,718	15,853	22,324	27,899	32,620	38,057
Grants – in – Aid			803	867	406	228	893	139	0	0	0
Capital Paid In	611	17,881	10,399	1,190	908	159	96	827	43	18	6
Loan Drawdowns											
Loans Contracted	377	18,581	0	3,950	8,360	7,006	4,343	5,496	2,987	1,129	369
Bonds	2,000	7,716	2,290	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
Loans to be Contracted	0	0	0	729	2,903	7,960	11,203	12,528	14,269	16,358	18,983
Gross Borrowings	2,377	26,298	2,290	7,179	13,763	17,466	18,046	20,524	19,756	19,987	21,852
Reductions in Working Capital											
Cash	0	1,024	0	0	0	2,300	1,821	1,920	689	0	0
Other	25	0	1,155	0	27	0	0	0	0	0	0
Total Funds Available	2,997	50,616	19,709	17,113	24,559	31,871	36,709	45,734	48,387	52,625	59,915
APPLICATIONS OF FUNDS											
Investment Program											
Capital Investment	355	44,207	12,490	10,051	17,145	21,361	23,104	26,412	28,019	28,099	30,421
Interest Capitalized	618	635	983	736	1,542	2,701	2,633	1,408	1,030	965	902
Total Capital Investment	973	44,842	13,473	10,787	18,687	24,062	25,737	27,820	29,049	29,064	31,323
Debt Service											
Interest on Long – term Loans	620	2,293	2,488	2,896	4,047	5,822	7,604	9,210	11,029	13,173	15,665
Principal Repayments	0	765	1,123	1,088	1,316	1,551	2,102	2,332	3,739	4,522	6,834
Amortization of Bonds	0	1,050	1,295	370	30	1,640	1,323	3,874	1,757	343	2,987
Total Debt Service	620	4,109	4,906	4,354	5,393	9,013	11,029	15,416	16,525	18,038	25,486
less: Interest Capitalized	(618)	(635)	(983)	(736)	(1,542)	(2,701)	(2,633)	(1,408)	(1,030)	(965)	(902)
Net Debt Service	2	3,474	3,923	3,618	3,851	6,312	8,396	14,008	15,495	17,073	24,584
Payment of Dividend	0	0	0	1,206	1,203	1,240	2,180	2,187	2,245	2,248	2,249
Increases in Working Capital											
Cash	2,022	0	2,313	447	817	0	0	0	0	2,839	281
Other	0	2,300	0	1,056	0	257	396	1,719	1,598	1,401	1,478
Total Funds Applied	2,997	50,616	19,709	17,113	24,559	31,871	36,709	45,734	48,387	52,625	59,915
Ratios :											
Self – financing – 3 – year average	(%)	–	20.3	20.4	20.4	20.6	23.6	26.8	25.7	20.9	21.3
Debt Service Coverage	times	–	1.7	1.7	1.8	2.0	1.8	1.5	1.5	1.4	1.3

SUMMARY INITIAL ENVIRONMENT EXAMINATION FOR THE NORTHEASTERN TRANSMISSION AUGMENTATION SUBPROJECT

A. Introduction

1. This summary initial environmental examination (SIEE) has been prepared for the Power Transmission (Sector) Project in compliance with requirements of the Asian Development Bank. The SIEE summarizes information gathered and analyzed by the staff of Power Grid Corporation of India Limited (POWERGRID) in cooperation with the Department of Revenue and the Ministry of Environment and Forestry. This SIEE shows the typical environmental impact that may be expected of a subproject of the Project. SIEEs of the other subprojects will be submitted to the Bank for review and concurrence after approval by the Ministry of Environment and Forestry.

B. Project Description

2. The subproject component used as an example in this SIEE is described in detail in the main text of the Report.

C. Description of the Environment

1. Physical Setting

3. The Northeastern Region, where the proposed lines are located, comprises seven states, of which Arunachal Pradesh, Assam, Mizoram, and Tripura are covered by the Project. The four states lie within the eastern Himalayan range. The topography varies from undulating hills to steep mountain slopes with deep gorges, and elevations range from 150 meters (Gauwahti, Assam) to 3000 meters (Arunachal Pradesh). The Project area falls in seismic Zone V and is prone to earthquakes. Average annual rainfall in the three states varies from approximately 1,000 to 4,000 millimeters (mm). Temperature variations are influenced by altitude. In the plains temperatures range from 6-39°C, in mid elevations 4-22°C and in high elevations 2-20°C. The Project area is crisscrossed by numerous streams and rivers flowing from the Himalayas, and groundwater is abundant. Mineral resources include oil and natural gas, as well as coal, dolomite, and limestone.

2. Ecological Resources

4. The Project area in general is rich in ecological resources. Forest cover, including degraded forest, as a proportion of land area is 82 percent in Arunachal Pradesh, 31 percent in Assam, 89 percent in Mizoram, and 53 percent in Tripura. The major forest types include tropical wet evergreen, tropical semi-wet evergreen, and tropical moist deciduous. Montane subtropical wet forest, or khasi pine, occurs along the area's hill systems. Additionally, there are extensive bamboo groves that are generally of secondary origin following degradation of primary forest by shifting cultivation. Extensive plantations of tea, coffee, and rubber have significantly contributed to forest loss.

3. Socioeconomic Setting

5. Assam is the most densely populated of the four states within the Project area. Assam has 22.4 million inhabitants, a density of 286 people per square kilometer (km²), and an

annual growth rate of 2.17 percent. Tripura's population is 2.8 million with 263 people/km² density and an annual growth rate of 3.0 percent. Mizoram's population is 2.7 million, a density of 33 people/km², and an annual growth rate of 3.34 percent (1991 census). Literacy rates are 42 percent in Arunachal Pradesh, 53 percent in Assam, 82 percent in Mizoram, and 60 percent in Tripura. A notable characteristic of the area is its ethnic diversity, including peoples of Austro-Asiatic, Negrito, Alpine, Aryan, and Tibeto-Burmese origins. The Northeastern Region's economy is less developed than the nation's average. Approximately 80 percent of the region's residents are engaged in agriculture. Sizable land is under cash crops, most notably tea. Jute is a major cash crop in Assam and Tripura. Productivity is generally low, but some large-scale farmers have modernized their operations and are setting an example for smaller farmers. Shifting cultivation is prevalent in each of the four states, and has had serious impacts on forest resources. Many of the region's residents are engaged seasonally in farm labor and supplement their income by migrating to urban centers following the harvest season.

D. Screening of Potential Environmental Impacts and Mitigation Measures

6. Many potential environmental impacts of transmission lines can be avoided or mitigated through careful site selection. The following guidelines were used in selecting each route: (i) The route of the proposed transmission line will not involve any human rehabilitation. (ii) No monument of cultural historical importance will be affected. (iii) The route will not threaten the survival of any community. (iv) The route will not affect any public utility services such as a playground, school, etc. (v) The route will not traverse any sanctuaries, national parks, etc. (vi) The route will not infringe upon areas of natural resources. If it passes through a forest area, a detailed survey is to be conducted in association with the forest authorities to identify the most suitable route to involve the minimum amount of forest and entail a negligible effect on flora and fauna. After the detailed survey, forest authorities will suggest the best possible route.

7. After taking all points into consideration, the final route selected will involve minimum or no forest while being economically viable. As a rule of thumb, alignments are 10-15 kilometers from major towns whenever possible to account for future urban expansion. Similarly, forests are avoided whenever possible, and, when this is not possible, a route is selected, in consultation with the local divisional forest officer, that does minimum damage to existing forest resources. Alignments are selected to avoid wetlands and unstable areas for both financial and environmental reasons.

8. In some localities, visual aesthetics may be impaired by tower erection. To mitigate impacts on aesthetics, latticed towers will be constructed. Wherever POWERGRID feels it appropriate, discussions will be held with local Forest Department officials to determine the feasibility of planting trees along roads running parallel to transmission lines to buffer the visual effect in these areas.

9. The loss of forest and wildlife habitat is often a major environmental impact associated with transmission lines. Most forests to be traversed by the lines of the proposed Project are already heavily degraded and the wildlife species present are adapted to open or disturbed habitats. Therefore, with provision of compensatory forests, the overall forest status will in many cases improve. Nonetheless, to mitigate losses to existing forests, clearing of the transmission line right-of-way will be done under Forest Department supervision. Lopping of trees to maintain line clearance will be done under direction from the Forest Department.

10. Transmission lines could serve as new access routes into previously inaccessible or poorly accessible forests, thereby accelerating forest and wildlife loss. In such cases, POWERGRID cannot act, but local Forest Department personnel would normally assess the dangers and take appropriate action, such as establishing guard stations at the entrance to the forest. Given the already easy access and degraded conditions at the proposed Project sites, this problem is not expected to be encountered. Nonetheless, POWERGRID staff will report to the Forest Department any noticeable encroachment induced by the Project.

11. Impacts on agricultural land will be restricted to the construction phase and when large-scale maintenance measures are required. Agricultural land will be lost at the base of the tower, an amount estimated to be on the order of 0.2-1 square meter per average farm holding. Where lines will traverse agricultural land, compensation will be paid to owners for any crop damage incurred as a result of construction activities.

E. Institutional Requirement and Environmental Monitoring Program

12. Monitoring of impacts on ecological resources will be done by the concerned Divisional Forest Officer, Chief Wildlife Warden, and their staff as a part of their normal duties. A monitoring system (maintained by the Forest Department) is also in place for compensatory forests established as part of the Project. An Environmental Management Cell was created within POWERGRID in 1992 and was upgraded to an Environment Management Department in 1993, thus providing it functional autonomy. The Department is staffed by four professionals trained in forestry, environmental geology, geology and botany. They have combined experience of more than 40 years. As a covenant to the loan, POWERGRID has agreed that an Environment Officer will be stationed at each of POWERGRID's regional offices. The officers will be responsible primarily for close interaction and supervision during the site selection and forest clearance stages, and for monitoring during construction and operation phases. They will also help train field staff.

F. Findings and Recommendations

13. Although the Government does not require preparation of an environmental impact assessment for transmission lines, the screening process for the sector loan has been thorough, particularly in relation to affected forest lands. Parts of the Northeastern and Northern Regions are rich in natural endowments with considerable physical and ecological resources, although biodiversity in the Northern Region is not as splendid as that in the Northeast. Both the regions, however, are lagging in development. Therefore, the immediate objective of the subproject is to bring economic progress to the regions.

G. Conclusions

14. The development value of the projects outweighs the environmental costs. As regards the latter, compensatory and mitigative measures have been taken and due consideration has been given to route alignment, compensatory afforestation, engineering and biological measures to prevent soil erosion. Substations are located away from human settlements and forests.

FINANCIAL AND ECONOMIC ANALYSIS

A. Financial Analysis

1. The Power Grid Corporation of India Limited (POWERGRID) charges a regulated tariff for transmission services based on its cost of service and allowed rate of return on equity. An average transmission tariff is charged for each region, based on the total cost of fixed charges and operating costs of all POWERGRID assets in that region, divided by the total central sector generation (i.e., National Thermal Power Corporation [NTPC] and National Hydro Power Corporation) transmitted by POWERGRID to the region. Although POWERGRID will not charge a separate tariff for each new subproject, POWERGRID's average tariff will be adjusted so that the total tariff revenue increases will cover the costs and allowed rate of return on each new subproject. For this purpose, the incremental tariff revenue allowed is treated as the financial revenue due to a particular subproject. A financial evaluation has been made on this basis for the Vindhyachal Stage-II transmission subproject, which is the largest subproject to be financed under the Bank loan and accounts for about half of the proposed total loan. The financial rates of return for other subprojects will be similar. The financial internal rate of return (FIRR) for the Vindhyachal subproject is based on an estimated debt/equity ratio of 60/40,¹ an average interest rate on debt of 15 percent and allowed rate of return on equity of 16 percent in rupees at current prices, an inflation rate of 8 percent, an allowed depreciation rate of 6 percent, and other assumptions described in the footnotes of Table 1 of this Appendix. The expected FIRR is 8.4 percent for this typical subproject (see Table 1), which is above the average real weighted cost of capital of 7.4 percent.²

B. Economic Analysis

2. A preliminary economic analysis of the major subprojects has been undertaken, and the results are summarized in the following paragraphs. Details for the Vindhyachal Stage-II Transmission subproject are shown in Table 2 and results of the sensitivity analysis covering the major subprojects are given in Table 3.

1. Northeastern Transmission Projects

3. The economic benefits of the 132-kilovolt (kV) transmission system augmentation in South Assam, Mizoram and Tripura in the Northeastern Region, with a total cost of \$38.8 million, are estimated on the basis of increased load to be served due to normal load growth, reduction

¹ The current debt:equity ratio is 46/54 but it is expected that this will change to 65/35 in the medium to long term.

² Weighted average cost of capital is calculated as:

Debt	60%	@	15%	=	9.0 %
Equity	40%	@	16%	=	6.4 %
Weighted Average Nominal Cost of Capital				=	15.4 %
Less: Inflation					(8.0) %
Weighted Average Real Cost of Capital				=	7.4 %

in transmission losses, and improved reliability of power supply.¹ The overall economic internal rate of return (EIRR) for this group of projects is estimated at 18.2 percent.

4. The economic benefits of the Northeastern Regional System Coordination Center (RSCC), with a total cost of \$73.9 million, are estimated on the basis of a 2.0 percent improvement in the effective use of generation and transmission capacity in the region, a reduction in average annual bulk power supply tripping from 25 to 10 hours per year, and a reduction of about 0.7 percent in total fuel required at thermal power plants. These benefits are considered realistic and are perhaps conservative in view of the poor coordination of generation and transmission facilities currently practiced in the region. On this basis, the estimated EIRR for the Northeastern RSCC is about 22.5 percent.

5. The economic benefits of transmission required to evacuate power from new generation projects, such as Agartala and Kopili, are difficult to determine independently. Such transmission is an integral part of the total investment in a new generation project, and on a broader scale it would be an integral part of the power system development plan, and not an independent or discretionary investment. The EIRR on the complete investment required in a new generation project plus associated transmission is normally considered as representative of the rate of return on this investment, as transmission is typically a small part of the total investment. The 132-kV transmission line required for the Agartala gas-fired generation project in Tripura will have an average economic cost of service of \$0.0016 (Rs0.05)/kilowatt-hour (kWh) to evacuate power from this project. This is relatively small compared to the total economic cost of generation, which will be about \$0.048 (Rs1.50)/kWh at 1993 prices. To evacuate power from this project, the 220-kV transmission line required for the Kopili hydro project expansion in Assam will have an average economic cost of service of \$0.002 (Rs0.059)/kWh, which is also relatively low.

2. Northern Region: Unchahar Power Evacuation

6. The 220-kV and 400-kV transmission lines required for the Unchahar Thermal Power Project will cost a total of \$46.8 million. The average economic cost of service to evacuate power from this project will be \$0.002 (Rs0.067)/kWh, which is very reasonable. The EIRR of the 420-megawatt (MW) Unchahar Stage-II Power Plant, financed under Bank Loan No. 907-IND, was updated in October 1994, when Board approval was obtained for a change in executing agency and implementation arrangements for this power plant. The EIRR was reestimated at 13.6 percent based on the economic value of power supply to the ultimate consumers for this project.

¹ The benefits due to improved reliability of power supply are based on an estimated economic cost of unscheduled power outages of \$0.45 (Rs14.1)/kWh. This estimated value is considered conservative (i.e., low) and is based on an extensive literature review of costs of power outages in India, Pakistan and other developing countries, as reported in "Power shortages in developing countries: Impacts and policy implications," by Arun Sanghvi, published in *Energy Policy Journal*, June 1991.

3. East-South Interconnector

7. The high-voltage direct current regional interconnection between Jeypore substation in the Eastern Region and Guzawaka substation in the Southern Region, with a total cost of about \$135 million including \$70.4 million for the alternating current portion, will enable power transfers between these regions, which are not currently interconnected. An agreement has also been made to export a firm power output of 500 MW from NTPC's Talcher power plant in Orissa in the Eastern Region to the Southern Region. The Southern Region currently has to import coal from Orissa for power generation, and future generation at mine-mouth power plants in Orissa and transmission to the Southern Region will be much more economic. The economic benefits of the East-South interconnection have been evaluated on the basis of alternative coal transport costs from Talcher to the Southern Region, which results in an estimated EIRR for this project of 21.3 percent.

4. Western Region: Vindhyachal Power Evacuation

8. The Vindhyachal Stage-II 400-kV transmission subproject is required to evacuate power from the Vindhyachal Stage-II mine-mouth power plant (2 x 500-MW) in the northeast corner of Madhya Pradesh. NTPC awarded the construction contracts for the Stage-II power plant in March 1995, and POWERGRID will develop the required transmission, which will include a 400-kV double circuit line of about 500 km from Vindhyachal to Bina and several other smaller 400-kV transmission components with a total cost of \$283.6 million. These lines will transmit power from Vindhyachal to load centers in central Madhya Pradesh, and in Maharashtra and Gujarat, the other states in the Western Region. If this transmission was not constructed, the alternative would be to transport coal by rail from coal mines in the Vindhyachal region to power plant sites closer to the load centers. Indeed, Maharashtra already imports substantial quantities of coal from Madhya Pradesh and even Orissa for power generation. The economic evaluation of this alternative shows that the EIRR of the Vindhyachal transmission project will be 19.7 percent based on alternative costs of coal transport by rail (see Table 2).

9. An economic analysis has also been conducted of the complete integrated power system expansion plan for a seven-year period for Maharashtra State Electricity Board, which is the largest state in the Western Region and will be entitled to a 46 percent share of the output from Vindhyachal Stage II. This analysis, which compares the total economic costs of increased generation, transmission, and distribution over the Eighth Five-Year Plan (FY1993-97) with the increased economic benefits of power consumption to final consumers, indicates an EIRR of 15.1 percent for integrated power system development. This demonstrates that additional power supply is economically justified, and the alternative cost comparison described above demonstrates that mine-mouth generation at Vindhyachal with transmission by POWERGRID to major load centers in the Western Region is the most economic method of power supply.

C. Sensitivity Analysis

10. A sensitivity analysis has been conducted to evaluate the impact on the major subprojects of (i) a 20 percent increase in subproject costs; (ii) a 20 percent reduction in subproject benefits; and (iii) a one-year implementation delay. The results of the analysis are summarized in Table 3.

Table 1: Financial Analysis for Vindhyachal Stage – II Transmission
(Rs million)

(Rs million)

Year	Project Construction				Annual Revenues for Fixed Costs					Net Cash Flow Current Prices	Price Index (Rs)	Net Cash Flow 1995 Prices		
	Con-tract Cost	IDC @ 15%	Sources of Funds		End of Year Total Debt	End of Year Total Equity	Deprec. 6%	Interest 15%	Ret. on Equity 16%				Total Fixed Charges	
			60% Debt	40% Equity										
1994-95	598.2		598.2	358.9	239.3							-598.2	1,000	-598.2
1995-96	2117.9	53.8	2171.7	1303.0	868.7	1662.0	1108.0					-2117.9	1,071	-1977.5
1996-97	3364.1	249.3	3613.4	2168.0	1445.4	3830.0	2553.3					-3364.1	1,129	-2980.2
1997-98	664.2	574.5	1238.7	743.2	495.5	4573.2	3048.8					-664.2	1,185	-560.4
1998-99				4298.8	2865.9	457.3	686.0	487.8	1631.1			1631.1	1,245	1310.6
1999-00				4024.4	2683.0	457.3	644.8	458.5	1560.7			1560.7	1,307	1194.3
2000-01				3750.0	2500.0	457.3	603.7	429.3	1490.3			1490.3	1,372	1086.1
2001-02				3475.6	2317.1	457.3	562.5	400.0	1419.8			1419.8	1,441	985.5
2002-03				3201.3	2134.2	457.3	521.3	370.7	1349.4			1349.4	1,513	892.0
2003-04				2926.9	1951.2	457.3	480.2	341.5	1279.0			1279.0	1,588	805.2
2004-05				2652.5	1768.3	457.3	439.0	312.2	1208.5			1208.5	1,668	724.6
2005-06				2378.1	1585.4	457.3	397.9	282.9	1138.1			1138.1	1,751	649.9
2006-07				2103.7	1402.5	457.3	356.7	253.7	1067.7			1067.7	1,839	580.7
2007-08				1829.3	1219.5	457.3	315.6	224.4	997.3			997.3	1,931	516.5
2008-09				1554.9	1036.6	457.3	274.4	195.1	926.8			926.8	2,027	457.2
2009-10				1280.5	853.7	457.3	233.2	165.9	856.4			856.4	2,129	402.3
2010-11				1006.1	670.7	457.3	192.1	136.6	786.0			786.0	2,235	351.7
2011-12				731.7	487.8	457.3	150.9	107.3	715.6			715.6	2,347	304.9
2012-13				457.3	304.9	457.3	109.8	78.0	645.1			645.1	2,464	261.8
2013-14				182.9	122.0	457.3	68.6	48.8	574.7			574.7	2,587	222.1
2014-15				0.0	0.0	304.9	27.4	19.5	351.8			351.8	2,717	129.5
2015-16						0.0	0.0	0.0	0.0			0.0	2,853	0.0
2016-28														
NPV@10%	5,275		5,899	3,540	2,360	2,485	2,449	1,741	6,675			1,400		(426)
SUM	6,744		7,622	4,573	3,049	7,622						13.9%		8.4%
										Rate of Return:				

IDC = Interest during construction; NPV = Net Present Value
 Local cost escalation rates in India are estimated by Bank to be 7.1% in 1995, 5.4% in 1996, and 5% thereafter.
 Source: POWERGRID

Table 2: Economic Evaluation of Vindhyachal Stage-II Transmission

(Rs million)								
Year	Energy Transfer (GWh)	Vindhyachal Transmission					Benefits Based on Alt. Coal Transport	Net Benefits
		Capital Cost	O&M Charge	Trans. Losses		Total Cost		
				@2% (GWh)	Cost @ Rs1.50			
1994-95		473.0				473.0		(473.0)
1995-96		1,674.8				1,674.8		(1,674.8)
1996-97		2,660.3				2,660.3		(2,660.3)
1997-98		525.2				525.2		(525.2)
1998-99	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
1999-00	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2000 - 01	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2001 - 02	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2002 - 03	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2003 - 04	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2004 - 05	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2005 - 06	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2006 - 07	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2007 - 08	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2008 - 09	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2009 - 10	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2010 - 11	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2011 - 12	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2012 - 13	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2013 - 14	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2014 - 15	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2015 - 16	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2016 - 17	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2017 - 18	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2019 - 20	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2020 - 21	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2021 - 22	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2022 - 23	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2023 - 24	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2024 - 25	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2026 - 27	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2028 - 29	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2029 - 30	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2031 - 32	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2032 - 33	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
2033 - 34	5,520		53.3	110.4	165.6	218.9	1,589.8	1,370.8
NPV@10%	35,917	4,171.7	347.0	718.3	1,077.5	5,596.2	10,344.0	4,747.8
SUM		5,333.4	EIRR					19.7%

EIRR = Economic Internal Rate of Return; GWh = gigawatt-hour; NPV = Net Present Value

O&M = Operation and Maintenance; Rs = rupees

Average Transmission Cost = 0.156 Rs/kWh, including losses

All costs are at February 1995 price levels.

Cost of coal transport by rail from Vindhyachal to Bina, a distance of 575 km, would be Rs384/ton, which is equivalent to 0.288 Rs/kWh

Source: POWERGRID

Table 3: Sensitivity Analysis of Subprojects

Scenario	EIRR (%)	Sensitivity Indicator ^a
Base Case		
- Vindhyachal Power Evacuation	19.7	
- Northeastern Transmission Augmentation	18.2	
- Northeastern RSCC	22.5	
- East-South Interconnector	21.3	
20% Increase in Costs		
- Vindhyachal Power Evacuation	16.8	0.15
- Northeastern Transmission Augmentation	15.6	0.13
- Northeastern RSCC	18.9	0.18
- East-South Interconnector	17.1	0.21
20% Reduction in Benefits		
- Vindhyachal Power Evacuation	15.7	0.20
- Northeastern Transmission Augmentation	15.0	0.16
- Northeastern RSCC	18.1	0.22
- East-South Interconnector	16.3	0.25
One-Year Implementation Delay		
- Vindhyachal Power Evacuation	18.1	
- Northeastern Transmission Augmentation	17.1	
- Northeastern RSCC	20.5	
- East-South Interconnector	19.4	

^a The sensitivity indicator is the ratio of the percentage change in the FIRR and EIRR to the percentage change in given parameter.

Source: Staff