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Report No. 7383-IN

STAFF APPRAISAL REPORT

INDIA

NATHPA JHAKRI POWER PROJECT

JANUARY 25, 1989

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Asia Country Department IV (India)
Transport and Energy Operations Division

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CURRENCY EQUIVALENTS

Currency Unit	=	Rupees (Rs)
Rs 1.00	=	Paise 100
US$1.00	=	Rs 13.30
Rs 1,000,000	=	US$76,923

MEASURES AND EQUIVALENTS

1 Kilometer (km)	=	1,000 meters (m) = 0.6214 miles (mi)
1 Meter (m)	=	39.37 inches (in)
1 Cubic Meter (m3)	=	1.31 cubic yard (cu yd) = 35.35 c.ft.
1 Thousand Cubic Meter (MCM)	=	1,000 cubic meters
1 Barrel (Bbl)	=	0.159 cubic meter
1 Normal Cubic Meter of Natural Gas (Nm3)	=	37.32 Standard Cubic Feet (SCF)
1 Ton (t)	=	1,000 kilograms (kg) = 2,200 pds. (lbs)
1 Metric Ton (39 API)	=	7.60 barrels
1 Kilocalorie (kcal)	=	3.97 British Thermal Units (BTU)
1 Kilovolt (kV)	=	1,000 volts (v)
1 Kilovolt ampere (kVa)	=	1,000 volt-amperes (VA)
1 Megawatt (MW)	=	1,000 kilowatts (kW) = 1 million watts
1 Kilowatt-hour (kWh)	=	1,000 watt-hours
1 Megawatt-hour (MWh)	=	1,000 kilowatt-hours
1 Gigawatt-hour (GWh)	=	1,000,000 kilowatt-hours
1 Ton of Oil Equivalent (toe)	=	10 million kilocalories

ABBREVIATIONS AND ACRONYMS

CEA	-	Central Electricity Authority
CWC	-	Central Water Commission
GOHP	-	Government of Himachal Pradesh
GOI	-	Government of India
GSI	-	Geological Survey of India
HPSEB	-	Himachal Pradesh State Electricity Board
ICB	-	International Competitive Bidding
LCB	-	Local Competitive Bidding
LRMC	-	Long Run Marginal Cost
MMCMD	-	Million Cubic Meter per day
MOU	-	Memorandum of Understanding
MPPD	-	Multipurpose Projects and Power Department
NHPC	-	National Hydroelectric Power Corporation, Ltd.
NJPC	-	Nathpa Jhakri Power Corporation
NPP	-	National Power Plan
NREB	-	Northern Region Electricity Board
NTPC	-	National Thermal Power Corporation, Ltd.
PIB	-	Public Investment Board
REB	-	Regional Electricity Board
REC	-	Rural Electrification Corporation
SEB	-	State Electricity Board

Fiscal Year

April 1 - March 31

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This report is based on the findings of an appraisal mission to India in November 1987. Mission members were Messrs. A. Sanchez (Principal Engineer), P. Hubbard (Financial Analyst), W. Jones (Senior Economist). Mr. R. Goodland assisted with environmental and resettlement aspects of the project on a separate mission. The economic and financial sectiors of the report were completed by Messrs. M. Tomlinson (Economist) and C.K. Teng (Financial Analyst) respectively.

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ANNEXES

MAP

IBRD No. 20515

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NATHPA JHAKRI POWER PROJECT

Loan and Project Summary

Borrower	:	India, Acting by its President.
Beneficiaries	:	1. Nathpa Jhakri Power Corporation, Ltd (NJPC) 2. Himachal Pradesh State Electricity Board (HPSEB) 3. Central Electricity Authority (CEA), Central Water Commission (CWC), and other agencies of the Government of India (GOI)
Amount	:	US$485 Million Equivalent
Terms	:	Twenty years, including a 5-year grace period.
Onlending Terms	:	Government of India (GOI) to Nathpa Jhakri Power Corporation (NJPC): about US$437 million equivalent with repayment over 20 years including 5 years grace period at an interest rate of not less than 14.5% per annum. GOI to Government of Himachal Pradesh (GOHP): about US$43 million as part of Central assistance to Himachal Pradesh for development projects on terms and conditions applicable at the time. GOHP to Himachal Pradesh State Electricity Board (HPSEB): about US$43 million with repayment over 20 years, including 5 years grace period at GOHP's interest rate applicable at the time for its lending to HPSEB (currently 10.5% per annum). GOI would bear the foreign exchange and interest rate risks.
Project Description	:	The main objective of the Project is to assist in meeting electricity demand in the Northern Region of India through the addition of 1500 MW of hydro capacity. The Project includes construction of the Nathpa Jhakri power station comprising: (i) a 60 m high, 155 m long gravity dam and underground desilting facilities; (ii) a 30 km long headrace tunnel of about 10 m diameter, and surge tank; and (iii) penstocks, power house (including 6x250 MW units) and a 500 m long tailrace tunnel; and reinforcement and expansion of the transmission and distribution system in the state of

Himachal Pradesh, including the contruction of 500 km of 132 km transmission lines and associated substations. In addition the Project will provide for implementation of a program to modernize and streamline HPSEB management and operations including a load management program and implementation of a program comprising assistance and training to strengthen the capabilities of CEA, CWC and other selected agencies, for planning, design and management of hydropower projects. The Project would provide funds for the training and consulting services, and computer hardware and software, as needed, for the implementation of the above components.

<u>Benefits and Risks</u> : Through the Project, the Bank will be supporting GOI's efforts to: (a) alleviate power shortages in the Northern Region by exploiting indigenous hydro resources; (b) improve the reliability of supply and reduce system losses in Himachal Pradesh; and (c) improve the planning and design capabilities of CEA and CWC. The proposed Nathpa Jhakri hydro scheme involves the usual risks associated with major underground works, such as unforseen geological conditions which may effect the cost or construction schedule or both. However, as a result of an intensive geological exploration program and experience with the excavation works of an another hydro scheme immediately upstream of Nathpa Jhakri, these risks are at an acceptably low level. In addition, external consultancy expertise is being provided under the Project to assist during project construction. The transmission and training components do not present any extraordinary risks.

Project Costs:

	Local	Foreign	Total
	(US$ Million)		
A. Nathpa Jhakri Power Station			
- Land, and Site Preparation	78.5	-	78.5
- Resettlement of Population	0.5	-	0.5
- Environment Protection Prog.	1.0	-	1.0
- Dam, Intake & Desilting Works	49.7	72.3	122.0
- Headrace Tunnel & Surge Tank	108.7	184.3	293.0
- Pressure Shaft, Powerhouse & Tailrace Tunnel	267.1	251.1	518.2
Sub-Total	505.5	507.7	1,013.2
B. Expansion & Reinforcement of Transmission in Himachal Pradesh	38.6	3.4	41.9
C. Communication & Load Dispatch for HPSEB	2.5	-	2.5
D. Institutional Development for HPSEB	0.8	0.7	1.5
E. Training Program & Assistance for CWC	1.7	2.5	4.2
Total Baseline Costs	549.1	514.2	1,063.3
Physical Contingencies	92.1	114.2	206.3
Price Contingencies	94.1	110.9	205.0
Total Project Cost	735.3	739.3	1,474.6
Interest During Construction	195.0	167.0	362.0
Total Financing Required	930.3	906.3	1,836.6

Financing Plan:

	Local	Foreign	Total
IBRD	55.0	430.0	485.0
Cofinanciers		300.0	300.0
GOI/GOHP/HPSEB	875.3	176.3	1,051.6
	930.3	906.3	1,836.6

Estimated Disbursements:

Bank FY	1989	1990	1991	1992	1993	1994	1995	1996	1997
Annual	0.3	25.0	48.0	78.0	117.0	113.0	67.0	26.0	10.7
Cumulative	0.3	25.3	73.3	151.3	268.3	381.3	448.3	474.3	485.0

Rate of Return: 14.3%

INDIA

NATHPA JHAKRI POWER PROJECT

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I. Sectoral Context

Overview

1.01 India's power systems presently have a combined installed power generating capacity of nearly 54,000 MW and provide about 210,000 GWh of energy, making them comparable in size to the power sectors of France and the U.K. and to the combined power sectors of all the countries of sub-Saharan Africa. However, despite impressive progress in expanding supply over the last few years (installed capacity has increased from 32,000 MW in 1981/82 and energy availability from 114,000 GWh) shortages persist - equivalent to about 10% of total energy demand and 20% of maximum power demand. The quality of electricity supplies also remains mostly unsatisfactory. In an effort to meet a higher proportion of demand, improve the quality of supplies and to complete its ambitious program of village electrification, GOI plans further rapid expansion of the sector through installation of an additional 80,000 MW of capacity by the turn of the century. This would cost about US$150 billion at present prices and claim between 25% and 30% of total allocations under the Eighth and Ninth Plans (compared with 20% under the present Plan). Sector development on this scale would almost certainly add sharp pressures to government finances. Implementing such a large program of investments and operating the greatly enlarged power systems also would pose considerable managerial and technical challenges for sector entities. Currently, the Bank finances about 5% of the sector's investments.

1.02 Over the past decade, significant progress has been made in expanding India's power supply, in improving the utilization of existing assets, and, though more modestly, in increasing tariffs. An important institutional gain has been the emergence of NTPC as the foremost entity in India for installing new generating capacity. Nevertheless, India's power system is relatively inefficient by international standards. Institutional, financial and technical constraints undermine efficient operations and planning, with the result that India's power systems deliver to consumers less power and of a poorer quality than they should be able to, and at a higher cost. The costs to the economy of shortages and poor quality supplies are magnified by inefficient end-use of electricity - the result mostly of inadequate retail tariffs and only weak commercial incentives in many markets. Sector development is also constrained by the divided responsibility (between GOI and the States) for power development, political interference in the operations of the State Electricity Boards (SEBs), and weaknesses in the financial structure of the sector which has undermined financial performance as well as held down resource mobilization.

1.03 GOI is cognizant of the extent of present inefficiencies, the nature of the underlying constraints and the repercussions which they will have on future sector development unless improvements are made. To date, however, only isolated efficiency enhancing initiatives have been mounted. However, under the Seventh Plan, there have been encouraging signs of a strengthening resolve to address sectoral constraints and promote efficiency. GOI has mounted initiatives to bring basic financial discipline to the SEBs (para 1.14) and has accelerated development of the relatively efficient central utilities, particularly the National Thermal Power Corporation (NTPC) which now provides about 10% of India's total power supplies (para 1.12). GOI also has formed the Power Finance Corporation to mobilize additional resources for sector development and is reviewing its policy on private sector involvement in power supply, specifically with a view to easing regulatory and financial disincentives to private investment (para 1.13). Finally, GOI is also reviewing its fuel supply policy for power generation not only by increasing the use of natural gas, but also by examining several imported energy options. The principal challenge facing GOI under the Eighth Plan is to bring better balance than before between expansion and efficiency improvement within existing resource constraints. Central to achieving this will be to ensure that institutional development of sector entities keeps pace with their physical expansion. Finally, to help meet the sector's enormous investment requirements, GOI must also realize more of the sector's potential to mobilize private resources.

<u>Commercial Energy Resources</u>

1.04 India's principal commercial energy sources comprise coal, oil, gas, hydro and nuclear energy. Of the nonrenewable resources, coal is the most abundant. Reserves of thermal coal have been estimated at over 125 billion tons of which 60 billion are considered technically and economically recoverable. Although reserves are ample, the quality of coal produced is generally low and is deteriorating. The high ash content, up to 50%, increases power station capital and operating costs and has exacerbated problems of coal transport. The Government of India's (GOI) emphasis on concentrated development of pithead stations helps to alleviate transport problems but will not reduce the other costs associated with poor coal quality. Moreover, pithead development will be constrained by pollution problems and water availability. The growing constraints to further development of India's coal resources, high transportation costs, and increasing production costs have together raised questions in regard to the continued competitiveness of India's coal industry. Recently, GOI has begun to give preliminary consideration to imports of coal, which probably would be economic at some coastal and inland locations.

1.05 India's oil and gas reserves (proven and probable) are relatively sizeable, being estimated at 580 million tons, which at current consumption levels would be exhausted in approximately twenty (20) years. Crude oil production, which currently provides about two-third of India's oil requirements, is peaking; as a result, oil imports are expected to rise again in the next few years. India's natural gas reserves are increasing and are estimated at 360 mtoe; natural gas could substitute for a part of future oil consumption. In the past, GOI had limited natural gas to premium markets such as petro-chemicals and fertilizer. With the growth in gas reserves and recent completion of a large gas pipeline, the market for gas has also expanded and natural gas is now becoming an important fuel for power generation, particularly in the north western areas of India where power shortages are acute. Oil products continue to have limited use in thermal power generation, being confined primarily to captive plant generation.

1.06 India's hydroelectric potential is equivalent to about 100,000 MW. At present only 16,000 MW have been developed, 4,700 MW are under construction and a further 23,000 MW are being studied for future development. Despite its potential, hydroelectric capacity addition to the India power systems has declined during the past decade. Under the Sixth Plan, hydroelectric represented about 34% of capacity addition. Estimates indicate that by the end of the Seventh Plan, hydro capacity addition will represent about 30% of India's power systems. Concerned with the decline and recognizing the prominent role of hydro generation in regional least-cost power development plans, GOI has decided to accelerate hydro development; however, progress has been slow owing to the lack of financial resources of states with the greatest hydro potential, the growing time required to resolve water rights and environmental issues, and the limited technical resources available for the simultaneous preparation of a large number of hydro schemes. Attempts to address these issues through increased central sector involvement have so far met with limited success (para 1.12).

1.07 The country's uranium reserves could support a modest nuclear program (8,000 - 10,000 MW), and thorium reserves are enough for a large fast breeder program. India's nuclear power generating capacity is currently 1,230 MW.

Electricity Supply and Demand

1.08 As mentioned in para 1.01, in 1987/88, utilities' gross power generation1/ amounted to approximately 210,000 GWh from an installed capacity of 54,000 MW (Annex 1.1). Almost 60% of generation was from coal, 35% from hydro, and the rest from oil, nuclear energy, and natural gas. The deteriorating quality of coal has increased station-use (to about 10% of gross generation) and the large expansion in very low load density rural electrification, together with otherwise inadequate investment in transmission and distribution, have increased system losses (to more than 26% of gross generation). The Bank has stressed the importance of giving more balance to future investment in power in order to reduce system losses and improve service quality and will continue to support transmission and distribution investments designed to achieve these objectives.

1.09 Over the past two decades, the consumption of electricity has grown approximately twice as fast as total commercial energy consumption. Electricity consumption now accounts for more than 30% of total commercial energy consumption. Over the period 1981/82 to 1987/88, total consumption of electricity grew at an average rate of 8.8% p.a. in terms of energy

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1/ Net of consumption by power stations.

consumed and 11.9% in terms of maximum power demand (Annex 1.1). However, even though the power sector receives over 20% of total public investment, the supply of electricity has not kept pace with increases in demand. The Central Electricity Authority (CEA) estimates that present shortages of electricity are about 21,000 GWh and 8,400 MW, equivalent in terms of present consumption to approximately 10% of energy demand and 20% of maximum power demand. CEA projects that electricity demand (in terms both of energy demand and maximum power demand) will grow at approximately 9% p.a. through 1996/97 and that demand will continue to be supply-constrained (Annex 1.2), although to a lesser extent than at present. Continued real increases in retail electricity tariffs (which averaged 5% p.a. between 1981 and 1987) may slow the pace of demand growth somewhat and provide further relief to supplies. However, this relief partly may be mitigated through the relative ease with which industrial and commercial consumers can pass on cost increases to their customers. The principal sectoral shares of total electricity consumption are: industrial, 55%: agricultural, 18%; domestic, 13% and commercial, 8%. Agriculture's share has grown steadily owing to increased electrical irrigation pumping made possible by rural electrification and encouraged by heavy subsidies.

Organization of the Power Sector

1.10 The Central and State Governments share the responsibility for supplying electricity. The Central Government controls the CEA, the National Thermal Power Corporation (NTPC), the National Hydro-Electric Power Corporation (NHPC), and the Rural Electrification Corporation (REC) and (through CEA) the regional electricity boards (REBs). The States control the State Electricity Boards (SEBs) and the day-to-day operations of the REBs. CEA is part of the Department of Power within the Ministry of Energy. NTPC, NHPC and REC are public corporations reporting to the Department of Power. SEBs were instituted under the Electricity (Supply) Act, 1948 (the Act), to promote the development of the power sector and to regulate private licensees such as the Tata Electric Companies. Although SEBs are supposed to be autonomous in managing their day-to-day operations, in practice they are under the control of State Governments in such matters as capital investment, tariffs, borrowings, pay, and personnel policies. As a first step towards national integration, the SEBs have been grouped into five regional systems, each coordinated by an REB. Coordinated responsibilities include overhaul and maintenance programs, generation schedules, interstate power transfers and concomitant tariffs.

1.11 CEA was created in 1950 to develop a national power policy and to coordinate the various agencies involved in supplying electricity. It is formally responsible for vetting investment proposals, providing consulting support to SEBs, assisting in the integration of supply systems, training of personnel, and research and development. However, in its execution of these responsibilities, CEA has been severely limited by shortages of skilled staff and other resources. GOI recently formed the Power Finance Corporation (PFC) whose functions are to mobilize additional resources for sector development, accelerate priority projects and pursue institutional reform of sector entities, particularly the SEBs. At present, the Corporation's lending operations are giving priority to projects being implemented by SEBs in the areas of system rehabilitation and modernization, and power distribution.

1.12 NTPC and NHPC were formed in 1975 to construct and operate large power stations and associated transmission facilities. They sell bulk power to the SEBs for distribution. NTPC has had marked success. It has grown rapidly and now provides about 10% of India's total power supplies, in the process establishing itself as a utility that is efficient by international standards and with a proven track record of implementing major projects. NTPC also enjoys a strong financial position: in 1987/88 it earned a return on net fixed assets (most less than five years old) of 17%. In contrast, NHPC is still struggling to establish a role for itself; the states control water rights and are reluctant to relinquish hydro sites to the Center. This has prompted GOI to explore joint ventures with the states to develop hydro schemes. The Nathpa Jhakri Power Corporation (NJPC), which has been established to construct and operate the proposed Nathpa Jhakri power station, is the first such joint venture between GOI and a state, in this case Himachal Pradesh. REC was established in 1969 to coordinate rural electrification and provide financial and technical expertise for SEB schemes. Currently, REC finances more than 70% of total rural electrification investments. At present, there is no organization with responsibility for developing a national transmission grid, although GOI is contemplating th formation of such a body (para 1.24).

1.13 Private utilities at present make only a marginal contribution to public electricity supply, though private supply through captive generation is extensive (equivalent to about 15% of public supply). To mobilize additional resources for sector development and in recognition of the potential efficiency gains, GOI now is attempting to increase private sector participation in public power supply. GOI has a White Paper on power under final review which aims to address existing regulatory and financial disincentives to private participation in the sector.

Financial Performance and Tariffs

1.14 Only two SEBs made a profit in 1986/87 and SEBs as a whole incurred a combined loss in that year of approximately Rs 15,799 million (US$1,215 million) exclusive of subsidies, corresponding to a return on historically valued net fixed assets of 3.5% before interest, and -8.3% after interest. Internal cash generation, which was equivalent to only about 2.7% of capital expenditure in 1984/85, has been correspondingly poor. Almost all SEBs' capital expenditures are financed by debt, primarily loans from state governments. Recognizing the unsatisfactory state of SEBs' finances GOI has, through an amendment to the Act notified in April 1985, required each SEB to earn an annual return, after meeting operating expenses, taxes, depreciation and interest, of at least 3% on its historically valued net fixed assets (GOI does not accept the principle of revaluation of assets). The Bank supports this initiative by GOI and has changed the form of its financial covenants to reflect this. Although, in terms of the Bank's conventional method of calculation, the return specified in the Act, which corresponds in some cases to 4 to 6% on revalued assets, is modest, it represents a substantial improvement on past performance. Many SEBs, particularly those of the poorer states, are experiencing considerable difficulty achieving even this level of performance. In parallel, GOI is also considering increasing the rate of return on paid-in capital that private power utilities are permitted to earn from 12% to 15% to stimulate private sector interest in power supply.

1.15 NTPC's tariffs are approximately equal to its long-run marginal costs (LRMC). However, the structure of NTPC's tariff has certain shortcomings, the main one being that it does not distinguish between peak and off-peak supply costs. This distorts SEBs' generation planning with the result that NTPC's power stations are not utilized as efficiently as they might be. A committee established by GOI has recommended NTPC's tariff be divided between peak and off-peak rates. In anticipation of GOI's endorsement of this recommendation, the forthcoming operation with NTPC2/ will include a component to design and implement a new bulk supply tariff. A similar component is being planned for the first operation with NHPC. Also, under the proposed project, the Nathpa Jhakri Power Corporation (NJPC) has agreed to design and implement a bulk supply tariff the structure of which will reflect the Corporation's peak and off-peak supply costs (para 4.06). SEBs' tariffs are now 60-70% of long run marginal cost (LRMC); a significant improvement from about 50% of LRMC in 1981 following real tariff increases averaging around 5% p.a. between 1981 and 1987. Prices relative to LRMC will continue to improve as rates are increased to achieve the GOI's target rate of return. However, the structure of tariffs remains unsatisfactory. Tariffs are frequently excessively complex and invariably heavily cross-subsidize low voltage consumers. Very little has been done through tariffs either to tap load management potential or consumers' willingness to pay, which in many cases substantially exceeds existing tariff levels. Despite accepting the principle that energy prices should "reflect true costs" in both its Sixth and Seventh Plans, social and agricultural objectives have in practice limited progress towards this pricing objective. To impress on the relevant authorities the true costs of cross-subsidization, the Bank will continue to require SEBs to carry out tariff studies wherever tariff structures appear to be badly distorted. Currently, three such studies are underway in the states of Kerala, Maharashtra and Karnataka. However, resistance to economic pricing is such that progress in pricing reform is likely to be slow.

1.16 In lending to individual SEBs, the Bank will continue to address state-specific programs to improve resource mobilization, for example, by developing financial programs capable, as a minimum, of achieving the rate of return specified in the Act. Where higher returns are both feasible and desirable, the Bank will press state governments to use their discretion under the Act to notify a higher rate of return. Under the proposed project, the Government of Himachal Pradesh (GOHP) has agreed to enable Himachal Pradesh SEB to take such actions as needed (including increasing tariffs) to earn a rate of return after interest in excess of 3%, rising to 7% by 1995/96. This 7% return is equivalent to a rate of return as defined by the Bank of approximately 13% (para 4.15).

2/ Currently under preparation.

Power Subsector Planning

1.17 The Bank has consistently encouraged GOI to pursue integrated planning and coordinated operation of the country's electricity supply systems. In response, GOI has prepared a set of regional least cost development plans, published as the National Power Plan (NPP) in 1983. Although the NPP represented a good first step towards integrated planning, it needs further refinement and regular updating. In addition, in fulfillment of an agreement reached under the Rihand Power Transmission Project (Ln. 2535-IN), GOI recently has completed (through CEA) a National Transmission Plan. This is an important step towards least-cost transmission development and towards integrating generation and transmission planning, and will form the basis of NHPC's Northern Region Transmission Project, which is being prepared for Bank financing in 1989. However, national generation and transmission plans can only lead to effective improvements if complemented by measures to bring about coordinated system operation. At present, only the Northern Region is approaching this. GOI is encouraging states to reach the necessary agreements on operating parameters but progress is likely to be slow so long as severe power shortages exist. To improve regional coordination of SEBs' operations, the proposed Maharashtra Power Project and forthcoming operations with NTPC and NHPC will include components to provide equipment needed for regional load dispatch and to undertake studies to recommend tariffs and commercial arrangements to stimulate for bulk power exchanges. Even if coordinated intra-regional operation is achieved, inter-regional transfers will be very difficult without the use of direct current facilities to overcome problems of frequency control. The first such facility, a link between Northern and Western Regions, is a component of the Central Power Transmission Project.

1.18 Disparities between the long-term NPP, national five-year plans, short-term budgets and actual performance have been substantial. Owing to a lack of resources, fewer projects have been included in five-year plans than in the NPP and, as a result of inadequate allowance for escalation and delays in project implementation, fewer still have been executed. The resulting power deficit has undermined long-term least-cost planning by necessitating rapid expansion of supply; for example, shorter gestation thermal plants have been favored at the expense of lower cost hydro. Furthermore, it has prompted over-investment in captive plant, a second best measure leading to excessive use of high value petroleum products for power generation. The proposed project includes a component that aims to strengthen the planning capabilities of CEA and the Central Water Commission (CWC), particularly as regards the planning of hydroelectric stations and the use of modern techniques for power system planning. The forthcoming operation with NHPC will also help ease CEA's shortage of resources by establishing a fund for pre-feasibility studies of hydroelectric projects. In addition to supporting GOI's efforts to increase the supply of power, the Bank will continue to stress to GOI the role of pricing and load management in eliminating power deficits, and the importance of integrating planning and pricing.

Management and Operations

1.19 Institutional evolution of the sector, in terms of the structure and capabilities of entities' management, has not kept pace with the tremendous physical growth of India's power systems. Moreover, the roles of particular sector institutions and the services they provide (principally CEA and CWC), need to be adapted to respond more closely to important sector development constraints, for example, the needs to improve investment planning and to integrate system operations more closely. Compared with the relatively efficient management and operations of NTPC, the capabilities of most SEBs are extremely weak. In general, SEBs have adequately qualified engineering staff, but lack experienced personnel in financial planning and control. Management practices also are generally outmoded and inadequate. Accounts have been maintained principally to track cash receipts and expenditures, and there has been little use of accounting information for managerial purposes. Unfortunately, significant pay differentials between the public and private sectors make it difficult to recruit competent staff. The Bank has encouraged GOI to develop a new uniform system of commercial accounting for SEBs. After initial delays, implementation of this new system is now proceeding. The Bank will continue to support institutional development programs through lending to selected SEBs which, together with their state governments, are committed to reform. In addition, the Bank will continue to support ad hoc initiatives, such as the PFC Workshop on SEBs' Finances held in February, 1989, which aims to improve understanding of the factors underlying poor financial performance and explore ways these constraints might be addressed.

1.20 The operations of many SEBs are hampered by the poor condition of their plant and equipment. Factors that have contributed to the poor condition of thermal plant include inadequate maintenance (in part due to capacity shortages), deficiencies in manufacture, lack of spares, and the poor quality of coal; in general, these problems have been recognized by the relevant authorities and corrective steps are being taken. Distribution systems also suffer from inadequate maintenance, overloading owing to inadequate investment and deficiencies in the manufacture of equipment. Rehabilitation, particularly of thermal plant and distribution networks, appears to be a very cost-effective way to improve efficiency and augment system capacity. GOI has recently initiated a rehabilitation program for thermal plant but is less able to effect improvements in distribution. The Bank will continue, whenever appropriate, to include rehabilitation components under its loans. In addition, to help ease technical efficiency constraints, the Bank is seeking through a Power System Efficiency Study (initiated in January, 1989 as part of the Bank's program of economic sector work) to identify the causes of recurring technical problems and to recommend solutions that could be implemented throughout the sector.

GOI's Strategy in the Power Sector

1.21 The Five Year Plan constitutes the only formal statement of GOI's energy and power policies. Formalization of power policy, in particular, is made difficult by the constitutional arrangement in which responsibility for power is shared between Center and states (para 1.10). However, the Plan reflects a broad consensus of the objectives of energy and power policies. While the Eighth Plan has yet to be finalized, preliminary indications suggest there will be little change from the consensus of objectives reflected under the Seventh Plan. However, recent GOI initiatives (its establishment of PFC and attempts at bringing improved financial discipline to the SEBs and its proposed White Paper on private sector participation in power supply) are encouraging signs that the Eighth Plan will be more sharply focussed on tackling root causes of sector inefficiencies. Principal objectives of GOI's energy policy likely to remain are: (a) developing energy supplies economically at a rate commensurate with growth in the economy and social needs; (b) substituting indigenous energy resources for imported petroleum wherever this is economically feasible; and (c) encouraging the rational and efficient use of energy resources. India's power policy is governed by essentially the same objectives, although alleviation (or at least containment) of the acute power shortages suffered nationwide most probably will continue to dominate GOI's short-term strategy. Over the longer term, achievement of least-cost development assumes greater importance. Specific policy objectives to help ease power shortages most likely will continue to focus on:

(a) rehabilitating thermal plant - a program involving some 30 plants is currently being implemented (para 1.20);

(b) accelerating implementation of ongoing projects - a recent reorganization of Government created a new ministry specifically to monitor and improve implementation of public sector projects; in addition, lending by PFC will aim to accelerate implementation of projects to rehabilitate and modernize existing plant (para 1.11);

(c) adopting a more supportive approach towards private sector involvement in power supply (para 1.13);

(d) permitting the construction of shorter gestation gas or oil-fired plants (para 1.05); and

(e) improving the quality and reliability of coal supplies to power stations (para 1.04).

1.22 GOI's long-term strategy requires a blend of policies designed to address investment, organizational, institutional and financial issues. The amount of investment available to the power sector is limited. The Seventh Plan allocation was about only half that sought by the Working Group on Power, a sum which was itself inadequate to eliminate power shortages. Long-term investment priorities under the Eighth Plan most likely will continue to be:

(a) accelerated hydro development (para 1.06);

(b) an increased proportion of investment in transmission and distribution (para 1.08);

(c) the formation of a national grid (para 1.12);

(d) coal beneficiation to improve both quality and homogeneity (para 1.04);

(e) diversification of the modes in which coal for power generation is transported, such as the introduction of coastal shipping or slurry pipelines (para 1.04);

(f) diversification of the fuels used for power generation; GOI now recognizes that gas-fired plant, especially combined cycle, has an economic role to play in system development (para 1.05); also that imported coal may be economic at some coastal and inland locations; and

(g) steady growth in the development of nuclear power (para 1.07).

1.23 Long-term organizational, institutional and financial issues are more controversial and GOI still needs clearly defined strategies in these areas. GOI recognizes the institutional and financial weakness of many of the SEBs, but constitutional constraints limit the rate at which it can bring about improvement. Measures which GOI is following include:

(a) increasing the role of efficient central sector institutions, particularly NTPC, inter alia, by encouraging joint ventures with SEBs (para 1.12);

(b) implementing a uniform system of commercial accounting for all SEBs (para 1.19);

(c) requiring, through a recent amendment of the Act, that SEBs earn a rate of return of not less than 3% after all expenses and interest (para 1.14), a significantly more stringent financial requirement than hitherto; and

(d) giving more favorable treatment to private sector proposals for power generation, particularly when it can be demonstrated that such developments are mobilizing resources which would not otherwise be available to the public sector (para 1.13).

In addition, as noted, GOI has formed the PFC as a financial intermediary to serve the sector (para 1.11). Funds lent by PFC will be attractive to SEBs because, at least in part, they will be additional to agreed Plan outlays. It is expected that PFC will pursue institutional reform of the SEBs through subjecting loan beneficiaries to conditionality designed to improve efficiency and financial performance.

1.24 GOI recognizes that development and operation of an integrated national grid will be difficult to achieve with the present organization of the sector and GOI is contemplating the formation of a separate body with responsibility for the grid (para 1.12).

Bank Group Strategy in the Power Subsector

1.25 The Bank supports the elements of GOI's strategy outlined in the preceeding paragraphs. However, while each of these elements is desirable, they do not address all of the sector's serious deficiencies in a sufficiently determined way. In particular, additional efforts are needed to address problems in the areas of planning, pricing, load management, institutional development and finance. The prevalent nature of these problems suggest that a sector-wide approach should be sought. However, the comparative autonomy of the states and SEBs from the Center makes it difficult to achieve progress through involvement exclusively with central agencies. With the exception of the introduction of uniform commercial accounting in SEBs, few improvements at the state level have been realized through umbrella projects coordinated by CEA or REC, primarily owing to the very weak control that these institutions are able to exercise over SEBs. Consequently, the Bank is emphasizing projects with a more direct involvement with individual SEBs and where state-specific programs can be designed to address areas of deficiency. Initial experience with individual SEBs -in Karnataka and Uttar Pradesh- has been encouraging. Under the Uttar Pradesh Power project, for example, UPSEB agreed to a comprehensive program of institutional and financial reform. Further operations with selected SEBs will focus on: (i) strengthening SEBs' technical and financial planning capabilities; (ii) improving the utilization of generating plant and transmission and distribution; (iii) improving plant maintenance; (iv) continuing adjustment of prices towards economic costs; and (v) reorganizing SEBs and improving management information systems. Tariffs and financial performance will continue to be the areas in which progress is most difficult to make (para 1.14): states have limited financial incentives to improve SEBs' performance (as tax remittances are paid direct to GOI), whereas the political costs of increasing prices are direct and strongly felt.

1.26 In parallel with lending to individual SEBs, however, the Bank proposes continued support for central sector entities, because: (a) increased reliance by the states on central sector generation appears to be the best way to encourage decisions at the state level consistent with the national interest; and (b) a higher proportion of total generation provided at economic tariffs by NTPC and NHPC will help to improve tariffs to final consumers. The difficulties that GOI has experienced in bringing hydro projects into the central sector mean that NTPC will continue to be the main vehicle for the Bank's support of the central sector. NTPC's record to date is impressive. However, it is still far from being a mature institution and, owing to its rapid development, it will continue to face problems in which it could benefit from Bank support. In the wider context, the Bank feels that a review is needed of the organization and technical services provided by sector entities and it is desirable that this should include a review of the organization and functions of CEA and examination of the desirability of establishing a utility specifically to develop and operate a national power grid. Such an institutional review is included in the Bank's program of economic sector work and the Bank will continue to mount institutional initiatives through particular lending operations: the proposed project includes a component which aims to strengthen the planning capabilities of CEA and CWC (para 3.06(C)), and the forthcoming operation with NTPC will include a component to reorganize and strengthen the Corporation's management.

1.27 In addition to addressing areas in which GOI's strategy appears deficient, it is appropriate that the Bank should focus on aspects of the strategy already adopted, where the Bank can do most to catalyze progress. In this respect specific aspects identified include:

(a) integrating operations of power supply systems including the formation of the national grid. The forthcoming transmission operation with NHPC will improve coordination of SEBs' operations in the Northern Region and facilitate efficient dispatch of new and existing power stations;

(b) accelerating hydro development - by strengthening project planning, design, implementation and management of hydro power projects (for example, the proposed project for the first time includes foreign consulting assistance to CEA to assist in detailed project design and implementation), and by mobilizing additional financial resources through Bank's proposed loan and funds from cofinanciers;

(c) developing projects of international interest that could result in low-cost sources of power for India, such as the Karnali Hydroelectric Project in Nepal and the Pancheshwar Hydroelectric Project on the border between India and Nepal;

(d) elements of strategy that involve concerted action by organizations, both inside and outside the power subsector - the Bank can coordinate its own lending operations within the different subsectors in order to improve intersectoral cooperation. Priority examples concern improvements in coal quality and transportation, and the use of natural gas for power generation; and

(e) supporting private sector power generation - a possible operation with Bombay Suburban Electricity Supply, and the possibility of a further operation with Tata Electric Companies, will aim to complement GOI's initiatives to stimulate private sector participation in power supply (para 1.13). Specific project objectives will be to mobilize funds that would not have been available to public power utilities and to improve commercial arrangements between private utilities and SEBs.

Bank Group Participation

1.28 The Bank has made 27 loans (US$4,994 million) and 17 IDA Credits (US$2,424 million) for Indian power projects (Annex 1.3). Twenty-two projects have been completed: 15 generation; 4 transmission; and 3 rural electrification. Projects currently under implementation include: 11 generation, 2 of which are hydro; 2 transmission; and five which include a mix of generation, transmission and distribution. With respect to NTPC projects, the first-phase projects at Singrauli, Korba, and Ramagundam were commissioned on or ahead of schedule and the plants have been operating at high efficiency. The second-phase extensions at these sites, the Farakka, the Rihand Power Transmission, and the Combined Cycle Projects are proceeding satisfactorily.

1.29 Through its participation in the sector in recent years, the Bank has contributed to the creation and development of NTPC which, with 2,500 MW commissioned in the last five years and around 3,000 MW under construction, is becoming a large and efficient generating company by international standards. The Bank also has assisted one of the few private utilities in the country, the Tata Electric Companies, in supporting the construction of the first 500 MW thermal unit in India and is planning further operations to support development of private utilities. Similarly, the Bank promoted -- through two transmission projects, the Central and Rihand Power Transmission Projects -- the introduction of high voltage, direct current technology. In addition to contributing in a substantive way to the supply of power, projects financed by the Bank also have promoted the development in India of a large public and private manufacturing sector for the construction of the required equipment (e.g. steam generators, turbo-generators, auxiliary and transmission equipment). While these industries still lack the quality and efficiency of their international counterparts, the competition resulting from international competitive bidding will encourage further improvements in the quality and technology employed in the equipment they produce.

1.30 A performance audit conducted in 1980 for the Second Power Transmission Project (Credit 242-IN) concluded that the project succeeded in helping the nine beneficiary SEBs extend their transmission systems to meet their growing power requirements. Utilization of generating capacity in these SEBs exceeded the appraisal forecast. However, the audit highlighted the difficulties of effecting institutional improvements in the absence of a close working relationship between the Bank and beneficiary SEBs. Another performance audit, conducted in 1985 for the First and Second Rural Electrification Projects (Credits 572-IN and 911-IN), concluded that India's rural electrification program, of which the projects were a part, has helped the country to achieve food self-sufficiency, alleviate poverty, and strengthen the rural economy; however, little progress was made in bringing about institutional improvements. In common with the previous audit, this also emphasized that the Bank should devote resources to deal with the SEBs directly, rather than indirectly through central institutions, such as REC.

II. THE BENEFICIARIES

Introduction

2.01 The Borrower of the proposed loan will be India and the main beneficiaries will be: (i) Nathpa Jhakri Power Corporation (NJPC); (ii) Himachal Pradesh State Electricity Board (HPSEB); and (iii) Central Electricity Authority (CEA) and Central Water Commission (CWC). A summary description of the basic Project components to be executed by each beneficiary is listed below and a detailed Project description is given in Chapter III.

(i) NJPC: Construction and operation of the 1,500 MW power station in the state of Himachal Pradesh;

(ii) HPSEB: (a) construction of 500 km of 132 kV transmission line and reinforcement and extension of the transmission system in the state of Himachal Pradesh;

(b) implementation of a communication and load despatch facility for HPSEB;

(c) implementation of a program to strengthen HPSEB's operations and finances;

(iii) CEA/CWC: implementation of a training program in the preparation of hydropower projects and in the design and planning of large power systems.

The institutional aspects relating to NJPC and HPSEB are discussed below while the financial aspects are dealt with in Chapter IV. Institutional details pertaining to CEA/CWC are given in Chapter I.

A. Nathpa Jhakri Power Corporation

2.02 Background: Water resources are under State jurisdiction in India and hydro development has been constrained by lack of financial resources of States with the greatest hydro potential. The formation of Nathpa Jhakri Power Corporation (NJPC), as an undertaking jointly owned by GOI and GOHP, represents the first cooperative effort of its kind between the Central Government and a State Government for development of a major hydro resource. The financing of the Project will be shared on the basis of 25% of the costs being borne by GOHP and 75% of the costs by GOI. Moreover, the funds will be in the form of 50% equity and 50% loan. Furthermore, in recognition of the State's jurisdiction over water resources, the partnership arrangement entitles GOHP to receive 12% of the energy generated free of charge and 25% of the balance of 88% shall be allocated to GOHP at the busbar rate. The remainder will be available to GOI for sale through NJPC to SEBs and other major purchasers of power in the Northern Region.

2.03 NJPC was formed under the Companies Act (1956) on May 24, 1988 to act as the executing agency, on behalf of GOI and GOHP, for the implementation and operation of the power station component of the project. The main objectives of the Corporation are to plan, promote, organize and execute the proposed power station on the Sutlej river including investigations, afforestation, environmental development, research and design activities. NJPC is also empowered to develop, in a similar manner, various other hydroelectric sites in the Sutlej river basin for execution in Himachal Pradesh and to undertake where necessary the construction of transmission lines and ancillary works for proper evacuation and distribution of power. No additional undertakings are planned for the period, during which, the proposed power station will be implemented.

NJPC Management and Organization

2.04 Annex 2.1 shows the organization chart for NJPC. The Articles of Association provide for the Chairman, Vice Chairman and other Members of the Board of Directors to be appointed by the President of India. The Chairman's appointment is subject to terms and conditions as may be determined by the President, while each Board member's term is to be for a period of three years and is renewable. The Articles specify that the number of directors would not be less than six nor more than 15 and that some of them may be part time or full time directors with functional responsibilities. At least one quarter of the part time directors would be nominated by GOHP. The Articles provide for the Board to have considerable autonomy on matters related to the execution and operation of the power station, such as entering into contracts, procurement, staffing, pricing, etc. However non-project related capital expenditures require further clearance by GOI and GOHP. The Secretary of Power, GOI, has been nominated as Acting Chairman and five top-level officials from HPSEB, CEA and DOP are acting as Directors. NJPC has formed a recruitment committee to select the staff for the Corporation. HPSEB has been nominated as the Agent of the Corporation to begin implementation of the works but NJPC will gradually take over as its strength builds up. HPSEB has been developing the project thus far and the Bank is satisfied that it is capable of undertaking project implementation initially as proposed. NJPC has agreed to furnish the Bank with a staffing plan, including qualifications and timetable for appointments, for key positions no later than June 30, 1989 (para 6.02(a)).

Field Organization

2.05 The field staff of the Corporation will be organized along functional lines to execute the Project (Annex 3.8). Six principal technical departments each to be headed by a Chief Engineer will cover designs, civil construction (2 departments), materials procurement, electrical and mechanical works, and transmission. There will also be an accounting wing headed by a Chief Accounts Officer which would maintain the project accounts during implementation. Many of NJPC's staff during the implementation phase will be on secondment assignment from HPSEB, NHPC, CWC and CEA. They will bring considerable expertise gained from working on other hydro projects in India, including the preparatory and feasibility work for Nathpa Jhakri power station. In addition their skills will be augmented through the training to be provided under the project (para 3.06(B)(d)) and by association with the project consultants who will provide assistance during the construction phase (para 3.08). The composition and number of NJPC's staff will undergo transition as the date of commissioning of the last unit in FY97 draws closer and construction related staff are replaced by fewer operational and commercial staff.

Financial Organization

2.06 NJPC's Accounts Department will be headed by a Chief Accounts Officer. He will be assisted by a small staff at headquarters in Shimla and at the construction site. Initially the Accounting Department will undertake the project financing functions and will maintain project accounts for the construction of the Nathpa Jhakri power station until its commissioning in FY97. Once the generating units are commissioned, the Accounting Department will operate a commercial accounting system and become responsible for all the financial aspects of the operation, including billings and collections from the SEBs. Initially, the accounting system will track the processing of expenditures, drawdowns of loans and equity, disbursements, payment of salaries, etc. Periodic statements of accounts will be prepared at monthly, quarterly and annual intervals and will be available for review by GOI, GOHP and the Bank. Prior to the first unit becoming operational, NJPC will modify its accounting organization set up and staffing profile to provide for the efficient operation of a satisfactory commercial accounting system as used by NHPC, NTPC and other Indian power sector corporations.

Audit

2.07 The external audit of NJPC's accounts will be carried out by an independent auditor to be appointed by the Comptroller and Auditor General of India. The auditor will normally be a member of the Indian Institute of Chartered Accountants and his audit report on NJPC's financial statements will be subject to comment by the Auditor General. NJPC has agreed to provide the Bank with audited financial statements within seven months of the end of each financial year, together with a certified report by the auditors and comments of the Comptroller and Auditor General of India (para 6.02(e)).

B. Himachal Pradesh State Electricity Board

HPSEB Background

2.08 A succession of small private and public electricity supply companies operated in Himachal Pradesh from 1908 until 1948, at which time the state government acquired control of most power supply assets in the state. The Multipurpose Projects and Power Department (MPPD) became responsible for operating the system until 1971 when it relinquished control to the Himachal Pradesh State Electricity Board (HPSEB) upon its formation, pursuant to the provisions of the Electricity (Supply) Act, 1948. HPSEB continues to serve as the principal producer, distributor and retailer of electricity within the State of Himachal Pradesh. In comparison to other SEBs in India, HPSEB operates a relatively small system with an installed capacity of 134 MW (hydro-132 MW; diesel-2 MW) and about 13,700 km of transmission lines and 29,500 km of distribution lines. As of March 31, 1987, HPSEB served about 700,000 connections comprising: 619,000 domestic; 66,000 commercial; 11,000 industrial; 3,000 agricultural and 1,000 miscellaneous. Legally, HPSEB is an autonomous entity reporting to MPPD, however GOHP exerts substantial influence on matters of pricing, planning, capital expenditure and staffing. HPSEB's dealings with GOHP on these matters are facilitated by HPSEB's chairman who concurrently holds the position of Secretary at MPPD.

HPSEB Management and Organization

2.09 HPSEB's organization structure is shown in Annex 2.2. HPSEB's Board of Directors is responsible for establishing internal policies. It consists of seven members, six of whom are full time. Implementation of the policies and responsibility for the various functional units is divided among the Financial Adviser and Chief Accounts Officer, Secretary, Chief Procurement Officer, Director-Commercial and eight Chief Engineers. Two of the Chief Engineers are responsible for particular generation projects (i.e., Kholdam and Bhaba hydro schemes). Two others are zonal Chief Engineers in charge of operations and maintenance in the two geographic zones of North and South, into which the state is divided. The three other Chief Engineers are responsible for new projects, generation and transmission planning, and technical coordination respectively.

2.10 The various operating units and the division of tasks and responsibilities have evolved in an ad hoc manner in response to the demands of the growing electrical system being managed. Although the organization structure is generally satisfactory for HPSEB's scale of operations, there are deficiencies which need to be addressed in the operation of some functional units particularly planning, operations and maintenance, and accounting. These deficiencies stem from a lack of suitably trained staff, outmoded procedures and practices and insufficient equipment and tools for staff to utilize in their work. A major reorganization of HPSEB's management structure is not needed but HPSEB concurs that a thorough study should be undertaken to review the functions, responsibilities and present practices within its main operating units (i.e., Personnel, Finance and Accounting, Commercial, Planning and Design, and Operations and Maintenance). Implementation of a Utility Management Study is proposed under the Project. It is particularly appropriate at this juncture in HPSEB's development since the utility is on the verge of a major period of expansion, wherein its assets in operation are projected to increase by over ten times from FY88 to FY96. The study will be undertaken with the assistance of consultants. The objective is to propose and implement policies and practices and identify a staffing and training program and equipment requirements which will enable HPSEB to perform its projected responsibilities and functions for the next 5 to 10 years. The proposed scope of work for the study is outlined in Annex 3.7(III). GOHP has agreed to cause HPSEB to provide for Bank's comment, the recommendations arising from the Utility Management Study and a timetable for implementing the study's recommendations before December 31, 1989 (para 6.03(b)). GOHP further agreed to cause HPSEB to implement the recommendations in accordance with the timetable agreed with the Bank.

Personnel Staffing and Training

2.11 Since June 1983, HPSEB has adhered to the hiring freeze imposed by GOHP. New personnel can be recruited only if there is a vacancy and that no present employee possess the requisite skills. Otherwise vacancies must be filled through redeployment. Table 2.1 shows HPSEB's staffing as of March 31, 1987, distributed according to skill level. Overstaffing has been a problem. Excluding construction related staff at various project sites, HPSEB employs about 18,000 people to operate a system with 134 MW capacity and 700,000 consumers. HPSEB recognizes that staff growth should be curtailed and that a suitable training program should be developed to ensure that, to the extent possible, future staffing requirements can be met from within the organization. GOHP has agreed to cause HPSEB to furnish to the Bank, before December 31, 1989, for its comment, a 5-year Staffing Plan and Training Program for HPSEB. GOHP further agreed to cause HPSEB to implement the Program in accordance with a timetable agreed between HPSEB and the Bank (para 6.03(c)).

Table 2.1: HPSEB STAFF ALLOCATED BY SKILL CATEGORY
(as of March 31, 1987)

	Actual
Management above Chief Engineer level	6
Engineers	2,720
Accounting Staff	142
Administrative and Clerical Staff	3,100
Technical Staff	13,727
Unskilled Laborer	13,786
Total	33,481

2.12 To date, HPSEB's in house training activities have been constrained by budget limitations, and restricted to the training of linemen and maintenance crews. About 300 have been trained at its Linemen Training Centre which was established at Solan in 1979. Approximately 25 engineers have benefited from outside training at various institutions within India and elsewhere. Some accounting training was received from consultants in 1985 during implementation of the new commercial accounting system but more is needed (para 2.19). HPSEB recognizes that a much improved training program is required in order for it to make better use of its large workforce and to meet the demands of its growing system. A review of the present and planned training arrangements and provision of training will be included in the proposed Utility Management Study, and Accounting and Management Information System Study.

Planning

2.13 The planning function is under the responsibility of the Chief Engineer (Planning and Monitoring). Presently, this unit does not perform any long or medium-term planning in a systematic manner. The Chief Engineer (Planning) clears the execution of projects for system expansion proposed by other units. The review serves only to ensure that the proposed designs meet HPSEB's established standards and that cost estimates satisfy the established norms. There is no organized effort to fit the project into a long-term expansion plan. Normally, selection of projects is dictated by budget considerations. The unit is also responsible for the collection of statistical information on the system. In most cases information is not processed or analyzed for planning purposes. In other cases it is manually processed and filed. There are three different levels of planning in India: (i) regional plans comprising generation and transmission above 220-kV which are prepared by CEA based on information and proposals received from the SEBs; (ii) State plans for generation and transmission below 220-kV, which is the responsibility of the SEB; and (iii) SEB plans for subtransmission and distribution. The final investment plans should normally be the result of several iterations at the three levels. In contrast, at HPSEB, expansion is driven by proposals prepared by the technical staff to alleviate overloading or shortages identified in the system but no attempt is made to establish these individual proposals as part of an integrated plan. The planning function needs to be strengthened in HPSEB. It needs to be reoriented into a forward-looking function rather than the present record-keeping and checking role. The planning unit should prepare and maintain long-term (15-20 years) indicative plans for expansion of HPSEB's power system framed within the regional plans prepared by CEA. The planning unit should prepare aggregated and disaggregated load demand forecasts in order to properly decide upon additions to generating capacity, transmission and distribution works and to formulate least cost development plans. The planning unit should be responsible for preparing detailed 5-year plans for immediate implementation. Appropriate skills will need to be acquired in project economic analysis and in formulating least cost solutions. Finally, the plans should include forecasts of annual investments and financing requirements and draw upon the assistance of the Finance and Accounts Department as required. A review of the planning unit's functions, organization set up, staffing needs, and training requirements will be included in the proposed Utility Management Study (para 2.10).

Engineering, Design and Construction

2.14 In contrast to its weakness in planning, HPSEB's design and construction performance for new power plants, HV transmission lines and substations has been good. The concerned staff are qualified and have experience in the construction of hydro power projects both with HPSEB, and while on deputation to NHPC. Technical support is obtained from CEA and CWC as required.

Operations and Maintenance

2.15 HPSEB's approach to operating and maintaining its generation, transmission and substation facilities should be revised to take into account the increasing size and complexity of its facilities. Maintenance of generating stations and transmission lines has generally been performed according to established schedules but upkeep of the subtransmission and distribution system is not routine and is usually dictated by breakdowns. The metering equipment which is used to record electricity flows at voltages above 11-kV is not checked after installation for accuracy. As a result, the calculation of system losses may be inaccurate. Equipment needs to be routinely tested and recalibrated. HPSEB does not maintain a central record keeping system to monitor compliance with maintenance schedules or the occurrence of breakdowns in its system. Moreover, it lacks a system of centralized technical files to compile, store and allow for easy retrieval of up-to-date information on the transmission/distribution system and power plants. The lack of basic communication equipment, including two way radios, results in the inefficient use of maintenance crews which must report back to crew dispatch centres after each assignment to obtain new orders. These shortcomings in HPSEB's operation and maintenance function would also be addressed under the proposed Utility and Management Study (para 2.10). The consultants to be engaged under the Study will assist HPSEB in setting appropriate procedures and record keeping systems and in procuring suitable communications equipment.

Materials and Stores Management

2.16 The Purchase Unit is responsible for bulk procurement and storage of consumable materials and goods. The unit prepares an annual assessment of needs, invites bids for supply of materials as needed and awards supply contracts to the lowest evaluated bidders. Storekeeping functions are decentralized regionally. Inventory controls are kept in ledgers but there is no codification of items or standard forms for requisitions, dispatches, etc. Physical inventory of the stores is taken annually. The reorganization and modernization of this unit is urgent. The necessary revisions will be identified and implemented under the proposed Utility Management Study.

Organization and Methods

2.17 The work of the Organization and Methods Unit consists of reviewing and processing of proposals for creation of new positions or organizational units and introducing new procedures. The analysis and criteria for decision making in this unit are not clear. The task of defining the systems, procedures, and standardization of forms, etc., has not been assigned within the organization. The result is the proliferation of forms, reports and procedures created ad-hoc by the different units. Under the proposed Utility Management Consultancy, HPSEB's systems and procedures will be streamlined and modernized.

Financial Organization

2.18 HPSEB's Finance and Accounts Department is headed by the Member Finance and Accounts who is a Senior Member of the Indian Administrative Service. A Financial Adviser and Chief Accounts Officer is responsible for the day to day management of financial operations and he is assisted at headquarters by three deputies who supervise the various accounting functions. In addition, HPSEB maintains 20 accounting units in the field, each headed by a Superintendent of Accounts who supervises about four staff. The organization of the Department and qualifications and experience of HPSEB's senior financial staff are generally satisfactory. However, primarily because of a lack of adequately trained middle and lower staff level HPSEB has not fully implemented the new Commercial Accounting System (CAS) introduced in April 1985. HPSEB recognizes the need for further training in respect of the new system and plans to introduce improvements in financial planning and in the development of its management information system.

Accounting System

2.19 The accounting firm which designed the new Accounting System for GOI also helped HPSEB in the preparation of the new accounts and initial implementation of the system. However, the duration of their assistance was too brief and the one week of training provided to lower level staff was inadequate. As a consequence of the new system not becoming fully operational, accounting staff, particularly in the field offices, are not properly trained in the new system and do not systematically report appropriate data to head office. HPSEB recognizes the need for an improved implementation program and for accounting training.

2.20 Similarly, HPSEB's financial planning function needs strengthening in order for the utility to cope with the projected expansion in its operations during the next decade. Financial planning has been limited to the preparation of annual budget forecasts and estimates of funding requirements, for submission to the state government. As with some other SEBs', it has not been the practice of HPSEB to prepare longer term financial forecasts needed for effective planning and operation of the utility. Key operational and financial data and indicators should be prepared on a routine basis to facilitate timely management decisions. Accordingly, the Board proposes to engage consultants to provide training and assistance in: (i) implementing the new Accounting System; (ii) preparing projected financial statements based on a 10-year forecast period; and (iii) introducing a modern computerized management information system (MIS). The consultants will provide training to HPSEB accounting and finance staff and will assist in the finalization of year end accounts for two financial years. They will assist HPSEB to procure appropriate computer equipment, and software for use in financial planning and in the MIS, and will provide related training. In conjunction with these efforts the consultants will also help HPSEB design and implement a management information system which will provide HPSEB's senior management with valuable financial and operational information on a timely basis. The implementation of an improved MIS will significantly enhance management's capacity to effectively manage the Board's operations. Consequently, HPSEB will be undertaking an Accounting and MIS study with the assistance of consultants to help it introduce a modern MIS and improve its financial planning and management. The scope of work for the proposed Accounting and MIS Study is contained in Annex 3.7. The Accounting and MIS Study will be carried out upon completion of the Utility Management Study. This is to ensure that the findings of the Utility Management Study will be incorporated in the Accounting and MIS Study.

Fixed Asset Accounting

2.21 HPSEB's fixed asset registers reflect historical costs as required by GOI. However, the registers do not accurately reflect the original value of the Board's plant and equipment. The value of some assets is understated or overstated owing to inaccurate record keeping, inappropriate allocation of costs associated with capital works and because obsolete assets have not always been written off. In view of the projected increase in HPSEB's asset base from FY88 to FY96 by over ten times the present value, the Board recognizes the need to establish an appropriate fixed asset recording system. Consequently one of the objectives of the Accounting and MIS Study, included in the Project, is to establish such a system as required by the new CAS.

Audit

2.22 HPSEB has an internal audit unit headed by the Chief Auditor who reports to the Member Finance. He supervises the work of 24 internal audit parties which audit all monetary transaction including capital expenditures, stores purchases, billing and collections etc. In the past, the improvements in record keeping which were recommended by the audit unit were not properly implemented by the line managers. To correct this deficiency the Member Finance has recently introduced procedural changes requiring concerned Chief Engineers to take corrective actions within specified time periods. Quarterly progress reports, monitoring their progress are submitted to the Board for review. HPSEB's internal audit arrangements are satisfactory.

2.23 The Comptroller and Auditor General of India, through his representative, the Auditor General of Himachal Pradesh is responsible for the external audit of HPSEB's accounts. The quality of audit is satisfactory. The Board is required by the Electricity (Supply) Act to finalize its accounts and have them audited within six months of the end of the financial year to which they relate. However, HPSEB has been late in finalizing and auditing its accounts for the past several years. GOHP has agreed to cause HPSEB to furnish to the Bank its audited financial statements together with the Auditor's Report and certification by the Auditor General of Himachal Pradesh as soon as they are available but in any case no later than nine months from the end of the financial year under consideration (para 6.03(d)).

Billing and Collections

2.24 HPSEB serves about 700,000 consumers, of which, about 88% are domestic consumers accounting for about 50% of the connected load. Approximately 9% of consumers are in the commercial category and they draw about 14% of the load. Only about 2% of consumers are in industry but they account for about 25% of consumption. The balance is divided among public lighting, agriculture and other miscellaneous consumers. All electricity consumption within HPSEB's system is metered. Meter reading and billing is done on a monthly basis for all industrial and agricultural consumers. For other consumers in urban areas, meter readings are recorded every two months but the bills are issued monthly, and are based on an estimate of average consumption for interim months in which meter readings are not taken. In rural areas, the meter readings for the non industrial and non agricultural consumers are recorded every four months but the bills are issued every two months based on estimates of average consumption. HPSEB levies penalty charges for late payments. Computerization of consumer billing has not yet been introduced. In view of the rural nature and broad geographic dispersal of HPSEB's consumers, the existing decentralized manual billing system is appropriate. However, HPSEB is presently investigating the benefit of introducing computerized billing for the Shimla area. Accounts receivable outstanding as of FY88 is estimated at Rs 353 million equivalent to roughly eight months sales of electricity. GOHP has agreed to cause HPSEB to reduce HPSEB's accounts receivable from no more than 6 months average monthly sales of electricity in FY89 to 2 months electricity sales by FY91 and maintain them at that level thereafter (paras 4.12(f) and 6.03(a)).

Income Taxes

2.25 HPSEB is liable for income tax. However, its accumulated losses, and the accelerated depreciation allowed for tax purposes in respect of its investment program, are such that it will not incur income tax obligations during the period of the financial projections. A tax equalization reserve is therefore not required.

Electricity Tariff

2.26 HPSEB's tariff structure as of March 1987 is summarized in Annex 2.3. The tariff structure is generally simple and easy to administer. However, the tariff levels have been insufficient to meet its financial requirements (para 4.10). The largest categories of consumption (i.e., medium and large industrial consumers, domestic and commercial) are subject to a two tier system of pricing with a separate rate applicable to higher levels of consumption. Commercial and medium and large industrial consumers are also subject to a minimum rate on the connected load and must enter into a separate agreement with HPSEB, involving higher charges in order to obtain power during the peak load hours of the day. HPSEB requires the approval of GOHP to introduce any changes in its tariff structure or rates.

III. THE PROJECT

Project Setting

3.01 The Northern Region of India,3/ where the proposed Project is located, is experiencing acute power deficits. Unconstrained peak capacity requirements in 1987 for the Region were estimated at 12,000 MW and annual energy demand at 61,000 GWh. The load met was about 75% of the unconstrained demand and only 90% of the energy requirements were supplied. CEA's demand projections show that in 1995 the capacity demand would reach 25,600 MW, which implies an annual rate of growth of 9.6% during the 1987-95 period. Similarly, energy consumption is expected to reach 131,000 GWh during that year, equivalent to 10% per annum growth. As a result of present shortages, utilities in the Region have had to resort to rationing. In addition, poor voltage and frequency regulation have increased costs to users particularly to industry (consuming about 52% of the electricity supplied) and to agriculture (consuming 30% of the supply). Moreover, the lack of hydropower capacity in this predominantly thermal system has

3/ The Northern Region of India comprises the states of Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab, Rajasthan, Uttar Pradesh and the Union Territories of Chandigarh and Delhi.

resulted in uneconomic peaking with thermal units. Maintenance schedules cannot be adhered to frequently because of the pressure on the utilities to maintain the supply sacrificing in this manner the long-term life of the plant. In view of the poor supply, many industrial and agricultural consumers have resorted to the use of standby generating equipment and diesel motors for irrigation pumps. These have higher capital unit costs than the large utility installations and operate on high value petroleum products. The least cost power expansion plan prepared by CEA for the Region contemplates an increase in installed capacity from 14,200 MW in 1987 to 28,300 MW in 1995 and includes, as expected, a number of hydroelectric schemes to alleviate the situation. The most important projects are: Chamera (780 MW) being financed by the Canadian Government; Uri (480 MW) for which GOI is negotiating bilateral assistance; Kholdam (600 MW) under construction; Srinagar (380 MW) being financed by the Bank under the Uttar Pradesh Power Project; and, the proposed Nathpa Jhakri Scheme (1,500 MW).

3.02 HPSEB will be one of the beneficiaries of the power generated at Nathpa Jhakri. However, HPSEB's system needs to be strengthened to be able to use its share of power. In addition, the existing transmission system in the State is overloaded in many sections resulting in poor service quality, increased losses in the lines, and reduced revenues. HPSEB's system operates several power plants and major substations many of them located in remote places in the rugged Himalayan region. HPSEB presently relies on deficient telephone and power-line carrier communications for the coordination of its operations and for the dispatch of the generating plants. Not all major facilities are connected to the communications network. The complexity of the system and its projected growth justify a strengthened communications system and a basic central load dispatch facility. The proposed project includes the provision of communications and load dispatch facilities that would permit a more efficient use of the existing plant and would reduce the response time of the center in case of emergencies or breakdowns.

3.03 HPSEB's organizational structure is adequate in respect of its present and projected objectives and size. However, the responsibilities of the different organizational units need to be revised to eliminate existing duplications and, more importantly, to add essential tasks not being presently performed (para 2.10). Similarly, systems and procedures in use are outdated and unsuitable to the administrative duties of the Board. In this regard one of the most pressing needs is the modernization of the financial wing and the full implementation of a commercial accounting system, as prescribed by GOI. The proposed Project will address these issues and provide training for HPSEB's staff as necessary in the operation of the new systems.

3.04 Because of the increased emphasis on development of hydroelectric capacity in India, the central agencies responsible for vetting and providing the engineering services for this kind of projects have been severely taxed. The problem has been compounded by a number of factors of which the most important are the need for: (i) improved standards in project preparation required to secure external financing; (ii) high-quality bidding documents required by the increased volume of procurement subject to international tendering as opposed to the traditional local tendering in India; (iii) increased productivity of the organizations responsible for the technical work; and, (iv) improved methods for the selection of investments in the power sector. To these ends the proposed Project takes a two-prong approach. Expatriate consultants will assist CEA, CWC and other institutions in the implementation of a training program to strengthen their capabilities for planning, preparation, design, and management of hydropower projects. In parallel, expatriate consultants will assist NJPC staff and supplement local experts in the preparation of final design and supervision of construction of the proposed Nathpa Jhakri power plant.

Project Objectives

3.05 The principal objectives of the proposed Project are to: (a) increase the power capacity of the Northern Region System; (b) improve the reliability of supply and reduce system losses in Himachal Pradesh; (c) strengthen the operational performance of HPSEB; and (d) improve and modernize the capabilities of government institutions for preparation, design and construction supervision of hydropower projects.

Project Description

3.06 The proposed project comprises:

(A) Construction of the Nathpa Jhakri power station including:4/

- (a) a 60 m high and 155 m long gravity dam across the Sutlej River, and intake and underground desilting chambers;
- (b) a 30 km long head-race tunnel, about 10 m in diameter with a maximum capacity of 405 m^3/sec;
- (c) a 130 m deep and 25 m in diameter surge tank;
- (d) three steel lined pressure shafts 650 m long and 6.0 m diameter, bifurcating at the downstream end into 60 m long 4.0 m in diameter branches;
- (e) an underground power house, transformer cavern and switchyard for 6x250 MW generating units for a nominal head of 468 m and ancillary equipment;
- (f) a 280 m long, 10 m wide arch-type tail race tunnel discharging back in the Sutlej River;
- (g) implementation of a resettlement and rehabilitation program for the population dislocated by the project;
- (h) implementation of a plan to protect the environment in the project area; and

4/ Dimensions subject to minor changes as detailed engineering is carried out.

(i) consultancy services as needed for design and supervision of the construction of the power station.

(B) A program of physical and institutional improvements for the power system of Himachal Pradesh including:

(a) construction of about 500 km of 132 kV transmission lines and associated substations, totalling about 184 MVA, to expand and reinforce the transmission system in Himachal Pradesh, including tools and transport equipment for construction, inspection and maintenance of the system;

(b) installation of a communication system and a state load dispatch facility for control and operation of the Himachal Pradesh power system;

(c) preparation of a 10 year transmission Plan for HPSEB;

(d) preparation and implementation of an Accounting and Management Information Study and Utility Management Study to streamline HPSEB operations including:

(i) implementing a commercial accounting system;

(ii) training for accounting staff;

(iii) establishing a fixed asset accounting system;

(iv) provision of computer equipment, software and training for financial planning and operations;

(v) establishing a management information system;

(vi) undertaking a redistribution and reorganization of responsibilities according to main functional lines (planning, design and construction, operation and maintenance, financial management, metering, billing and collections and administrative services); and

(vii) establishing and implementing a training plan for HPSEB's managerial, technical and clerical staff;

(e) consultancy services as needed to implement the physical and institutional improvements of HPSEB.

(C) Implementation of a training program to strengthen the capabilities of CEA, CWC and other selected agencies to plan, design and manage hydropower projects with particular emphasis on underground works. The program includes the acquisition of specialized office engineering equipment, technical literature, computer hardware and software, office space to install such facilities, and consultancy services as needed to implement the program.

Annex 3.1 gives a detailed description of the Project and Annex 3.7, the suggested scope for the consultancy services under the proposed project.

Project Engineering

3.07 CWC, the Geological Survey of India (GSI) and the HPSEB have been investigating the Nathpa Jhakri scheme for about 20 years. The engineering designs for the power station are at the bidding stage of preparation. HPSEB has prepared bid documents and technical specifications for the civil works and general conditions, conditions of contract and special conditions for procurement of major equipment. The technical specifications for the turbo generating units and for other major equipment are under preparation. HPSEB has prepared the designs with the assistance of CEA for the electromechanical equipment and CWC for the civil works. HPSEB has appointed a five-member Panel of Experts (POE) to review the technical aspects of the power plant. The terms of reference for the POE (Annex 3.7) are acceptable to the Bank. However, the present composition of the POE may need to be modified during the detailed design and construction stages, to include other specialists in rock mechanics, geotechnical engineering and sediments as needed. The terms of reference enable the POE to retain temporary members or advisors in specific disciplines. To expedite the recruitment of temporary or permanent members of the POE, NJPC will maintain during the construction period a roster of specialists in different disciplines from which POE members can be selected. The roster and the qualifications of the candidates included in it will be furnished to the Bank for comments no later than June 30, 1989 (para 6.02(b)). Any subsequent additions to the roster should be acceptable to the Bank. The POE would oversee the technical aspects of project implementation until commissioning of the last generating unit.

3.08 The scale of the underground works for Nathpa Jhakri is unprecedented in India and amongst the largest in the world. The size of the generating units (250 MW) exceeds considerably the largest hydropower unit ever installed in the country (169 MW). Furthermore, the need to excavate four major underground desilting caverns in addition to the ones for the power house and for the transformers, presents design and construction complexities which call for the use of state of the art engineering in this field. Therefore, NJPC will retain consultants under terms and conditions satisfactory to the Bank to assist the Corporation in the preparation of the detailed design and the supervision of the construction of the power station. NJPC will issue a letter of intent to the selected consultants no later than June 30, 1989 (para 6.02(c)). NJPC will sign a contract with the selected consultant within 60 days of the letter of intent (para 6.02(c)). The lead consultant to the project will be CEA. NJPC will establish a project design and supervision team with the independent consultants, its own staff, CEA's, CWC's, GSI's and HPSEB's staff on full-time deputation to this project. All will work under a unified direction. The details of such arrangements, including organization chart, the specific staff positions to be filled with staff from each organization and duties and responsibility of each unit within the design-supervision team will be furnished to the Bank for review, no later than June 30, 1989 (para 6.02(d)). In case CEA or CWC or GSI are not able to furnish the agreed staff, they will be supplied by the independent consultants. In order to facilitate CEA, CWC and GSI assistance to the Project, NJPC will enter into consultancy contracts with these institutions under which NJPC will cover the cost of the services provided. The Bank will finance all reimbursable expenditures, except salaries and fringes of the staff. These contracts will be signed before June 30, 1989.

3.09 The site investigation and engineering work conducted thus far are sufficient to determine costs of the power station at the bidding level. There are, however, a number of additional studies which need to be completed for the preparation of the detailed designs. These include, inter alia, hydraulic modelling of the intake area and desilting chamber, a number of geotechnical tests to confirm rock properties and collection and processing of additional sediment data. These tasks will be completed before mid 1989 when the bulk of the detailed construction drawings will be required. The Project will include funds to retroactively finance the expenditures for equipment, materials and services contracted for these investigations incurred after April 1, 1988, and before the date of the loan agreement (para 3.18). Engineering for the transmission component in Himachal Pradesh is at feasibility level. The detailed route survey is underway and will be finalized by March 31, 1989.

Project Implementation and Construction Schedule

3.10 The Project will be implemented over a period of 8 years. Annex 3.2 shows the implementation schedule for the Project. NJPC will be responsible for the construction of the power station with the support of CEA, CWC and consultants (para 3.08). NJPC will also implement the resettlement and environment protection plan associated with the power plant. Access roads to the construction fronts, campsites and power supply for construction are ready which allows immediate start of works. Prequalification of contractors for the civil works of the powerhouse has taken place. The first generating unit will be commissioned in June 1995 and the remaining five units will be operative at three months' intervals thereafter. The sixth unit will be commissioned in December 1996. NJPC has proposed a field organization which is adequate to implement the power station (Annex 3.8). NJPC will give the Bank opportunity to comment on any substantial changes on the organization before they are implemented (para 6.02(i)). HPSEB will be responsible for the implementation of the transmission component, the load dispatch and communications system and the institutional development program for the SEB. HPSEB will prepare the detailed engineering for the 132 kV transmission lines and for the associated substations including the specifications for the procurement of materials and equipment. HPSEB has adequate in-house expertise to carry out this task and no external assistance is envisaged. Consultants acceptable to the Bank will, however, assist HPSEB in the design and selection of the load dispatch and communication equipment. CEA will implement the training program for CEA, CWC, GSI and other selected agencies. GOI agreed to establish a training unit in CEA, before June 30, 1989, and appoint a coordinator to implement the training program (para 6.01(a)). CEA's training coordinator will be responsible for the overall administration of the program, and will serve as the liaison between the beneficiary institutions, the consultants, and the Bank for all matters related to this project component. Most likely there will be more than one consultant for this program because it consists of a number of modules for CEA on planning and electromechanical disciplines, and a civil engineering module for CWC. The main training consultants for CWC and those for HPSEB institutional improvement plan will be retained before June 30, 1989, under terms and conditions acceptable to the Bank.

Water Rights

3.11 The proposed Nathpa Jhakri power station is located on the Sutlej River, which originates in the Tibetan Plateau and flows into Pakistan where it becomes a tributary of the Indus River. The Sutlej is subject to the provisions of the 1960 Indus Water Treaty between India and Pakistan. The two Governments established the permanent Indus Commission under the treaty to facilitate implementation of its provisions. It serves as regular channel of communication between the two governments on relevant matters referred to in the Treaty. The Sutlej is an Eastern river under the terms of the Treaty and consequently, India has the unrestricted use of its waters. Furthermore, the scheme is a run-of-the-river facility which would affect river flows on a daily basis only. The daily flow fluctuations, however, will be fully attenuated over the downstream reaches of the river and at the Bhakra Dam located 148 km downstream on the Sutlej river, which has been in operation since 1963, and has a live storage 1,700 times that of Nathpa Jhakri. Accordingly, the Bank is satisfied that the project will not result in any adverse effects on the quality, the quantity or the time-distribution of water flows into Pakistan. The project does not cause any upstream flooding because the maximum level of water in the diversion pondage is controlled by the existing Bhaba power station located about 8 km upstream of Nathpa Jhakri in Himachal Pradesh. There are no pending water rights disputes that could affect project construction or operation. The Bank is satisfied that the proposed project will not cause any harm to the interests of the riparians.

Resettlement

3.12 In view of the absence of a major reservoir, only 457 ha of land needs to be appropriated for the Nathpa Jhakri scheme and much is river bed. The diversion pond lies in a 300 m deep canyon. The rest of the works are underground. This means few people need to be resettled. About 73 families, will be affected, involving a total of 47 ha of land. There are neither squatters nor landless people in this area. Employment is so high that Nepali, Bihari, and Rajasthani labor is currently imported to Himachal Pradesh. The small reservoir lies within Kinnaur Province, largely inhabited by the Kinnauri Tribal people who are Buddhist in this mainly Hindu State, and who speak their own language (Kinnauri), although many also speak Hindi. Owing to the location of the reservoir in a deep canyon, no Kinnauri tribal people will be affected. All 73 affected families have been consulted. The local legislature (Panchayat) helped to choose the new sites, all of which are within about one kilometer of the areas to be acquired by the Project. Cash compensation is not envisaged. All displaced families will be given land commensurate with land of equivalent productive capacity. The leader of the community (Lumbru Ram of Chakri) representing 53 displaced families reported that all displaced families are satisfied with the planned resettlement partly because less than one third are dependent upon the land to be forfeited. The remaining two thirds lose only a small portion of their holdings and in any event support themselves by paid employment or in shopkeeping. They are further satisfied because few displaced families plan to live on their resettlement plot; most are said to plan to build near relatives and will move into dwellings on their other holdings. Most plan to use their resettlement plot for agriculture. Although Himachal Pradesh provides the temperate fruit (e.g. apples, peaches, plums, almonds, apricots) of India, no fruit trees would be inundated. HPSEB's Land Acquisition office, in conjunction with the Revenue Department, will assess assets to be lost by displaced families, and will calculate equivalent compensation in order to specify the new relocation sites for each family. HPSEB has prepared a detailed resettlement plan. The Bank has reviewed the plan and found it acceptable. The project provides funds to finance part of the costs of the resettlement program.

<u>Environmental Aspects</u>

3.13 The environmental impact of this project is minor for the following reasons: (a) the power plant is a run-of-the river facility; (b) the dam and the reservoir would be located at the bottom of a 300 m, deep canyon; all the remaining structures would be underground; (c) since the river is at the bottom of the canyon, few people ever approach the river and fewer live near it; (d) the Bhakra reservoir, would eliminate any daily flow variations resulting from peaking operations of the plant (para 3.11). GOI has cleared the Nathpa Jhakri scheme with regard to environmental and forest aspects. HPSEB has applied for forest clearance for most of the transmission lines contemplated in this project. No difficulties are envisaged in obtaining the clearance because many of the lines run through corridors where other lines already exist, and the new ones would be routed to minimize forest crossing. GOHP has agreed to cause HPSEB to submit the remaining applications for forest clearance for the transmission lines and substations under the project no later than June 30, 1989 (para 6.03(e)). In addition, the Bank will not disburse against transmission lines and associated substations until all the forest clearances are obtained (para 6.06). The most important environmental aspects of the proposed project are as follows:

(a) <u>Water-borne Diseases</u>. Water-borne diseases are not expected to become a problem for five main reasons. First, the project will be operated as run-of-river, so little or no disease vector breeding habitat will be created. Second, there is little water storage; the 457 ha reservoir is largely contained in the river bed and canyon. Third, the project site is far (30°) north latitude in mountains commonly higher than 3,000 m, although the reservoir lies in a canyon at less than 1000 m above sea level. This means temperatures are too cold for much of the year for aquatic disease vector proliferation. Fourth, the project is distant from the known foci of schistosomiasis (bilharzia) in Ratnagiri Province, Maharashtra. Fifth, Himachal Pradesh is a "Malaria-free" state of the Union.

(b) Forest and Wildlife. The "forest land" of the project region includes some productive plantations of Chir Pine (*Pinus roxburghi*) but little, if any, intact natural forest partly because of the high elevation steep rock and cliff substrate of the area and partly from population pressures, both human and livestock (cows, goats, sheep). Therefore there is little wildlife in the general area and especially in the affected areas. There are no migratory fishes in the river to be affected by the scheme. The project has been carefully designed in order to minimize damage to pine plantations. Access roads to the construction fronts have been already constructed with no noticeable effects on ecology because the alignment of the project runs parallel to the existing national highway from Shimla to Shipkila (NH 22) at an average distance of only half a kilometer from it. A total of 118 ha of forest plantation would be used in the overall project, mainly for work areas and adits. No reserve forest will be affected by the dam or submergence area. Even so, some 800 trees will be felled on 14.4 ha to be cleared in the pine plantations of Pashada to open a quarry for quartzitic aggregate needed for the project which is not available elsewhere according to an extensive search done by GSI. Compensatory forest plantations have been planned by HPSEB's Foresters in conjunction with the Forest Department. All areas used will be graded, restored and reforested after use. In compensation for 118 ha (10,517 trees) used, HPSEB has acquired 160 ha near Rampur (42 ha more than required) in order to plant 200,000 trees. HPSEB has agreed to include as part of the construction specifications for the transmission lines adequate provision to stabilize and restore the soil disturbed by the construction work.

(c) Cultural Property. Because the general habitation level is of the order of 300 m above the Sutlej bed, there is little human contact with the river in this largely canyon stretch. The Bank is satisfied that there are no cultural properties (e.g. archeological sites) likely to be affected. The main shrine, a temple to the godess Khali, is at 11,000 ft. on the Kotla-Kunni road, hence safely distant from the scheme.

(d) Instream Flows. Water will be spilled during the April to June snow melting period and through the July to September monsoon period. During the October to March period the Project will be operated as a peaking facility and a minimum discharge (above average lean season flows) will be maintained. There is no irrigation and no cattle watering (or human habitation) downstream from the dam. The first major tributory enters the Sutlej 4 km below the Nathpa Jhakri dam.

GOI has prepared a satisfactory plan to implement the proposed afforestation and environmental protection measures. The Project provides for Bank financing of part of the costs of this component.

Project Cost

3.14 Table 3.1 shows a summary of Project costs. Annex 3.3 presents the detailed cost estimates.

Table 3.1: Project Cost Summary

	Local	Foreign	Total	Local	Foreign	Total
	(Rupees Million)			(US$ Million)		
A. Nathpa Jhakri Power Station						
- Land, and Site Preparation	1043.7	-	1043.7	78.5	-	78.5
Resettlement of Population	6.7	-	6.7	0.5	-	0.5
Environment Protection Prog.	13.5	-	13.5	1.0	-	1.0
Dam, Intake & Desilting Works	660.7	962.1	1622.8	49.7	72.3	122.0
Headrace Tunnel & Surge Tank,	1445.6	2450.8	3896.4	108.7	184.[illegible]	293.0
Pressure Shaft, Powerhouse &						
Tailrace Tunnel	3553.0	3339.0	6892.0	267.1	251.1	518.2
Sub-Total	6723.2	6751.9	13475.1	505.5	507.7	1013.2
B. Expansion & Reinforcement of Transmission in H.P.	513.0	44.8	557.9	38.6	3.4	41.9
C. Communication & Load Dispatch for HPSEB	33.1	-	33.1	2.5	-	2.5
D. Institutional Development for HPSEB	11.0	9.2	20.0	0.8	0.7	1.5
E. Training Program & Assistance for CWC	22.2	33.1	55.3	1.7	2.5	4.2
Total Baseline Costs	7302.6	6839.0	14141.6	549.1	514.2	1063.3
Physical Contingencies	1224.9	1518.5	2743.4	92.1	114.2	206.3
Price Contingencies	2190.7	2506.9	4697.7	94.1	110.9	205.1
Total Project Cost	10718.2	10864.5	21582.7	735.3	739.3	1474.6
Interest During Construction	3021.1	2578.8	5599.9	195.0	167.0	362.0
Total Financing Required	13739.3	13443.3	27182.6	930.3	906.3	1836.6

The total cost of the Project including physical and price contingencies (but excluding about $170 million equivalent of taxes and duties) is about $1,300 million equivalent of which US$740 million (56%) represents the direct and indirect foreign exchange costs. Interest during construction adds another $362 million to the financing required. The project costs are based on September 1988 forecast prices which were derived from: (a) contractor-type analysis of unit prices (heavy-construction estimating method) prepared for the civil works of Nathpa Jhakri; (b) recent quotations received for similar equipment and miscellaneous civil works in India; and (c) inquiries with manufacturers of major rotating equipment. Quantities were obtained from designs at tender level for the power plant and from feasibility estimates for the transmission component. The cost of consulting services was based on an estimated 600 man-months, of which about

200 man-months are expected to be from local consultants. An allowance of 3% of the base cost has been made for engineering and administration of the power plant, in addition to the consulting services, and of 5% for other Project components. Physical contingencies have been provided for as follows: (a) 30% of the base cost for all underground works; (b) 20% of the base cost for all other works; (c) 10% of the base cost for materials and equipment. These allowances are in line with the status of Project design and with the risks of extra costs for complex underground works such as those contemplated under the proposed Project. Price contingencies, which amount to 19% of the base cost, are based on expected annual inflation rates of 6% for local costs and 4% for foreign costs over the entire construction period. Interest during construction has been calculated on the basis that half of the power station cost would be funded by equity and half by loan from GOI bearing an interest of 14.5% per annum, which is the current interest rate for GOI loans to Central Government Corporations.

Project Financing

3.15 The proposed Bank financing for this Project is US$485 million, equivalent to about 37% of the total financing requirements, net of duties and taxes. The Bank loan will be lent to India. About $5 million will be retained by GOI to finance the training program for CEA, CWC and other institutions. About US$43 million would be onlent through the GOHP to HPSEB for expansion and reinforcement of the transmission system, institutional development and implementation of communications and load dispatch facilities for HPSEB. The balance of US$437 million would be onlent to NJPC, for the implementation of the hydropower plant. GOI will seek cofinancing, particularly for major equipment, in the amount of US$300 million equivalent from bilateral donors, export and suppliers' credits or commercial Banks. GOI has already received expressions of interest from donor countries and suppliers of equipment, including concrete financing proposals which are under consideration. In case cofinancing materializes for any project item in excess of that envisaged under the proposed financing plan, the Bank has agreed to reallocate any Bank funds no longer needed for that item to other items of the project. Any sums not financed by cofinanciers will be financed by GOI, GOHP and, for the Himachal Pradesh Component, HPSEB's own generated funds. GOI will bear the exchange rate and interest risks. Table 3.2 gives the project financing plan.

Table 3.2: Project Financing Plan
(US$ Million Equivalent)

	Local	Foreign	Total
IBRD	55.0	430.0	485.0
Cofinanciers		300.0	300.0
GOI/GOHP/HPSEB	875.3	176.3	1,051.6
	930.3	906.3	1,836.6

On-Lending Arrangements

3.16 The on-lending terms from GOI to NJPC will be established in a Subsidiary Loan Agreement which will provide for a maturity of 20 years, including a grace period of five years with interest payable on outstanding balance at not less than 14.5% per year. This rate is consistent with GOI's interest rate on loan funds provided to central government corporations. The conclusion of a Subsidiary Loan Agreement satisfactory to the Bank will be a condition of loan effectiveness (para 6.05). GOI will also onlend about US$43 million from the proposed Bank loan to GOHP, which will in turn onlend it to HPSEB. GOHP will on-lend the proceeds of the loan to HPSEB at the standard interest rate it charges for loans to its corporations and agencies but not less than 10.5% p.a., with a repayment period of twenty years, including a grace period of five years (para 6.04).

Procurement

3.17 Table 3.3 summarizes the procurement arrangements for the proposed Project.

Table 3.3: Summary of Procurement Arrangements a/
(US$ Million)

	ICB	LCB	Other b/	N.A. c/	Total
Land and Site Preparation			76.8	10.2	87.0
Civil Works	724.0	8.0			732.0
	(221.7)	(3.6)			(225.3)
Materials and Equipment	566.9	33.3	2.0		602.2
	(249.4)	-	(1.6)		(251.0)
Training and Consulting Services			8.7		8.7
			(8.7)		(8.7)
Compensation and Other Expenses for Resettlement and Environment Protection				1.3	1.3
Engineering and Administration				43.4	43.4
Total	1,290.9	41.3	87.5	54.9	1474.6
	(471.1)	(3.6)	(10.3)	-	(485.0)

a/ Amounts include taxes and duties (US$170 million), and figures between brackets are the Bank-financed portion.
b/ Direct contracting, international and local shopping and employment of consultants.
c/ Land acquisition, administrative overheads and items not subject to commercial procurement.

Annex 3.4 shows the detailed procurement arrangements and Annex 3.5, the timetable for processing the individual contract packages. All contracts for civil works with an estimated cost of US$10 million equivalent or more and most other contracts for supply of goods financed by the Bank, will be subject to ICB. Prior review would apply to civil works bidding documents for contracts tendered under ICB. Other contracts for works will be awarded after LCB procedures acceptable to the Bank. Foreign suppliers will not be precluded from participating in LCB. About 87% of the goods and services will be subject to ICB. The balance will be subject to procurement procedures acceptable to the Bank. Local contractors, competing under ICB will have a 7.5% of preference margin for civil works and local manufacturers a 15% preference or the applicable duty, whichever is less, for supply of goods. Survey equipment, laboratory instruments and equipment, specialized office engineering equipment and computer hardware and software, up to an aggregate cost of US$5 million may be procured through international or local shopping procedures satisfactory to the Bank. The Bank will review ex-ante the lists of items to be procured through international or local shopping. Consultants will be selected in accordance with the Bank's Guidelines for the use of consultants. All civil works contracts with an estimated cost of US$10 million or more equivalent will be subject to the Bank's prior review. All contracts for supply of goods financed by the Bank with an estimated cost of US$1 million equivalent or more will also be subject to Bank's prior review. A standard bidding document acceptable to the Bank will be used for ICB procurement of goods. Overall, prior review would apply to about 95% of the Bank financed elements. Other Bank financed contracts would be subject to selective post award review.

Disbursements

3.18 Disbursements of Bank funds will be made against: (a) 60% of the CIF cost or of the ex-factory cost (if manufactured in India) of equipment and materials procured under ICB and international or local shopping for the Nathpa Jhakri power plant and 100% of the CIF or of the ex-factory cost of equipment and materials procured for other project components; (b) 65% of the cost of the civil works for the Nathpa Jhakri power plant up to a maximum of $200 million equivalent and 20% of the cost of the civil works thereafter; (c) 60% of the cost of the civil works for the transmission component in Himachal Pradesh; (d) 60% of eligible works for environment protection and resettlement of population;5/ and (e) 100% of consulting and training services, including POE's services and eligible expenditures for CWC and CEA consulting services to the project. Disbursements will be fully documented except for payments against civil works, training, equipment, materials, consultants, and compensatory afforestation contracts each less than US$200,000 equivalent. Such disbursements will be made against statements of expenditures (SOEs), the documentation of which will not be sent to the Bank but retained by NJPC, HPSEB and CEA, as appropriate, for inspection by the supervision missions. Standard procedures for auditing SOEs will apply. To facilitate disbursements, a special account will be established by GOI with an authorized allocation of US$35 million. The estimated disbursement schedule is consistent with the standard disbursement

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5/ Eligible items include those works awarded under LCB or contracted with government agencies but exclude land acquisition and compensation paid to affected population.

profile for power projects in India. The Bank agreed to finance retroactively up to US$5 million of eligible expenditures incurred after April 1, 1988 for consultancy work for project preparation including laboratory testing, hydraulic modeling, field investigation, survey equipment, laboratory instruments and equipment, office engineering equipment and other specialized equipment. Annex 3.6 shows the schedule of estimated disbursements for Bank funds. The closing date for the loan will be December 31, 1997.

Project Operation

3.19 The Nathpa Jhakri power plant will be part of the integrated system of the Northern Region. It will be operated and maintained by NJPC. The load dispatch will be coordinated through the Northern Region Electricity Board. GOI and GOHP have agreed that HPSEB is entitled to 37% of the output of the plant and the remaining 63% will be available for sale to other SEBs in the Region in accordance with the allocations to be established by the REB. Any surpluses of HPSEB's share not consumed in the state will be also available for sale to other SEBs. The station will operate as a run-of-the-river facility meeting base load requirements during monsoon and snow-melting periods (April to October) and peak load during the rest of the year (September to March). There are no water uses downstream from the station that may constrain the plant operation. The power station will generate 775 MW (6,700 GWh) of firm power per annum at 90% dependability, and an average power of 805 MW (7,050 GWh) per annum. The transmission system to link the Nathpa Jhakri power plant to the Northern Region grid is part of a separate project, the Northern Region Transmission Project, which GOI has proposed for Bank financing and is currently under preparation. The project is in the lending program for FY89. GOI will furnish to the Bank, no later than June 30, 1989, a satisfactory timetable of key actions, including a full assessment of environmental impact, for the preparation and implementation of the Northern Region Transmission Project. GOI will implement the project in accordance with the agreed timetable (para 6.01(b)).

Project Monitoring

3.20 NJPC, HPSEB and CWC will furnish to the Bank quarterly progress reports covering physical works, consultancy services, costs, disbursements and administrative aspects of the project. NJPC will be responsible for coordinating the preparation of the quarterly report covering all project components. The reports will be due 45 days after the end of the calendar quarter. The first quarterly report will relate to the quarter ending September 30, 1989. In addition other reports will be required on the financial and operational results of HPSEB and on the administrative and managerial situation of the Board. NJPC will make arrangements satisfactory to the Bank to periodically inspect the safety and operating conditions of the Nathpa Jhakri scheme. The proposed arrangements will be furnished to the Bank one year before the expected completion of the dam (para 6.02(j)).

Project Risks

3.21 The proposed Nathpa Jhakri scheme presents the usual risks associated with major underground works such as unexpected geological conditions that may adversely affect the cost or the construction schedule or both. However, an intensive geological exploration program (Annex 3.1) and the excavation works carried out for the Bhaba power project, an underground scheme immediately upstream of Nathpa Jhakri indicate that the geological setting of Nathpa Jhakri is adequate for the proposed work, and that these risks are at an acceptable level. The scale of the Nathpa Jhakri scheme in terms of underground excavation is beyond any similar project previously built in India. Therefore, the necessary expertise may not be locally available to deal with eventual technical issues. This risk is being minimized by the provision within the project for external qualified consultancy assistance for the completion of detailed designs and for supervision of the construction. Heavy sediment loads carried by the Sutlej river, particularly during monsoon, may result in frequency and costs of equipment and works maintenance higher than average. Excessive siltation of the forebay pond might also restrict full load operating time. The project, however, provides for facilities to periodically flush sediments from the forebay pond, and to remove sediments from water used for generation. The selection and specification of equipment would minimize maintenance time and frequency. In case these measures are not as effective as expected, a compensatory storage barrage of about 1.5 Mm^3 capacity, equipped with gates would be constructed upstream of the pond to operate during the low flow season when sediment loads are small (Annex 3.1, para 4). The Bank considers these provisions adequate to minimize the risk of major discrepancies between actual project performance and that assumed for planning and design purposes. The Bank is satisfied that the Sutlej flows originating in India are sufficient to operate the power plant as planned. Therefore, the effects of any extractions of water from the Sutlej upstream of the Indian border do not pose any significant risk to the project. The transmission and training components do not present any extraordinary risks.

IV. FINANCE

A. Nathpa Jhakri Power Corporation

Introduction

4.01 The NJPC will have an initial authorized share capital of Rs 10 billion (US$752 million). Further capital increases will be subject to GOI and GOHP approval. The Corporation is empowered under its Articles of Association to charge electricity rates which will be based on all costs of generation and provide for a return on equity. NJPC revenues will be derived from selling power under contractual arrangements to state electricity boards and other major purchasers of power located in the Northern Region of India.

NJPC Financing Plan

4.02 NJPC's financing plan for the period of execution of the proposed power station, i.e., FY89-FY97, is presented in Table 4.1. The plan does not envisage other capital investments during the period. The proposed Bank loan will be onlent by GOI to NJPC (para 3.16) to finance about 21% of the investment program and the balance of 79% will be financed from additional GOI/GOHP loans to NJPC (27%), equity contributions from GOI (39%) and GOHP (13%). Internal resources during FY89-FY97 will be sufficient to cover debt-service obligations and working capital requirements only. The low internal resources is a result of the plant operating for only about three months after project commissioning in FY97 (para 4.05). The financing plan is consistent with the cost sharing and ownership arrangements agreed by GOI and GOHP under the Memorandum and Articles of Association establishing the corporation. The foreign exchange and interest rate risks will be borne by GOI.

Table 4.1: NJPC's FINANCING PLAN FY89-97

Source of Funds	Rs Million	%
Internal Sources	471	-
Less: Debt-Service	377	-
Increase in Working Capital	83	-
Net Internal Sources	11	-
Bank Loan onlent to NJPC	5,811	21
GOI/GOHP Loans	7,503	27
GOI Equity	10,824	39
GOHP Equity	3,607	13
Total	27,756	100
Application of Funds		
Nathpa Jhakri Power Plant	20,708	75
Interest During Construction	6,970	25
Feasibility Studies Other Projects	78	-
Total	27,756	100

NJPC Financial Projections

4.03 NJPC's projected financial statements for FY1989 through FY2001 with related assumptions are presented in Annex 4.1. Table 4.2 provides a summary of projected financial performance and key indicators for each fiscal year from project commissioning in FY1997 until FY2001.

Table 4.2: NJPC'S KEY FINANCIAL INDICATORS
(FY1997 TO FY2001)

FY Ending March 31	FY97	FY98	FY99	FY2000	FY2001
Electricity Generation (GWh)	1,000	4,300	7,050	7,050	7,050
Electricity Sales (GWh)a/	990	4,257	6,980	6,980	6,980
Average Tariff (P/kWh)	68	68	68	68	68
Operating Revenues (Rs Million)	592	2,547	4,177	4,177	4,177
Operating Expenses (Rs Million)	225	929	959	992	1,027
Operating Income (Rs Million)	368	1,619	3,217	3,184	3,150
Operating Ratio (%)	38	36	23	24	25
Debt Service Coverage (times)	1.3	1.2	1.7	1.8	1.9
Current Ratio	0.5	0.6	0.8	0.8	0.8
Debt as percentage of Debt plus Equity (%)	48	46	44	39	35
Rate of Return (%)					
Historical Costs b/	3	6	12	12	12
Revalued Asset Base c/	3	6	11	10	10

a/ GOHP will receive 12% free power (para 4.05).
b/ Net income before interest on average net fixed assets historically valued.
c/ Net income before interest on average revalued net fixed assets.

4.04 NJPC's future earnings forecast assumes that the Corporation will supply bulk power at 400 kV to state electricity boards and other major purchasers of power in the Northern Region at prices which will cover NJPC's operating and maintenance costs, administration expenses, employees' remuneration, depreciation, interest and provide a reasonable earned surplus. To meet this objective GOI, GOHP and NJPC have agreed that NJPC will take appropriate actions, including tariff adjustments, to enable NJPC to achieve in FY98 an annual rate of return before interest of not less than 6% on the original cost of its average net fixed assets in service, and thereafter at a rate of not less than 12% (para 6.02(f)). The rate of 12% is considered appropriate because it is consistent with the estimated average cost of capital to NJPC and as demonstrated in the financial projections, it will allow NJPC to cover its operational expenses, and debt service. The lower return of 6% in FY98 is justified because plant output during the first year following initial commissioning will be about 60% of the estimated annual average due to forced outages of units normally needed for adjustments during this year.

4.05 An average annual electricity generation has been estimated at 7,050 GWh of which about one percent will be consumed at the station. In addition, twelve percent of the balance will be available to GOHP at no charge as per the power sharing arrangement outlined in the Memorandum and Articles of Association establishing NJPC (para 2.02). Based on these figures NJPC's annual electricity sales are expected to amount to 6,980 GWh. The forecast average bulk supply tariff of 68 paise per kWh will be the minimum level necessary to earn the 12% rate of return after FY98. During the period FY1997 to FY2001, NJPC's forecast debt to debt plus equity ratio average about 42% and its projected debt-service coverage ratio averages about 1.6. Its strong financial position is due mainly to high earnings, low operating expenses and steady debt-service obligations. An annual expenditure of Rs 13 million is projected for feasibility study work during FY91 to FY96, which may result in the development of other hydro projects by NJPC in the Sutlej river basin. In view of the uncertainty pertaining to NJPC's future capital investments and their potential impact upon the implementation or operation of the proposed project, NJPC has agreed: (i) to provide to the Bank, for its review, an updated five-year investment program, along with its sources of financing, each year from FY91 onwards (para 6.02(g)); and (ii) not to undertake additional investments which are not included in the agreed investment plan and which in the Bank's opinion will be detrimental to NJPC's financial viability (para 6.02(g)). During the initial commissioning year of FY97, a funding shortfall of about Rs 1,119 million is anticipated. The shortfall is a result of the plant operating for only about three months during the financial year. GOI/GOHP will finance the shortfall with bridge funds which NJPC will repay to GOI/GOHP in FY98 and FY99 from its internal resources. NJPC's earnings in FY98 and FY99 will be sufficient to pay for these bridge funds. NJPC's surplus cash generation for the period FY97 to FY2001 will amount to Rs 3,491 million which will be available for investment in new projects. Dividends on equity are not anticipated and it is assumed that investment and depreciation allowances permitted by GOI in connection with NJPC's investment program are expected to exceed any tax liabilities which may arise.

NJPC Bulk Supply Tariffs

4.06 NJPC will be responsible for commercial operation of the power station after project commissioning in FY97 and will enter into bulk supply contracts with SEBs and other major purchasers of power in the Northern Region states. The contracts will reflect an appropriate pricing methodology which takes into account economic efficiency criteria, peak and off-peak generation costs, the availability of seasonal energy and the financial viability of NJPC. NJPC has agreed to carry out, by December 31, 1990, on terms of reference satisfactory to the Bank (Annex 3.7), a study to establish the price of electricity to be sold by NJPC. NJPC will also furnish to the Bank a detailed report of the findings of the study for Bank's comment. In addition, NJPC agreed that it will establish bulk supply contracts based on the findings of the study with beneficiary SEB's and any other major purchaser of power from NJPC by March 31, 1994 (para 6.02(h)). NJPC will require all purchasers of power to maintain an irrevocable letter of credit in favor of NJPC. Such letter of credit should cover at least the equivalent of one month average consumption estimated for the following financial year.

B. Himachal Pradesh State Electricity Board

Introduction

4.07 HPSEB's financial performance during the period FY83 to FY87 are difficult to analyze because of the inconsistent treatment of rural electrification subsidy, depreciation, other revenues and expenses (para 4.08). For instance, GOHP subsidies for compensating the operating cost of rural electrification were recorded in some years (FY83 and FY87) as operating revenues even though they were not collected, while in other years the subsidies were not recorded. On the operating expense side, during FY83 to FY85, depreciation was not recorded (para 2.19 and 2.21). Throughout the period, various revenues, interest charges and expenses were incorrectly recorded.6/ Overall, HPSEB has generally earned sufficient revenues to cover operating expenses. However it has not been able to meet all interest expenses or make a contribution towards financing part of its investment program. This unsatisfactory financial performance has resulted mainly from GOHP's policy to provide only loan funds to HPSEB, while simultaneously restricting the amounts of increases in HPSEB's tariff rates. Under the proposed Project, HPSEB with the support of GOHP will implement a financial action plan which will enable the utility to achieve satisfactory financial performance and make a reasonable contribution to its proposed investment program. In addition, HPSEB will introduce, with the assistance of consultants, improvements in its financial management and organization to increase its overall operational efficiency and to ensure that its financial information is accurately captured in its future accounts.

Past and Present Financial Performance

4.08 HPSEB's key financial indicators for FY83 to FY87 are shown in Table 4.3 and its detailed financial statements (income statement, sources and application of funds statement and balance sheet) are contained in Annex 4.2.

6/ In FY86, a prior period adjustment of Rs 149 million was made to rectify the inconsistent recording of past revenues and expenses. In FY87, a debit adjustment of Rs 219 million was made to correct for the past errors in recording depreciation (Rs 110 million), cost of purchased power (Rs 70 million) and miscellaneous expenditures.

Table 4.3: HPSEB'S KEY FINANCIAL INDICATORS FOR FY83-87

Fiscal Year End March 31	FY83	FY84	FY85	FY86	FY87
Electricity Sales (GWh)	687	804	687	787	883
Average Tariff (P/kWh)	34.6	35.2	37.7	45.6	58.9
Operating Revenues (Rs Million)	299	322	287	407	662
Operating Expenses (Rs Million)	215	250	279	343	466
Operating Income (Rs Million)	83	72	8	64	196
Interest (Rs Million)	52	63	79	296	385
Net Income (Rs Million)	31	9	-71	-83	-408
Accumulated Loss (Rs Million)	-56	-47	-118	-201	-610
Operating Ratio (%)	72	78	97	84	70
Debt as % of Debt and Equity a/	98	97	99	101	110
Debt Service Coverage (times)	0.9	0.6	0.0	0.6	0.2
Current Ratio	1.0	0.9	0.9	0.8	0.9
Rate of Return (%) b/	-	-	neg.	neg.	neg.
Contri. to Investment (%)	neg.	neg.	neg.	neg.	neg.

a/ Accumulated losses are treated as negative equity.
b/ As per GOI definition: Net Income after interest as a percentage of net fixed historically valued asset base at the beginning of the fiscal year.

4.09 As shown in the above table, HPSEB's electricity sales increased from 687 GWh in FY83 to 804 GWh in FY84 before declining to 687 GWh in FY85 and then rising during the next two years to 883 GWh in FY87. The reduced sales volume in FY85 and FY86 as compared to FY84, resulted from drought conditions in Himachal Pradesh which adversely affected HPSEB's hydro electric generation. Consequently, revenues declined from Rs 322 million in FY84 to Rs 287 million in FY85 and a net income loss of Rs 71 million resulted. In 1985 and 1986, GOHP permitted tariff increases, and HPSEB's average revenue per kWh increased from 37.7 paise per kWh in FY85 to 58.9 in FY87, helping it to earn total revenues of Rs 662 million and achieve an operating surplus of Rs 196 million. Although HPSEB's operating revenues exceeded operating expenses during FY83 through FY87, they were insufficient to cover all interest expenses. As a result, at the end of FY87, HPSEB's accumulated losses totalled Rs 610 million (US$45.9 million). Its performance indicators, (i.e. rate of return, contribution to investments, debt-equity ratio, debt service coverage, etc.) for the past five year period under review, have been unsatisfactory. Except for FY85 and FY86, HPSEB's operating ratio was between 70% and 78% which is satisfactory.

4.10 HPSEB's poor financial performance has been the result of a variety of factors, some of which have been beyond its control. As with other state Governments and SEBs in India, it has been the practice of GOHP to provide loan funds but not any equity funds to HPSEB. About 63% of HPSEB's funding has been from GOHP and the balance of loan capital was obtained from various Central Government organizations which are regular sources of funding for SEBs. The relatively high debt service load associated with HPSEB's all-debt capital structure has implied the need for timely tariff adjustments. However, GOHP has constrained the amount of increases in HPSEB's electricity tariffs, such that the utility has been able to cover operating expenses and to pay debt service on loans from its other funding sources different from GOHP (Life Insurance Corporation, Rural Electrification Corporation, etc.). However, in an attempt to move towards compliance with the minimum 3% rate of return requirement stipulated for all SEBs by GOI, GOHP has approved significant adjustments in HPSEB's tariff rates during FY86 and FY87. HPSEB's average revenue per kWh sold, increased by 56% from 37.7 paise in FY85 to 58.9 paise in FY87.

4.11 Two other factors which contributed to HPSEB's past poor financial performance were relatively high administrative and establishment expenses and high system losses. In FY87, HPSEB employed about 18,000 people excluding construction staff, which is excessive for a utility with 134 MW installed capacity and 700,000 consumers. A hiring freeze is now in effect and HPSEB plans to make better use of existing staff. With the help of consultants to be engaged under the Utility Management Study being financed under the Project, HPSEB will prepare a training program and staffing plan which will cover its staff requirements in the next decade (para 2.11). Although HPSEB's system losses are lower in comparison to most SEBs in India, there is further scope for reduction from the FY87 level of 22%. It is expected that system losses will be reduced to 16% by FY96 as a result of the transmission system improvements underway and planned under the Project.

HPSEB - Proposed Financial Recovery Program

4.12 HPSEB'S loans and accrued interest, owed to GOHP, have accumulated over the last decade. Their liquidation from internal cash generation, will not be possible without unrealistically high tariff increases, yet their continuation in HPSEB's accounts will distort its future operating results. Consequently, an appropriate financial plan for HPSEB will free the utility from past problems by immediate measures to produce a solvent, acceptable balance sheet and will include longer term measures to improve future financial performance. GOHP recognizes the need for such a plan if HPSEB is to operate in conformance with accepted commercial principles, achieve a satisfactory rate of return and make a reasonable contribution towards the financing of future investments. Accordingly, GOHP has agreed to cause HPSEB to implement a financial recovery program to restore HPSEB's financial viability, including the measures listed below (para 6.03(a)).

(a) Write-off the interest on GOHP's loans outstanding as of March 31, 1988 by March 31, 1989. The interest to be written-off is estimated at Rs 1,439 million.

(b) Treat GOHP's loans outstanding as of March 31, 1988 as perpetual loans bearing a 10.5% p.a. interest rate. New GOHP's loans from FY89 to FY95 will also be perpetual with the same interest rate.

(c) From FY96 onwards, new GOHP's loans will have a repayment period of 15 years, including a 3 year grace period and an interest rate of 10.5% p.a.

(d) GOHP will promptly pay the rural electrification (R.E.) subsidies for the period of FY90 to FY95. On the other hand, HPSEB will not request payment from GOHP for R.E. subsidies accumulated (about Rs 736 million) up to March 31, 1988.

(e) Implement tariff increases as necessary to ensure as a minimum the following annual rate of returns after interest payments of (computed in accordance to the amended Electricity (Supply) Act): 2.9% in FY90, 3.8% in FY91, 4.3% in FY92, 4.7% in FY93, 4.9% in FY94 and FY95, and 7.0% in FY96 and thereafter.

(f) Maintain its receivables at the following levels of electricity sales: 6 months in FY89, 3 months in FY90, 2 months in FY91 and thereafter.

(g) GOHP will provide additional loans to HPSEB to fund the financing gap in FY89 and FY90.

(h) HPSEB will furnish to the Bank by December 31 of each year, an updated five year investment plan and a report of its forecast operational and financial performance for the ensuing five financial years specifying the actions that it will take to achieve the annual rate of returns (para 4.12(e)).

4.13 HPSEB's projected financial statements for FY88 through FY96 are presented in Annex 4.2, together with assumptions for the financial projections which reflect the implementation of the financial recovery measures. Table 4.4 summarizes the projected financial performance and the key indicators for each year during the period.

Table 4.4: HPSEB's KEY FINANCIAL INDICATORS FOR FY88-96

Fiscal Year Ending March 31	FY88	FY89	FY90	FY91	FY92	FY93	FY94	FY95	FY96
Electricity Sales (GWH)	908	1109	1761	1885	2088	2385	2606	2933	3797
Operating Revenues*	690	715	1344	1696	1907	2335	2787	3334	4404
Operating Expenses*	571	589	907	981	1135	1400	1617	1778	2217
Operating Income*	119	125	437	714	772	936	1169	1555	2188
Net Income* a/	-30	-179	95	136	184	259	291	349	990
Average Tariff (P/kWh)	60.9	62.1	67.0	80.5	82.0	89.0	98.0	105.0	115.0
Operating Ratio (%)	83	82	67	58	60	60	58	53	50
Debt as % of Debt & Equity	108	97	96	95	94	92	91	90	86
Debt Service Coverage (times)	0.3	1.4	0.7	1.2	1.3	1.4	1.3	1.3	1.7
Current Ratio	0.8	1.2	1.2	1.2	1.2	1.3	1.4	1.3	1.0
Rate of Return									
As per GOI (%) b/	neg	neg	2.9	3.8	4.3	4.7	4.9	4.9	7.0
As per Bank Guidelines, (%) c/	11.8	5.6	12.1	16.5	14.1	14.2	15.1	12.8	13.3
Self Financing Ratio (%)	neg	neg	neg	9	5	7	8	10	26

* Rs Million

a/ In FY89, a prior period adjustment of Rs 703 million was not included in the computation of net income since it was the result of offsetting the R.E. subsidy of Rs 736 million and Accrued Interest of Rs 1,439 million as part of the financial recovery program (para 4.12 a and d). Consequently, it was not related to FY89 operational performance.

b/ Net income as a percentage of net fixed assets (historically valued) at the beginning of the fiscal year.

c/ Operating income as a percentage of average revalued asset base.

4.14 HPSEB's electricity sales are projected to grow at an average annual rate of about 19% per annum from FY88 through FY96 as compared to an average annual rate of about 8% during the preceeding five years. The anticipated higher sales growth is explained by the addition of recently commissioned generating capacity and expected station additions during the forecast period including; Giri/Binwa (60 MW in FY87), Bhaba (120 MW) in FY88 and FY91, Andhra (17 MW) in FY88, Kholdam (800 MW) and Karcham (600 MW) in FY96 (Annex 4.2). The cost of power purchases, a major expense item, will vary on an annual basis during the forecast period, according to the timing of expected additions to HPSEB's generation capacity and HPSEB's seasonal requirements. The Board is expected to continue its practice of selling hydropower to neighboring states, particularly to Punjab and Uttar Pradesh, during months with greater rainfall and to purchase thermal power during the dry winter months.

4.15 Implementation of the financial measures described in para 4.12 will enable HPSEB to transform itself from an organization suffering chronic losses to a financially viable utility. HPSEB's average revenue per kWh is projected to increase from 67.0 paise in FY90 to about 115.0 paise in FY96 representing an average annual increase of over 9% which is a 3% real increase assuming inflation to be at 6%. This will provide HPSEB with a rate of return of 2.9% in FY90 increasing to 7.0% in FY96 (para 4.12e). The high rate of return in FY96 is the result of increased electricity sales due to the commissioning of the Kholdam and Karcham projects. It is expected that HPSEB's financial performance after FY96 will improve further with the commissioning of the proposed Nathpa Jhakri project in FY97. HPSEB's, achievement in FY96 of a 7% rate of return, after interest on net fixed historical valued asset, is equivalent to earning a rate of return before interest of 13.3%, on average net fixed assets in operation based on a proforma revaluation (Bank's Guidelines).

4.16 HPSEB's large investment program, throughout the forecast period, will cause an increase in gross fixed assets from Rs 1600 million at the end of FY88 to Rs 16,640 million at the end of FY96. Most of the investment during the nine year period is for additional generation capacity. The bulk of expenditures in the first half of the period relate to new generation schemes already under implementation including Bhaba (120 MW) and Andhra (17 MW). In the period from FY92 through FY96 substantial investment is anticipated in connection with generation schemes which will be undertaken with external aid (i.e. Larji-126 MW and Uhl III-70 MW) or with funds allocated by GOI (i.e. Dhamwari Sunda - 60 MW). Based on a three year moving average of capital expenditure, HPSEB is expected to self-finance reasonable proportion of its new investments throughout the period; about 9% in FY91, 5% in FY92, 7% in FY93, 8% in FY94, 10% in FY95 and 26% in FY96. The relatively low self-financing levels in the initial years are acceptable in view of the relatively small size of its commercial operations vis-a-vis expected capital expenditures. When the Kholdam and Karcham projects are commissioned in FY96, HPSEB's self-financing ratio of 26% is respectable. As noted in para 4.15, commissioning of the proposed Nathpa Jhakri project in FY97 will further improve HPSEB's finances.

4.17 HPSEB's debt as a percentage of debt plus equity will improve from about 108% in FY88 to 86% in FY96. The high ratio is a reflection of GOHP policy of not providing equity to HPSEB. Despite the high debt ratio, its debt-service coverage of 1.2 beginning in FY91 and increasing to 1.7 in FY96 is satisfactory. The satisfactory debt-service coverage ratios are due to the fact that GOHP's loans outstanding as of March 31, 1988 and new GOHP's loan from FY89 to FY95 are perpetual, i.e. no principal repayment (para 4.12(b)), thereby reducing the debt-service burden of HPSEB during the period.

Financing Plan

4.18 HPSEB'S financing plan for the period FY88-FY96 is presented in Table 4.4. HPSEB will finance about 5% of its investment program (including interest during construction) from internal cash generation and 10% from miscellaneous internal sources. The proposed Bank loan will finance about 3% and the balance will be financed from GOHP's loans to HPSEB (70%) and other loan sources (12%).

Table 4.4: HPSEB'S FINANCING PLAN FY88-96
(Rs Million)

Proposed Project	861	5%
Other Capital Expenditures	15,415	95%
Total	16,276	100%
Sources of Finance:		
Internal Generation	9,374	-
Less: Change in Working Capital	1,532	-
Debt Service	7,102	-
Net Internal Generation	740	5%
Miscellaneous Sources a/	1,583	10%
Loans:		
IBRD	572	3%
GOHP	11,426	70%
Others b/	1,955	12%
TOTAL	16,276	100%

a/ Staff Superannuation Fund, Consumers Contribution, Security Deposits and prior period adjustment as a result of incorporating the financial recovery program (para 4.12 a and d).

b/ Life Insurance Corporation, Rural Electrification Corporation, Bonds, Industrial Development Bank of India, etc.

V. ECONOMIC ANALYSIS AND JUSTIFICATION

Least Cost and Demand Analyses

5.01 The principal components of the proposed Project are the 1,500 MW Nathpa Jhakri hydropower station on the Sutlej River and 500 km of 132 kV transmission lines and reinforcement of the transmission system in Himachal Pradesh. With regard to the power station, CEA has carried out studies to determine the optimum installed capacity for Nathpa Jhakri based on hydrological records of the Sutlej, system load curves and the costs of alternative sources and forms of generation in the Northern Region. These studies indicate that the optimum installed capacity for Nathpa Jhakri is 1,500 MW. In addition, CEA has carried out system planning studies for the Northern Region which indicate that the earliest feasible implementation of a 1,500 MW station at Nathpa Jhakri forms an integral part of the regional least-cost development plan. The assumptions used in CEA's capacity optimization and system planning studies, as well as the results of the studies, have been reviewed by the Bank and found satisfactory.

5.02 The demand projections which underlie CEA's capacity optimization and system planning studies are summarized in Annex 5.1. These projections are formulated by CEA from disaggregated analyses of patterns and trends of electricity consumption by each main consumer group. Compared with growth in peak load in the Northern Region averaging 13.2% p.a. over 1981/82 to 1987/88, CEA's projections of growth in peak demand through 1996/97 of 10.9% p.a. appear reasonable. This is particularly so when considering that over the period 1981/82 to 1987/88, peak load was heavily supply constrained, suggesting that peak demand was growing at least as quickly as the load actually met. CEA's projections of energy demand also seem reasonable. Compared with annual growth averaging 12% (again, heavily constrained) CEA projects energy demand will grow at 11% p.a. through 1996/97. CEA's projections of power and energy demands are consistent with India's present elasticity of electricity consumption to economic growth of approximately 1.5 and expected economic growth of 6% p.a. For Nathpa Jhakri not to be required at its time of commissioning, the elasticity of power demand to economic growth would have to fall to under 1.0. This would represent a significant change in the present electricity intensity of India's economic growth and therefore is considered very unlikely. Hence there is little risk that generation from Nathpa Jhakri will not be required when the station is commissioned.

5.03 With regard to the transmission component of the Project, a range of technical options were examined by CEA. The Bank is satisfied that the voltage levels and the configurations which have been adopted are optimal and constitute part of the least-cost regional development program.

Internal Economic Rate of Return of Program Analysis

5.04 Benefits derived from the components in the proposed Project cannot easily be separated from those of other investments in generation, transmission and distribution in the Northern Region. Therefore, having established that the proposed project is an integral part of the least cost expansion plan for the Northern Region, it is appropriate to focus cost-benefit analysis primarily on the Northern Region investment program as a whole in order to examine whether the expansion envisaged is desirable. For this purpose, a "time-slice" of the Northern Region's investment program between the financial years 1988/89 and 1996/97 has been analyzed. Capital costs of the investment program (covering generation, transmission and distribution) together with incremental operating and fuel costs are given in Annex 5.2, Table 1.

5.05 Expected benefits of the investment program relate mainly to the incremental consumption which the program will make possible. The program may also lead to benefits in terms of a reduction in the cost of meeting existing demand, particularly through fuel savings at existing thermal power stations. However, India's persistent shortages of electricity (Annex 1.1) are such that by far the greater part of the generation from plants in the investment program will lead to increased sales. Fuel savings therefore have not been taken into account in estimating benefits from the investment program. In addition, the program will also provide benefits to existing electricity consumers through reducing the frequency of supply interruptions and facilitating more stable voltage levels and supply frequencies.

5.06 A minimum measure of program benefits can be derived from incremental sales revenues. Considering only these benefits, the estimated rate of return on the 1988/89 to 1996/97 time-slice of the Northern Region investment program is 6.8 (Annex 5.2, para 8). However, as retail tariffs in the Northern Region are lower than marginal costs, particularly for agricultural consumers (Annex 5.2, Table 2), this estimate is more a reflection of the level of tariffs than of the economic merit of the investment program.7/ In reality, in addition to benefits as reflected through incremental sales revenues, there will be consumer surplus associated with the incremental consumption: consumers' reactions to the severe shortages of power experienced for the present (and expected for the foreseeable future) suggest that consumers' willingness-to-pay substantially exceeds present tariffs levels (Annex 5.2, para 12). In order to estimate a realistic economic rate of return, a portion of the consumers' surplus likely to be associated with the incremental consumption that the program will facilitate has been added to estimates of benefits as expressed through incremental sales revenue.

5.07 Annex 5.2 summarizes how rates of consumer surplus have been estimated for each main category of electricity consumer. Rates of surplus have assumed to be expressed through the cheapest alternative to public electricity supply. For most consumer categories this is the cost of private generation, though for agricultural consumers it is the additional cost of replacing electric irrigation pumps with diesel pumpsets. Many consumers are presently observed to find these options economic when public supply is not available. However, it would not be reasonable to assume that all consumers would be willing to pay the higher costs associated with private generation or diesel pumping. So as not to over-estimate consumer surplus, the analysis has assumed that for each category of consumers the surplus attributable to incremental sales accrues at half the difference between the costs of private generation (and diesel pumping) and consumers' prevailing tariff. This is a conservative assumption. It implies that at present levels of demand, consumers have a price elasticity of (minus) unity. In practice, price elasticities at low levels of electricity consumption (as in India) are usually much lower than unity (in the range -0.1 to -0.5), implying that consumers are relatively insensitive to price and (hence) that more than half would be prepared to pay the costs of private supply. The assumption that half of consumers would be willing to pay the higher costs of private supply suggests an average rate of consumer surplus of Rs 0.39/kWh (Annex 5.2, Table 5) and benefits including incremental revenues at the rate of Rs 0.98/kWh (Annex 5.2, para 12).

5.08 Under the assumptions set out above, the economic rate of return of the 1988/89 to 1996/97 time-slice of the Northern Region development program is 14.3% (Annex 5.2 para 13). With a 12% discount rate, the corresponding NPV is Rs 15,048 million, equivalent to US$1,131 million. This central estimate of the program return shows that the 1988/89 to 1996/97 is expected to be economic, particularly as benefits to existing consumers on imputed

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7/ The average tariff level in the Northern Region is Rs 0.74/kWh, whereas the average incremental cost of supply (a measure of marginal cost) is about Rs 1.2/kWh (Annex 5.2, paras 7 and 8).

security and quality of supplies have not been taken into account. Sensitivity analysis suggests the investment program as presently configured could absorb combined adverse changes in costs and benefits of approximately 15% and remain economic (in the sense of earning a rate of return of at least 12%). Adverse changes in costs and benefits amounting to more than 15% would necessitate some reconfiguration of the investment program to ensure it remained economic. The project analysis which follows provides a good measures of confidence that the Nathpa Jhakri project would not be a candidate for deferment in this eventuality. Sensitivity analyses also suggest that the Northern Region program as presently specified could withstand about 1 1/2 year delay in implementation or a 2 year delay in benefits and remain economic. In practice, delays in implementation usually are associated with cost increases. The sensitivity analysis suggests the program could withstand a delay in implementation of approximately one year and a 10% increase in costs before some reconfiguring of the program would be required.

Project Analysis

5.09 When prices are substantially below marginal cost, it does not follow automatically that the selection of a project into a least-cost expansion program means that the project in question is economic, even if the program as a whole is shown to be economic. This is because demand, and hence the investment program, can be inflated through the low prices. In such cases, it is important to supplement the program analysis with an analysis of the project in question. Confining the analysis to the Nathpa Jhakri power station and associated investments in transmission and distribution, the estimated rate of return is 17.0% (Annex 5.2, para 18). The estimated NPV (with a 12% discount rate) is Rs 7,399 million, equivalent to US$556 million). Generation from Nathpa Jhakri, net of technical losses, will provide supplies to about 1.3 million new domestic consumers, 132,000 new commercial consumers, 75,500 new industrial consumers and about 110,000 new agricultural consumers. Sensitivity analyses suggest that the project could absorb combined adverse changes in costs and benefits of up to 35% and remain economic. Variations this large are considered to be highly unlikely, thereby affording a good measure of confidence that the project will prove economic. Similarly, the sensitivity analyses suggest the project could absorb an implementation delay of up to 2 1/2 years and remain economic. Such lengthy delays are considered to be very unlikely and even allowing for associated cost increases, this again provides a good measure of confidence that the project will remain economic. The fact that the rate of return of the Nathpa Jhakri project is estimated to be higher and more robust than the rate of return of the Northern Region program as a whole also provides important assurance that Nathpa Jhakri would not be a preferred candidate for deferment in the event that some reconfiguration of the Northern Region program became desirable.

5.10 It also must be remembered that against each of these adverse sensitivities that have been explored are set against the equal likelihoods of more favorable outcomes for both the Northern Region program as a whole and for Nathpa Jhakri.

VI. AGREEMENTS AND RECOMMENDATION

Agreements

6.01 GOI agreed to:

(a) establish a training unit in CEA by June 30, 1989, and appoint a co-ordinator to implement the program (para 3.10); and

(b) furnish to the Bank, no later than June 30, 1989, a satisfactory timetable of key actions, including full assessment of the environmental impact, for the preparation and implementation of the Northern Region Transmission Project and implement the project in accordance with the agreed timetable (para 3.19).

6.02 NJPC agreed to:

(a) furnish the Bank with a staffing plan, no later than June 30, 1989, including qualifications and timetable for appointments for key positions (para 2.04);

(b) maintain during the construction period, a Panel of Experts (POE). The roster and the qualifications of the candidates for POE will be furnished to the Bank for comments no later than June 30, 1989 (para 3.07);

(c) retain consultants under terms and conditions satisfactory to the Bank to assist the Corporation in the preparation of the detailed design and the supervision of the construction of the power station. NJPC will issue a letter of intent to the selected consultants no later than June 30, 1989, and will sign a contract with the selected consultant within 60 days of the letter of intent (para 3.08);

(d) provide to the Bank, no later than June 30, 1989, details of the project design and supervision unit, which will comprise CEA's, CWC's, GSI's and HPSEB's staff and consultants (para 3.08);

(e) provide the Bank with audited financial statements within seven months of the end of the fiscal year to which they relate (para 2.07);

(f) achieve an annual rate of return before interest of not less than 6% in FY98 and 12% thereafter on the original cost of its average net fixed assets in service (para 4.04);

(g) provide to the Bank for its review an updated five year investment program, each year from FY91 onwards and not to undertake additional investments which are not included in the agreed investment plan, which in the Bank's opinion will be detrimental to NJPC's financial viability (para 4.05).

(h) carry out, by December 31, 1990, a study to establish the price for electricity to be sold by NJPC; and establish bulk supply contracts with SEBs and any other major purchasers of power from the Project no later than March 31, 1994. NJPC will also require all purchasers of power to maintain irrevocable letters of credit in favor of NJPC covering the estimated one month's average consumption (para 4.06);

(i) provide the Bank an opportunity to comment on any substantial changes in NJPC's organization structure or in the organization of the field project implementation unit before they are implemented (para 3.10); and

(j) furnish the Bank, one year before the expected completion of the dam, with a proposal for periodic inspection of the safety and operating conditions of the Nathpa Jhakri scheme (para 3.20).

6.03 GOHP agreed to cause HPSEB to:

(a) implement the proposed financial recovery program on a timely basis (para 4.12);

(b) furnish for Bank's comment, before December 31, 1989, the recommendations arising from the Utility Management Study and a timetable for implementing the recommendations; and to implement the recommendations in accordance with the timetable agreed with the Bank (para 2.10);

(c) furnish to the Bank, before December 31, 1989, a five-year Staffing Plan and Training Program for HPSEB and to implement the program in accordance with a timetable agreed with the Bank (para 2.11);

(d) furnish to the Bank its audited financial statements within nine months of the end of the financial year to which they relate (para 2.23); and

(e) submit applications for Forest Clearances in respect of the transmission lines and associated substations, financed under the Project, before June 30, 1989 (para 3.13).

6.04 GOHP further agreed to on-lend the proceeds of the loan to HPSEB at the standard interest rate it charges for loans to its corporations and agencies but not less than 10.5% p.a. with repayment period of twenty years, including a grace period of five years (para 3.16).

6.05 The conclusion of a Subsidiary Loan Agreement between GOI and NJPC satisfactory to the Bank, specifying an interest rate of not less than 14.5% per annum and repayment of 20 years including a 5 year grace period, will be a condition of effectiveness of the proposed loan (para 3.16).

6.06 Receipt of forest clearance for the transmission lines is a condition of disbursement for the expenditures related to the transmission system (para 3.13).

Recommendation

6.07 On the basis of the project justification and the agreements reached during negotiations, the proposed Project is suitable for a Bank loan of US$485 million equivalent.

ANNEX 1.1

INDIA

NATHPA JHAKRI POWER PROJECT

National Electricity Supply and Demand from Public Utilities

	Actual				Provisional		Estimated									
Description	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97
Installed Capacity (MW)	32,347	35,363	39,339	42,585	46,769	49,258	53,905	59,091	64,886	70,424	75,573	83,834	93,743	103,916	n.a.	n.a.
Peak Availability (MW)	20,121	21,527	23,077	24,971	26,777	29,574	31,225	34,767	37,674	42,188	44,984	49,394	54,919	61,418	n.a.	n.a.
Peak Load (MW)	20,121*	21,527*	23,077*	24,971*	26,777*	29,574*	39,660	43,308	47,014	50,945	55,800	60,832	66,705	72,711	79,249	86,437
Surplus (Deficit)	-	-	-	-	-	-	(8,435)	(8,541)	(9,340)	(8,757)	(10,816)	(11,438)	(11,786)	(11,293)	n.a.	n.a.
Energy Availability (GWh)	113,827	121,233	130,045	145,296	156,775	174,794	189,417	211,582	234,188	217,224	291,729	315,545	345,281	381,856	n.a.	n.a.
Energy Requirement (GWh)	113,827*	121,233*	130,045*	145,296*	156,775*	174,794*	210,492	229,662	249,059	269,460	295,043	322,311	352,837	384,764	419,450	457,367
Surplus (Deficit) (GWh)	-	-	-	-	-	-	(21,075)	(18,080)	(14,871)	1,764	(3,314)	(6,766)	(7,566)	(2,908)	n.a.	n.a.

* Restricted
n.a. not available

Source: Thirteenth Electric Power Survey of India, December, 1987, CEA.

INDIA

NATHPA JHAKRI POWER PROJECT

Forecasts of Regional Power Demand in India, 1987/88 - 1996/97

(Excluding Captive Generating Plant)

	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97
Energy										
(GWh)										
Northern	59,721	65,525	72,080	78,821	86,493	95,004	104,336	114,786	125,861	138,028
Western	62,082	67,177	72,474	78,105	65,475	93,015	101,283	109,038	118,177	128,094
Southern	55,578	60,443	65,322	70,319	76,736	83,355	91,158	99,164	107,713	117,015
Eastern	30,705	33,795	36,083	38,740	42,420	46,497	51,036	56,097	61,290	66,995
North-Eastern	2,363	2,672	3,041	3,406	3,839	4,346	4,915	5,552	6,260	7,060
Andaman and Nicobar Islands	36	44	51	60	71	83	97	114	134	158
Lakshadweep	6	7	8	8	9	11	12	13	15	17
All India (TOTAL)	210,491	229,663	249,059	269,459	275,043	322,311	352,837	384,764	419,450	457,367
Peak Load										
(MW)										
Northern	11,991	13,161	14,474	15,805	17,375	19,089	20,966	23,068	25,270	27,722
Western	11,060	11,981	12,956	13,994	15,289	16,538	16,059	19,416	21,040	22,804
Southern	10,377	11,282	12,189	13,172	14,426	15,647	17,183	18,688	20,280	22,019
Eastern	5,640	6,215	6,641	7,131	7,765	8,489	9,290	10,177	11,129	12,165
North-Eastern	579	653	735	821	920	1,040	1,173	1,322	1,484	1,672
Andaman and Nicobar Islands	12	14	16	19	22	26	30	36	42	51
Lakshadweep	2	2	2	3	3	3	3	4	4	5
All India (TOTAL)	39,661	43,308	47,013	50,945	55,800	60,832	64,704	72,711	79,249	86,438

Source: Thirteenth Electric Power Survey of India, CEA, December, 1987.

ANNEX 1.3

INDIA

NATHPA JAHKRI POWER PROJECT

Previous Loans and Credits to Indian Power Sector (June 30, 1988)

Borrower	IBRD Loans	No.	Approval Date	Closing Date	Loan Amount	Amount Disbursed	Status
India	First DVC - Bokaro - Konar	23	4/50	2/56	18.50	16.72	Complete
India	Second DVC - Malthon - Panchot	72	1/53	6/58	19.50	10.50	Complete
Tata	Trombay Power	106	11/54	9/66	16.20	13.85	Complete
Tata	Second Trombay	164	5/57	9/66	9.80	9.66	Complete
India	Third DVC - Durgapur	203	7/58	6/65	25.00	22.00	Complete
India	Koyna Power	223	4/59	4/65	25.00	18.70	Complete
India	Power Transmission	416	6/65	12/70	70.00	50.00	Complete
India	Second Kothagudem Power	417	6/65	12/70	14.00	13.97	Complete
Tata	Third Trombay Thermal Power	1549	4/78	12/84	105.00	105.00	Complete
India	Ramagundam Thermal Power (*)	1648	1/79	6/87	50.00	45.15	Complete
India	Farakka Thermal Power (*)	1887	6/80	12/88	25.00	0.00	
India	Second Ramagundam Thermal Power (*)	2076	12/81	6/88	300.00	142.13	
India	Third Rural Electrification	2165	6/82	6/88	304.50	239.12	
India	Upper Indravati Hydro	2278	5/83	6/91	156.40	0.39	
India	Central Power Transmission (*)	2283	5/83	3/89	250.70	4.96	
India	Indira Sarovar	2416	5/84	[illegible]/92	157.40	4.35	
India	Second Farakka Thermal Power (*)	2442	6/84	12/91	300.80	6.72	
Tata	Fourth Trombay Thermal	2452	6/84	6/90	135.40	52.50	
India	Chandrapur Thermal Power	2544	5/85	12/92	300.00	26.47	
India	Rihand Power Transmission (*)	2555	5/85	12/89	250.00	24.38	
India	Kerala State Power	2582	6/85	9/91	176.00	0.03	
India	Combined Cycle (*)	2674	4/86	12/91	485.00	0.46	
India	Karnataka Power	2827	6/87	12/95	330.00		
India	National Capital Power Supply (*)	2844	6/87	6/95	485.00		
India	Talcher Thermal Power (*)	2845	6/87	3/96	375.00		
India	Second Karnataka Power	2938	5/88	12/96	260.00		
India	Uttar Pradesh Power	2957	6/88	12/96	350.00		
	Total				4,994.20		
	(Total Loans for NTPC Projects)				(2,511.50)		

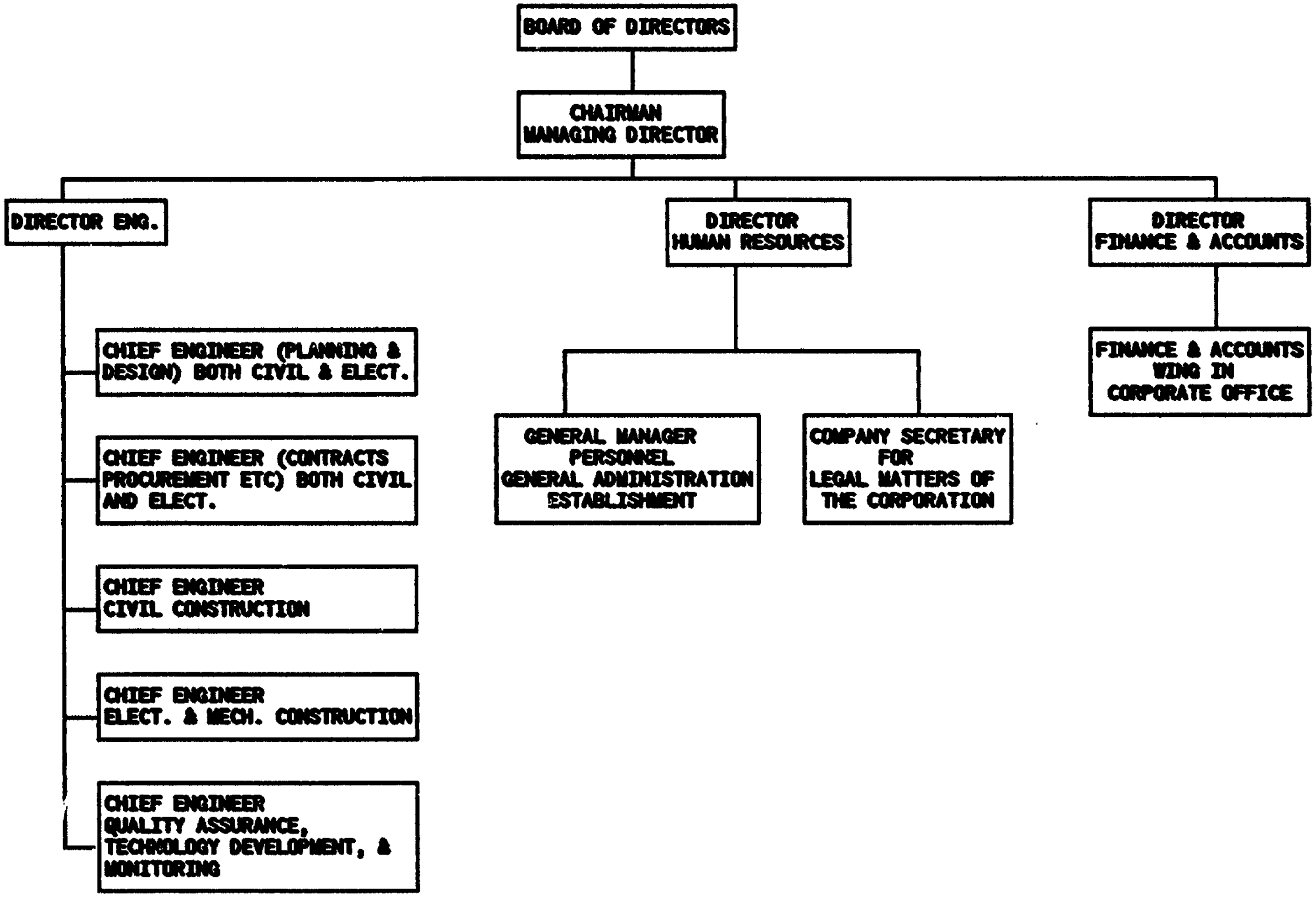
Borrower	IDA Credits	No.	Approval Date	Closing Date	Loan Amount	Amount Disbursed	Status
India	Fourth DVC - Durgapur	19	2/62	12/69	21.88	19.88	Complete
India	Second Koyna Power	24	8/62	9/70	21.10	21.10	Complete
India	Kothagudem Power	37	5/63	12/68	24.13	24.13	Complete
India	Beas Equipment	89	6/66	6/74	26.59	26.32	Complete
India	Second Power Transmission	242	4/71	3/77	75.00	72.93	Complete
India	Third Power Transmission	377	3/73	9/78	85.00	85.00	Complete
India	Rural Electrification	572	7/75	12/80	57.00	57.00	Complete
India	Fourth Power Transmission	604	1/76	6/83	150.00	149.87	Complete
India	Singrauli Thermal Power (*)	685	3/77	6/84	150.00	150.00	Complete
I[illegible]	Korba Thermal Power (*)	793	4/78	3/86	200.00	199.92	Complete
India	Ramagundam Thermal Power (*)	874	1/79	6/87	200.00	200.00	Complete
India	Second Rural Electrification	911	5/79	3/84	175.00	171.74	Complete
India	Second Singrauli Thermal Power (*)	1027	5/80	3/88	300.00	280.01	
India	Farakka Thermal Power (*)	1053	6/80	12/88	225.00	213.87	
India	Second Korba Thermal Power (*)	1172	7/81	12/89	400.00	244.86	
India	Upper Indravati Hydro	1356	5/83	6/91	170.00	66.06	
India	Indira Sarovar	SF020	5/84	6/92	129.80	0.56	
India	Indira Sarovar	1613	5/86	6/92	13.20	-	
	Total				2,423.70		
	(Total Credits for NTPC Projects)				(1,475.00)		

(*) NTPC Projects

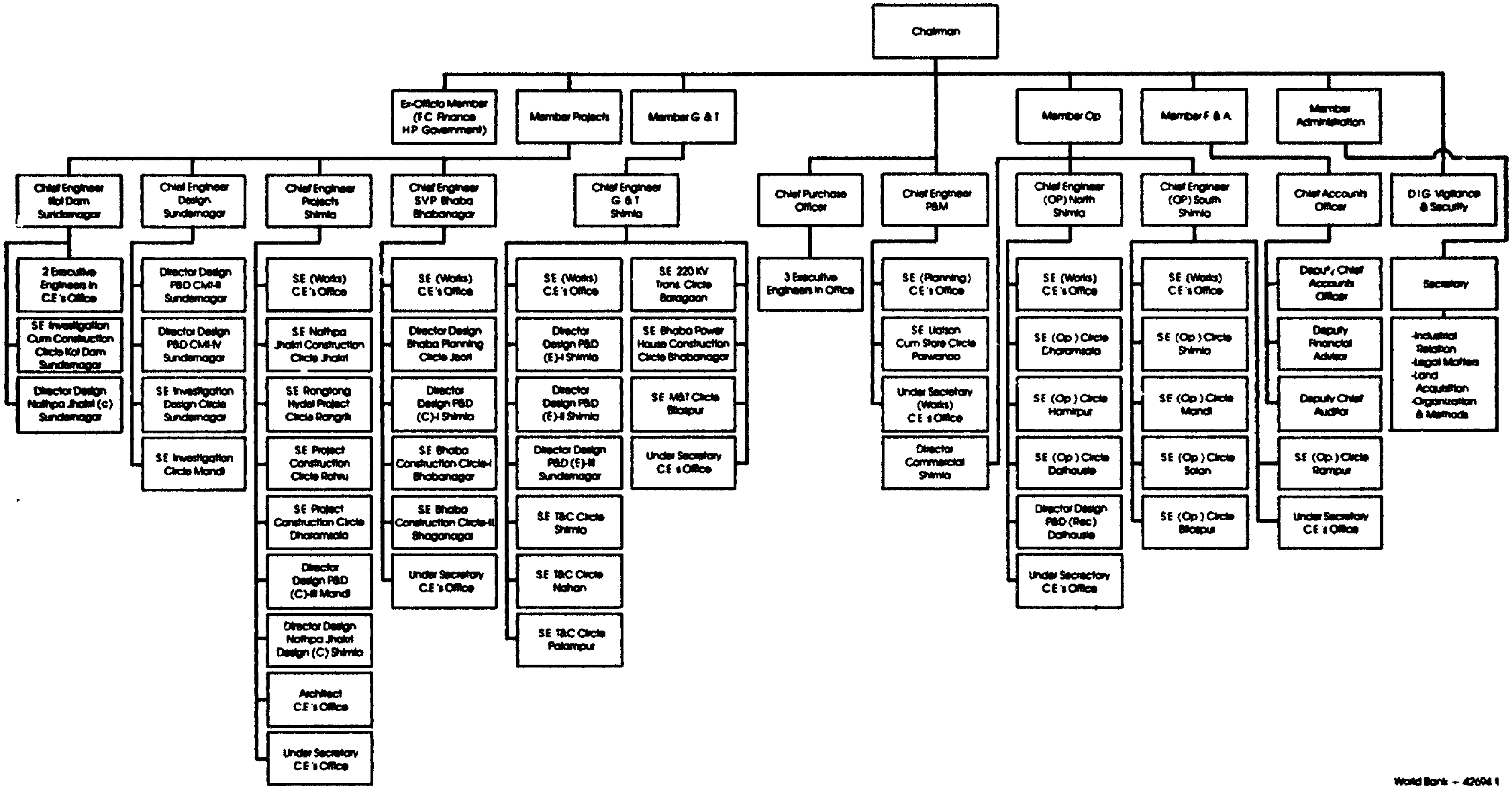
INDIA

NATHPA JHAKRI POWER PROJECT

Nathpa Jhakri Corporation Organization Chart



INDIA
NATHPA JHAKRI POWER PROJECT
Himachal Pradesh State Electricity Board Organization Chart as of 3/31/1987



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ANNEX 2.3

INDIA

NATHPA JHAKRI POWER PROJECT

HIMACHAL PRADESH STATE ELECTRICITY BOARD

Average Tariff by Consumer Category 1/

Category	Percent of Units Sold	Paise/kWh
Domestic	15.5	47.0
Commercial	6.6	82.0
Agriculture and Irrigation	2.6	30.0
Industry	46.8	63.0
Public Lighting	0.3	101.0
Sale Outside State	23.0	62.6
Supplies in Bulk to Others	5.3	48.0

1/ As of FY87, figures includes electricity duty and other state levies.

INDIA

NATHPA JHAKRI POWER PROJECT

Detailed Project Description

A. Nathpa Jhakri Hydroelectric Station

Location

1. The Nathpa Jhakri Hydroelectric Station would be located in the State of Himachal Pradesh in Northern India. It is one of a series of identified hydropower schemes in the Sutlej river which is a tributary of the Indus river. The Sutlej originates in the Tibetan Plateau. The intake of the proposed project would be located about 180 km north-east of Shimla, the State capital, on national highway NH 22. In the project area the highway runs parallel to the Sutlej at less than 1 km from the river. The river bed in the project area is located at the bottom of a 300 m deep and narrow canyon confined within almost vertical or very steep clifts. The proposed development utilizes a 470 m fall in a distance of about 28 km between the villages of Nathpa and Jhakri. The scheme runs generally parallel to NH 22 at short distances of it, which facilitates access to construction faces. The elevation of the crest of the intake dam is 1,493 m above the sea level. The river bed ascends steeply upstream of the proposed dam site and reaches 3,000 m altitude within 80 km and over 4,500 m altitude at the Tibetan Plateau (400 km upstream of Nathpa). The tail waters of the Bhaba Hydroelectric project, now in its final construction stages and located immediately upstream of Nathpa Jhakri control the maximum water level at the intake of the proposed Nathpa Jhakri scheme.

Geology

2. The geological exploration carried thus far for this project includes: (i) mapping and analysis of major regional geological features; (ii) detailed surface mapping of the project area; (iii) execution and logging of about 4,000 m of boreholes; (iv) construction of exploration adits into desilting and power caverns; and, (v) exploration adits into the headrace tunnel of four key locations. Additional confirmatory work is being carried out as part of the preparation of detailed designs. Rock properties (strength, moduli, chemical composition, etc.) have been determined and additional tests are under way to refine data for detailed designs. The project works would be located in metamorphic rocks in the Great Himalayas. The predominant rocks are gneisses of holocene period and schists of the pre-cambriam period. In some places these rocks are covered by recent slide debris and old compacted slide debris. The general strike direction is E-W to WNW-ESE and the dip ranging between 35° to 70° towards northern to NNE direction. The rocks are folded and foliated. The

principal set of joints runs parallel to the foliation. There are also horizontal, cross and oblige joints. Because of the foliation of the rock, the topography in the project area is characterized by steep slopes with sharp edges. Most of the joint systems are tight. Therefore the rock mass should be competent for foundation of structures and for tunnel construction. The permeability of the rock is generally low except for a limited number of open discontinuities and shear zones. Two important features of this geological formation are: (i) the relief of natural rock stresses that has occurred over the years, resulting in eventual open joints (now filled with cohesive materials) parallel to the steep slopes and (ii) the anisontropic behavior of the rock under mechanical stress due to the foliation and schistocity. These aspects as well as the mineralogical composition of the rocks (relevant to long-term behavior and resistance to weathering after excavation) have been taken into consideration in the preliminary engineering and would be refined for the preparation of the detailed designs. According to GSI's findings, sufficient materials of adequate quality for manufacturing of concrete are available within reasonable hauling distance from the works.

Physiography and Hydrology

3. The catchment area of the Sutlej river at Nathpa (the location of the intake) is about 50,000 km^2 of which about 37,000 km^2 are in the Tibetan Plateau and the balance, 13,000 km^2, in the Indian Himalayan slopes. The snow line in this region is at about 3,000 m above the mean sea level. The Tibetan Plateau in this region is located at about 4,570 m of altitude. There is absolutely no vegetation in this region and no rainfall. The plateau has been formed by successive deposits of boulders, gravel, clay and mud. The deposits lie in nearly horizontal beds. The Sutlej, fed basically by the glaciers, has been able to cut a channel about 900 m deep through the plateau. Because of lack of rainfall the banks stand un-eroded vertically. The channels of the several tributaries in this region present similar features with deep, narrow vertical-walled canyons. During snowmelting periods deep channels are formed in the plateau. Downstream of the Tibetan plateau to Nathpa the river is confined by high hills (1,500 m) within a 300 m deep canyon. Rainfall in this section, averaging 780 mm per annum, is mostly concentrated between June and September and is determined by the onset of the south-west monsoon. The peak flows of the river occur during this period, while the lean period occurs between October and April. Between April and June the river is fed almost exclusively by snowmelt flows from the glaciers. The 90% dependable annual flow at Nathpa is 7,690 Mm^3 and the average flow is 9,560 Mm^3. The power station would be able to use 85% of the firm flow in a lean year and 76% of the flow in an average year. The balance would be used for flushing sediments deposited in the forebay pond or would be spilled during monsoon season. Hydrological analysis for this project have been based on a 56 year data record.

Sediments

4. The Sutlej river carries a considerable volume of sediments particularly during the high-flow season. Sediment control measures

upstream of Nathpa Jhakri such as soil management and afforestation offer only limited possibilities because of the physiography of the region, the soil morphology and the impossibility to introduce vegetation at high altitude. Therefore, the project has provided for: (i) periodic flushing of the forebay pond; (ii) retention of sediments above 0.15 to 0.2 mm in the underground desilting basins; and (iii) selection and specification of units to minimize equipment wear and off-time for maintenance. In addition, the project authorities would monitor during the early years of operation the performance of the sediments handling provisions. In case of unsatisfactory performance, they would construct in the future a barrage, upstream of the Nathpa dam, for compensatory storage (about 1.5 Mm^3). The barrage's sill would be at river bed level and would be equipped with gates about 15 m high. The gates would be open during monsoon and would regulate the flow during the low flow season when water is almost sediment-free. The storage would make up for any loss of live storage of Nathpa (4.7 Mm^3) between flushing operations. These measures have been incorporated in the light of actual experiences in similar projects in the Himalayan region in India, and the expected behavior of the proposed structures and operating procedures is being confirmed through hydraulic model studies. No substantial design changes are expected as a consequence of the modeling studies. CEA has carried out sensitivity analyses to determine the effects of different levels of forebay pond siltation on the operation of the plant. The analyses show that, during the critical period, there would be no significant effect on the plant operation with levels of siltation up to 35% of the forebay live capacity. The detailed design of the flushing system is being prepared to limit sediment built-up to no more than 30% of the live capacity. The topography (steep and narrow) of the forebay basin is suited for effective sediment flushing during high flow periods.

Powerplant Layout[1]

5. The diversion dam would be of the gravity type, 60.5 m high, in concrete. The length of the dam at the top is 155 m It would be equipped with five sluice gates of 6.5 x 9.5 m. Emergency gates would be also provided for. The crest of the dam would be at elevation 1,493 and the crest of the sluice gates is at elevation 1,458. The dam is provided with a two-bay (7.5 m wide each) ogee-type spillway. The crest of the spillway is at elevation 1,488. The dam has a flip bucket energy disipation system. The surplussing structures are designed for the probable maximum flood of 5,400 m^3/s. The sluice ducts would be protected with steel plate against erosion by sediments. The total pondage 4.7 Mm^3.

6. The power intakes would be located on the right side of the reservoir about 200 m upstream of the dam axis. There would be four intakes each of 6 m wide by 7 m high. The invert of the inlets would be at elevation 1,460. The inlets would be provided with a 10 m diameter semi-circular cages with a semidomed cage cover. The cages would slide on rails laid on the hill slopes, operated by hoisting arrangements located on a platform on the hill side above the high flood level. The flow would be controlled by sliding gates operated through gate shafts. Four short intake tunnels would connect the intakes to the desilting chambers.

1/ All dimensions are approximate and subject to change as detailed design proceeds.

7. There would be four desilting caverns 15 m wide x 15 m high and 120 long with semicircular roof. Each cavern would have three collecting hoppers at the bottom. Two chambers would operate as a unit that can be isolated at the intakes and at the entrance of the headrace tunnel for servicing. Sediments from each unit would be flushed back to the river through three tunnels of 1.75 m in diameter, on for two hoppers, controlled by gates at the outlet end. The tunnel taking off the first upstream pair of hoppers, which would convey the coarser sediments, would be steel-lined. The desilting chambers would connect with the headrace tunnel through a 6 m diameter tunnel provided with sliding gates.

8. The headrace tunnel is 10.15 m in diameter and 31.4 km in length and runs generally parallel to the Sutlej river. The tunnel would be concrete lined. However, if excavation with tunnel boring machine proves more economical (both conventional and tunnel boring machine excavation can be quoted by the bidders) or if the rock is of suitable quality, the lining could be eliminated in some sections of the tunnel, or replaced by reinforced gunite. About 6 km downstream of the intake works, the waters of the Sholding river (about 6 m^3/s), a tributary of the Sutlej, are injected through a vertical shaft into the headrace tunnel. The tunnel ends at a surge tank of the restricted orifice type. The surge tank is 25 m in diameter and 130 m deep, and is provided with two expansion galleries 150 m long, 15 m wide and 15 m high each with semicircular roof.

9. The penstock starts horizontally at the surge tank. At about 200 m downstream it trifurcates into 6 m diameter branches, each provided with a butterfly type valve. Immediately after the valves the pressure shafts descend at about 45° to the power house area through a distance of 650 m. At this point each pressure shaft bifurcates into horizontal tunnels of 4 m in diameter and 60 m long leading to the powerhouse. The pressure shafts would have concrete-embeded steel lining (steel lining thickness varying from 12 mm to 45 mm).

10. The powerhouse complex would be constituted by three parallel caverns: (i) the valves cavern (8 m wide, 17 m high and 115 m long) where the spherical type valves would be located; (ii) the generators cavern (20 m wide, 40 m high, 170 m long), located 30 m downstream of the valves cavern, would house 6 turbo generating units of 250 MW each (equipped with Pelton type turbines) and ancillary equipment; and (iii) the transformers and switchyard cavern (17 m wide, 24 m high, 170 m long) located about 50 m downstream of the generators cavern; this cavern would provide space for 19 x 95 MVA single phase transformers (15/400-kV), 4 x 105-MVA interlinking transformers (400/220-kV) and, the SF6 (400-kV, 220-kV) insulated switchgear. Power would be evacuated to the surface through two cables shafts of 3 m diameter each. Access to the powerhouse would be through a tunnel 8 m wide and about 10 m high.

11. The tail race tunnel discharges back into the Sutlej river. It is 300 m long, 10.15 m wide and 15 m high with semicircular roof section.

B. Expansion and Reinforcement of Transmission System in Himachal Pradesh

12. This component would include the construction of the following 132-kV transmission lines and substations in the state of Himachal Pradesh (Map No. IBRD 20515).

Transmission Lines

From	To	No. of Circuits	Length (km)
Kumhar	Solan	1	22
Dehra	kangra	1	20
Bassi	Palampur	1	36
Jassore	Kandross	1	34
Larji	Sarabhai	1	22
Dehra	Amb	1	30
Amb	Una	1	36
Gagal	Kumhar	1	45
Giri	Dosarka	1	30
Giri	Solan	1	66
Dehra	Hamirpur	2	40
Larji	Hamirpur	2	115
	Total		496

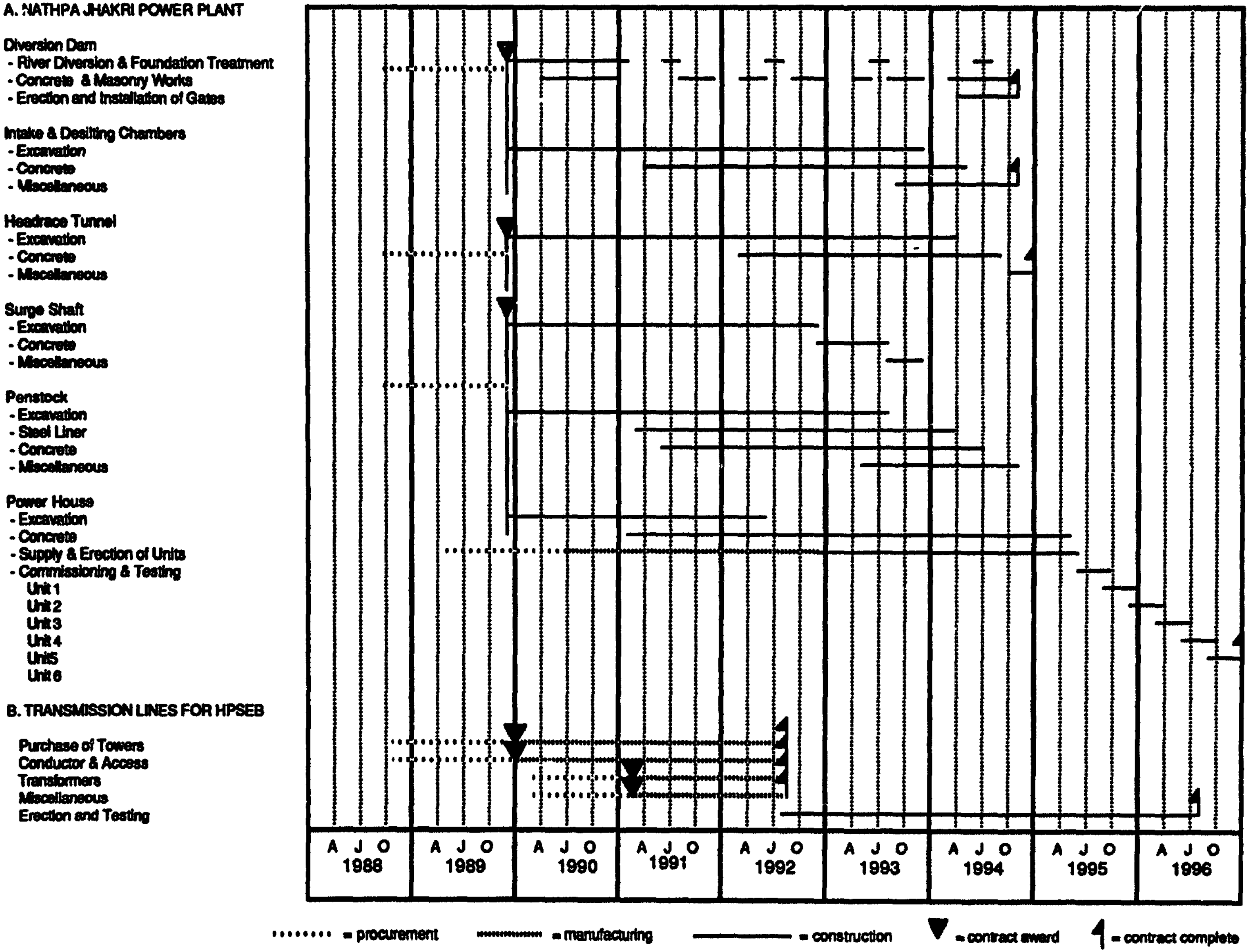
Substations

Name of Substation	Voltage	Capacity
Palampur	132/33 kV	2x16 MVA
	33/11 kV	2x4 MVA
Kandrari	132/33 kV	16 MVA
	132/11 kV	16 MVA
Sarabhai	132/33 kV	2x16 MVA
Amb	132/33 kV	2x16 MVA
Dosaska	132/33 kV	2x16 MVA
Hamirpur	16 MVA	16 MVA
	Total	184 MVA

13. The load dispatch facility and communication system for HPSEB operations would be finally selected and designed with the assistance of consultants during project implementation. For project appraisal purposes the mission, after review of preliminary studies prepared by HPSEB staff, assumed that HPSEB's minimum needs may be satisfied with a central load dispatch center including mimic display, and telemetering of generating plants. No remote control was contemplated. The communication system would be power line carrier and radio or satellite communications (depending upon cost and accessibility) with all generating plants and major substations and regional offices.

INDIA
NATHPA JHAKRI POWER PROJECT

IMPLEMENTATION SCHEDULE FOR PHYSICAL WORKS



1) For detailed procurement schedules and list of contracts see Annex 3.5

ANNEX 3.2

INDIA

NATHPA JHAKRI POWER PROJECT

Summary Accounts by Year

Totals Including Contingencies (RUPEE Million)

	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96	Total
I. INVESTMENT COSTS									
A. GENERAL									
LAND	135.8	-	-	-	-	-	-	-	135.8
SITE PREPARATION AND FACILITIES	708.6	214.6	113.7	-	-	-	-	-	1,036.9
Sub-Total GENERAL	844.4	214.6	113.7	-	-	-	-	-	1,172.7
B. CIVIL WORKS									
1. POWER STATION									
DAM, INTAKE AND DESILTING FACILITIES	-	314.3	447.0	711.6	503.4	400.4	-	-	2,376.8
HEAD RACE TUNNEL AND SURGE TANK	-	809.6	863.5	1,221.9	1,296.5	1,031.4	729.1	386.5	6,338.6
PRESSURE SHAFT, POWER HOUSE, AND TAIL RACE TUNNEL	-	243.3	346.0	550.9	389.6	206.6	109.6	-	1,846.0
Sub-Total POWER STATION	-	1,367.3	1,656.6	2,484.4	2,189.5	1,638.5	838.7	386.5	10,561.4
2. EXPANSION AND REINFORCEMENT OF TRANSMISSION IN HP									
ERECTION OF LINES AND WORKS FOR SUBSTATION YARDS	-	2.4	12.1	71.0	21.4	-	-	-	107.0
Sub-Total EXPANSION AND REINFORCEMENT OF TRANSMISSION IN HP	-	2.4	12.1	71.0	21.4	-	-	-	107.0
3. RESETTLEMENT OF POPULATION									
WORKS FOR HOUSING, ROADS, UTILITIES, ETC	-	-	1.1	0.9	0.6	0.3	-	-	2.9
Sub-Total RESETTLEMENT OF POPULATION	-	-	1.1	0.9	0.6	0.3	-	-	2.9
4. ENVIRONMENT PROTECTION PLAN									
WORKS FOR AFFORESTATION, SOIL PROTECTION, ETC	-	-	2.2	1.7	1.2	0.6	-	-	5.8
Sub-Total ENVIRONMENT PROTECTION PLAN	-	-	2.2	1.7	1.2	0.6	-	-	5.8
5. TRAINING PROGRAM AND ASSISTANCE FOR CWC									
COMPUTER CENTER, LIBRARY, AND SPECIALIZED WORKS SPACE	-	-	-	1.9	4.0	4.2	6.7	4.7	21.5
Sub-Total TRAINING PROGRAM AND ASSISTANCE FOR CWC	-	-	-	1.9	4.0	4.2	6.7	4.7	21.5
Sub-Total CIVIL WORKS	-	1,369.7	1,672.0	2,559.9	2,216.7	1,643.6	845.4	391.2	10,698.6

Totals Including Contingencies
(RUPEE Million)

. SUPPLY OF MATERIALS AND MANUFACTURING, SUPPLY AND ERECTION OF EQUIPMENT

	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96	Total
1. POWER STATION									
RADIAL GATES, HOISTS, SLIDING GATES AND STOP-LOGS	-	-	-	-	30.7	48.7	51.7	36.5	167.6
MISCELLANEOUS METAL WORK AND ACCESSORIES	-	-	-	1.4	3.1	6.5	5.2	-	16.2
MANUFACTURING AND ERECTION OF PENSTOCK	-	15.6	66.2	70.3	142.9	164.7	139.7	37.0	636.3
BUTTERFLY VALVES	-	-	10.7	-	59.9	44.5	6.7	-	121.8
ELECTRICAL OVERHEAD TRAVELLING CRANE AND OTHER CRANES	-	-	2.9	24.3	3.2	-	-	-	30.4
TURBOGENERATING UNITS AND INLET VALVES	-	487.8	-	1,106.1	1,760.7	1,867.9	330.2	350.0	5,902.7
ISOLATED BUSS DUCTS	-	6.7	-	15.0	23.9	25.4	9.0	-	80.0
440 KV AND 220 KV OIL FILLED CABLES	-	10.9	-	24.7	39.4	41.8	14.8	-	131.6
MAIN STEP - UP TRANSFORMERS AND ANCILARIES	-	29.6	-	66.5	105.7	112.1	19.8	21.0	354.7
GAS INSULATED SWITCHGEAR	-	-	48.1	-	216.8	172.5	61.0	64.7	563.2
AUXILIARY TRANSFORMERS	-	-	-	0.6	4.9	0.6	-	-	6.1
RELAYS, CONTROL BOARDS, METERING	-	-	-	6.7	56.4	7.5	-	-	70.6
POWER AND CONTROL CABLES	-	-	-	1.6	6.7	7.1	1.9	-	17.4
AUXILIARY SERVICES AND MISCELLANEOUS EQUIPMENT	-	-	-	13.6	57.6	61.1	16.2	-	148.5
Sub-Total POWER STATION	-	550.5	127.9	1,330.8	2,512.0	2,560.4	656.0	509.2	8,246.9
2. EXPANSION AND REINFORCEMENT OF TRANSMISSION IN HP									
TOWERS AND ACCESSORIES	-	3.8	4.0	33.6	197.8	-	-	-	239.2
ACSR CONDUCTOR	-	4.1	19.4	20.6	-	-	-	-	44.1
EARTHWIRE	-	0.1	0.4	3.0	-	-	-	-	3.6
INSULATORS AND HARDWARE	-	1.5	7.1	40.2	-	-	-	-	48.8
TERMINAL EQUIPMENT AND PLCC EQUIPMENT	-	5.8	17.8	64.9	-	-	-	-	88.5
TRANSFORMERS (MAIN & AUX), CTS, PTS	-	-	17.0	51.3	-	-	-	-	68.4
SWITCHGEAR AND CONTROL RELAYS AND LT PANELS	-	-	14.3	40.5	-	-	-	-	54.8
ISOLATORS	-	-	2.0	5.2	-	-	-	-	7.2
LIGHTING ARRESTERS	-	-	2.0	5.8	-	-	-	-	7.8
DC EQUIPMENT	-	-	1.4	3.5	-	-	-	-	4.8
WORKSHOP TOOLS	-	4.5	6.8	14.5	-	-	-	-	25.8
STRUCTURES AND BUS BARS	-	-	1.8	9.8	-	-	-	-	11.6
POWER AND CONTROL CABLES	-	-	2.3	7.5	-	-	-	-	9.8
Sub-Total EXPANSION AND REINFORCEMENT OF TRANSMISSION IN HP	-	19.7	96.5	300.4	197.8	-	-	-	614.4

Tota's Including Contingencies
(RUPEE Million)

	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96	Total
3. COMMUNICATIONS AND LOAD DISPATCH FACILITIES FOR HPSEB									
SUPPLY AND ERECTION OF EQUIPMENT AND MATERIALS	-	3.9	12.3	13.0	9.2	4.9	-	-	43.2
Sub-Total COMMUNICATIONS AND LOAD DISPATCH FACILITIES FOR HPSEB	-	3.9	12.3	13.0	9.2	4.9	-	-	43.2
4. INSTITUTIONAL DEVELOPMENT AND TRAINING									
TRAINING AND COMPUTERS MATERIALS AND EQUIPMENT FOR HPSEB	-	1.5	1.6	1.7	1.9	2.0	-	-	8.8
TRAINING AND COMPUTERS MATERIALS AND EQUIPMENT FOR CWC	-	6.7	3.6	3.8	4.0	-	-	-	18.1
Sub-Total INSTITUTIONAL DEVELOPMENT AND TRAINING	-	8.2	5.2	5.5	5.9	2.0	-	-	26.8
Sub-Total SUPPLY OF MATERIALS AND MANUFACTURING, SUPPLY AND ERECTION OF EQUIPMENT	-	582.3	241.8	1,649.7	2,724.9	2,567.2	656.0	509.2	8,931.3
D. TRAINING AND CONSULTING SERVICES									
POWER STATION DESIGN AND IMPLEMENTATION	9.1	9.8	7.5	8.0	8.4	9.0	5.7	6.0	63.5
INSTITUTIONAL DEVELOPMENT OF HPSEB	-	3.6	3.9	4.1	4.4	4.6	-	-	20.6
TRAINING PROGRAM AND ASSISTANCE SERVICES FOR CWC	-	7.3	7.8	8.3	8.8	9.3	-	-	41.4
Sub-Total TRAINING AND CONSULTING SERVICES	9.1	20.7	19.1	20.3	21.6	22.9	5.7	6.0	125.5
E. COMPENSATIONS AND OTHER EXPENSES FOR RESETTLEMENT AND ENVIRONMENT PROTECTION	-	-	5.3	7.6	4.0	2.1	-	-	19.0
F. ENGINEERING AND ADMINISTRATION	27.6	63.9	60.0	132.1	153.4	127.6	44.1	27.0	635.6
Total INVESTMENT COSTS	881.1	2,251.3	2,112.0	4,369.6	5,120.5	4,363.5	1,551.2	933.5	21,582.7
Total PROJECT COSTS	881.1	2,251.3	2,112.0	4,369.6	5,120.5	4,363.5	1,551.2	933.5	21,582.7

February 1, 1988 12:18

INDIA
NATHPA JHAKRI HYDROELECTRIC PROJECT
SUMMARY ACCOUNTS COST SUMMARY

	(RUPEE Million)					(US$ Million)				
	Local	Foreign	Total	% Foreign Exchange	% Total Base Costs	Local	Foreign	Total	% Foreign Exchange	% Total Base Costs
I. INVESTMENT COSTS										
A. GENERAL										
LAND	119.8	-	119.8	-	1	9.0	-	9.0	-	1
SITE PREPARATION AND FACILITIES	893.5	-	893.5	-	6	67.2	-	67.2	-	6
Sub-Total GENERAL	1,013.3	-	1,013.3	-	7	76.2	-	76.2	-	7
B. CIVIL WORKS										
1. POWER STATION										
DAM, INTAKE AND DESILTING FACILITIES	517.2	951.5	1,468.7	65	10	38.9	71.5	110.4	65	10
HEAD RACE TUNNEL AND SURGE TANK	1,332.1	2,450.8	3,782.9	65	27	100.2	184.3	284.4	65	27
PRESSURE SHAFT, POWER HOUSE, AND TAIL RACE TUNNEL	400.3	736.5	1,136.9	65	8	30.1	55.4	85.5	65	8
Sub-Total POWER STATION	2,249.6	4,138.8	6,388.4	65	45	169.1	311.2	480.3	65	45
2. EXPANSION AND REINFORCEMENT OF TRANSMISSION IN HP										
ERECTION OF LINES AND WORKS FOR SUBSTATION YARDS	79.2	-	79.2	-	1	6.0	-	6.0	-	1
Sub-Total EXPANSION AND REINFORCEMENT OF TRANSMISSION IN HP	79.2	-	79.2	-	1	6.0	-	6.0	-	1
3. RESETTLEMENT OF POPULATION										
WORKS FOR HOUSING, ROADS, UTILITIES, ETC	2.1	-	2.1	-	0	0.2	-	0.2	-	0
Sub-Total RESETTLEMENT OF POPULATION	2.1	-	2.1	-	0	0.2	-	0.2	-	0
4. ENVIRONMENT PROTECTION PLAN										
WORKS FOR AFFORESTATION, SOIL PROTECTION, ETC	4.3	-	4.3	-	0	0.3	-	0.3	-	0
Sub-Total ENVIRONMENT PROTECTION PLAN	4.3	-	4.3	-	0	0.3	-	0.3	-	0
5. TRAINING PROGRAM AND ASSISTANCE FOR CWC										
COMPUTER CENTER, LIBRARY, AND SPECIALIZED WORKS SPACE	13.9	-	13.9	-	0	1.0	-	1.0	-	0
Sub-Total TRAINING PROGRAM AND ASSISTANCE FOR CWC	13.9	-	13.9	-	0	1.0	-	1.0	-	0
Sub-Total CIVIL WORKS	2,349.1	4,138.8	6,488.0	64	46	176.6	311.2	487.8	64	46

C. SUPPLY OF MATERIALS AND MANUFACTURING, SUPPLY AND ERECTION OF EQUIPMENT	(RUPEE Million)					(US$ Mil.				
	Local	Foreign	Total	% Foreign Exchange	% Total Base Costs	Local	Foreign	Total	% Foreign Exchange	% Total Base Costs
1. POWER STATION										
RADIAL GATES, HOISTS, SLIDING GATES AND STOP-LOGS	96.3	10.6	106.9	10	1	7.2	0.8	8.0	10	1
MISCELLANEOUS METAL WORK AND ACCESSORIES	9.6	1.1	10.7	10	0	0.7	0.1	0.8	10	0
MANUFACTURING AND ERECTION OF PENSTOCK	285.1	145.6	430.7	34	3	21.4	10.9	32.4	34	3
BUTTERFLY VALVES	58.4	24.8	83.2	30	1	4.4	1.9	6.3	30	1
ELECTRICAL OVERHEAD TRAVELLING CRANE AND OTHER CRANES	20.2	2.2	22.4	10	0	1.5	0.2	1.7	10	0
TURBOGENERATING UNITS AND INLET VALVES	1,941.5	2,094.6	4,036.1	52	29	146.0	157.5	303.5	52	29
ISOLATED BUSS DUCTS	47.3	8.3	55.6	15	0	3.6	0.6	4.2	15	0
440 KV AND 220 KV OIL FILLED CABLES	43.4	46.9	90.3	52	1	3.3	3.5	6.8	52	1
MAIN STEP - UP TRANSFORMERS AND ANCILARIES	221.5	24.4	245.8	10	2	16.7	1.8	18.5	10	2
GAS INSULATED SWITCHGEAR	179.3	193.5	372.8	52	3	13.5	14.5	28.0	52	3
AUXILIARY TRANSFORMERS	3.9	0.4	4.3	10	0	0.3	0.0	0.3	10	0
RELAYS, CONTROL BOARDS, METERING	41.8	7.3	49.1	15	0	3.1	0.5	3.7	15	0
POWER AND CONTROL CABLES	10.6	1.2	11.8	10	0	0.8	0.1	0.9	10	0
AUXILIARY SERVICES AND MISCELLANEOUS EQUIPMENT	90.5	10.0	100.5	10	1	6.8	0.7	7.6	10	1
Sub-Total POWER STATION	3,049.4	2,570.7	5,620.1	46	40	229.3	193.3	422.6	46	40
2. EXPANSION AND REINFORCEMENT OF TRANSMISSION IN HP										
TOWERS AND ACCESSORIES	152.3	16.8	169.1	10	1	11.5	1.3	12.7	10	1
ACSR CONDUCTOR	30.5	3.4	33.6	10	0	2.3	0.3	2.5	10	0
EARTHWIRE	2.4	0.3	2.7	10	0	0.2	0.0	0.2	10	0
INSULATORS AND HARDWARE	32.9	3.6	36.5	10	0	2.5	0.3	2.7	10	0
TERMINAL EQUIPMENT AND PLCC EQUIPMENT	60.1	6.6	66.8	10	0	4.5	0.5	5.0	10	0
TRANSFORMERS (MAIN & AUX), CTS, PTS	46.2	5.1	51.3	10	0	3.5	0.4	3.9	10	0
SWITCHGEAR AND CONTROL RELAYS AND LT PANELS	37.1	4.1	41.2	10	0	2.8	0.3	3.1	10	0
ISOLATORS	4.9	0.5	5.5	10	0	0.4	0.0	0.4	10	0
LIGHTING ARRESTERS	5.3	0.6	5.9	10	0	0.4	0.0	0.4	10	0
DC EQUIPMENT	3.3	0.4	3.6	10	0	0.2	0.0	0.3	10	0
WORKSHOP TOOLS	17.8	2.0	19.8	10	0	1.3	0.1	1.5	10	0
STRUCTURES AND BUS BARS	7.8	0.9	8.7	10	0	0.6	0.1	0.7	10	0
POWER AND CONTROL CABLES	6.6	0.7	7.4	10	0	0.5	0.1	0.6	10	0
Sub-Total EXPANSION AND REINFORCEMENT OF TRANSMISSION IN HP	407.3	44.8	452.1	10	3	30.6	3.4	34.0	10	3

	(RUPEE Million)					(US$ Million)				
	Local	Foreign	Total	% Foreign Exchange	% Total Base Costs	Local	Foreign	Total	% Foreign Exchange	% Total Base Costs
3. COMMUNICATIONS AND LOAD DISPATCH FACILITIES FOR HPSEB										
SUPPLY AND ERECTION OF EQUIPMENT AND MATERIALS	32.1	-	32.1	-	0	2.4	-	2.4	-	0
Sub-Total COMMUNICATIONS AND LOAD DISPATCH FACILITIES FOR HPSEB	32.1	-	32.1	-	0	2.4	-	2.4	-	0
4. INSTITUTIONAL DEVELOPMENT AND TRAINING										
TRAINING AND COMPUTERS MATERIALS AND EQUIPMENT FOR HPSEB	1.3	5.1	6.4	80	0	0.1	0.4	0.5	80	0
TRAINING AND COMPUTERS MATERIALS AND EQUIPMENT FOR CWC	2.8	11.0	13.8	80	0	0.2	0.8	1.0	80	0
Sub-Total INSTITUTIONAL DEVELOPMENT AND TRAINING	4.0	16.1	20.2	80	0	0.3	1.2	1.5	80	0
Sub-Total SUPPLY OF MATERIALS AND MANUFACTURING, SUPPLY AND ERECTION OF EQUIPMENT	3,492.9	2,631.6	6,124.5	43	43	262.6	197.9	460.5	43	43
D. TRAINING AND CONSULTING SERVICES										
POWER STATION DESIGN AND IMPLEMENTATION	-	42.4	42.4	100	0	-	3.2	3.2	100	0
INSTITUTIONAL DEVELOPMENT OF HPSEB	9.7	4.1	13.9	30	0	0.7	0.3	1.0	30	0
TRAINING PROGRAM AND ASSISTANCE SERVICES FOR CWC	5.6	22.0	27.6	80	0	0.4	1.7	2.1	80	0
Sub-Total TRAINING AND CONSULTING SERVICES	15.3	68.6	83.9	82	1	1.2	5.2	6.3	82	1
E. COMPENSATIONS AND OTHER EXPENSES FOR RESETTLEMENT AND ENVIRONMENT PROTECTION	12.8	-	12.8	-	0	1.0	-	1.0	-	0
F. ENGINEERING AND ADMINISTRATION	419.1	-	419.1	-	3	31.5	-	31.5	-	3
Total BASELINE COSTS	7,302.6	6,839.0	14,141.6	48	100	549.1	514.2	1,063.3	48	100
Physical Contingencies	1,224.9	1,518.5	2,743.4	55	19	92.1	114.2	206.3	55	19
Price Contingencies	2,190.7	2,506.9	4,697.7	53	33	94.1	110.9	205.1	54	19
Total PROJECT COSTS	10,718.2	10,864.5	21,582.7	50	153	735.3	739.3	1,474.6	50	139

February 1, 1988 12:24

Cost Estimate by Nature of Expenditure
(Million of Rs)

	Nathpa Jhakri Power Station	Expansion & Reinforcement of HPSEB Transmission System	Communications and Load Dispatch Facilities for HPSEB	Institutional Development for HPSEB	Training & Assistance for CWC and CEA	Total	Physical Contingencies	
							%	Amount
A. Land	1,013.3						10.0	101.3
B. Civil Works	6,794.9	79.2			13.9	6,488.0	29.7	1,926.5
C. Materials & Equipment	5,620.1	452.1	32.1	6.4	13.8	6,124.5	10.0	612.5
D. Consultancy Services	42.4			13.9	27.6	83.9	20.0	16.8
E. Engineering and Administration	391.6	26.6	1.0			419.1	20.0	83.8
F. Miscellaneous Services	12.9	-	-	-	-	12.8	20.0	2.6
Total Baseline Costs	13,475.1	557.9	33.1	20.2	55.3	14,141.6	19.4	2,743.4
Physical Contingencies	2,669.9	58.4	3.4	3.4	8.3	2,743.4	-	-
Price Contingencies	4,522.2	144.4	8.1	5.7	17.3	4,697.7	16.1	754.8
Total Project Costs	20,667.2	760.7	44.6	29.4	80.9	21,582.7	16.2	3,498.3
Taxes	2,441.0	73.7	5.2	1.1	2.2	2,523.2	9.1	229.4
Foreign Exchange	10,741.7	62.0	-	13.2	47.6	10,864.5	18.0	1,958.7

INDIA

NATHPA JHAKRI POWER PROJECT

Procurement Arrangements
(Million US$) 1/

Project Element	ICB Contract Value	ICB Bank Finance	LCB Contract Value	LCB Bank Finance	Other Contract Value	Other Bank Finance	N.A. Contract Value	Total
A. General								
Land							10.2	10.2
Site Preparation Facilities					76.8		76.8	
B. Civil Works								
1. Power Station								
Dam, Intake and Desilting Facilities	163.9	53.5						49.2
Head Race Tunnel and Surge Tank	431.6	129.5						129.5
Pressure Shaft, Power House, and Tail Race Tunnel	127.1	38.1						38.1
2. Expansion and Reinforcement of Transmission in HP								
Erection of Lines and Works for Substation Yards			7.4	3.3				7.4
3. Resettlement and Population								
Works for Housing, Roads, Utilities, etc.			0.2	0.1				0.2
4. Environment Protection Plan								
Works for Afforestation, Soil Protection, etc.			0.4	0.2				0.4
5. Training Program and Assistance for CWC and Others								
Computer Center, Library and Specialized Work Space	1.4	0.6						1.4

Project Element	ICB Contract Value	ICB Bank Finance	LCB Contract Value	LCB Bank Finance	Other Contract Value	Other Bank Finance	N.A. Contract Value	Total
C. Supply of Materials and Manufacturing, Supply and Erection of Equipment								
1. Power Station								
Radial Gates, Hoists, Sliding Gates and Stop-Logs			11.0					11.0
Miscellaneous Metal Work and Accessories			1.1					1.1
Manufacturing and Erection Penstock	42.6	17.0						42.6
Butterfly Valves	8.2	2.5						8.2
Electrical Overhead Travelling Crane and Other Cranes	2.1	1.1						2.1
Turbogenerating Units and Inlet Values	398.0	159.2						398.0
Isolated Buss Ducts	5.4	2.9						5.4
440 kV and 220 kV Oil Filled Cables	8.9	3.6						8.9
Main Step-Up Transformers & Ancillaries	23.9	12.6						23.9
Gas Insulated Switchgear	37.5	15.0						37.5
Auxiliary Transformers			0.4					0.4
Relays, Control Boards, Metering			4.8					4.8
Power and Control Cables			1.2					1.2
Auxiliary Services & Miscellaneous Equip.			9.9					9.9
2. Expansion and Reinforcement of Transmission in HP								
Towers and Accessories	16.2	14.3						16.2
ACSR Conductor	3.1	2.7						3.1
Earthwire			0.3					0.3
Insulators and Hardware	3.4	3.0						3.4
Terminal Equipment & PLCC Equipment	6.1	5.4						6.1
Transformers (Main & Aux), CTS, PTS	4.7	4.2						4.7
Switchgear & Control Relay & LT Panels	3.8	3.3						3.8
Isolators			0.5					0.5
Lighting Arresters			0.5					0.5
DC Equipment			0.3					0.3
Workshop Tools			1.8					1.8
Structures & Bus Bars			0.8					0.8
Power & Control Cables			0.7					0.7
3. Communications and Load Dispatch Facilities for HPSEB								
Supply & Erection of Equipment & Material	3.0	2.6						3.0
4. Institutional Development and Training								
Training and Computers Materials and Equipment for HPSEB					0.6	0.5		0.6
Training and Computers Materials and Equipment for CWC					1.3	1.1		1.3

Project Element	ICB Contract Value	ICB Bank Finance	LCB Contract Value	LCB Bank Finance	Other Contract Value	Other Bank Finance	N.A. Contract Value	Total
D. Training and Consulting Services								
Power Station Design and Implementation					4.4	4.4 2/		4.4
Institutional Development of HPSEB					1.4	1.4 2/		1.4
Training Program and Assistance Services for CWC					2.9	2.9 2/		2.9
E. Compensation and Other Expenses for Resettlement and Environmental Protection							1.3	1.3
F. Engineering and Administration	—	—	—	—	—	—	43.4	43.4
TOTALS	1,290.9	471.1	41.3	3.6	87.5	10.3	54.9	1,474.6

1/ Figures subject to rounding errors.
2/ Procured in accordance with Bank's Guidelines for use of consultants.

INDIA

NATHPA JHAKRI POWER PROJECT

Procurement Schedule for Major Contracts

Contracts	Bid Docs. Furnish to Bank	Invite Bids	Opening of Bids	Contract Award
A. POWER STATION				
Civil Works				
Dam, Intake and Desilting Chambers	1/89	4/89	7/89	12/89
Headrace Tunnel	1/89	4/89	7/89	12/89
Penstock, Power Station and Tailrace Tunnel	1/89	4/89	7/89	12/89
Equipment				
Turbogenerating Units and Inlet Valves	3/89	6/89	9/89	3/90
15/400-kV, Single Phase 95-MVA Transformers	3/89	6/90	9/90	4/91
400/200-kV, 105-MVA Single Phase Auto Transformers	2/89	3/90	9/90	4/91
Station Service & AUxiliary Transformers	6/91	8/91	2/92	9/92
Relay and Control Panels	3/89	5/89	11/89	6/90
400-kV SF6 and 220-kV Indoor Switchgear	9/88	5/90	11/90	6/91
400-kV and 220-kV Oil-filled Cable with Terminal Equipment, etc.	3/89	8/90	4/91	11/91
15-kV & 400-V LT Switchgear, & Switchboards	7/90	11/90	2/91	12/91
DC Batteries and Charging Equipment	5/91	9/91	12/91	10/92

Contracts	Bid Docs. Furnish to Bank	Invite Bids	Opening of Bids	Contract Award
Travelling Cranes for Power House, and Valve House & Other Cranes	5/89	10/89	1/90	11/90
Power and Control Cables	1/91	5/91	8/91	6/92
15-kV Isolated Phase Ducts	11/90	3/91	6/91	4/92
Firefighting Equipment for Generators, Transformers, & Equipment	1/91	5/91	8/91	6/92
PLCC & Communication Equipment	4/91	8/91	11/91	9/92
220-kV & 400-kV Lightning Arrestors	4/91	8/91	11/91	9/92
220-kV & 400-kV Group Operated Outdoor Isolators & Switchyard Structures, etc.	4/91	8/91	11/91	9/92
Tractors, Mobile Cranes, & Vehicles	6/89	9/89	12/89	6/90
Workshop Equipment, Site Communication, Emergency DG Set, Electric Lift, Compressed Air & Cooling & Service Water Systems	8/89	12/89	3/90	12/90
B. TRANSMISSION SYSTEM FOR HPSEB				
Transmission Lines				
Line Towers, Nuts and Bolts and Accessories	2/88	3/89	6/89	10/89
Line Conductor and Earthwire	8/88	3/89	6/89	10/89
Insulators with Hardware, Line Clamps/Connectors, etc.	8/88	3/89	6/89	10/89
Foundations and Tower & Line Erection	6/89	8/89	10/89	3/90
Terminal Equipment Including PLCC	6/89	8/89	10/89	3/90
Tools, Transport Equipment for Construction & Inspection of Lines	6/89	8/89	10/89	3/90

Contracts	Bid Docs. Furnish to Bank	Invite Bids	Opening of Bids	Contract Award
Substations				
Civil Works (Six S/S)	5/89	8/89	10/89	3/90
Transformers (Main, Auxiliary, Station, CTs and PTs)	7/89	10/89	12/89	5/90
Switchgear, Control, Relay & LT Panels	7/89	10/89	12/89	5/90
Switchyard Structures & Bus Bars	5/89	8/89	10/89	3/90
Group-operated disconnects 132-kV & 33-kV	5/89	8/89	10/89	3/90
Lightning Arrestors 132 & 33-kV	7/89	10/89	12/89	5/90
DC Batteries & Charging Equipment	5/91	4/92	6/92	10/92
Power & Control Cables	5/89	8/89	10/89	3/90
Workshop, Machinery, Special Tools and Plant	2/89	5/89	7/89	12/89
Erection & Commissioning (S/S Wise) (a) Sarabhai & Hamirpur	5/89	8/89	10/89	3/90
(b) Palampur, Kandrori Abm, & Dosaka	5/90	8/90	10/90	3/91

ANNEX 3.6

INDIA

NATHPA JHAKRI POWER PROJECT

Schedule of Estimated Disbursements
(US$ Million)

Bank FY and Semester	Half Yearly Disbursement	Cumulative	Cumulative (%)
1989 I	0.0	0.0	0.0
II	0.3	0.3	0.1
1990 I	0.3	0.6	0.2
II	25.0	25.3	5.2
1991 I	24.0	49.3	10.1
II	24.0	73.3	15.1
1992 I	24.0	97.3	20.1
II	54.0	151.3	31.2
1993 I	54.0	205.3	42.3
II	63.0	268.3	55.3
1994 I	63.0	331.3	68.3
II	50.0	381.3	78.6
1995 I	50.0	431.3	88.9
II	17.0	448.3	92.4
1996 I	17.0	465.3	95.9
II	9.0	474.3	97.8
1997 I	10.7	485.0	100.0

INDIA

NATHPA JHAKRI POWER PROJECT

SUGGESTED TERMS OF REFERENCE FOR VARIOUS STUDIES AND CONSULTANCY ASSIGNMENTS

(I) Terms of Reference for Consultancy Services for the Power Plant

1. All the major components of the Nathpa Jhakri Hydroelectric Project, except the diversion dam and intake structures are underground. The NJPC proposes to execute this Project in a most expedient and economical manner by deploying modern methods available in the relevant branches of engineering. The Project, therefore, specially requires expertise in the design and construction of the underground works in addition to advice on the design, erection and commissioning of electrical and mechanical equipment adopting latest technologies available in these fields.

2. The Central Electricity Authority (CEA) and the Central Water Commission (CWC) are the Principal Consultants for this Project. The responsibility of finalising the designs/drawings and specifications shall be discharged by the Nathpa Jhakri Power Corporation (NJPC) in consultation with the Principal Consultants. A Panel of Experts (POE) has been constituted for this Project. The design criteria and memoranda for various Project components have been prepared by the NJPC in consultation with Principal Consultants and these have been vetted by the POE. The layout of various structures has been finalised and approved by the POE. Considering the size and complex nature of the Project, the need to appoint Consultants has been recognised. The NJPC would retain the services of CEA/CWC to assist in the preparation of the detailed design of the project and in the supervision of the construction. The design and supervision team would include, inter alia, CEA's and CWC's staff, HPSEB's staff, and GSI staff. The consulting firm referred to here would work in coordination with to this team.

3. The consultants should have proven experience in planning, design and supervision of projects of similar size and nature to those of Nathpa Jhakri. The consultants would assist and advice the project authorities during the implementation of the project in the preparation of the detailed designs, supervision of construction and project management. The consultants should have wide experience in:

(a) preparation of specifications and supervision of construction of civil works, particularly large underground works in geology similar to Nathpa Jhakri;

(b) preparation of specifications for major hydro units and ancillaries particularly for heavily silted waters;

(c) supervision of erection and testing of big (200 MW or more) rotating generation equipment and ancillaries for similar projects; and

(d) management of large projects involving international contractor(s) and suppliers and international financing.

4. It is desirable that the Consultants possess knowledge about the conditions in India such as general geology of the area, construction practices, laws and cost structure of the material and labour etc.

5. The consultants would particularly:

(a) assist the project authorities in the preparation and review of technical specifications for the civil works and equipment, including turbines and generators, gas insulated switchgear, inlet valves, full sealed radial gates and ancillary equipment as needed;

(b) review the bidding drawings/documents for civil works and equipment as required;

(c) assist in the techno-economical analysis of bids as needed;

(d) review of construction drawings as required;

(e) review of shop drawings of critical equipment proposed by suppliers;

(f) assist the project authorities in setting up quality control procedures and in interpretation of results as required;

(g) review the drilling and blasting patterns of support systems, blasting and rock anchor tests proposed and assist in the interpretation of results;

(h) assist the project authorities in handling claims submitted by the contractors as required;

(i) assist the project in solving specific technical problems that may arise during construction;

(j) advise on construction methodology, selection of construction equipment and machinery for the Project; and

(k) provide general advise in matters related tc contract management as necessary.

6. To perform their duties, the consultant will assign full time lead experts for assistance in project management, design and construction of underground works and for approval of drawings and supervision of erection and testing of electromechanical equipment as required. These lead experts will be assigned for a period sufficient to ensure the successful completion of the civil works and the commissioning of the units.

7. The consultants would deploy lead experts and other specialised staff as may be necessary, with the approval of the project authorities or at their request.

8. The consultants will work in close coordination with CEA and CWC staff responsible for the ultimate clearance of the specifications.

9. The main disciplines in which external expertise would be required are:

- underground excavation of large cavities and rock supporting systems, including mechanical excavation tunneling methods;

- geotechnical engineering and rock mechanics including analytical methods (tridimensional finite elements analysis);

- quality control of civil works and inspection of manufacturing of critical equipment;

- electro-mechanical engineering;

- general project management and monitoring; and

- claims handling, where ever necessary.

In addition to experts in the above major disciplines, the consulting firm would provide the services of a lead project advisor of ample experience in design and construction supervision of large hydropower schemes similar to Nathpa Jhakri to assist the chief Engineers for Design and Construction during project implementation as needed. The firm would also supply specialized services from the headquarters offices when it is more efficient to do so or when the required facilities such as laboratory, software programs, etc. are not locally available. The firm would also provide services of other specialists on short term basis if necessary.

10. The timing and duration of the consulting firm services would be related to the executions of particular project activities. The consultants input would be more intense during the earlier stages of project implementation (preparation of design memorandums, core designs, specifications, establishing quality control procedures and establishing monitoring system) and in the supervision of critical aspects (caverns excavation and erection of major equipment). As construction activities progress consultant's assistance would be reduced gradually. Eventually periodic reviews of the consultants would be sufficient in particular instances.

11. As the project layout has already been finalised in consultation with the Principal Consultants and has also been approved by the POE, no further substantial studies are envisaged so far as Project concept is concerned. The layout of the structures may, however, be reviewed with a view to achieve economy as also improvement in operation and maintenance.

12. The Consultants may after reviewing the Project proposals, propose further studies, if any, to be done by the NJPC. These shall be listed out in the Technical proposal.

13. The Project is expected to be completed in a period of 7 years including 1 1/2 years for infrastructural works. Drawing indicating construction schedule is enclosed.

14. The man months required to be put in by the Consultant in different areas are estimated to be about 200. These would, however, depend on the actual requirements worked out by the project authorities from time to time.

15. In the light of the above objectives, the Consultant shall elaborate in their proposals about their methodology and approach for this assignment, giving various alternatives they propose for reviewing the general layout, equipment and construction methods, etc, as well as the breakup of man-months for individual assignments/activities.

(II) Suggested Scope for a Training Program for CEA, CWC, GSI and Other Institutions[1]

1. The objectives of the training assistance are to:

(a) familiarize CEA, CWC, GSI and other institutions staff with the state of the art in: (i) planning, investigation and design of hydropower schemes with particular emphasis on underground works; and (ii) planning and design of large power systems;

(b) equip CEA and CWC with up-to-date design manuals and standards for investigation, preparation and design of hydropower projects including type of project reports, standard-specifications, typical bidding and construction drawings, etc.;

(c) to equip CEA and CWC with the necessary specialized office equipments, computer facilities, software and training technical literature and other elements necessary for carrying out their work in the field of hydropower planning and design.

2. Training would be imparted primarily on the job but would also include class-room conferences, workshops, study tours and courses abroad and any other means considered appropriate. The target group would be the professionals at the level of executive engineer and above, and selected staff from the SEBs NHPC, GSI and other institutions designated by GOI.

3. CEA and CWC would enter into an agreement with a seasoned and highly experienced design consulting firm or with a highly reputed hydropower utility or with a combination of them with extensive background in design and construction of hydropower plants particularly underground and in planning and design of large power systems. CEA and CWC would also, directly or through the training consultant, contract the services of experts in specific areas of training that the Consultant is not able to provide.

4. The main vehicle for staff training and development of manuals would be the preparation and design of two or three projects selected by CEA and CWC to be jointly carried out with the training consultant. CEA and CWC teams in charge of preparing or designing particular components of the project would work together with the consultants as needed. The consultants would not do the actual design work but would guide and train the concerned staff in doing it in order to ensure that they master the state of the art techniques and acquire necessary knowledge at the end of the training period.

5. It is envisaged that the training program would extend for a period of about three years and would involve about 150 staff-months of consultants. The detailed training program would be prepared jointly by CEA, CWC and the consultant on the basis of guidelines to be provided by CWC.

1/ To be updated after training mission scheduled in April 1988.

6. Some specific topics in which GOI's agencies have expressed interest and should be part of the training are:

(a) Power Systems:

(i) Use of computer in project evaluation and planning. Economic evaluation practices of peaking and pumped storage schemes.

(ii) Optimum development planning in a river basin, optimisation of project features, modelling and simulation of multipurpose/multi-reservoir water resources system, planning for cascade power development, optimum sequencing of hydro projects.

(iii) Models for study and analysis of the role of a hydro electric project in the system load curve in an integrated power system.

(iv) Development of simulation models suited to specific problems in the Indian context by CEA engineers with the active help, training and interaction with specialised institutions, organisations. Integration of the results of simulation models with general optimum power planning models.

(v) Environmental impact studies of a hydro electric project.

(vi) Micro processor based control systems and protection for large hydro power stations.

(vii) Modern practices in design and engineering of high head francis turbines, pumped storage schemes, particularly split runner, two speed motor generators, etc.

(viii) Remote control of hydro projects through modern technology such as optical fibers.

(ix) Modern management information system for investigation, monitoring and construction monitoring.

(x) Large capacity generator units with Francis/Kaplan/Pelton/Bulb type turbines.

(xi) Site assembly of large capacity transformers, gas insulated switch gears, 400 kV oil filled and dry cables.

(xii) State estimation of power projects through micro computers.

(b) Hydroelectric Projects

(i) Finite element analysis for underground excavations

(ii) Uses of shotcrete, rock support system design, chemical grouting and use of tunnel boring machines

(iii) State of the art in blasting technology

(iv) Latest trends in design of gates, valves and hydraulic hoists

(v) Advanced construction planning and management

(vi) Site investigation techniques and modern technology available

(vii) Surge and water hammer analysis

(viii) Structural analysis of dams, barrages, hydel power houses etc. including finite element analysis

(ix) Analysis of underground openings and structures with foundation complexities

(x) Computer aided drafting for preparation of Engineering drawings for the various river valley projects

(xi) Development of behavioral models for safety assessment of dams and hydraulic structures based on interpretation of observed data

(xii) Creation and maintenance of data bases for seismic criteria for the design of various structures, special problems etc.

(III) Scope of Work for Utility Management Study

Objective

1. The objective of the study is to formulate and introduce the changes necessary in:

(i) the allocation of responsibilities amongst the different organizational units of HPSEB;

(ii) the routines and working procedures;

(iii) the reporting, monitoring systems and internal controls.

The proposed changes would result in overall improved efficiency and would furnish HPSEB with working procedures and tools compatible with its needs. The study would identify the needs for training of the staff to properly operate the new procedures and routines. The recommendations of the study would culminate in: (i) the preparation of an operational manual covering the obligations and routines of HPSEB's organizational units; and (ii) the establishment of procedures and formats for recording, processing, storing and retrieving all the information and transactions necessary for the operation of HPSEB. These proposals should be coordinated with the management information system study (MIS) being prepared separately.

Scope of Consultancy Work

2. The consultant should:

(i) review of existing allocation of functions amongst the organizational units to determine the existence of duplications or gaps and to identify the justification and purpose of the presently assigned tasks. The consultants should review whether the necessary tasks are being performed in the following areas: planning; engineering and construction; operation and maintenance; financial management and accounting; personnel administration and training; administrative services including data processing, materials management, organization and methods, etc.; customer services such as processing of new connections, claims, billings, collections, etc., and internal controls and monitoring;

(ii) prepare a proposal for a revised allocation of functions including, if considered essential, recommendations for changes in the existing organization;

(iii) prepare an operational manual for each organizational unit;

(iv) establish the routine procedures within each unit and for HPSEB as a whole. The procedures would include the flow of work, the systems to monitor task implementation, the level of technology to be used, and the routines and formats to be used to process work order and to record, maintain and retrieve information pertaining to each unit's operations;

(v) design standard forms and establish form flow charts and procedures in the form of working instructions;

(vi) identify and assist in the implementation of the training program for HPSEB staff in the use of the new procedures; and

(vii) prepare a plan for gradual implementation of the proposed changes.

3. The consultants would also assist HPSEB in the implementation of the study recommendations. After a trial period of, say, 6 months the consultants should help HPSEB in the identification of any adjustments necessary to the system and would reflect the same in the final manuals, procedures and forms.

(IV) Terms of Reference for the Panel of Experts

1. The main purpose of the panel would be to review the design concept of the project and of its structures and the adequacy and safety of their design. The Panel, should also conduct periodic reviews during final engineering and construction to assess whether there is need for changes in the design or in the construction methods. The Panel's activities would be geared to ensure safe and economic designs.

2. It is suggested that the Panel should include experts in the following fields:

- Dam planning and design (including spillways and energy dissipation structures)
- Tunneling and underground works
- Hydrology and sediments
- Geotechnics, foundations, and soil mechanics
- Planning and design of hydropower facilities

3. In discharging its duties the Panel may request for the assistance, on a temporary basis, of experts in matters which due to its high specialized nature it is, in the Panel's opinion, advisable to do so.

4. The Panel, unless they otherwise decide, would meet regularly every four months to review the status of technical works. It would meet also at project authorities' request when the need for consultation appears.

5. The Panel would prepare and submit written proceedings of the meetings (regular or extraordinary), including recommendations, within three weeks of the meetings, and, in case of urgency, will prepare technical memorandums or aide memoirs immediately after or during the meetings. A preliminary report would be prepared before each meeting adjourns. The preliminary reports, proceedings and any other memorandums, aide memoirs, etc. would be submitted to the project authorities, and through them to the Bank.

6. The Panel should in particular, but not limited to, review and suggest the necessary changes to:

(a) The final layouts of the project and the recommended ones.

(b) The field investigation program including geology, soils and foundations, construction materials.

(c) The proposed tests, analysis and quality control methods to determine the properties of the materials to be used in the construction or as foundations of the main structures as well as the proposed processing for the materials (aggregates, concrete, land fills, filter materials, etc.).

(d) The design criteria and assumptions to be used for the different components of the project.

(e) The technical solutions (its adequacy and economy) proposed to deal with special or uncommonly difficult situations during design or construction.

(f) The safety factors proposed for the different components of the project.

(g) The hydrological analysis for determining the design flood for temporary as well as for permanent works, the output of the project, and the operation rules of the reservoir.

(h) The analysis of potential sediment problems for the project and the proposed counter measures to eliminate or ameliorates them.

(i) The proposed capacity of the surplusing facilities for the dam (spillway, sluices, etc) and the energy dissipation structures.

(j) The tunneling and underground work methods, designs and procedures.

(k) The instrumentation program (temporary as well as permanent) proposed for project construction and subsequent monitoring.

7. The Panel's assignment would last until the completion of the construction of the project.

(V) Suggested Scope of the Bulk Supply Tariff Study

1. NJPC wishes to undertake a study to plan the pricing of electricity that will be generated by the Nathpa Jhakri hydroelectric power station. NJPC's objectives are to ensure that: (i) NJPC maintains a sound financial position; (ii) the power station is fully utilized; and (iii) that prices which are charged encourage efficient operations planning and investment planning amongst NJPC's customers.

2. The first phase of the study will be to estimate the optimal way in which the station should operate as part of the Northern Region system. This will entail estimating the marginal operating costs of existing plant and other new plant on the Northern Region and scheduling plants' operations to minimize operation costs. Operation of Nathpa Jhakri would be scheduled to meet incremental demands at times when system marginal costs are highest and to maximize fuel cost savings against existing thermal plant.

3. The second phase of the study will estimate the marginal costs of generation from Nathpa Jhakri at different times of the day and during different seasons. At times when water used for generation would not be replaced by water that would otherwise be spilled, marginal generation costs will include both capital and operating costs of the power station. Generation using water that would otherwise be spilled would be costed based on marginal operating costs only.

4. The third phase of the study will design a bulk supply tariff to be applied at the power station busbars at would produce demands for Nathpa Jhakri's output enabling the station to operate as closely as possible to the optimal way. The level and structure of this tariff will be based on the stations marginal generation costs, but (where necessary) will include adjustments to:

(a) take account of differences between the prices charged for other bulk supplies and their marginal generation costs;

(b) any technical or economic constraints on electricity generation and transmission in the Northern Region; and

(c) provide adequate revenues to NJPC.

In instances where adjustments from marginal generation costs are required, these will be designed to so as to minimize the distortion to Nathpa Jhakri's optimal pattern of generation.

6. The study will include sensitivity analyses to show how Nathpa Jhakri's pattern of generation and bulk supply tariff should be charged in response to feasible changes in development or operation of the Northern Region system. Also, the study will examine the desirability of setting up a stabilization fund to protect NJPC's financial interests in years of exceptionally low rainfall. Finally, the study will specify the form of contracts that could be used to implement the recommended bulk supply tariff.

7. Should the Bank so request, NJPC will extend the scope of the study to include transmission lines associated with the Nathpa Jhakri power station being installed by the NHPC. This extension to the study would, using the same economic principles as for pricing the generation from Nathpa Jhakri, propose tariff supplements that would ensure that: (i) NHPC would recover the full costs of installing and operating the transmission lines; and (ii) transmission capacity would be utilized efficiently.

(VI) Suggested Scope of Work for Accounting and Management Information System (MIS) Study for HPSEB

Objectives

The objectives of the study would be to assist HPSB in strengthening its finance and accounting operations by:

(i) Providing assistance to fully implement the new commercial accounting system (CAS) recently introduced by HPSEB;

(ii) Assisting in closing the books of accounts and compiling annual accounts for the first two years after the CAS is fully implemented;

(iii) Training of Finance and Accounts Staff, at all Accounting Units including Head Office, for the CAS;

(iv) Assisting HPSEB in the design and implementation of a suitable Management Information System which would cover both operational data and financial information;

(v) Training of about 8 - 10 staff in the use of personal computers in preparing projected financial statements for financial planning purposes, and in preparing reports to be generated by the MIS.

(vi) Assisting HPSEB in formulating and implementing an appropriate fixed asset recording system.

Terms of Reference

(i) Prepare with HPSEB a detailed program for implementation of the CAS, including a training schedule;

(ii) Review with HPSEB management and adjust, if necessary, the organization and staffing of the Accounting Wing of HPSEB;

(iii) Design and discuss with the Accounts Member and Chief Accounting Officer of HPSEB the procedures, formats, forms, etc. to be implemented. To the degree possible, the Consultants should make use of the existing forms and procedures, or simplifications thereof, which are satisfactory and meet with the requirements of the CAS;

(iv) Provide formal classroom training to the HPSEB Finance and Accounts Staff on the proposed CAS;

(v) Make periodic visits as needed and as agreed with HPSEB to the Accounting Units during CAS implementation to review the progress and to give on-the-spot guidance and advice;

(vi) Ensure that forms and registers recommended for use are properly completed and that procedures laid down in the areas of financial accounting, fixed asset recording and information systems are properly followed;

(vii) Assist HPSEB Accounting Staff in closing of Accounts for the financial years ending March 31, 1990 and March 31, 1991;

(viii) Analyze the current information systems and recommend an MIS which will include inter alia:

(a) Information to be collected-where, when and by whom;

(b) Design of various reporting formats for different functional departments including construction, generation, transmission, distribution, financial, commercial, personnel, statistical and administration;

(c) Flow of reports;

(d) Procedure for synthesis and analysis of reports;

(e) Procedure for follow-up action;

(ix)[2] Recommend and assist in the procurement of 4 to 6 personal computers and suitable software for use in the preparation of (a) projected financial statements; and (b) reports for the MIS;

(x) Provide classroom and hands-on training to HPSEB's staff as needed in the operation and use of the personal computers and preparation of projected financial statements and MIS reports;

(xi) Coordinate as necessary with the consultants for the utility management consultancy.

Reporting

The consultants would:

(i) Prepare quarterly progress reports on the implementation of the study and help in preparing special reports, if any, required to be furnished by HPSEB to the World Bank;

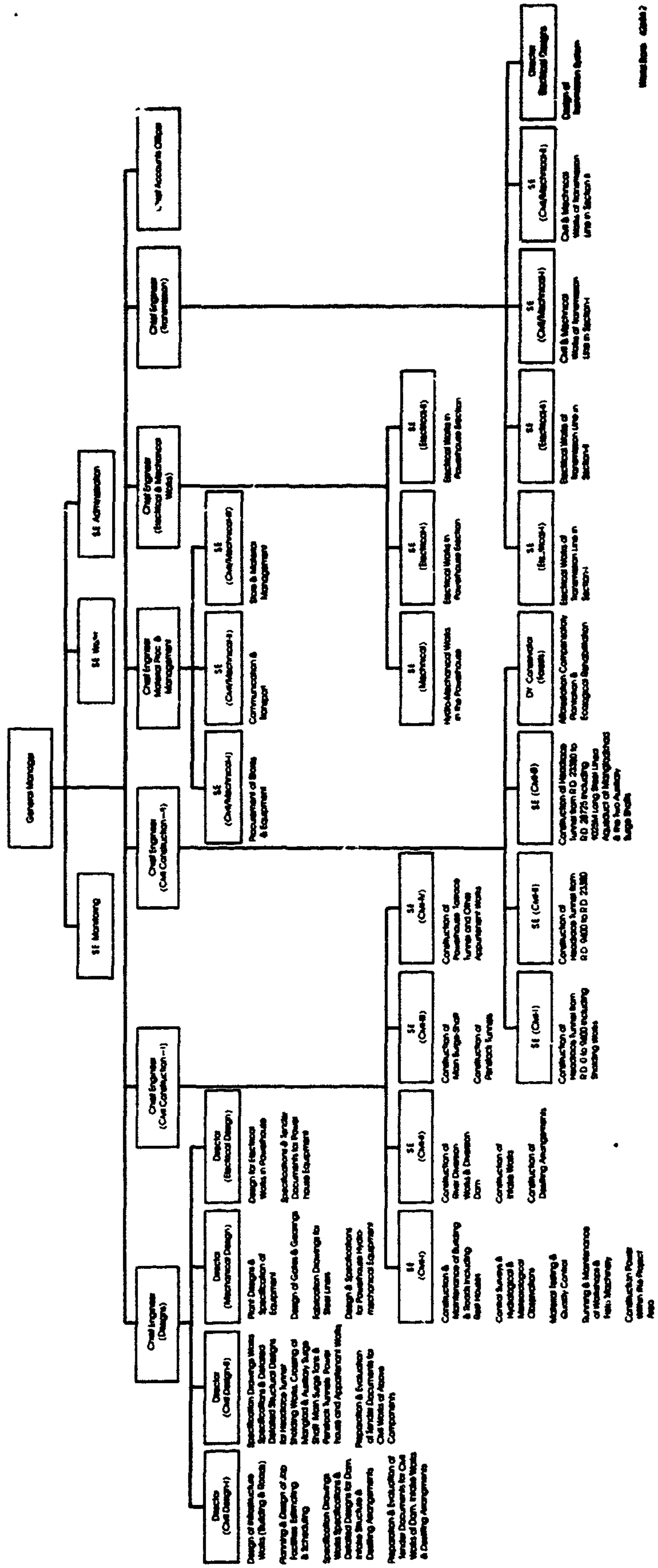
(ii) Furnish reports discussing implementation as well as further steps to be taken where progress is tardy or unsatisfactory;

(iii) At the end of the training and implementation assignment, furnish a report describing matters that require continuing attention.

2/ The consultants and HPSEB would liaise closely with the Bank in the formulation of a financial model for HPSEB. This would ensure consistency of approach with models being developed for other SEBs.

ANNEX 3.8

INDIA
NATHPA JHAKRI POWER PROJECT
Field Organization for Implementation of the Nathpa Jhakri Scheme



INDIA
NATHPA JHAKRI POWER CORPORATION
FORECAST INCOME STATEMENTS
(YEAR ENDING MARCH 31)

(In Rs. Million)

	FORECAST												
	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01
Energy Availability (GWh)													
NJPC Generation									1000	4300	7050	7050	7050
Station Consumption									10	43	71	71	71
Net Generation									990	4257	6980	6980	6980
Sales of Electricity (GWh)									990	4257	6980	6980	6980
Of which: GHOP									218	937	1535	1535	1535
GOHP(12% free share)									119	511	838	838	838
NHPC/SEBs									653	2810	4606	4606	4606
Av. Revenue (ps./kwh)									60	60	60	60	60
Av. Tariff (ps./kwh)									68	68	68	68	68
Revenues													
Sales of Electricity									592	2547	4177	4177	4177
Of which: GOHP									148	637	1044	1044	1044
NHPC/SEBs									444	1911	3132	3132	3132
Total Revenues									592	2547	4177	4177	4177
Expenses													
Administration									17	73	78	82	87
Employees' Remuneration									35	147	155	165	175
Operation & Maintainence									69	293	311	330	349
Depreciation									104	415	415	415	415
Total Expenses									225	929	959	992	1027
Operating Income									368	1619	3217	3184	3150
Total Interest	32	144	296	512	833	1168	1382	1473	1507	1494	1432	1331	1231
Less: IDC Capitalised	32	144	296	512	833	1168	1382	1473	1130	0	0	0	0
Net Income									-9	124	1785	1853	1919
Rate of Return (%)													
Historical Costs 1/									3	6	12	12	12
Revalued Asset Base 2/									3	6	11	10	10
Operating Ratio (%) 3/									38	36	23	24	25

INDIA
NATHPA JHAKRI POWER CORPORATION
FORECAST BALANCE SHEET
(YEAR ENDING MARCH 31)

(In Rs. Million)

	FORECAST												
	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01
Assets													
Fixed Assets													
Gross Fixed Assets in Operation									27678	27678	27678	27678	27678
Less: Accu. Depreciation									104	519	934	1349	1764
Net Fixed Assets in Operation									27574	27159	26744	26329	25913
Capital Works-in-Progress	913	3263	5533	10011	15713	21219	24146	26548					
Total Fixed Assets	913	3263	5533	10011	15713	21219	24146	26548	27574	27159	26744	26329	25913
Other Assets			13	26	39	52	65	78	78	78	78	78	78
Capital Invest. Fund											277	1851	3491
Current Assets													
Cash									12	49	52	55	58
Inventories									17	73	78	82	87
Accounts Receivable									74	318	522	522	522
Total Current Assets									103	441	652	659	668
Total Assets	913	3263	5546	10037	15752	21271	24211	26626	27755	27678	27750	28917	30150
Equity & Liabilities													
Equity													
GOHP Paid-In Capital	114	408	693	1255	1969	2659	3026	3328	3608	3584	3328	3328	3328
GOI Paid-In Capital	342	1224	2080	3764	5907	7977	9079	9985	10824	10753	9985	9985	9985
Retained Earnings								0	-9	115	1901	3754	5673
Total Equity	457	1631	2773	5018	7876	10636	12106	13313	14423	14453	15213	17057	18985
Total Long Term Debt	457	1631	2773	5018	7876	10636	12106	13313	13140	12448	11756	11064	10372
Current Liabilities													
Curr. Mat. of LT Loans									173	692	692	692	692
Accounts Payable									9	37	39	41	44
Other Curr. Liabilities									12	49	52	55	58
Total Current Liabilities									193	778	783	788	794
Total Equity & Liabilities	913	3263	5546	10037	15752	21271	24211	26626	27755	27678	27750	28917	30150
Debt as % of (Debt+Equity) 4/	50	50	50	50	50	50	50	50	48	46	44	39	35
Current Ratio 5/									0.5	0.6	0.8	0.8	0.8
Accounts Receivable (Months) 6/									1.5	1.5	1.5	1.5	1.5

INDIA
NATHPA JHAKRI POWER CORPORATION
FORECAST SOURCES & APPLICATIONS OF FUNDS
(YEAR ENDING MARCH 31)

(In Rs. Million)

	FORECAST												
	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01
Sources													
Internal Sources													
Operating Income									368	1619	3217	3184	3150
Depreciation									104	415	415	415	415
Total Internal Sources									471	2034	3632	3600	3565
Paid-In Capital	457	1175	1142	2245	2858	2760	1470	1207	1119	-94	-1025		
Borrowings													
GOI/GOHP Loan	457	311	419	478	1731	2023	1122	962					
IBRD Loan	0	864	723	1767	1127	737	348	246					
Total Borrowings	457	1175	1142	2245	2858	2760	1470	1207					
Total Sources	913	2350	2283	4491	5715	5520	2940	2415	1590	1940	2607	3600	3565
Applications													
Proposed Project	881	2206	1974	3965	4869	4339	1545	929					
IDC Capitalised	32	144	296	512	833	1168	1382	1473	1130				
Total Investment Program	913	2350	2270	4478	5702	5507	2927	2402	1130				
Feasibility Studies			13	13	13	13	13	13					
Capital Invest. Fund											277	1574	1640
Debt Service													
Total Interest	32	144	296	512	833	1168	1382	1473	1507	1494	1432	1331	1231
Less: IDC Capitalised	32	144	296	512	833	1168	1382	1473	1130				
Net Interest									377	1494	1432	1331	1231
Repayment									0	173	692	692	692
Total Debt Service									377	1667	2124	2023	1923
Change in Working Capital													
Variation in Cash									12	37	3	3	3
Variation other than Cash									71	235	203	-1	-1
Net Change in Working Capital									83	272	206	2	2
Total Applications	913	2350	2283	4491	5715	5520	2940	2415	1590	1940	2607	3600	3565
Debt Service Coverage 7/									1.3	1.2	1.7	1.9	1.9

INDIA
NATHPA JHAKRI POWER CORPORATION
FORECAST FINANCIAL INDICATORS /a
(YEAR ENDING MARCH 31)

	FORECAST				
	1996/97	1997/98	1998/99	1999/00	2000/01
Rate of Return % :					
-Historical Base (1)	3	6	12	12	12
-Bank Guidelines (2)	3	6	11	10	10
Operating Ratio % - (3)	30	36	23	24	25
Debt as % of Debt + Equity (4)	48	46	44	39	35
Current Ratio (5)	0.5	0.6	0.8	0.8	0.8
Accounts Receivable - (6) Months	1.5	1.5	1.5	1.5	1.5
Debt Service Coverage (7)	1.3	1.2	1.7	1.8	1.9

/a Definitions are provided in the following page.

NATHPA JHAKRI POWER CORPORATION (NJPC)

Financial Indicators - Definitions

1. Rate of Return Based on Historical Costs

The Corporation shall take from time to time all such measures as may be necessary including, if necessary, adjustment of tariffs of the Corporation to ensure that the total revenue in any financial year shall, after meeting: (i) all expenses properly chargeable to revenues, including operating, maintenance and management expenses; (ii) taxes on income and profits; and (iii) depreciation; produce such surplus before interest as is not less than 6% in financial year 1997/98 and 12% thereafter, of the average net fixed assets of the Corporation in service at the beginning and at the end of such year. Critical terms listed above would be defined as follows:

(a) "total revenues" means revenues of the Corporation from the sale of electricity and other services, miscellaneous income, and subventions in respect of extraordinary costs which are borne by the Corporation and which are not passed on to customers of the Corporation;

(b) "expenses" means the cost of power purchased, fuel, operating, maintenance, management and administrative expenses, and all taxes and duties accruing during the financial year, other than taxes on income and profits of the Corporation;

(c) "taxes on income and profits" consists of income taxes and other levies accrued by the Corporation according to the provisions of any legislation or regulation applicable in this respect;

(d) "depreciation" means a provision derived in accordance with the straight-line method based on the useful life of assets as stipulated in the Borrower's notification G.S.R. No. 1330 (E) dated December 12, 1986, issued under the provisions of Section 68 of the Electricity (Supply) Act 1948, of the Borrower, based on the gross value of the Corporation's fixed assets in service at the beginning of each year; and

(e) "net fixed assets of the Corporation in service" means the original cost of such fixed assets, as reduced by the aggregate of the cumulative depreciation in respect of such assets.

2. Rate of Return as per Bank Guidelines

Numerator: Income after depreciation but before interest.
Denominator: Average net fixed assets in operation after deducting accumulated depreciation. A pro-forma revaluation was made by revaluing assets yearly at the domestic inflation rate.

3. Operating Ratio

    Numerator: Operating Expenses
    Denominator: Operating Revenues

4. Debt as % of Debt + Equity

    Numerator: Long-term debt
    Denominator: Long-term Debt plus Total Equity

5. Current Ratio

    Numerator: Current Assets
    Denominator: Current Liabilities

6. Accounts Receivables as a % of Electricity Sales

    Numerator: Accounts Receivables for Electricity Sales
    Denominator: Electricity Sales divided by 12 months

7. Debt Service Coverage Ratio

    Numerator: Operating Income plus Depreciation
    Denominator: Total Debt-service

Financial Projections' Assumptions

Price Escalation

1. Local Inflation is assumed to be 7% in 1988/89 and 6% in each fiscal year thereafter during the projection period.

2. Foreign Inflation is assumed to be 4% from 1988/89 through 1995/96.

Foreign Exchange

3. For the Investment Program and yearly disbursement of the Bank's loan, the exchange rate between one United States dollars and Indian Rupee is assumed to be as follows:

Fiscal Year	Rs	Fiscal Year	Rs
		1992	14.8
1988	13.3	1993	15.1
1989	13.8	1994	15.4
1990	14.2	1995	15.7
1991	14.5	1996	16.0

Income Statements

4. The amount of NJPC generation is based on CEA's feasibility studies which indicate that the six 250 MW units of Nathpa Jhakri power station would generate 7,050 GWh of electricity in a year with average precipitation commencing in normal capacity in FY99. Generation in FY97 and FY98 would be about 14% and 61% respectively due to outages needed for adjustment following initial commissioning. Note that in FY97, the units will be operation for only 3 months following commissioning in December 1996.

5. At normal capacity, NJPC sales of electricity would be 6,980 GWh after 1% is utilized by station consumption. Twelve percent is provided to GOHP at no charge as per the Memorandum and Articles of Association establishing the Corporation.

6. Administration expense is assumed to be 0.25% of gross fixed assets in FY97, and thereafter is escallated at the domestic inflation rate.

7. Employees' remuneration is assumed to be 0.5% of gross fixed assets in FY97, and thereafter is escallated at the domestic inflation rate.

8. Operations and maintenance expense is assumed to be 1% of gross fixed assets in FY97 and thereafter is escallated at the local inflation rate.

9. Depreciation expense is assumed to be 1.5% of gross fixed assets.

10. Interest on loans is forecast to be 14.5% which is the current GOI on lending rate to central government corporations.

Balance Sheet

11. Gross Fixed Assets and Work in Progress are based on the historical costs of the power station. All expenses during construction are capitalized.

12. Other assets pertain to the cost of feasibility study of other projects.

13. Capital investment fund is the provision of funds to be used for future capital investments.

14. Cash balances are expected to be maintained at the equivalent of two months operation and maintenance expenses.

15. Inventories are estimated at about three months of operation and maintenance expenses.

16. Accounts receivable from electricity sales are assumed to be maintained at the equivalent of 1.5 months of electricity sales.

17. Equity funds from GOHP and GOI are assumed to be provided in a 25:75 ratio as per the Memorandum and Articles of Association establishing NJPC in order to fund about one half of the project cost.

18. GOI/GOHP loans including the onlent Bank loan are expected to finance the balance 50% of the power station investment costs. Repayment would commence the first year after project commissioning.

19. Current maturity of long-term loans is a provision for loan repayment due in the following financial year.

20. Accounts Payable are assumed to be equivalent to 1.5 months of cash expenses from FY89 thru FY96.

21. Other current liabilities are assumed to be two months operation and maintenance expenses.

Sources and Applications of Funds

22. NJPC's Capital Investment costs for the power station are based on 1988 cost estimates and incorporate the Bank's escalation factors for the foreign and local components. Any further capital investments, which may be undertaken by NJPC, during the forecast period are too uncertain to be included in the financial forecast at this time.

23. Debt-service obligations reflect NJPC's obligations to meet both interest and principal repayments of its borrowings. Due to the commissioning of the project in December 1996, in FY97, 75% of the interest due is capitalized. Repayment of principal begins in FY98.

INDIA
HIMACHAL PRADESH STATE ELECTRICITY BOARD
ANNUAL INVESTMENT PROGRAM a/

(YEAR ENDING MARCH 31)

(In Rs Million)

	Total Project Cost	Expend. Before 1986/87	Yr. of Comm.	Expend. 1986/87 to 1994/95	FORECAST 1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96
ESCALATION FACTORS					1.00	1.08	1.17	1.25	1.32	1.40	1.49	1.58	1.67	1.77
(% increase)						8.0%	8.0%	7.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%
I. GENERATION SCHEMES														
A. ONGOING/COMPLETED (PLAN)														
1. Giri/Binwa(60+6MW)	450	446	86/87	4	4									
2. Rong tong Project(2MW)	133	104	86/87	29	29									
3. SVP-Bhaba and Aug.(120MW)	1664	1036	88;90/91	629	315	195	29	50	40					
4. Andhra(17MW)	484	280	87/88	204	124	80								
5. Thirot(4.5MW)	227	19	89/90	208	22	32	53	75	27					
6. Baner(12MW)	320	13	93/94	307	2	5	35	100	106	60				
7. Gaj(10.5MW)	351	4	92/93	346	2	16	35	100	106	88				
8. Chamba Aug.& mini/micros	21	21	comm.											
TOTAL 'A'	3649	1923		1726	496	330	152	324	278	147				
B. NEW PROJECTS (PLAN)														
1. Killar(300kW)	1	0	90/91	1	1									
3. Dhamwari-Sunda(60MW)	1434	0	94/95	1434	0	1	0	38	132	393	416	221	134	100
3. Bolt(7.5MW)	1	0	92/93	1	0	1								
4. Sal II	1	1	93/94	0										
TOTAL 'B'	1436	1		1436	1	2	0	38	132	393	416	221	134	100
C. PROJECTS WITH EXTERNAL AID														
1. Larji(126MW)	2643		93/94	2643	2	18	19	187	331	421	446	552	668	
2. Ghanwi(22.5MW)	435		91/92	435	0	1	2	13	26	70	149	158	17	
5. Uhl-III(70MW)	1483	0	94/95	1483	0	1	23	38	79	140	223	394	585	60
3. Chamera II(300MW) (NHPC Project)	3		93/94	3	0	3								
TOTAL 'C'	4565	0		4565	2	24	44	237	437	631	817	1103	1269	60
D. PROJECTS WITH NEIGHBOURING STATES														
1. Kol Dam (25% of 800MW)	7	7	95/96	0										
2. Karcham Wantoo (25% of 600	0		95/96	0										
TOTAL 'D'	7	7		0										
TOTAL HYDRO GEN. SCHEMES	9658	1931		7727	499	355	196	599	847	1171	1233	1324	1403	160
II. TRANSMISSION														
a. HPSEB TRANSM. INVESTMENT	4124	622	3yr.cons	3502	181	158	215	250	344	365	416	457	518	600
b. PROPOSED PROJECT	861	0	94/95	861				32	131	410	276	11		
III. DISTRIBUTION	109		2yr.cons	109	55	54								
				0										
IV. RURAL ELECTRIFICATION	1853	786	2yr.cons	1067	119	74	87	94	99	105	111	118	125	133
				0										
V. RENOVATION & MODERNISATION	175		1yr.cons	175			18	19	20	21	22	24	25	27
				0										
VI. SURVEY & INVESTIGATION	195	43	1yr.cons	152	4	3	7	11	13	14	22	24	25	28
				0										
VII. BOARD'S BUILDING	270	39	1yr.cons	231	4	3	2	6	13	21	30	39	50	62
VIII. TOTAL	17244	3421		13823	863	648	525	978	1336	1696	[illegible]	1986	2140	2360

a/ Excluding IDC but including escalation based on projected domestic inflation

INDIA
HIMACHAL PRADESH STATE ELECTRICITY BOARD
ACTUAL AND FORECAST INCOME STATEMENTS
(YEAR ENDING MARCH 31)

(In Rs. Million)

	ACTUAL					FORECAST								
	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96
Energy Availability (GWh)														
HPSEB Generation	540	587	490	597	614	518	785	1171	1184	1301	1352	1395	1774	2143
Station Consumption	2	2	2	2	2	2	4	6	6	6	7	7	9	9
Net Generation	538	585	488	595	612	516	781	1165	1178	1295	1345	1388	1765	2134
Purchases	301	405	383	392	527	691	630	1065	1149	1267	1564	1782	1794	2400
Total	839	990	871	987	1139	1207	1411	2230	2327	2562	2909	3170	3559	4534
System Losses (%)	18.1	18.8	21.1	20.3	22.5	24.8	21.4	21.0	19.0	18.5	18.0	17.8	17.6	16.3
Sales of Electricity (GWh)	687	804	687	787	883	908	1109	1761	1885	2088	2385	2606	2933	3797
Of which: Within State	363	395	470	525	680	769	899	1040	1178	1419	1698	2048	2446	2800
Exports	325	409	217	262	203	139	210	721	707	669	687	558	487	997
Av. Tariff (ps./kwh)	34.6	35.2	37.7	45.6	58.9	60.9	62.1	67.0	80.5	82.0	89.0	98.0	105.0	115.0
Av. Tariff increase (%)		2	7	21	29	3	2	8	20	2	9	10	7	10
Avg. Tariff: Within State	36.6	41.0	40.9	55.4	57.8	60.6	62.0	67.0	80.5	82.0	89.0	98.0	105.0	115.0
Exports	32.3	29.6	30.9	26.0	62.6	62.6	62.6	67.0	80.5	82.0	89.0	98.0	105.0	115.0
Revenues														
Sales of Electricity	238	283	259	359	520	553	688	1180	1517	1713	2123	2554	3080	4367
Of which: Within State	133	162	192	291	393	466	557	697	948	1164	1511	2007	2568	3220
Exports	105	121	67	68	127	87	131	483	569	549	612	547	511	1147
RE Subsidy	23	0	0	0	102	112	0	136	149	164	181	199	219	0
Central Excise Duty	12	9	6	20	16	0	0	0	0	0	0	0	0	0
Other Revenues	26	30	22	28	24	25	26	28	29	31	32	34	35	37
Total Revenues	299	322	287	407	662	690	715	1344	1696	1907	2335	2787	3334	4404
Expenses														
Cost of Power Purchase	39	55	53	53	142	237	222	454	487	586	781	941	1025	1234
Employee Salaries	48	50	56	72	84	91	97	103	109	116	123	130	138	146
Operation & Maintenance	103	119	147	158	177	195	214	236	259	285	314	345	379	417
Establishment & Other Exp.	14	17	17	16	14	15	16	17	18	19	20	22	23	24
Central Excise Duty	12	9	6	20	16	0	0	0	0	0	0	0	0	0
Depreciation	0	0	0	24	33	34	40	97	107	129	162	180	213	395
Total Expenses	215	250	279	343	466	571	589	907	981	1135	1400	1617	1778	2217
Operating Income	83	72	8	64	196	119	125	437	714	772	936	1169	1555	2188
Total Interest	52	63	79	296	385	427	532	632	847	860	1020	1323	1447	1597
Less: IDC Capitalised	0	0	0	0	0	278	228	290	269	272	343	445	241	399
Adjustment for Prior Period				149	-219		703							
Net Income	31	9	-71	-83	-408	-30	-179	95	136	184	259	291	349	990
Rate of Return (%)														
-GOI Definition 1/						-3.4	-16.6	2.9	3.8	4.3	4.7	4.9	4.9	7.0
-Bank Guidelines 2/						11.8	5.6	12.1	16.5	14.1	14.2	15.1	12.8	13.3
-Historical Base 3/						11.8	5.7	12.7	18.1	15.8	16.3	17.9	14.7	15.3
Operating Ratio (%) 4/	72	78	97	84	70	83	82	67	58	60	60	58	53	50

INDIA
HIMACHAL PRADESH STATE ELECTRICITY BOARD
ACTUAL AND FORECAST BALANCE SHEETS
(AS ON MARCH 31)

(In Rs Million)

Assets	ACTUAL					FORECAST								
	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96
Fixed Assets														
Gross Fixed Assets in Operation	815	908	954	1180	1349	1601	3877	4286	5166	6479	7186	8536	15800	16640
Less: Acc. Depreciation	79	79	79	103	247	281	321	418	525	654	816	996	1209	1604
Net Fixed Assets in Operation	736	829	875	1077	1102	1320	3556	3868	4641	5825	6370	7541	14591	15036
Capital Works-in-Progress	1239	1610	2169	2753	3447	4122	2598	3457	4183	4837	6309	7389	2513	4432
Total Fixed Assets	1975	2439	3044	3830	4549	5442	6154	7325	8823	10663	12679	14930	17103	19467
Current Assets														
Cash	0	0	0	31	51	45	46	67	73	84	103	120	130	152
Inventories	113	111	186	236	240	264	290	319	351	387	425	468	514	566
Accnts.Receivable (electricity)	161	147	82	113	361	353	344	295	253	285	354	426	513	728
Accum. RE Subsidy	23	23	23	23	624	736								
Other Current Assets	298	277	475	563	710	781	859	945	1040	1143	1258	1384	1522	1674
Total Current Assets	595	558	766	966	1986	2179	1540	1627	1717	1899	2140	2397	2680	3120
Total Assets	2570	2997	3810	4796	6535	7621	7693	8952	10540	12562	14819	17327	19784	22587
Equity & Liabilities														
Equity														
Consumers' Contributions	90	122	147	149	221	243	267	294	324	356	392	431	474	521
Capital Reserve	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Retnd. Earnings/(Acc. Losses)	-56	-47	-118	-201	-610	-640	-116	-21	116	300	559	850	1200	2189
GOHP Equity							0	0	0	[illegible]	0	0	0	0
Total Equity	35	76	30	-51	-388	-396	153	274	440	657	951	1282	1674	2711
Long Term Debt														
GOHP Loan	1156	1371	1770	2274	2803	3155	3959	4890	6018	7358	8900	10807	12585	14229
Other Loans	695	819	981	1241	1637	1940	1992	2053	2098	2155	2215	2286	2198	1310
IBRD Loan	0	0	0	0	0	0	0	22	110	369	557	572	544	517
Total Long Term Debt	1851	2190	2751	3515	4440	5095	5951	6965	8226	9882	11672	13665	15327	16056
Staff Superannuation Fund	83	105	133	151	186	214	246	283	325	374	433	495	569	654
Security Deposits	18	26	31	37	45	52	60	68	79	91	104	120	138	158
Current Liabilities														
Accounts Payable	377	360	500	405	859	902	947	994	1044	1096	1151	1209	1269	1333
Accrued Interest	9	10	14	198	1156	1439								
Other Curr. Liabilities	140	140	217	356	209	230	253	278	306	337	370	407	448	493
Curr. Mat. of LT Loans	57	90	134	185	28	85	85	90	120	126	140	150	358	1182
Total Current Liabilities	583	600	865	1144	2252	2656	1285	1363	1470	1559	1661	1766	2076	3008
Total Equity & Liabilities	2570	2997	3810	4796	6535	7621	7693	8952	10540	12562	14819	17327	19784	22587
Debt as % of (Debt+Equity) 5/	98	97	99	101	110	108	97	96	95	94	92	91	90	86
Current Ratio 6/	1.0	0.9	0.9	0.8	0.9	0.8	1.2	1.2	1.2	1.2	1.3	1.4	1.3	1.0
Accounts Receivable (Months) 7/	8	6	4	4	8	8	6	3	2	2	2	2	2	2

INDIA

HIMACHAL PRADESH STATE ELECTRICITY BOARD

ACTUAL AND FORECAST SOURCES AND APPLICATIONS OF FUNDS STATEMENTS

(YEAR ENDING MARCH 31)

(In Rs Million)

	ACTUAL					FORECAST								
	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96
Sources														
Internal Sources														
Operating Income	83	72	8	64	196	119	125	437	714	772	936	1169	1555	2188
Depreciation	0	0	0	24	33	34	40	97	107	129	162	180	213	395
Total Internal Sources	83	72	8	88	229	153	166	534	822	902	1098	1349	1769	2583
Adjustment for Prior Period				149	-110	0	703	0	0	0	0	0	0	0
Capital Reserves	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Staff Superannuation Fund	83	22	28	18	35	28	32	37	42	49	56	65	74	85
Consumers Contribution	20	32	25	2	72	22	24	27	29	32	36	39	43	47
Security Deposits	18	8	5	6	8	7	8	9	10	12	14	16	18	21
Borrowings														
IBRD Loan	0	0	0	0	0	0	0	22	88	259	188	15	0	0
GOHP Loan	117	215	399	506	529	352	804	931	1128	1340	1542	1907	1778	1644
Other Loans	248	214	296	443	4[illegible]5	388	137	151	166	182	201	221	243	267
Total Borrowings	365	429	695	949	954	740	941	1104	1382	1781	1931	2143	2021	1911
Total Sources	569	563	761	1212	1188	950	1873	1710	2285	2776	3134	3611	3925	4647
Applications														
Proposed Project	0	0	0	0	0	0	0	32	131	410	276	11	0	0
Other Projects	370	464	605	810	863	648	525	946	1205	1286	1559	1975	2146	2360
IDC Capitalised	0	0	0	0	0	278	228	290	269	272	343	445	241	399
Total Investment Program	370	464	605	810	863	926	753	1268	1605	1968	2178	2431	2387	2759
Debt Service														
Total Interest	52	63	79	296	385	427	532	632	847	860	1020	1323	1447	1597
Less: IDC Capitalised	0	0	0	0	0	278	228	290	269	272	343	445	241	399
Net Interest	52	63	79	296	385	149	304	342	578	588	677	878	1206	1198
Repayment	44	57	90	134	185	28	85	85	90	120	126	140	150	358
Total Debt Service	96	120	169	430	570	177	389	427	668	708	803	1018	1356	1556
Change in Working Capital														
Variation in Cash	0	0	0	31	20	-6	1	22	5	11	19	17	11	21
Variation other than Cash	103	-21	-13	-59	-265	-148	730	-7	7	89	133	146	172	310
Net Change in Working Capital	103	-21	-13	-28	-245	-154	731	15	12	100	152	162	182	331
Total Applications	569	563	761	1212	1188	950	1873	1710	2285	2776	3134	3611	3925	4647
Debt Service Coverage 8/	0.9	0.6	0.0	0.6	0.2	0.3	1.4	0.7	1.2	1.3	1.4	1.3	1.3	1.7
Contri. to Invest. Ratio (%) 9/	-42	-6	-24	-18	-21	-18	-49	-15	9	5	7	8	10	26

INDIA
HIMACHAL PRADESH STATE ELECTRICITY BOARD
FORECAST FINANCIAL INDICATORS /a
(YEAR ENDING MARCH 31)

	FORECAST								
	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96
Rate of Return % :									
-GOI Definition (1)	-3.4	-16.6	2.9	3.8	4.3	4.7	4.9	4.9	7.0
-Bank Guidelines (2)	11.8	5.6	12.1	16.5	14.1	14.2	15.1	12.8	13.3
-Historical Base (3)	11.8	5.7	12.7	18.1	15.8	16.3	17.9	14.7	15.3
Operating Ratio % - (4)	83	82	67	58	60	60	58	53	50
Debt as % of Debt + Equity (5)	108	97	96	95	94	92	91	90	86
Current Ratio (6)	0.8	1.2	1.2	1.2	1.2	1.3	1.4	1.3	1.0
Accounts Receivable - (7) Months	8	6	3	2	2	2	2	2	2
Debt Service Coverage (8)	0.3	1.4	0.7	1.2	1.3	1.4	1.3	1.3	1.7
Contri. to Invest. % - (9)	-18	-49	-15	9	5	7	8	10	26

/a Definitions are provided in the following page.

HIMACHAL PRADESH STATE ELECTRICITY BOARD (HPSEB)

Financial Indicators - Definitions

1. **Rate of Return as per GOI's Definition**

As per the Act, HPSEB is required to take all necessary actions to ensure that total revenues in any financial year shall, after meeting (i) all expenses properly chargeable to revenues, including operating, maintenance and management expenses; (ii) taxes on income and profits; (iii) depreciation; and (iv) interest payable on all debentures, bonds and loans; produce such surplus of not less than 3% or higher as notified by GOHP, of their respective net fixed assets in service at the beginning of the financial. For this proposed project, HPSEB shall earn the following return: 2.9% in FY90; 3.8% in FY91, 4.3% in FY92, 4.7% in FY93, 4.9% in FY94 and FY95, and 7% thereafter. Critical terms listed above would be defined as follows:

(a) "total revenues" means revenues from the sale of electricity and other services, and miscellaneous income, rural electrification subsidies received from GOHP, state electricity duties received, and such other subventions received from GOHP to cover extraordinary costs which are borne by HPSEB and which should not reasonably be borne by its customers;

(b) "expenses" means the cost of power generated/purchased, fuel, operating, maintenance, management and administrative expenses, and all taxes and duties accruing during the financial year, other than taxes on income and profits;

(c) "taxes on income and profits" consist of income taxes and other levies accrued according to the provisions of any applicable legislation or regulation;

(d) "depreciation" means a provision, based on gross fixed assets in service at the beginning of the year, derived by using the straight line method in conjunction with the schedule of useful life of assets as notified according to provisions of Section 68 of the Act, on December 12, 1986;

(e) "interest payable on all debentures, bonds and loans" means all interest (whether paid, deferred or waived), excluding interest during construction, accrued during the financial year, and all other charges on debt; and

(f) "net fixed assets in service" means the original cost of fixed assets reduced by the aggregate of the cumulative depreciation taken on those assets. For HPSEB, this would be reduced by consumers' contribution for service lines.

2. Rate of Return as per Bank Guidelines

Numerator: Income after depreciation but before interest.
Denominator: Average net fixed assets in operation after deducting accumulated depreciation and net consumers' contributions. A pro-forma revaluation was made by revaluing assets yearly at the domestic inflation rate.

3. As per Historical Asset Base

Similar to Bank Guidelines except that assets are not revalued, i.e. based on historical cost.

4. Operating Ratio

Numerator: Operating Expenses
Denominator: Operating Revenues

5. Debt as % of Debt + Equity

Numerator: Long-term debt
Denominator: Long-term Debt plus Total Equity

6. Current Ratio

Numerator: Current Assets
Denominator: Current Liabilities

7. Accounts Receivables as a % of Electricity Sales

Numerator: Accounts Receivables for Electricity Sales
Denominator: Electricity Sales divided by 12 months

8. Debt Service Coverage Ratio

Numerator: Operating Income plus Depreciation
Denominator: Total debt-service (for FY88 to FY90, IDC are included as per CEA guidelines that provides that up to FY90, IDC be paid out of SEB's own funds).

9. Contribution to Investments

Numerator: Operating income plus depreciation minus total debt-service and change in working-capital excluding cash from FY91 and thereafter. Prior to FY91, an additional item was deducted; interest during construction (refer to CEA guidelines in item 8).
Denominator: Three year moving average of HPSEB's investment program: past, current and the following year.

Financial Projections' Assumptions

Price Escalation

1. Local Inflation is assumed to be 7% in 1988/89 and 6% in each fiscal year thereafter during the projection period.

2. Foreign Inflation is assumed to be 4% from 1988/89 through 1985/86.

Foreign Exchange

3. For the Investment Program and yearly disbursement of the Bank's loan, the exchange rate between one United States dollars and Indian Rupees is assumed to be as follows:

Fiscal Year	Rs.	Fiscal Year	Rs.
		1992	14.8
1988	13.3	1993	15.1
1989	13.8	1994	15.4
1990	14.2	1995	15.7
1991	14.2	1996	16.0

Income Statement

4. The amount of generation available for sale is based on HPSEB's electricity sales forecast as approved by CEA and power purchases from neighboring states.

5. Sales revenues are derived from the electricity sales forecast and by tariff increases which would enable HPSEB to achieve the following rate of returns calculated in accord with the Electricity Supply Act (1948) as amended: 2.9% in FY90, 3.8% in FY91, 4.3% in FY92, 4.7% in FY93, 4.9% in FY94 and FY95, and 7.0% in FY96.

6. Rural electrification subsidy for compensating the operating cost of rural electrification is assumed to increase at an annual rate of 10%. RE subsidy is further assumed to be collected beginning in FY90.

7. Electricity Duty was a tax levied by GOHP and collected by HPSEB, which was discontinued after FY87.

8. Other revenues represent income from investments, penalty charges for the late payment of bills, meter rentals etc and are expected to increase at about 5% per year during the projection period.

9. Cost of Power Purchases is based on projected energy purchases from neighboring states as provided by HPSEB.

10. Employee salaries and fringe benefits are escalated at the rate of local inflation. In view of restrictions on hiring new personnel, no new staff are expected, except in connection with construction of some new projects.

11. Operations and Maintenance Costs are escalated at the rate of about 10% p.a.

12. Establishment and Other Expenses are expected to increase at the rate of domestic inflation.

13. Depreciation is calculated at 2.5% of gross fixed assets in operation.

14. Interest on the Bank's loan and loans from GOHP is forecast to be 10.5% per annum. Interest on other loans varies by source (LIC - 13% p.a., Market bonds - 9.5% p.a., REC - 7.5%).

Balance Sheet

15. Gross Fixed Assets and Work in Progress are based on historical costs and HPSEB's investment program.

16. Cash is assumed at one months operating expenses less depreciation.

17. Inventories are estimated to increase at 10% p.a. consistent with increases in operation and maintenance expenses.

18. Accounts receivable from electricity sales are assumed to be maintained at the equivalent of the following months of electricity sales: 6 months in FY89, 3 months in FY90, 2 months in FY91 and thereafter.

19. Accumulated RE subsidy is assumed to be cleared in FY89 via HPSEB's financial action plan (para 4.12).

20. Other current assets and consumer contributions are assumed to increase 10% p.a. Capital reserve is assumed to remain unchanged.

21. GOHP loans are expected to finance the balance of HPSEB's investment program not financed from the combination of internal cash generation, Bank loan, and other loans.

22. Staff superannuation fund and security deposits are assumed to increase by 15% p.a.

23. Accounts Payable are assumed to increase by 5% p.a.

24. Accrued interest is assumed to be cleared in FY89 via HPSEB's financial action plan (para 4.12).

25. Current maturity of long-term loans is a provision for the following year loan repayment obligation.

Sources and Application of Funds

26. HPSEB's Total Investment Program is based on 1987 cost estimates and incorporates the Bank's escalation factors for the foreign and local components.

27. HPSEB's Debt Service obligations reflect its obligations to meet both interest and principal repayments for its borrowings in accordance with the financial action plan.

INDIA

NATHPA JHAKRI POWER PROJECT

Electricity Demand and Supply - Northern Region

	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97
Installed Capacity as on March 31, 1987 is 13,462 1/										
Capacity additions from sanctioned/ongoing schemes	1,930	1,411	1,105	1,106	266	1,636	2,027	1,984		
Capacity additions during the year from new schemes:										
Hydro (MW)	-	-	-	-	40	315	425	500	750	750
Thermal (MW)	-	1,000	500	200	400	685	1,275	1,500	1,250 2/	1,450 2/
Total	-	1,000	500	200	440	1,000	1,700	2,000	2,000	2,200
Overall Installed Capacity at the end of year:										
Hydro (MW)	5,692	5,944	6,625	7,125	7,295	8,221	9,251	11,201	11,951	12,701
Thermal (MW)	9,825	11,235	11,755	13,115	14,875	15,295	15,415	15,415	16,665	18,115
Nuclear (MW)	675	910	910	910	910	910	910	910	910	910
Total	15,392	17,803	19,408	20,714	21,420	24,056	27,783	31,767	33,767	35,967
Peak Availability	8,715	9,938	11,290	12,405	12,930	14,180	16,067	19,214	20,424	21,754
Peak Demand (MW)	11,991	13,161	14,474	15,805	17,375	19,069	20,966	23,068	25,270	27,722
Peaking Shortage (MW)	(3,276)	(3,223)	(3,184)	(3,400)	(4,445)	(4,909)	(4,899)	(3,854)	(4,846)	(5,968)
Energy Requirement (GWh)	59,721	65,525	72,080	78,821	86,493	95,004	104,336	114,786	125,861	138,028
Energy Availability (GWh)	53,566	61,169	71,616	83,913	88,574	94,273	104,729	119,611	129,032 2/	142,643 2/
Energy Shortage (GWh)	(6,155)	(4,356)	(464)	5,092	2,081	(731)	393	4,825	3,171	4,615

Source: CEA, plus Thirteenth Electric Power Survey of India, December, 1987, CEA.

1/ Hydro: 5,583 MW; Thermal: 8,185; and Nuclear: 440 MW
2/ Bank estimates at new capacity likely to be installed.

INDIA

NATHPA JHAKRI POWER PROJECT

Internal Economic Rate of Return

Introduction

1. As described in chapter 5, the proposed project is an integral part of the expansion program planned for the Northern Region. Because of this, the economic analysis has been undertaken principally for the program as a whole. However, this program analysis has been supplemented with a project analysis of the proposed Nathpa Jhakri power station and associated transmission facilities. The main assumptions underlying each analysis are summarized in the sections which follow.

Program Analysis

2. This analysis has estimated an economic rate of return on all investments included in the Northern Region development program between the financial years 1988/89 and 1996/97. This time-slice corresponds to the period of implementation of the Nathpa Jhakri power station. Table 1 summarizes the capital costs of this time-slice of investments in generation, transmission and distribution together with incremental operating and maintenance costs, fuel costs, incremental generation and the economic benefits of incremental sales revenue.

Table 1: Cost and Benefit Streams

	Generation Costs (Rs Million)				Transmission/Distribution (Rs Million)					Benefits		
	Capital Costs				Capital Costs				Fuel Costs	Incre. Supply	Econ. Value1/	Net Benefits1/
Year	Local	Foreign	Total	O&M	Local	Foreign	Total	O&M	(Rs M)	(GWH)	(Rs M)	(Rs M)
1988/89	2564	2668	5232	85	743	1873	2616	52				-7985
1989/90	2661	2770	5431	87	758	1912	2670	53				-8241
1990/91	4739	4932	9671	99	1373	3462	4835	76				-14681
1991/92	5021	5225	10246	177	1455	3668	5123	152				-15698
1992/93	3835	3992	7827	623	1111	2802	3913	192				-12585
1993/94	2344	2440	4784	876	679	1713	2392	215				-7829
1994/95	1316	1370	2686	1075	381	962	1343	229				-5333
1995/96	713	743	1456	1207	207	521	728	236	3128	7441	4390	-2365
1996/97	223	232	455	1214	64	163	227	238	7646	16862	9948	168
1997/2021				1214				238	7648	30473	17978	8898

O&M = Operations and Maintenance

1/ Excluding consumer surplus.

3. Assumptions. Capital expenditures and expenditures on operating and maintenance costs have been converted to economic prices by: (i) revaluing the imported components of goods and services procured domestically as c.i.f. border prices; (ii) valuing unskilled labor at 0.75 of the market wage rate; and (iii) applying the estimated standard conversion factor, 0.8, to other local costs. Transmission and distribution capital expenditures have been estimated at 50% of generation expenditure.

4. Incremental annual operating and maintenance costs have been estimated as the following percentages of the value of the capital to which they relate: coal-fired generating plant 2.5% p.a.; combined cycle and gas turbine generating plant 2.5% p.a.; hydroelectric generating plant 1.13% p.a.; and transmission lines and distribution systems 1.0% p.a.

5. The average fuel consumption of new coal-fired plant has been estimated at 0.61 kg/kWh of coal and 15 ml/kWh of oil for combustion stabilization. The economic cost of coal at the pithead has been estimated at Rs 131/tonne. The economic cost of delivering coal to local centre stations has been estimated at Rs 0.38 per tonne km. The economic cost of power station fuel oil is estimated at Rs 3,146 per thousand litres. The economic cost of natural gas for power generation has been estimated as Rs 1,800/1,000 m^3 and the specific consumption of gas-fired plant has been taken as 0.23 m^3/kWh (an average of the consumption of gas turbine and combined cycle plants).

6. The 1988/89 to 1996/97 time-slice of investments is assumed to provide benefits through 2021. Benefits from the investments have been valued as the incremental sales revenues they would facilitate plus a portion of the consumers' surplus associated with this incremental consumption. However, no allowance has been made for any fuel cost savings at existing plants, nor for any benefits to existing consumers through improvements in the security or quality of public electricity supplies.

7. Incremental sales revenues has been valued at a weighted average of retail tariffs in the Northern Region. The average rate, weighted by consumer category and by states' levels of consumption, is approximately Rs 0.81/kWh. The average tariff (i.e. excluding duties) is approximately Rs 0.74/kWh. After application of the standard conversion factor (0.8) to the weighted average tariff, the equivalent rate of economic benefit is Rs 0.59/kWh.

Table 2: Weighted Average Retail Tariffs in the Northern Region

Consumer Category	Tariff (Rs/kWh) Rate 1/	Tax	Total	Consumption Weights (%) 2/
Domestic	76.8	8.1	84.9	16.70
Public Light	67.4	6.6	74.0	0.87
Public Water	71.2	6.6	77.8	2.33
Agriculture	29.3	0.9	30.2	17.59
Industry	84.7	8.4	93.1	52 59
Transport	71.2	6.6	77.8	2.35
Commercial	96.7	7.8	104.5	7.56

1/ Rates for each consumer category are the average of the rates levied by the nine members boards of the Northern Region weighted by their expected energy consumption in 1994/95 (the last year for which disaggregated projections are available).
Source: Average Electric Rates and Duties in India, CEA, May, 1988.

2/ Expected proportions of total energy consumption (All-India) in 1994/95 (last year of disaggregated data).
Source: Thirteenth Power Survey of India, CEA, December, 1987.

8. Benefits - Consumers' Surplus. Considering as program benefits only the economic value of incremental sales revenues, the estimated rate of return of the 1988/89 to 1996/97 time-slice of the Northern Region investment program is 6.8. However, incremental revenues do not capture all the economic benefits likely to result from the proposed investments. In part, this is because the average tariff level (Rs 0.74/kWh) is below the marginal economic cost of supply. The capital, operating and maintenance costs shown in Table 1, related to the expected incremental consumption they will facilitate suggest the average incremental cost of supply (a suitable approximation for marginal cost in this instance) in the Northern Region is approximately Rs 1.2/kWh. However, even if the average tariff level was equal to marginal cost, consumers would still derive net benefits (surplus) from their consumption. There are two reasons for this. First, with a conventional downward sloping demand curve, price is equated with consumers' willingness-to-pay only for marginal consumption; lower rates of consumption usually are associated with higher willingness-to-pay. A price set equal to marginal cost therefore will not capture all of consumers' willingness-to-pay. Second, when supply is constrained (as in the Northern Region) the marginal cost of public supply is (by definition) lower than consumers' marginal willingness-to-pay. The existence of autogeneration facilities (which are relatively costly, compared with public supply) indicate consumers' willingness-to-pay exceeds the marginal cost of public supply, at least for some part of consumption.

9. This analysis has imputed rates for consumers' surplus in a conservative way. It has been assumed that in addition to the amounts paid for public supply, consumers would be willing to pay half of the additional

costs that they would incur through meeting their electricity requirements through autogeneration. Put another way, this assumption implies that consumers' demand curve is downward sloping at an angle of 45 degrees. The implication of this is that consumers have a price elasticity of minus unity. In practice, consumers' price elasticities at low levels of consumption (as in India) are likely to be in the rage -0.1 to -0.4, implying that much more than half of consumers would be willing to pay the costs for autogeneration to preserve a supply of electricity.

10. Estimated costs of autogeneration are summarized in Table 3. Costs have been estimated separately for large diesel generations (in the range 200 kW to 400 kW) as used by medium and large industries, and for small generators (of about 50 kW capacity) as used in workshops and commercial undertakings. Assuming 30% machine utilization (typical of private generating installations), the average cost of autogeneration is estimated to be approximately Rs 1.25/kWh from a large machine and Rs 1.49/kWh from a small machine.

Table 3: Estimated Costs of Autogeneration

	Costs per kW of Capacity (Rs)	
1. Fixed Costs	50 kW Machine	200-400 kW Machine
Purchase Price 1/	6,000	4,220
Annual Charge 2/	881	620
Salaries	620	420
Routine Maintenance	125	85
Total Annual Fixed Costs	1625	1125
2. Variable Costs	Costs per kWh Generated (Rs)	
Diesel fuel	0.50	0.76
Lubricant	0.07	0.06
Total Variable Costs	0.87	0.82
3. Average Cost of Generation (Rs/kWh) 2/	1.49	1.25

1/ C.I.F. price plus handling and installation.
2/ Assuming a 15-year life and a 12% discount rate.
3/ Assuming 30% machine utilization.

11. For agricultural consumers, the costs of replacing public electricity supply have been estimated as the additional cost of providing irrigation pumping from diesel pumps rather than electric pumps. This additional cost has been estimated as the increase in price of electricity that would equate the costs of electric pumping with diesel pumping. Table 4 illustrates the estimation. Assuming pumps are operated for 800 hours per year (which seems typical for agriculture in the Northern Region), electricity would have to be priced at about Rs 2.33 per kWh for diesel pumping to cost the same as electric pumping.

Table 4: Estimated Costs of Diesel and Electric Pumping

	Electric	Diesel
Motor/Engine size (H.P.)	5.0	7.0
Pump Lifetime (yrs.)	15.0	10.0
Pump Capital Cost (Rs)	4,240	10,865
Annual Charge (Rs)	623	19.22
O&M Costs (Rs)	943	2,650
Cost of Diesel/hr (Rs)	-	5.11
Cost of Diesel p.a. (Rs)	-	4,088
Cost of Electricity/kWh (Rs)	x.xx	-
Cost of Electricity p.a. (Rs)	2,984 (x.xx)	-
Total Annual Cost (Rs)	1566 + 2984 (x.xx)	8650

Cost of electricity at which costs of electric pumping are same as diesel pumping:

$$\text{Rs } x{:}xx/\text{kWh} = (8650 - 1566)/2984 = \underline{\text{Rs } 2.38/\text{kWh}}$$

12. Table 5 summarizes estimation of the average rate of consumer surplus in the Northern Region. The estimation assumes that for domestic consumers, public lighting and commercial consumers, the relevant comparator is the cost of autogeneration from a small diesel set. For public water pumping, industry and transport, the relevant comparator is assumed to be the generating cost of a large diesel set. For agriculture, the comparator is assumed as the cost of diesel irrigation pumping. The weighted average rate at which consumer surplus is estimated to accrue is Rs 0.39/kWh. Adding the average economic tariff of Rs 0.59/kWh - (para 7) brings total estimated economic benefits to Rs 0.98/kWh. However, it must be borne in mind that the estimation of the rate of consumer most probably is conservative.

Table 5: Assumed Rates of Consumers' Surplus

Consumer Category	Consumption Share (%) 1/	Autogeneration Cost (Rs/kWh)	Average Tariff (Rs/kWH)	Surplus Imputed (Rs/kWh) 3/
Domestic	16.70	1.49	0.77	0.36
Public Light	0.87	1.49	0.67	0.41
Public Water	2.33	1.25	0.71	0.27
Agriculture 2/	17.59	2.38	0.29	1.05
Industry	52.59	1.25	0.85	0.20
Transport	2.35	1.25	0.71	0.27
Commercial	7.56	1.49	0.97	0.26

1/ All-India forecast for 1994/95. Source: Table 2.
2/ Autogeneration cost is the power cost equating the costs of diesel and electric pumping.
3/ Surplus imputed is half the difference between the average tariff and the costs of autogeneration.

13. Economic Analysis. Table 6 summarizes estimated net benefit streams resulting from the 1988/89 to 1996/97 time-slice of Northern Region investments (and associated operating and maintenance costs) for a variety of cost and benefit scenarios. Estimated program returns are summarized in Table 7. For the base case, i.e. as per the assumptions set out in the paragraphs above, the estimated economic internal rate of return is 14.3%. The estimated net present value (NPV) (using a 12% discount rate) is Rs 15,048 million, equivalent to US$1131 million. Sensitivity analyses show that cost increases of 10% and 20% reduce expected returns from the program to 12.9% and 11.6% respectively. Similarly, rates of benefits which are 10% and 20% lower than assumed in the base case reduce the estimated returns to 12.7% and 11.0% respectively. In practical terms, this means that the program as presently specified would be able to withstand a combined adverse variation of costs and benefits of about 15% and remain economic (in the sense that the estimated return would exceed the 12% discount factor). Larger adverse variations of costs and benefits would require a compensating deferral of marginal projects for the program to remain economic. As the 15% cost and benefit margin is relatively slim, there is a reasonable likelihood that some reoptimization of the program will take place during implementation. Of course, it is equally likely that costs and benefits will change in favor of the program. In this case, no reoptimization would be required. In the event that some plant deferral is required, the following project analysis provides a good measure of confidence that Nathpa Jhakri would not be adversely affected; the rate of return of Nathpa Jhakri is estimated to be significantly higher than the return on the program as a whole; hence the program contains other projects with returns lower than that of Nathpa Jhakri and which would be preferred candidates for deferral.

Table 6: Net Benefit Streams

(Rs Millions)

Year	Base Case	Benefits -10%	Benefits -20%	Costs +10%	Costs +20%	Implementation Delays One Year	Implementation Delays Two Years	Benefit Delays One Year	Benefit Delays Two Years
1988/89	(7,985)	(7,985)	(7,985)	(8,784)	(9,582)	(3,993)	2,662	(7,985)	(7,985)
1989/90	(8,151)	(8,151)	(8,151)	(8,966)	(9,781)	(8,069)	(5,379)	(8,151)	(8,151)
1990/91	(19,681)	(14,681)	(14,681)	(16,149)	(17,617)	(11,417)	(10,273)	(14,681)	(14,681)
1991/92	(15,698)	(15,698)	(15,698)	(17,268)	(18,838)	(15,190)	(12,884)	(15,698)	(15,698)
1992/93	(12,555)	(12,555)	(12,555)	(13,811)	(15,066)	(14,127)	(14,312)	(12,555)	(12,555)
1993/94	(7,829)	(7,829)	(7,829)	(8,612)	(9,395)	(1,093)	(12,028)	(7,829)	(7,829)
1994/95	(5,333)	(5,333)	(5,333)	(5,866)	(6,400)	(6,582)	(8,573)	(5,333)	(5,333)
1995/96	537	(192)	(921)	(139)	(814)	(6,045)	(6,640)	(6,755)	(6,755)
1996/97	6,745	5,093	3,440	5,767	4,789	(976)	(7,290)	(2,488)	(9,780)
1997/98	20,784	17,798	14,811	19,876	18,968	7,095	(1,247)	7,445	(1,803)
1998/99	20,784	17,798	14,811	19,876	18,968	20,784	7,212	20,784	7,445
1999/2021	20,784	17,798	14,811	19,876	18,968	20,784	20,784	20,784	20,784

Table 7: Program Returns

Scenario	IRR (%)	NPV (at 12%) Rs Million	NPV (at 12%) US$ Million
Base Case	14.3	15048	1131
Benefits -10%	12.7	4663	351
Benefits -20%	11.0	-5,725	-430
Costs +10%	12.9	6165	464
Costs +20%	11.6	-2715	-204
One-year delay in implementation	12.5	3704	278
Two-year delay in implementation	11.1	-6431	-484
One-year delay in benefits	13.3	8565	644
Two-year delay in benefits	12.4	2928	220

14. The sensitivity analyses demonstrate that the present program could withstand delays in implementation of about 1-1/2 years or delays in benefits of about 2 years and remain economic. In practice, implementation delays are invariably associated with cost increases. A more realistic interpretation is that the program could withstand a delay in implementation of about one year and a cost increase of about 10%. Such a scenario is not implausible, though any longer delays (of the whole program) are considered to be unlikely. On balance, the analyses suggest that the 1988/89 to 1996/97 Northern Region development program as presently specified will prove economic.

Project Analysis

15. This analysis has estimated the economic rate of return of the proposed Nathpa Jhakri power station and associated investments in transmission and distribution. Associated transmission investments have been identified as the costs of five new transmission lines (between Nathpa Jhakri and Abdullapur, Kholdam and Bhiwani, Bhiwani and Bawana, Abdullapur and Bawana, and Nathpa Jhakri and Kholdam) and as the costs of four new substations (at Bawana, Bhiwani, Abdullapur, and Kholdam). The transmission lines and substations will serve not only Nathpa Jhakri, but also the proposed hydropower projects at Kholdam (600 MW), Karcham-Wangtoo (600 MW) and Baspa (250 MW). The costs of these investments have been apportioned between Nathpa Jhakri and the other power stations in relation to their installed capacity; 51% of these costs (1,500/2,950) therefore have been allocated to Nathpa Jhakri and are included in the project analysis.

16. The distribution investments that will be associated with the generation from Nathpa Jhakri cannot be identified discreetly. These investments most probably will be located throughout the Northern Region and cannot be separated from distribution investments related to other new generation projects in better than an arbitrary way. To circumvent this difficulty, associated distribution investments have been imputed at a rate that brings total investments in associated transmission and distribution to 50% of the investment costs of the generating facilities to which they relate; in this case Nathpa Jhakri. This is the same assumption as used in the program analysis.

17. Capital costs and operating and maintenance costs are summarized in Table 8. Capital cost estimates for the Nathpa Jhakri power station and associated transmission have been shadow-priced in the same way as program capital costs (para 3). As noted above, distribution capital costs have been imputed from the costs of Nathpa Jhakri and associated transmission costs. Operating and maintenance costs have been included at 1.13% per annum of station capital costs and 1% per annum of transmission, substation and distribution capital costs. Benefit estimations assume that: (i) three of Nathpa Jhakri's units will be commissioned in 1995/96 and that the station's net generation in that year will be 1,856 GWh (25% of the full output of the station); the remaining three units will be commissioned in 1996/97 and net generation in that year will be 5569 GWh (75% of full output); (ii) annual generation in 1997/98 through 2020/21 will be 7,425 GWh; and (iv) technical system losses (i.e. not considering commercial

losses of 6% as in economic terms these are a transfer rather than a loss) will remain constant at 20% of the station's net generation. To put the generation from Nathpa Jhakri in perspective, net of technical losses, the power station will be able to provide electricity supplies to about 1.3 million new domestic consumers, 132,000 new commercial consumers, 75,500 new industrial consumers and about 110,000 new agricultural consumers. These incremental supplies have in the project analysis been valued in the same way as in the program analysis; that is at the rate of incremental tariff revenues (shadow-priced) plus a portion of consumers' surplus (para 12).

18. Estimated net benefit streams from the project and associated transmission and distribution investments are shown in Table 9 for a variety of different scenarios. Rate of return estimates together with estimates of net present value (NPV) (using a 12% discount factor) are shown in Table 10. The estimated rate of return of the project is 17.0%, producing an NPV of Rs 7,399 million (equivalent to US$556 million). The table shows that rates of project benefits which are 20% lower and 40% lower reduce the estimated returns to 14.4% and 11.2% respectively. Similarly, cost increases of 20% and 40% reduce estimated returns to 14.9% and 13.1%. These results suggest that the project is able to withstand a combined adverse change in costs and benefits totalling 35% and still be economic (in the sense of providing a return in excess of 12%, the estimated opportunity cost of capital).

19. Delays in project implementation affect project returns less than cost increases or lower rates of benefits. This is because in these sensitivities both costs and benefits are affected adversely, so while benefits are delayed the net present value of project costs also declines. The sensitivities examining delayed benefits (with project implementation otherwise proceeding according to present plans) show sharper effects. Here, the analysis suggests the project could withstand delays in finalizing bulk supply contracts with NJPC's customers of about 2-1/2 years and still remain - albeit only marginally - economic.

20. The likelihood of costs and benefits changing by more than 40%, and/or implementation, or the start of operations slipping by more than two years is considered to be very unlikely. Consequently, there are good prospects that the project will prove economic.

Table 8: Cost and Benefit Streams

Year	Nathpa Jhakri Power Station (Rs Million) Capital Costs Local	Foreign	Total	Oper. & Maint.	Transmission & Substations (Rs Million) Capital Costs Local	Foreign	Total	Oper. & Maint.	Distribution (Rs Million) Capital Costs	Oper. & Maint.	Benefits Incremental Supply (GWh)	Economic Value (Rs Million)	Net Benefits (Rs Million)
1988/89	536.5	0.0	536.5	6.1	-	-	-	-	-	-	-	-	-542.6
1989/90	493.5	890.5	1,383.9	21.7	6.0	15.2	21.2	0.2	18.5	0.2	-	-	-1445.7
1990/91	457.9	877.2	1,335.1	36.8	48.3	92.0	140.2	1.6	122.7	1.4	-	-	-1637.8
1991/92	689.2	1,728.7	2,417.9	64.1	143.6	367.2	510.8	6.7	446.1	5.9	-	-	-3451.5
1992/93	745.5	1,979.0	2,724.5	94.9	428.6	1,100.8	1,529.4	22.0	1,336.3	19.2	-	-	-5726.3
1993/94	623.4	1,727.7	2,351.1	121.5	240.1	614.3	854.4	30.6	746.7	26.7	-	-	-4131.0
1994/95	258.3	627.8	886.1	131.5	52.5	132.3	184.8	32.4	161.5	28.3	-	-	-1424.6
1995/96	133.3	373.1	510.4	137.2	-	-	-	32.4		28.3	1,485.0	1,455.0	746.7
1996/97	-	-	-	137.2	-	-	-	32.4		28.3	4,450.0	4,366.0	4,168.1
1997/2021	-	-	-	137.2	-	-	-	32.4		28.3	5,940.0	5,821.0	5,623.1

Table 9: Net Benefits Streams

(Rs Millions)

Year	Base Care	Benefits -20%	Benefits -40%	Costs +20%	Costs +40%	Implementation Delays One Year	Implementation Delays Two Years	Benefits Delays One Year	Benefits Delays Two Years
1988/89	(542.60)	(542.60)	(542.60)	(651.10)	(759.60)	(271.30)	(180.90)	(542.60)	(542.60)
1989/90	(1,445.70)	(1,445.70)	(1,445.70)	(1,734.80)	(2,024.00)	(994.20)	(662.80)	(1,445.70)	(1,445.70)
1990/91	(1,637.80)	(1,637.80)	(1,637.80)	(1,965.40)	(2,292.90)	(1,541.80)	(1,208.70)	(1,637.80)	(1,637.80)
1991/92	(3,451.50)	(3,451.50)	(3,451.50)	(4,141.80)	(4,832.10)	(2,544.70)	(2,178.30)	(3,451.50)	(3,451.50)
1992/93	(5,726.30)	(5,726.30)	(5,726.30)	(6,871.20)	(8,016.80)	(4,589.00)	(3,605.10)	(5,726.30)	(5,726.30)
1993/94	(4,131.00)	(4,131.00)	(4,131.00)	(4,957.20)	(5,783.40)	(4,928.00)	(4,436.20)	4,131.00	(4,131.00)
1994/95	(1,424.60)	(1,424.60)	(1,424.60)	(1,709.50)	(1,994.40)	(2,777.80)	(3,760.20)	(1,424.60)	(1,424.60)
1995/96	746.70	455.70	164.70	605.00	463.80	(1,066.50)	(2,088.00)	(708.30)	(708.30)
1996/97	4,168.10	3,295.10	2,421.90	4,128.80	4,089.20	1,001.90	(777.00)	1,257.10	(197.90)
1997/98	5,623.10	4,459.10	3,294.90	5,583.80	5,544.20	4,168.10	1,021.00	4,168.10	1,257.10
1998/99	5,623.10	4,459.10	3,294.90	5,583.80	5,544.20	5,623.10	4,168.10	5,623.10	4,168.10
1999/2021	5,623.10	4,459.10	3,294.90	5,583.80	5,544.20	5,623.10	5,623.10	5,623.10	5,623.10

Table 10: Project Returns

Scenario	IRR (%)	NPV (at 12%) Rs Million	US$ Million
Base Case	17.0	7,399.0	556.0
Benefits -20%	14.4	3,255.0	245.0
Benefits -40%	11.2	-889.0	-66.8
Costs +20%	14.9	4,736.0	356.0
Costs +40%	13.1	2,071.0	156.0
One year delay in implementation	16.1	5,890.0	443.0
Two years delay in implementation	15.2	4,545.0	342.0
One year delay in benefits	15.3	5,174.0	389.0
Two years delay in benefits	13.9	3,188.0	240.0

ANNEX 6.1

INDIA

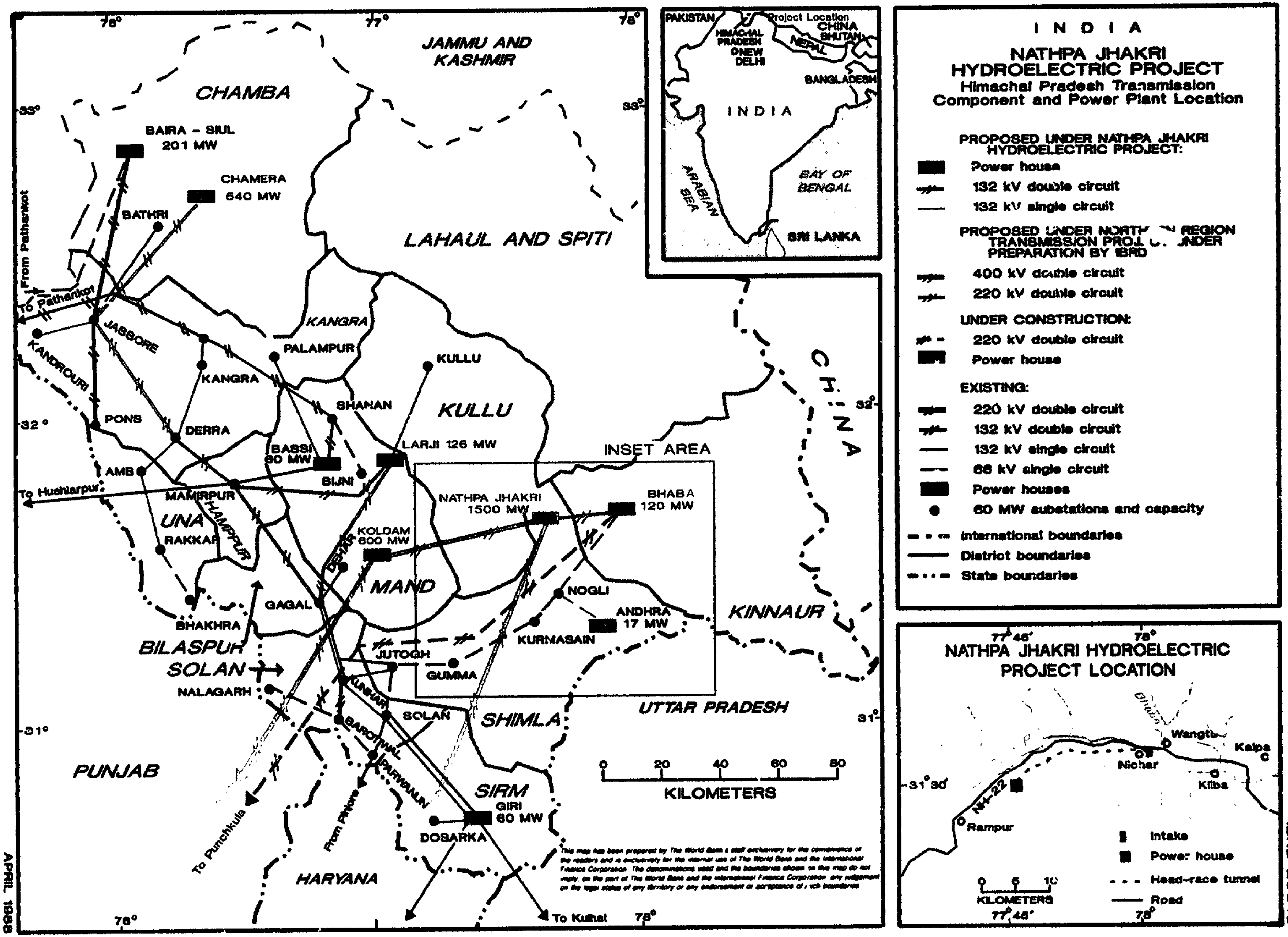
NATHPA JHAKRI POWER PROJECT

Documents in Project File

1. Identification Report of Nathpa Jhakri Hydroelectric Project - Ministry of irrigation and Power - April 1985

2. Nathpa Jhakri Hydroelectric Project (1,500 MW) - Modified Project Report - Himachal Pradesh SEB - April 1986

3. Nathpa Jhakri Hydroelectric Project Optimization of Installed Capacity - CEA - January 1986



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