

**REPORT AND RECOMMENDATION**

**OF THE**

**PRESIDENT**

**TO THE**

**BOARD OF DIRECTORS**

**ON A**

**PROPOSED LOAN**

**AND**

**TECHNICAL ASSISTANCE GRANT**

**TO THE**

**KINGDOM OF BHUTAN**

**FOR THE**

**SUSTAINABLE RURAL ELECTRIFICATION PROJECT**

October 1999

## CURRENCY EQUIVALENTS

(as of 15 October 1999)

Currency Unit	–	Ngultrum (Nu)
Nu1.00	=	\$0.0231
\$1.00	=	Nu43.35

The ngultrum is maintained at parity with the Indian rupee

## ABBREVIATIONS

BFAL	-	Bhutan Ferro Alloys Limited
CHPC	-	Chhukha Hydropower Power Corporation
DOP	-	Division of Power
GDP	-	Gross Domestic Product
GEF	-	Global Environmental Facility
ICB	-	International Competitive Bidding
MTI	-	Ministry of Trade and Industry
O&M	-	Operation and Maintenance
PPTA	-	Project Preparatory Technical Assistance
SCADA	-	Supervisory Control and Data Acquisition
TA	-	Technical Assistance
UNDP	-	United Nations Development Programme

## WEIGHTS AND MEASURES

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

## NOTES

- (i) The fiscal year (FY) of the Government of Bhutan ends on 30 June. FY1999, for example, begins on 1 July 1998 and ends on 30 June 1999.
- (ii) In this report, "\$" refers to US dollars.

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## LOAN AND PROJECT SUMMARY

<b>Borrower</b>	Kingdom of Bhutan
<b>Project Description</b>	The Project will provide electricity to poor communities of 16 rural districts in Bhutan and serve 6,038 consumers including 23 hospitals, 24 schools, and other public facilities for local communities.
<b>Classification</b>	Poverty reduction; more than two thirds (69.8 percent) of project beneficiaries live below the poverty line.
<b>Environmental Assessment</b>	Category B. An initial environmental examination was undertaken, and a summary is a core appendix.
<b>Social Assessment</b>	A social impact analysis was undertaken, and a summary is a core appendix.
<b>Rationale</b>	<p>Although Bhutan has substantial sources of clean and renewable indigenous hydropower energy, the distribution of electricity throughout the country is still limited, and thus approximately 80 percent of the population does not have access to electricity. The recent development of social infrastructure for basic human needs such as hospitals, schools, radio broadcasting, and newspaper publishing has resulted in strong anticipation of electrification for rural communities. In addition, rural electrification in the long term will gradually decrease the pressures of deforestation due to one of the world's highest consumption of fuelwood. Furthermore, positive impacts on reducing migration to the cities, population control, and overall rural lifestyle, are expected to be substantial in the long term.</p> <p>Along with the proposed Project, the Bank is also playing a pioneering role in improving sector governance. Through three cascading technical assistance (TA) grants, Policy and Legal Framework of the Power Sector Development approved in 1998, Corporatization of the Division of Power, and Private Sector Participation in Hydropower Development planned in 1999 and 2001 respectively, the Bank will assist in further commercializing of the power sector by establishing transparent and accountable sector operations and an autonomous power utility. Thus, the Project supports the Bank's strategy of balanced development between socioeconomic priorities and commercialization of the electricity supply in Bhutan.</p>
<b>Objectives and Scope</b>	The project objectives are to reduce poverty and promote economic development. The Project will provide opportunities for cash-generating businesses, create jobs, improve quality of rural life, and support adequate education and health services for rural people, especially low-income groups in Bhutan by improving electrification with distribution network expansion and use of solar panels. The Project will also facilitate efficient use of limited skilled human resources of the Division of Power (DOP) by introducing a simple Supervisory Control and Data Acquisition (SCADA) system and support institutional strengthening by corporatizing DOP.

The Project is an integral part of the rural electrification master plan of Bhutan. The Project will provide power to 6,038 consumers in rural villages of 16 districts where more than two thirds of project beneficiaries are living below the poverty line. The project scope includes (i) rural electrification through 33 kV, 11 kV, and 0.4 kV distribution systems; (ii) remote rural electrification using renewable energy sources by providing solar panels for local community centers including schools, hospitals, and other local community facilities in three districts; and (iii) a small-scale pilot SCADA system for substations close to Thimphu.

**Cost Estimates**

The total project cost is estimated at \$12.5 million equivalent, of which \$10.0 million (80 percent) is the foreign exchange cost and \$2.5 million equivalent (20 percent) is the local currency cost.

**Financing Plan**

Source	(\$ million)		
	Foreign Exchange	Local Currency	Total
Bank	10.0	0.0	10.0
Government	0.0	2.5	2.5
<b>Total</b>	<b>10.0</b>	<b>2.5</b>	<b>12.5</b>

**Loan Amount and Terms**

The equivalent in various currencies of Special Drawing Rights 7,206,000 (\$10 million equivalent) from the Bank's Special Funds resources with a term of 32 years, including an 8-year grace period, with a 1 percent per annum interest charge during the grace period and 1.5 percent per annum thereafter.

**Period of Utilization**

Until 30 March 2004

**Executing Agency**

DOP of the Ministry of Trade and Industry initially, and later, the corporatized DOP.

**Implementation Arrangements**

A project implementation unit will be set up in DOP to undertake day-to-day project implementation. All rural electrification construction will be undertaken by DOP staff, supplemented by local contract laborers and village volunteers. Participation in and ownership of the Project by DOP and the beneficiaries is thus assured to be high.

**Procurement**

All project equipment and materials to be financed under the Bank loan will be procured in accordance with the Bank's *Guidelines for Procurement* reflecting the Bank's Anticorruption Policy and mandatory use of the Bank's standard bidding documents. The Bank has approved advance procurement action.

**Consulting Services**

A total of 10 person-months of international consulting services will be required for project implementation to assist with Bank-financed procurement, project implementation, and monitoring. The consultants will be selected in accordance with the Bank's *Guidelines on the Use of Consultants*. The Bank has approved advance action for recruitment of consultants.

**Estimated Project  
Completion Date**

By 30 September 2003

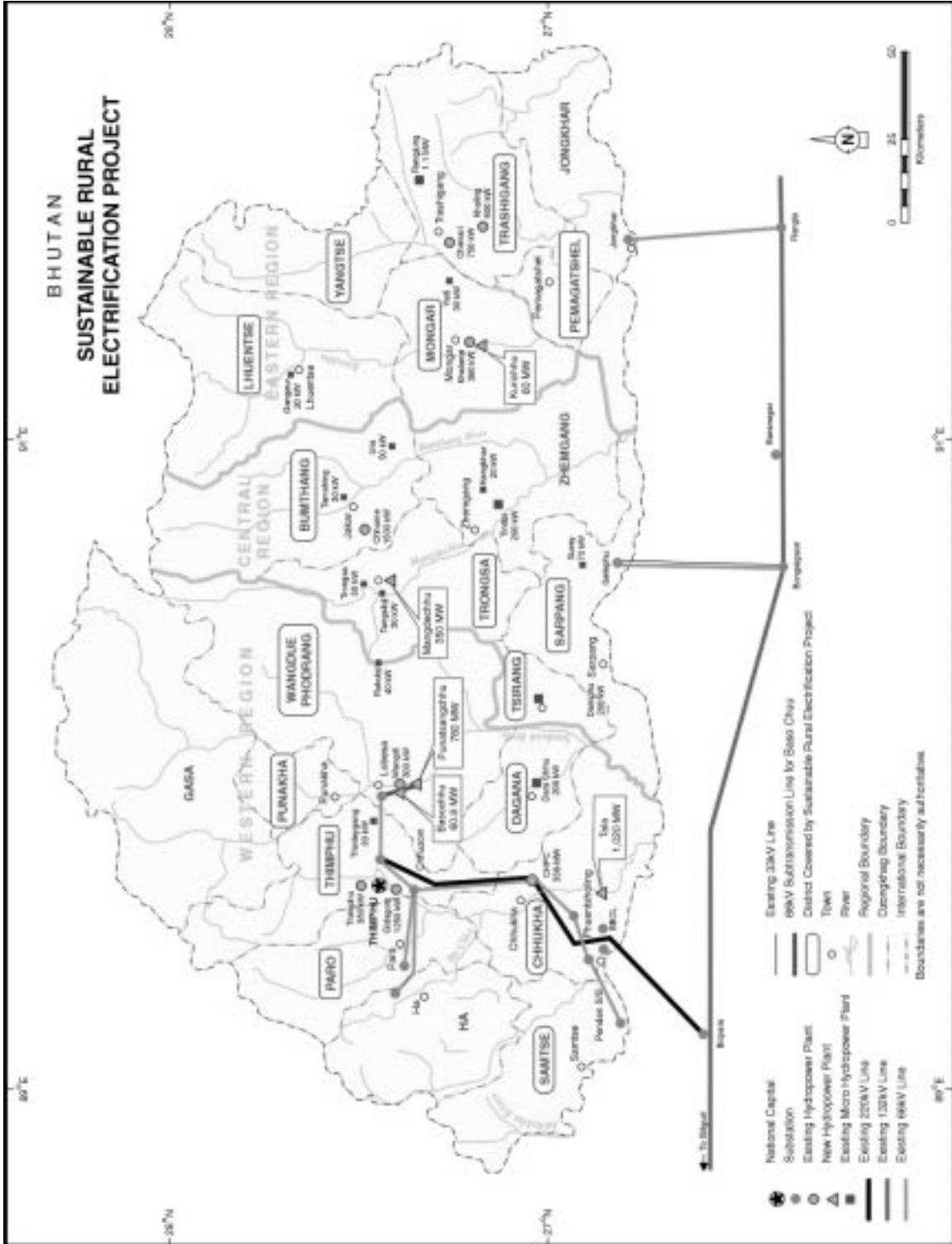
**Project Benefits  
and Beneficiaries**

The economic benefits of the Project are quantified in terms of consumer surplus based on willingness to pay and savings due to reduction of kerosene consumption for lighting and the use of more efficient electric motors as compared with diesel engines. The overall economic internal rate of return is about 13 percent. The Project will (i) improve the living conditions of the people in the rural area, (ii) provide opportunities for cash-generating businesses and thus promote economic development, (iii) reduce the use of fuelwood in the long term, which is hazardous to the health of the people, and decrease the pressure on deforestation, and (iv) make social infrastructure facilities, such as hospitals, schools, and other local community facilities, fully functional. It is estimated the Project will provide 115,000 person-days of unskilled employment opportunities particularly for the poor.

The Project will provide electricity service and improve standards of living and quality of life for 5,437 households in rural areas. More than two thirds (69.8 percent) of the beneficiaries of rural electrification are from poor or low-income households. The socioeconomic survey indicates that more than two thirds of the targeted households fall below the estimated poverty line of Bhutan. Women and children will be the prime beneficiaries of rural electrification as they spend more time in the household. It will have a beneficial impact upon their lifestyle as electricity provides a cleaner less harmful energy substitute, better lighting in homes and schools, and improved support for health care.

**Technical Assistance**

A TA grant of \$600,000 financed from the Japan Special Fund will support DOP's transition from a Government division to a corporation. The major works will include (i) conducting asset registration and valuation of DOP; (ii) recommending a financial structure for DOP; (iii) formulating the organizational structure of the corporatized DOP including administrative matters; (iv) establishing a tariff adjustment mechanism based on financial projections; (v) facilitating registration of the corporatized DOP as a company; (vi) finalizing a necessary human resource development program in consultation with the Bank; and (vii) providing necessary training on commercial accounting and corporate and financial management to DOP staff.



## I. THE PROPOSAL

1. I submit for your approval the following Report and Recommendation on a proposed loan to the Kingdom of Bhutan for the Sustainable Rural Electrification Project. The report also describes proposed technical assistance (TA) for the Corporatization of the Division of Power (DOP), and if the proposed loan is approved by the Board, I, acting under the authority delegated to me by the Board, shall approve the TA.

## II. INTRODUCTION

2. During the 1998 Country Programming Mission, the Royal Government of Bhutan confirmed its request for a Bank loan for the Project and an accompanying advisory TA for the Corporatization of DOP. The Project is based on the results of the project preparatory TA (PPTA) funded by the Bank.<sup>1</sup> The proposed TA is a subsequent assistance for the corporatization of DOP based on the recommendation of the previous Bank's advisory TA.<sup>2</sup> Appraisal was carried out from 19 to 30 July 1999.<sup>3</sup>

3. The Bank is the lead multilateral financing institution in Bhutan and since 1993 has played a pioneering role in the development of the country's power sector. Under the ongoing loan,<sup>4</sup> which was the first loan for the power sector in Bhutan from a multilateral financing institution, the Bank is undertaking comprehensive policy dialogue with the Government; they have agreed on a time-bound action plan for the corporatization of DOP, as well as retail tariff adjustments to prepare for corporatization. This Project will take the reform process further.

4. Based on a careful field survey and sector analysis, the Bank has sought to balance the commercial and financial development of the power sector with the socioeconomic priority for electricity supply. Considering the institutional and human resource constraints, and absorptive capacity of Bhutan, the reform process for the power sector is staged and is supported by cascading TAs. The project framework is given in Appendix 1.

## III. BACKGROUND

5. Bhutan was virtually isolated from the rest of the world prior to the early 1960s, with an economy based on subsistence agriculture. While work under a series of five-year plans helped establish basic infrastructure in the economy,<sup>5</sup> it was not until the 1980s with the commissioning of the Chhukha hydropower plant that a diverse economy really began to emerge. With the advent of hydropower in the country, and manufacturing enterprises benefiting from low cost power, gross domestic product (GDP) increased in the late 1980s to nearly 8 percent per year. With no large projects coming onstream, industrial growth in Bhutan has slowed in recent years, but the country still maintains GDP growth rates in excess of 5 percent. The Eighth Five-Year Plan, FY1998-FY2002 projects average annual GDP growth of 6.5 percent during the plan period and about 5.5 percent during the first two years of the plan. Although overall growth in the economy is currently on track to achieve the Eighth Plan's goals, inadequate physical

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<sup>1</sup> TA 2912-BHU: *Second Rural Electrification Project*, for \$500,000, approved on 19 November 1997.

<sup>2</sup> TA 2400-BHU: *Institutional and Financial Development of DOP*, for \$400,000, approved on 30 September 1995.

<sup>3</sup> The Mission comprised C. Pappas, Sr. Project Specialist/Mission Leader; Y. Kho, Financial Analyst; S. Handayani, Social Development Specialist; M. Hamano, Project Engineer; S. Ho, Programs Officer/Economist; and C. Gautrot, Counsel.

<sup>4</sup> Loan 1375-BHU: *Rural Electrification Project*, for \$7.5 million, approved on 30 September 1995 with the purpose of electrifying about 3,100 customers in seven districts.

<sup>5</sup> See also CER: BHU 99012: *Country Economic Review, Bhutan*, May 1999.

infrastructure, including lack of an efficient road network to markets, remains a major constraint to further development of the country in the longer term.

6. The Government is improving its development administration by decentralizing and involving the people in the policy-making process. The King visited and consulted with people in all 20 districts of Bhutan on the Eighth Plan. The King explained the development program in their districts and listened to their views. Similarly, through the district and local development committees, decision making has been gradually decentralized and made more participatory. In addition, at the last National Assembly, the King withdrew as chair of the Council of Ministers in July 1998, and the National Assembly elected new cabinet members. At the same time, the King empowered the National Assembly to dismiss him with a vote of no confidence. The Planning Commission of the Government was also recently reconstituted to accommodate bottom-up planning process from each level of local communities.

7. Bhutan continued to experience strong growth in production in 1999, with real GDP growth at 5.8 percent. Because of the Government's demonstrated support for implementing the policy reforms and fulfilling the goals outlined in the Eighth Plan, the economy should continue to experience output growth in excess of 5 percent for FY1999. Fiscal policy in FY1998 remained prudent with current revenues exceeding current expenditures. Although tax revenues remain relatively low—less than 7 percent of GDP—preparations for the introduction of personal income tax are still ongoing, and its introduction should help diversify the source of revenues in the country. Corporate taxes and profit transfers from the Chhukha hydropower plant are the Government's main source of revenue, accounting for 41 percent of current revenue. Provisional estimates show an overall budget surplus of more than 3 percent of GDP in FY1998, compared with a deficit of 2.4 percent of GDP in the previous year. The scope for monetary policy is limited because of the fixed exchange rate arrangement and the large quantity of Indian rupees circulating freely in the economy. Inflation in FY1998 rose to 9 percent from 7.4 percent as of the end of 1998.

8. Exports grew by 12 percent in FY1998 in dollar terms, much higher than the 4 percent growth in imports. As a result, the trade deficit declined from 9 percent of GDP to 6 percent, and the current account deficit fell from 16 percent of GDP to 12 percent. Bhutan maintained a slight trade surplus with India, the country's main trading partner, but the bilateral trade in services caused a current account deficit. Capital flows, mostly in the form of aid for infrastructure investments, were more than sufficient to cover the current account deficit. By the end of the fiscal year, foreign reserves exceeded \$200 million, enough to cover more than 19 months of imports. Debt service in FY1998 was 11 percent of merchandise export earnings, but the country's convertible currency inflows will come under increasing pressure as more of the grace periods expire on the concessional debt Bhutan acquired in the 1980s.

9. Increased efforts will be needed to prevent any deterioration in the fiscal situation, while safeguarding productive expenditures, social services, and operation and maintenance (O&M). The introduction of a personal income tax will be a promising step toward broadening the tax base, but direct cost recovery measures, such as introducing user fees and rationalizing electrical tariffs, also need to be considered. Managing the diverse number of development projects is straining the Government's limited resources. To effectively manage an increasingly complex economy, the central Government must devolve some project responsibilities to local governments. This has the added benefit of increasing community ownership of project results. Furthermore, more private sector involvement will be required if the Government is to maintain a compact civil service.

## A. Sector Description

### 1. Energy Consumption and Sources

10. Bhutan's per capita energy consumption is relatively high compared with other neighboring countries such as Nepal because its forest resources provide an abundant and readily available source of energy. Per capita energy consumption including noncommercial energy amounts to approximately 0.8 ton of oil equivalent. Although the local units of the Forestry Services Division are regulating the cutting down of live trees, fuelwood nevertheless accounts for more than 75 percent of total energy consumption and for virtually all non-commercial energy consumption in rural areas. Households consume 95 percent of fuelwood, the Government and commercial entities use 3 percent, and agriculture and industry use about 1 percent. Per capita consumption of fuelwood used mainly for cooking and heating is, estimated at 1.22 tons, one of the highest rates in the world.

11. Since Bhutan has no known reserves of fossil energy resources such as oil and natural gas, all petroleum products such as kerosene, liquefied petroleum gas, diesel oil, and petrol for lighting, cooking, and transportation are imported. The general demand for petroleum products has been increasing. Petroleum products are imported and distributed by two private companies, Bhutan Oil Distribution and Druk Petroleum Company. There are 24 fuel depots situated at convenient points in various districts (*dzongkhags*). The Ministry of Trade and Industry (MTI) regulates the price and supply of petroleum products aligned with Indian domestic prices. Import details of petroleum products from 1992 to 1997 are indicated in Table 1.

**Table 1: Import of Petroleum Products (1992 to 1997)**

Product	1992	1993	1994	1995	1996	1997
Kerosene (kilo liters)	7,122	8,078	6,691	8,236	12,152	9,612
Diesel (kilo liters)	16,778	16,461	17,647	21,193	20,343	20,403
Petrol (kilo liters)	3,506	3,469	3,530	4,151	3,852	4,122
LPG (tons)	720	1,800	1,741	1,675	1,675	2,920

LPG = Liquefied Petroleum Gas

12. The most important natural resource of Bhutan is water. The mountainous terrain and the network of perennially flowing rivers and streams provide an abundant source of renewable energy. The four major rivers, Ammochhu, Mangdechhu, Sankosh, and Wangchhu, all flow from north to south, and discharge into the Brahmaputra River in the plains of India and Bangladesh. These rivers provide significant hydropower potential. Compared with the theoretical potential of 30,000 megawatts (MW) capacity of hydropower, the identified hydropower projects are expected to harness a capacity of 16,280 MW based on the available feasibility and prefeasibility studies. This may be compared with the 23 run-of-river hydropower stations with a total installed capacity of only 344 MW in 1998. Although the domestic peak electricity demand is 72 MW, power exports to India are a major foreign exchange earner for Bhutan. The hydropower potential presents a significant opportunity for future expansion and economic benefit, with minimal environmental impacts, in view of an increasingly large export market for power in the subregion.

13. To date, about 60 biogas plants have been built in several districts and are used only for lighting. There are 1,316 solar panels existing in remote areas to charge batteries, particularly in schools, basic health units, and monasteries. Because of sufficient sunshine available in

Bhutan, solar panels have proved to be a viable alternative of providing grid supply to remote areas. Experiments with wind energy applications for battery charging are being undertaken in two districts to determine the sustainability of wind-based generation.

## **2. The Power Sector**

### **a. Institutional Overview**

14. Under the current structure of the power sector, policy making, regulation, system development, and operation of the power sector are the responsibility of DOP. DOP distributes electricity at the district and village levels through electricity supply units and electricity supply subunits. In a policy directive issued in late 1993 during the Seventh Five-Year Plan (FY1992-FY1997) period, the Government devolved responsibilities for power supply and O&M of distribution systems to the district level. This was done in seven districts, in a move designed to improve effectiveness and to enhance community participation in planning and implementation of the electrification program. Decentralization of responsibilities for power is to be eventually extended to all 20 districts of the country.

15. The Chhukha Hydro Power Corporation (CHPC), which is a wholly Government-owned company registered under the Bhutan Companies Act, accounts for 336 MW of the country's total generating capacity of 359 MW. In FY1997, DOP purchased 360 gigawatt-hours (GWh) or 94 percent of its requirements from CHPC. That same year, CHPC exported 1,430 GWh (78 percent of the energy generated) to India. Further development of the power sector is crucial to allow the Government to generate revenue required for O&M of the sector, future expansion of social programs, and sustained overall economic growth.

16. The Kurichhu Project Authority was created for the Kurichhu Hydropower Project. The Kurichhu Project (60 MW, funded by India) in the eastern region and the Basochhu Project (60.8 MW, funded by Austria) in the western region will be completed during the Eighth Plan period. The infrastructure development activities and civil works of the Tala Hydropower Project (1,020 MW, funded by India) have also commenced under a separate entity, namely, the Tala Hydroelectric Project Authority. The governments of Norway and Japan are funding full-scale technical feasibility studies for the Mangdechhu Hydropower Project (approximately 360 MW) and Punatsangchhu Hydropower Project (approximately 760 MW). Mangdechhu Hydropower Project feasibility study will be completed by the end of 1999 and the Punatsangchhu feasibility study by early 2001. Because the Government fully recognizes the implication of hydropower development, environmental and socioeconomic impact analyses have been undertaken as part of the detailed feasibility studies of these two new hydropower projects in accordance with internationally acceptable guidelines.

### **b. Supply and Demand**

17. In FY1997, the total electricity consumption of Bhutan was 366 GWh with peak demand of 72 MW. The five-year average of the load growth since FY1992 was approximately 19 percent per annum on energy basis. This high load growth was due to the commissioning of several electricity-intensive industries such as Bhutan Board Products Ltd., Bhutan Carbide and Chemicals Ltd., and Pendon Cement Authority Ltd. from FY1995 to 1996. Another electricity-intensive industry, Bhutan Ferro Alloys Ltd. was commissioned in 1993. The share of the industry sector reached about 82 percent in FY1997 of total energy sold by DOP. The historic annual load growth of the residential and commercial customers of DOP is about 5 percent per

annum. By the end of FY1997, DOP consumers totaled 30,321, and 39 towns and 363 rural villages were electrified by DOP.

18. The total energy requirement of DOP was 383 GWh in FY1997; CHPC supplied 361 GWh directly to DOP's transmission network at the price of Nu0.30 per kilowatt-hour (kWh). In addition, 7 GWh was purchased from CHPC through the Indian grid system with the wheeling charge of Nu0.05 per kWh. The balance was supplied by mini- and microhydropower plants as well as diesel generators through their dedicated isolated networks. The average system loss of transmission and distribution systems including nontechnical losses, in the past five years was about 9 percent. This performance is mainly due to the large share of the high voltage customers such as electricity-intensive industries. The system loss of low voltage customers is approximately 15 percent. Under the current power purchase agreement with India, CHPC has no obligation for power export to India on a fixed amount (capacity and energy) basis. The first priority is to supply the necessary electricity to DOP for domestic consumers, and the balance of electricity output of CHPC is to be exported to India. The power supply and energy balances of DOP from FY1991 to FY1997 are given in Appendix 2.

### **c. Existing Power System**

19. A milestone event for the power sector was the commissioning of the first unit of the Chhukha hydropower plant in 1986 with assistance from the Government of India. By 1988, three further units had been commissioned at Chhukha, increasing its total installed capacity to 318 MW. With completion of the second tailrace tunnel in 1995, the installed capacity of Chhukha reached 336 MW. Since commissioning of the first unit, 85 to 90 percent of generated electricity has been exported to India. Chhukha is the largest single foreign exchange earner of Bhutan. Because Bhutan could not finance Chhukha's investment costs and revenues of the power export were in Indian rupees, which were not convertible at that time, the Project was developed on a grant and loan basis by the Government of India. In return, India receives Chhukha's excess electricity for 99 years.

20. Although the Chhukha hydropower plant has the dominant capacity, there are 8 minihydro plants with capacities ranging from 300 kilowatt (kW) to 1,500 kW, and 14 microhydro plants with capacities ranging from 20 kW to 200 kW. The total installed capacity of microhydropower plants reached 1,000 kW.

21. Electrification of the eastern and central parts of Bhutan was achieved using the Indian grid system. During 1969-1970, the Gelephu, Samdrup Jongkhar, and Sarpang districts in the southern part of Bhutan were electrified through connection to the grid of Assam State Electricity Board of India. Similarly, the commissioning of the Jaldakha hydropower plant in 1972 in West Bengal led to the electrification of the neighboring districts of Phuntsholing, Samtse, and Sipsoo in Bhutan through the West Bengal State Electricity Board of India.

22. The current transmission and distribution system in Bhutan comprises three components: (i) the western grid system supplying electricity to the western part of Bhutan including Thimphu, fed from Chhukha and other small power plants, and connected to the 220 kV Indian grid system for power export from Chhukha; (ii) local transmission network supplied from the Indian grid system such as Gelephu and Samdrup Jongkhar electric supply units served by Assam State Electricity Board and Samtse district served by West Bengal State Electricity Board; and (iii) isolated local distribution network served by mini/microhydropower plants such as Bumthang and Trashigang electric supply units. A 132 kV transmission line associated with the Kurichhu Hydropower Project and a 400 kV transmission line to evacuate

power from the Tala Hydropower Project are presently under construction and are being funded by the Government of India. Details of the major components of the existing power system in Bhutan are given in Appendix 3.

## **B. Government Policies and Plans**

23. Under the Eighth Plan, the Government aims to accelerate growth and improve living standards, while ensuring the preservation of the country's environment and cultural heritage. The Government also aims to build and improve the enabling environment for private sector development by gradually reducing its own role in commercial areas of the economy by corporatizing or privatizing public sector entities, and by addressing structural and institutional constraints. Postal services and urban services were corporatized in 1997, and telecommunications will be corporatized in FY2000. The Plan also focuses on revenue-generating hydropower development and industrialization, human resource development, agriculture, and social services, mainly through expansion, consolidation, and improvement of the existing facilities. The share of electricity in GDP will be maintained at above 8 percent during the entire Eighth Plan period. To achieve this, the Government is currently constructing the three hydropower projects: Basochhu, Kurichhu, and Tala.

## **C. External Assistance to the Power Sector**

24. The Government of India provides more aid to the sector than any other funding source, and has contributed greatly to the expansion of the power sector. The Government of India has funded all three (Chhukha [336 MW], Kurichhu [60 MW], and Tala [1,020 MW]) of the major hydropower plants together with their associated high voltage transmission lines for evacuation of the generated power from these plants. In addition, from 1967 to 1988, the Government of India assisted with the installation of minihydropower plants in Gidagom, Gyetsa, Khaling, Mongar, Paro, Trashigang, Thimphu, and Wangdue Phodrang. The total capacity of these minihydropower plants was 4.9 MW in 1997. Rehabilitation of the existing minihydropower plants and urban distribution system continues to be assisted by the Government of India.

25. Japan too has been a major contributor to the power sector. From 1986 to 1992, 13 microhydropower plants with total capacity of 980 kW were commissioned for the electrification of isolated remote areas of Bhutan through the assistance of the Government of Japan. These microhydro plants were constructed under a self-help scheme in which the villagers provided free labor and customers paid for wiring of their homes. Japan is continuing its involvement through the feasibility study for the Punatsangchhu Hydropower Project.

26. The Government of Austria is another major bilateral source of aid to the power sector by financing the Basochhu hydropower plant (60 MW) located in the Sankosh River basin. It also funded the 2.2 MW Rangjung scheme in Trashigang District, which was commissioned in 1998. The Government of Austria is also considering providing assistance for human resource development of DOP in association with the Bank.

27. The Government of Netherlands provided assistance with rural electrification for about 1,200 households from 1995 to 1998. It also assisted with the installation of solar home systems during the same period.

28. The United Nations Development Programme (UNDP) and the Government of Norway funded the Bhutan Power System Master Plan as a World Bank-executed project in 1993. Currently, UNDP is undertaking a feasibility study of mini/microhydropower plants funded by the

Global Environmental Facility (GEF) and the Government of Sweden. The governments of Norway and Japan are funding full-scale technical feasibility studies for the Mangdechhu and Punatsangchhu hydropower projects respectively. The studies will be completed by 2000.

29. The Bank's operation for the Bhutan power sector commenced in 1993. Since then, the Bank has provided one loan (footnote 4) and 5 TAs—2 PPTAs and 3 advisory TAs out of which, one PPTA and one advisory TA are still being implemented.<sup>6</sup> Along with project implementation for the sustainable development of the power sector, the Bank has focused on the institutional development of the power sector and sector reform, which are not being covered by other funding agencies. The list of the external assistance from 1993 onward is given in Appendix 4.

#### **D. Lessons Learned**

30. To date, the Bank has provided grants for two PPTAs and two advisory TAs, and financed one loan for the rural electrification program. Another advisory TA for Policy and Legal Framework for Power Sector Development commenced in May 1999. The major obstacles identified for power sector reform are (i) the constraints of absorptive capacity and human resources in technical and commercial fields, (ii) lack of a human resource development program for the sector, (iii) weaker initiative of the Government to corporatize DOP compared with hydropower projects or corporatization of other sectors such as telecommunications, and (iv) the Government's historical reluctance to increase tariffs.

31. Considering the human resource constraints and institutional capacity, it has been agreed to undertake a phased approach to sector reforms supported by a group of cascading TAs. Three TAs, namely Policy and Legal Framework for Power Sector Development approved in 1998, and Corporatization of DOP and Solicitation of Private Sector Participation in Hydropower Development planned in 1999 and 2001 respectively are therefore included in the Bank's country assistance program. Under these TAs, necessary institutional capability for commercialization of the sector will be created in a gradual and structured manner.

32. As part of the Institutional and Financial Development of DOP TA, a commercial accounting system was created for DOP; it is to be fully implemented when DOP is corporatized. In the meantime, DOP is to use portions of the system concurrently with the existing Government accounting system. However, two of the critical staff trained under the TA were transferred to other Government departments, and the momentum for preparing to convert to the new accounting system was lost. Under the proposed Project, the Government has agreed to appoint one dedicated project manager and at least two financial/accounting officers to implement and expand the commercial accounting system. As a result of the earlier problems and to ensure that the Government takes ownership of the TA to develop a policy and legal framework for power sector development<sup>7</sup>, the Bank insisted that DOP establish a counterpart steering committee and a working group for the TA prior to the commencement of consulting services.<sup>8</sup>

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<sup>6</sup> TA 2912-BHU: *Second Rural Electrification Project*, for \$600,000, approved on 19 November 1997 and TA 3112-BHU: *Policy and Legal Framework for Power Sector Development*, for \$500,000 approved on 15 December 1998.

<sup>7</sup> TA 3112-BHU: *Policy and Legal Framework for Power Sector Development*, for \$500,000 approved on 15 December 1998.

<sup>8</sup> The committee comprises nine members drawn from MTI, DOP, Ministry of Finance, Planning Commission, and the High Court. The working group comprises four representatives from DOP and one representative from MTI.

33. The Bank's ongoing rural electrification project is delayed by approximately one year because of (i) lack of submission of bids from international bidders; (ii) delayed transport of materials and equipment due to geographical difficulties; (iii) insufficient experience of local contractors; and (iv) force majeure due to heavy rain in 1998. Despite the difficulties, these obstacles have been overcome. DOP determined the optimum contract sizes that will attract international bidders, and established logistics such as stores functions in several districts. A suitable organizational setup has been established in DOP to supervise implementation work in remote districts in association with district offices. DOP confirmed that it will maintain the same organization and facilities with necessary strengthening for the proposed Project.

#### **E. The Bank's Sector Strategy**

34. The Bank's sector strategy is integrated into the country strategy for Bhutan and aims to establish sustainable economic growth and reduce poverty. Bhutan is endowed with large hydropower resources. Expansion of hydropower generation capacity has supported the growth of electricity-intensive industries in recent years. Similarly, revenue from power export has been able to finance the rapid expansion of social services. To realize the sustainable operation of the power sector, the Bank's key concerns are (i) the restructuring of the power sector by corporatizing DOP, and enacting laws on national energy policy and regulation; (ii) tariff adjustment based on full cost recovery of the power supply; (iii) human resource development for the corporatized DOP; (iv) commercialization of the sector; and (v) private sector participation especially in hydropower generation for the midterm, which will be for power export to India.

35. As part of this strategy, the Bank approved its first loan to the power sector for Rural Electrification in 1995 together with a Bank TA for Institutional and Financial Development of DOP (footnote 2). This has provided an impetus for sector reform. The Bank will continue to focus on institutional development of DOP as well as the power sector, commercialization, private sector participation, and tariff structure adjustment to reflect the economic cost of power supply. The Bank's continuous support for the power sector, including the proposed Project will require compliance with the agreed sector reforms, such as implementation of the agreed action plan for corporatization of DOP and domestic tariff adjustment.

#### **F. Policy Dialogue**

36. Since 1993, the Bank has played a pioneering role and provided a driving force for power sector reform in Bhutan as the lead multilateral financing institution. As a result of agreements reached in the earlier project, the Government increased tariffs in 1 April 1995, from Nu0.4 to Nu0.5 per kWh (a 25 percent increase) and on 1 July 1997, from Nu0.5 to Nu0.6 per kWh (a 20 percent increase). Further in March 1998, the Government agreed to a time-bound action plan for sector reform. This includes (i) implementation of the tariff structure recommended by the Bank TA (footnote 2) in FY2001; (ii) ratifying the new legislation of the power sector in FY2002 based on the recommendation of another Bank TA (footnote 7); and (iii) gradual overall tariff increase to meet the agreed financial targets of the corporatized DOP by the end of FY2005. For the institutional development of DOP, it was agreed to (i) implement a full commercial accounting system in 2000; (ii) complete the asset evaluation by 2001; (iii) complete the registration of DOP as a company (per the Companies Act) by FY2002. The Bank will assist with this institutional development through the accompanying TA to the proposed loan. The time-bound action plan reflecting the policy dialogue is given in Appendix 5.

## 1. Legal and Policy Framework

37. The Government recognizes that a comprehensive legal framework such as an electricity act and its appropriate subsidiary legislation is necessary for sector development and regulation. The Government has agreed to segregate utility operation from policy making and regulation to ensure an efficient and financially viable sector structure and grant autonomy to the corporatized DOP. After new legislation for the power sector is established with the Bank's assistance, DOP will be transformed from a Government division into an autonomous and financially viable corporate entity, and the Government's role will be reduced to that of a regulator and a policymaker. Such a sector structure with transparent administrative tariff setting will help to ensure the financial viability of the sector. The new legislation will be ratified by the end of FY2002 prior to the corporatization of DOP. The Government also agrees that a transparent administrative tariff adjustment scheme will be implemented, such as tariff adjustment to foreign currency fluctuation and domestic inflation. Under such a tariff adjustment, the Government will consider approving DOP's proposal on tariff adjustment within a reasonable period in accordance with the new legislation for the power sector.

## 2. Corporatization of DOP and Human Resource Development

38. The DOP's present financial and accounting system follows a government budget system. Thus, as the first step of the action plan under the institutional and financial development TA (footnote 2), DOP implemented a pilot commercial accounting system to separate its accounting system from that of the Government. The Government will commence implementing the full commercial accounting system as per the agreed action plan. In addition, the institutional capability of engineering fields such as the creation of master plans, system planning, investment standards, and technical standards will be established in DOP prior to its corporatization.

39. The requirement for human resource development for a corporatized DOP is substantial. The Bank has therefore taken the initiative to bring in external assistance and is leading aid coordination on this matter. Along with the Bank's proposed TA for Corporatization of DOP, the Government of Austria will provide assistance for technical training and the E-7 network/fund<sup>9</sup> will provide expertise on utility management to DOP. The Bank has previously financed the Royal Institute of Management<sup>10</sup> for overall human resource development in Bhutan. The Royal Institute has confirmed its availability and cooperation to support DOP's human resource development. Details of the current human resource development plan are given in Appendix 6.

40. Because of the constraints of human resources, institutional capability, and small system size of the power sector of Bhutan, a simple sector structure would be preferable. The Government has agreed in principle on the direction proposed by the Bank for corporatizing DOP. However, the Government feels that electricity supply in Bhutan has the characteristic of a basic social service. In addition, the power sector, especially hydropower generation is expected to play a significant role as a major export industry. Therefore, the Government will always have a role in the power sector and recognizes that its role as an operator needs to be segregated from that as a regulator.

<sup>9</sup> The E7 network is the nonprofit organization to assist sustainable development of the power sector in developing countries. It comprises eight major utilities in G7 countries.

<sup>10</sup> The Royal Institute of Management was established in 1986 and completely restructured in 1997, funded by the Bank (Loan 1035-BHU: *Technical and Vocational Education and Training*), for \$7.13 million, approved on 27 September 1990.

41. The Government's aim is that all major hydropower projects be planned as separate entities. It is therefore logical for DOP to be structured as the national transmission and distribution power utility with small hydropower and diesel generators. In such a structure, DOP will generate revenues mainly from wheeling charges and domestic electricity distribution and will achieve the agreed financial targets with an overall electricity tariff at Nu1.0 per kWh and a wheeling charge of about Nu0.12/kWh in FY2005. The explicit tariff increase will be decided after asset evaluation under the accompanying TA in accordance with the corporate and financial structure of the corporatized DOP.

### **3. Tariff Adjustment**

42. Bhutan by virtue of its export of power has two tariffs, an export tariff and a domestic tariff.

#### **a. Export Tariff**

43. CHPC exports its power to India after satisfying domestic requirements,<sup>11</sup> and the export tariff is determined based on negotiations between the two governments. The agreement between Bhutan and India provides for a tariff revision every four years; however, in reality the adjustments have been made more frequently, within a 2- or 3-year period. A tariff adjustment was made in April 1997 from Nu0.5 to Nu1.0 per kWh. Following the latest round of negotiations, the export tariff was increased from Nu1.0 per kWh to Nu1.5 per kWh as of 1 July 1999. It is evident that through the export of power to India the power sector in Bhutan has become financially viable as a whole and provides substantial revenues to the Government. With the increase in export tariff, revenues from power accounts for one half of the country's total revenue. The new hydropower projects under construction will also be oriented toward the export of power to India. The Government has a strong desire to establish a transparent and commercial export tariff setting for the future hydropower projects under study. The Bank intends to assist in this matter through a planned TA in 2001 for private sector participation in hydropower development.

#### **b. Domestic Tariff**

44. Prior to 1 July 1997, the Government adopted a simple, uniform tariff for all categories of customers in all districts in Bhutan. In the mid 1980s, the uniform tariff was Nu0.7 per kWh, and after the commissioning of the Chhukha hydropower plant in 1987, due to excess power and its ability to export power to India, the Government decided to reduce the domestic tariff to Nu0.4 per kWh. Since the Bank's first power project in 1995, the Bank recommended that the Government gradually increase the domestic tariff so as to recover the cost of supply, and, in the midterm the tariff structure should be rationalized. Although DOP purchases power from CHPC at Nu0.30 per kWh, the investment costs on transmission and distribution need to be recovered. Therefore, the tariff was subsequently increased to Nu0.5 per kWh in 1995, and to Nu0.6 per kWh for urban and industrial customers in July 1997.

45. The current electricity supply in Bhutan is characterized by (i) low generation cost as the cost of CHPC is considered as the generation cost for the domestic market because DOP is permitted to consume the output power of CHPC up to its full capacity; (ii) the current share of low and medium voltage consumers, which are mainly residential and commercial consumers, is small, and CHPC has sufficient capacity to supply electricity to such consumers for more than 30 years; (iii) further investment for hydropower generation and transmission are targeted mainly for export, and their cost recovery can be achieved through the export tariff.

<sup>11</sup> Domestic consumption accounts for about 20 percent of CHPC total generation.

46. However, the domestic electricity tariff, which is set much below the export tariff, is an opportunity loss for Bhutan. This applies particularly to those electricity-intensive industries that are largely oriented to the Indian market. Although there could be some added value to Bhutan's economy (i.e., through additional employment and taxes) in providing electricity at the present low rates to such industries, the gap between the domestic and export tariffs needs to be reduced to mitigate fiscal losses to the Government. Furthermore, as the industry sector represents about 80 percent of domestic electricity sales, potential opportunity losses to the Government and hence to a corporatized DOP could be substantial, and thus cannot be ignored.

47. Following the ongoing policy dialogue with the Bank since the last Fact-Finding Mission in February 1999, DOP submitted a proposal to the Government to increase the electricity tariff to urban/industrial consumers to Nu0.8/kWh. Due to strong resistance from industries, at the request by the Government the Bank provided assistance to study the impact of the tariff increase on major industries. The study showed that one of the major industries, Bhutan Ferro Alloys Limited (BFAL), is not in a condition to absorb the tariff increase up to the proposed level this year. Its current financial condition is not healthy, as it was struck by natural disasters in 1998. BFAL currently consumes about 50 percent of total industry consumption in the country. The Government is reluctant to increase the electricity tariff to Nu0.8/kWh, as it will have substantial negative impact on industry, particularly at a time when it wants to promote the development of these industries. The Government further argues that the incremental revenues from increasing the tariff are negligible given the total revenues the country receives from power, and that the only advantage from the point of view of these industries is the cheap power. The Government also pointed out that if the industries are subjected to such a high tariff increase, their consumption of power would substantially reduce as some of them may close down, thereby further reducing the volume of internal power sales by DOP. The Bank understands the Government's position, although it also pointed out that BFAL's weak financial condition is merely due to last year's unfortunate incidents, which resulted in a major loss of inventory. Therefore, to give more breathing space to BFAL, the Bank proposed, and the Government agreed, to increase the tariff to urban/industrial consumers from Nu0.60/kWh to Nu0.70/kWh (an increase of 17 percent) as of 1 January 2000; the increase to Nu0.8/kWh will be effective on 1 July 2001 (a further increase of 14 percent). Cabinet approval for these tariff adjustments was obtained on 24 August 1999.

48. With regard to rural consumers, the Bank agreed to maintaining the rural tariff at Nu0.50/kWh in line with the socioeconomic and environmental objectives of electricity supply in the rural areas. However, it remains concerned with the current geographical and uniform tariff scheme, where rural consumers pay a lower tariff, as this could undermine the financial viability of the Project, which caters mainly to the rural areas. The Bank pointed out that a large percentage of consumers of the current tariff scheme are relatively well off. Although at present, the impact is not significant as consumers in rural areas represent a very small percentage of total electricity consumption (3 percent), the fact that the Government intends to increase electrification in the rural areas, could affect DOP's financial position over the long term. The tariff study addressed this issue, and based on the result of the study and to ensure adequate cost recovery (while taking into account the Government's social objectives) is reflected in the tariff, it was agreed that the Government will introduce a two-part tariff for high and medium voltage consumers and a three-block tariff for low voltage consumers. The high and medium voltage consumers will pay energy and demand charges. The low voltage consumers will be divided into low-end, medium-end, and high-end consumers. Of the three blocks, the first block contains consumers for whom a social rate can be applied. The proposed tariff structure will allow contribution to capital costs to be reflected in the rate and provides for cross subsidy to the

poor who consumed minimal electricity. Based on the survey conducted by the tariff study, a lifeline or social rate was recommended at 80 kWh per month. In this context, the Government agreed to implement the tariff structure by the end of FY2001.

49. The proposed tariff structure will also help DOP as it plans to become a corporate entity in the near future. Being an independent company separate from the Government's budgetary system, DOP will need to be financially self-sustainable, and thus tariffs need to be adjusted to enable DOP to meet its financial requirements. Based on the assumptions taken, for DOP to reach the financial targets once it is corporatized, the overall average tariffs and the wheeling charge will have to be gradually increased to reach Nu1.0 per kWh and Nu0.12 per kWh, respectively by FY2005. The explicit tariff adjustments and wheeling charges will be determined once the valuation of DOP assets is completed, currently planned for FY2001.

#### **4. Private Sector Participation in Hydropower Development**

50. Up until now, the Indian Government has been the main hydropower development financier in Bhutan. However, it is perceived that the Indian Government has limited resources and that after the Tala plant, it may not be in a position to finance further projects. The Government therefore recognizes that other foreign investment will be required to achieve the planned investments for hydropower development. The sector requires large amounts of funding from bilateral, multilateral, as well as private sector sources. A policy and guidelines to attract foreign investments for hydropower projects needs to be developed based on the electricity act. Therefore, in December 1998, the Bank approved a TA (footnote 7) to assist the Government in developing this act, which includes the policy and legal framework for the power sector, and private sector participation in the power sector, especially in hydropower projects.

51. Such policy and guidelines for private sector participation to be developed by 2001 will include feasible project structures, financing schemes, ownership arrangements, mitigating currency convertibility risks, creation of security package, issues on taxation and provision for risk sharing between the various parties. Under the TA, large foreign borrowing and investments will be carefully analyzed, from the viewpoints of macroeconomy, balance of payment, and foreign currency reserves of Bhutan. The Government and the Bank will maintain close cooperation with the other aid agencies during the TA implementation.

52. Furthermore, the Government fully recognizes the importance of transparent and fair competition with a well-formulated project structure for solicitation of proposals from private developers. In this context, the Bank agreed to provide TA to establish such solicitation procedures. It will include preparation of solicitation/requests for proposal documents comprising technical and financial requirements, power purchase agreement, water supply agreement, and other necessary documents to invite project developers for future hydropower projects such as Mangdechhu (funded by the Government of Austria) and Punatsangchhu (funded by the Government of Japan).

#### **5. Sustainable Rural Electrification**

53. During the Sixth Five-Year Plan (FY1987-FY1991), a rural electrification program using hydropower was formulated to cover most villages in Bhutan. However, due to lack of finance and human resources, the actual achievement was minimal of what was planned. In the Seventh Plan (FY1992-FY1997), the Government gave high priority to the remaining rural electrification and intended to implement rural electrification on a realistic scale. This program was delayed and is now expected to be completed in 1999 with Bank assistance. At the end of

FY1997, 39 towns and 363 villages were electrified, and the total number of DOP customers was 30,321. The household electrification ratio was approximately 28 percent in FY1998.

54. Under the Eighth Plan, the Government intends to electrify rural households in 17 of 20 districts of Bhutan. Most of the areas in the program are located in the vicinity of existing 132-kilovolt (kV) and 66-kV transmission lines. However, because of the enlarged project area, geographically scattered and isolated customers, rural electrification only by the transmission and distribution system is not feasible from technical and financial viewpoints. Therefore, the rural electrification program in the proposed Project will utilize existing generation from mini/microhydropower stations, as well as use solar panels for important local community facilities in remote areas.

55. UNDP has confirmed its assistance for mini/microhydropower plants to remote villages using a grant from the Government of Sweden and GEF in areas to be served by the Project. UNDP's consultants commenced their work in April 1999 and are expected to complete project design in December 1999. The transmission line plan created under the Bank PPTA was provided to UNDP's consultants to identify suitable sites based on a least-cost analysis.

#### IV. THE PROPOSED PROJECT

##### A. Rationale

56. Although Bhutan has substantial sources of clean and renewable hydropower energy and exports power to India, distribution of electricity throughout the country is still limited. By the end of FY1997, approximately 80 percent of the population, mainly in rural areas, did not have access to electricity.<sup>12</sup> Since 1981, the Government, has addressed balanced regional growth through community consultation and a participatory approach. Health services, construction and maintenance of feeder and farm roads, and primary education have been decentralized. Local communities (*gewogs*) now take part in the planning, implementation, and management of social infrastructure. To date, most rural communities have access to hospitals, primary schools, and local markets in their communities, but many of these facilities lack electricity. The development of such social infrastructure for basic human needs has resulted in strong demand for electricity in rural communities. Rural people now desire electricity to be provided to their households, schools, hospitals, and other community establishments. The Project is primarily aimed at the poorer members of Bhutan's rural community, as more than two thirds of its direct beneficiaries (69.8 percent) live below the estimated poverty line.<sup>13</sup> The provision of electricity is expected to reduce poverty in rural areas by increasing opportunities for employment and access to improved (through electrification) government services such as education and health. The Project is also expected to have a positive impact on reducing migration to the cities and population control.

57. Fuelwood consumption in Bhutan at 1.22 tons per capita is one of the highest in the world. Fuelwood accounts for approximately 77 percent of total energy consumption and virtually all noncommercial energy consumption as forest resources provide an abundant and readily available source of energy. This increases the pressure on deforestation in Bhutan. Collecting fuelwood is done by each household, with an estimated labor cost of Nu780 per capita. More than 30 percent of household owners are women; they will benefit substantially

<sup>12</sup> Loan 1375-BHU: *Rural Electrification Project*, for \$7.5 million, was approved on 30 September 1995 with the purpose of providing electricity to about 3,100 consumers in seven districts.

<sup>13</sup> Poverty line per household, Nu4,032 per month, is derived from average occupancy per house (8) times the estimated poverty line per person (Nu504 per month).

from rural electrification as they spend more time in their households and hence will use improved lighting and any household appliances more. Electrification of rice mills and other grain and food processing facilities will also reduce women's workload in the home. In addition, using fuelwood for cooking and heating causes respiratory diseases among women and children as they usually spend longer times in the home than do men.<sup>14</sup> Based on the PPTA survey findings, it is estimated that a 10 percent immediate decrease of fuelwood consumption will be achieved due to the proposed Project, and electrification will gradually further decrease fuelwood consumption in the long term as usage of electric heaters and water heaters increases in Thimphu and other towns.

58. Under the Government policy of using a participatory approach for rural infrastructure, the rural electrification program during the Eighth Plan (1998-2002) was created based on the consensus of local communities. Close consultation with the beneficiary local communities was undertaken during the technical feasibility study and socioeconomic study under the Bank PPTA. To maximize the development impact of rural electrification, the application of solar panels in local community centers comprising hospitals, schools, and other local community facilities is integrated in the Project based on other successful operations in Bhutan.

59. Among aid agencies, the Bank is taking a lead role in assisting with the power sector reform in the country. The Bank has maintained close consultation with UNDP/GEF, and other bilateral sources of aid, such as Austria. The Bank's initiatives for power sector reform will be enhanced by the three cascading TAs. The reform measures intend to commercialize the power sector by establishing transparent and accountable sector operation and an autonomous power utility. Therefore, the Project is also addressing DOP's human resource constraints by introducing advanced technology such as supervisory, control, and data acquisition system (SCADA),<sup>15</sup> which will efficiently utilize qualified technical staff in DOP.

## **B. Objectives and Scope**

60. The primary objective of the Project is poverty reduction. The Project will provide opportunities for cash-generating business, job creation, improvement of rural life, and strengthening education and health services to rural people, especially low-income groups, in Bhutan through electrification by locally generated hydropower from existing power stations and solar panels. Women will also be major beneficiaries of the Project as over 30 percent of household owners in the country are women. Provision of electricity under this Project will directly improve rural life and fully support other social infrastructure such as village hospitals and schools. An immediate tangible economic benefit is reduced expenditure on imported kerosene and to a small extent the use of fuelwood. In the long term, rural electrification will further reduce the use of fuelwood and decrease the pressure of deforestation. In addition, the Project will facilitate efficient human resource utilization of DOP by introducing a simple SCADA system for the planned corporatization of DOP.

61. The Project is an integral part of the rural electrification program, which was created during the Sixth Five-Year Plan. The Project will provide access to electricity to 6,038 consumers in rural villages in 16 districts (7 districts in the Western Region, 4 districts in the Central Region, and 5 districts in the Eastern Region). The number of consumers will increase by about 20 percent and the household electrification ratio will go up to about 33 percent. With the applying of SCADA, approximately 20 scarce technical staff working in substations of DOP can be transferred to other urgently necessary fields. The Project comprises (i) rural

<sup>14</sup> Respiratory infections accounted for roughly 20 percent of the patients treated in 1994.

<sup>15</sup> SCADA will be utilized for remote control of a power system.

electrification of distribution system to 6,010 consumers including 23 hospitals, 24 primary schools, and other public facilities for local communities; (ii) remote rural electrification in three districts including 4 schools, 4 hospitals, and 20 other local community facilities by renewable energy sources using solar panels; and (iii) a small-scale pilot SCADA system for substations close to Thimphu. The detailed project description is given in Appendix 7.

### C. Technical Justification

62. The Project represents the least-cost solution for providing electricity to selected rural villages in Bhutan based on a comparison with other alternate power systems. Based on the rural electrification master plan, rural electrification of villages is to be accomplished by a distribution network from the grid system to provide a reliable and sufficient supply to meet the forecasted demand. In remote villages, where electrification by a distribution system is not financially and technically feasible, solar panels were chosen to provide electricity to hospitals, schools, and other local community facilities to maximize their development impact.

63. The design of the distribution network considers both current distribution practices in Bhutan, lessons learned from the ongoing project, and cost-effective construction in accordance with international practices. The design includes (i) continuous adoption of the International Electrotechnical Commission standards for most electrical equipment and materials to facilitate international competitive bidding (ICB); (ii) improvement of portability of heavy equipment and materials considering geographic difficulties; and (iii) least-cost application of 11 kV and 33 kV distribution networks considering future load growth.

### D. Cost Estimates

64. The Project cost is estimated at \$12.5 million equivalent, comprising \$10.0 million in foreign exchange costs (80 percent) and \$2.5 million equivalent in local currency costs (20 percent). The summary is in Table 3 and the details are given in Appendix 8.

**Table 3: Cost Estimates**  
(\$ million)

Item	Foreign Exchange	Local Currency	Total Cost
<b>Base Cost</b>			
RE by distribution system	8.2	2.1	10.3
RE by solar panels	0.1	0.0	0.1
Small-scale pilot SCADA	0.3	0.0	0.3
<b>Subtotal</b>	<b>8.6</b>	<b>2.1</b>	<b>10.7</b>
Tax and duties	0.0	0.0	0.0
Physical contingency	0.9	0.2	1.1
Price contingency	0.3	0.2	0.5
IDC and service charge	0.2	0.0	0.2
<b>Total</b>	<b>10.0</b>	<b>2.5</b>	<b>12.5</b>

RE = Rural Electrification; SCADA = Supervisory Control and Data Acquisition

65. The project cost is in 1999 prices and provides for physical contingency (10 percent of the base cost) and price contingency (2.4 percent per annum for the foreign exchange cost and 7.4 percent per annum for local currency cost). The Project will be exempted from all direct taxes and duties in accordance with Government procedures for development projects.

## E. Financing Plan

66. The financing plan envisages all foreign exchange costs to be financed by the Bank loan and local currency costs to be financed by the Government, as shown in Table 4.

**Table 4: Financing Plan**  
(\$ million)

Source	Foreign Exchange	Local Currency	Total Cost	Percent
Bank	10.0	0.0	10.0	80
Government	0.0	2.5	2.5	20
<b>Total</b>	<b>10.0</b>	<b>2.5</b>	<b>12.5</b>	<b>100</b>

67. The proposed Bank loan of \$10 million equivalent will be from the Bank's Special Funds resources with a term of 32 years, including a grace period of 8 years with a 1 percent per annum interest charge during the grace period and 1.5 percent per annum thereafter. The Borrower will be the Kingdom of Bhutan.

## F. Implementation Arrangements

### 1. Project Organization

68. The Executing Agency of the Project will be DOP and after the corporatization of DOP, the corporatized DOP. As has been the practice with the existing Project, all construction and erection work of the distribution network will be undertaken by DOP staff, supplemented by local contract laborers as well as village volunteers, whose village will be electrified by the Project. The existing designated Rural Electrification Project Implementation Unit of DOP will continue to work on the proposed Project with a necessary increase in staff numbers. Existing available facilities for the ongoing project such as computer equipment, vehicles, and warehouses will be used for the Project.

### 2. Implementation Schedule

69. The project manager has already been appointed, and the Project will be implemented over a four-year period. Bidding documents for ICB and international shopping packages have been prepared by the PPTA consultants. Procurement of equipment and materials will be phased into two groups to suit DOP's storage capacity and physical implementation schedule. Physical implementation will commence in April 2001 and is expected to be completed by September 2003, six months before the anticipated loan closing in March 2004. The schedule is considered realistic as logistics and the project implementation unit have been streamlined through the ongoing project. The detailed implementation schedule is shown in Appendix 9.

### 3. Procurement

70. Procurement of necessary equipment and materials for the Project will be undertaken in accordance with the Bank's *Guidelines for Procurement*, which were revised in February 1999 reflecting the Bank's Anticorruption Policy, and mandatory use of the Bank's standard bidding documents. Since ICB contracts as originally packaged under the ongoing Project did not attract any bidders, the size, packaging arrangement, and timing of contracts was carefully reviewed. The ICB contracts were arranged into six packages and are to be issued in the same bidding document. Bidders will have the option to bid on any or all packages, thus assuring competition.

Tentative contract packages are shown in Appendix 10. Supply contracts estimated to cost the equivalent of \$500,000 or less, will be procured using international shopping procedures. Packages with an estimated contract value of more than \$500,000 will be procured through ICB. Local manufacturers may participate in bidding on the contract packages, and a domestic preference scheme may be applied in accordance with the Bank's *Guidelines for Procurement*. On 5 May 1999, the Bank approved advance procurement action in the interest of efficient and early implementation of the Project. It was clarified with the Government that the Bank's approval of advance procurement action will not in any way commit the Bank to approve the Project subsequently or to finance the cost incurred. Experience under the existing Project has been good.

#### **4. Consulting Services**

71. An international consulting firm will be recruited in accordance with the *Bank's Guidelines on the Use of Consultants*. As DOP is successfully implementing the ongoing rural electrification project in addition to more than 30 previous rural electrification schemes, limited consulting services will be required for project implementation. The international consultant will assist DOP with procurement, detailed design, construction supervision, training on the use of new equipment, and monitoring of project benefits. It is estimated that about 10 person-months will be required. DOP will provide sufficient counterpart staff. The terms of reference for the consulting services are given in Appendix 11. On 5 May 1999, the Bank approved advance recruitment action in the interest of efficient and early implementation of the Project. It was clarified with the Government that the Bank's approval of advance recruitment action would not in any way commit the Bank to approve the Project subsequently or to finance the cost incurred.

#### **5. Disbursement**

72. Disbursements under the Project will be mainly for the supply of goods and consulting services. Therefore, the Bank's commitment letter and direct payment procedures will be used for disbursement purposes.

#### **6. Reports, Accounts, and Audits**

73. Regular progress reports will be prepared for the Project and submitted to the Bank on a quarterly basis. The reports will include a description of physical progress, problems and difficulties encountered, and summary of financial accounts for the Project, which will consist of project expenditures during the period, year to date, and total to date. A project completion report will be submitted to the Bank within three months after completion of the Project. Separate accounts will be maintained for the Project by DOP. Within the nine months of the close of the financial year, detailed annual project accounts audited by an auditor acceptable to the Bank will be submitted. In addition, after corporatization of DOP in FY2002, financial statements of the corporatized DOP, consisting of an income statement, balance sheet, and a statement on sources and application of funds, audited by an auditor acceptable to the Bank will be submitted within nine months of the close of the financial year. DOP has generally been in compliance with the covenants on audited financial statements.

## **G. The Executing Agency**

### **1. Organization of DOP**

74. The existing organization of DOP reflects its responsibility for a portion of the electric power assets of the Government from generation to distribution except for CHPC. Regarding the Tala Hydropower Project Authority and the Kurichhu Project Authority, although they are separate entities, DOP seconded its staff to them for their engineering and contractual works, as well as monitoring of their physical implementation. DOP operates and maintains small power plants and 66 kV, 33 kV, 11 kV, and low voltage systems including service connections under the direct guidance of MTI. Because DOP is part of the Government, although technical matters are handled by DOP, all administrative and financial matters are supervised by the Administrative and Finance Division of MTI. Overall planning of the power sector is undertaken by DOP in consultation with other concerned ministries. Approved investment plans are conveyed to DOP for execution. All budgetary allocations are channeled from MOF through MTI to DOP. DOP collects revenues from the sale of electricity to residential consumers and remits the entire amount to the Government. DOP is also governed by the Bhutan Civil Service Rules (1990) on recruitment, pay scales, incentives, promotions, and fringe benefits as well as pensions and insurance.

75. DOP is divided into two wings, O&M, and Projects and Investigations. The O&M wing has responsibility for the maintenance and construction of transmission and distribution networks, as well as mini/microhydropower plants located in the different districts together with their associated distribution networks in electric supply units and subunits. Although the O&M wing does not have responsibility for the microhydropower plants that are operated by the local districts, it is providing necessary assistance for their maintenance and repair. The Projects and Investigations wing is responsible for monitoring implementation of projects and assisting the Government in project negotiations. The DOP organization chart is in Appendix 12.

76. In October 1993, the Government transferred certain assets and staff of DOP to local government units to improve O&M and customer service in line with the Government's decentralization policy. This resulted in the transfer of all microhydropower generation assets to the districts, which were made responsible for their O&M. In addition, the power distribution assets and the staff of DOP associated with the electric supply units of Gelephu and Samdrup Jongkhar in the Eastern Region, and Samtse in the Western Region, as well as electric supply subunits in Ha, were transferred to their respective districts. These districts are responsible for all billing and collection, and all administrative matters associated with power distribution. They operate as separate distribution entities receiving supply from locally installed microhydropower plants or from DOP through the grid.

77. For the future corporatization of DOP, the Bank has proposed that DOP be structured as the national transmission and distribution company responsible for all the transmission activities in and out of the country and the distribution activities within the country. With this sector structure, DOP will control and plan all the power transmission and distribution activities, and at the same time receive additional revenues from wheeling charges from export of power. As it now stands, with major transmission and distribution investments being planned throughout the country, DOP will not be able to survive with only domestic electricity revenues. The recommended sector structure will be further reviewed and rationalized under the Bank's ongoing TA.

## 2. Financial Projection of DOP

78. As a division within the Government, DOP does not have a separate accounting system as all financial and administrative matters are handled and supervised by the Administrative and Finance Division of MTI. At present, DOP is responsible for collection of the domestic electricity revenues while CHPC is in charge of all export sales. To see how its account will look as a corporate entity, separate from the Government budgetary system, a proforma financial projection of DOP was prepared. The projection was carried out for 1999 to 2010. As a corporate and independent entity, DOP will have to be financially self-sustainable. For this reason, the Bank proposed and the Government agreed to achieve by the end of FY2005, three years after DOP is fully corporatized, the following financial covenants: at least a 6 percent nominal rate of return on net revalued fixed assets, at least a 1.5 debt service ratio, at least a 20 percent self-financing ratio, and a maximum debt-equity ratio of 60:40. These financial targets are considered reasonable considering the relatively high inflation and savings rate in Bhutan of about 6.5 to 7.5 percent and 10 percent, respectively. A summary of DOP's financial projection is provided in Table 5, and the details and assumptions are provided in Appendix 13.

**Table 5: DOP's Financial Projection**  
(Nu Million)

Item	FY1999	FY2001	FY2003	FY2005	FY2007	FY2010
Domestic Sales (GWh)	400.0	419.0	461.9	509.2	561.4	649.9
Power Export Wheeled (GWh)			1,895.0	4,237.2	6,460.8	7,110.4
Energy Sources (GWh)	417.6	460.4	2,441.2	4,883.4	7,209.6	7,969.7
System Losses	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%
Energy Cost (Nu/kWh)	0.30	0.32	0.37	0.43	0.49	0.60
Avg Domestic Tariff (Nu/kWh)	0.60	0.69	0.85	1.00	1.13	1.48
Wheeling Charges (Nu/kWh)			0.11	0.12	0.13	0.14
Operating Revenues	238.8	291.0	595.1	1,017.7	1,468.7	1,977.8
Operating Expenses	265.8	314.7	569.9	671.7	758.0	1,278.9
Net Operating Profit	(27.0)	(23.7)	25.2	346.0	710.7	699.0
Interest Expenses	24.9	34.1	235.8	238.2	210.4	323.0
Foreign Exchange Losses	-	25.0	44.8	43.3	40.7	33.9
Income Tax					137.9	102.6
Net Profit	(51.9)	(82.8)	(255.4)	64.4	321.8	239.4
Gross Fixed Assets	1,850.9	2,558.8	6,098.3	7,979.9	9,170.4	14,589.3
Depreciation	605.0	845.3	1,284.8	1,923.6	2,634.2	4,541.2
Net Fixed Assets	1,245.9	1,713.5	4,813.5	6,056.3	6,536.2	10,048.1
Construction in Progress	1,412.3	3,285.8	2,090.2	2,595.9	3,581.0	2,725.8
Total Assets	2,724.6	5,050.7	7,027.3	8,987.8	11,086.2	13,103.0
Liabilities	1,081.8	2,287.9	2,990.6	3,519.8	3,548.2	3,100.7
Equity	1,642.7	2,741.9	4,037.7	5,468.0	7,537.9	10,002.3
Rate of Return	-1.8%	-1.3%	0.6%	6.0%	7.7%	6.0%
Debt Service Ratio	0.7	0.7	0.7	1.5	1.7	1.7
Self Financing Ratio	-8%	-5%	-16%	23%	46%	61%
Debt : Equity Ratio	33 : 67	46 : 54	45 : 55	45 : 55	41 : 59	34 : 66

79. Major assumptions in preparing the above financial projections include (i) DOP being structured as the national transmission and distribution entity for the country beginning in FY2002, thereby allowing it to earn wheeling charges for the service; (ii) energy cost for domestic use remaining at the present level of Nu0.30/kWh, increasing by the domestic inflation rate only; and (iii) assumptions on the assets level and the planned investments. The financial projections show that in the next few years and during the early years of the formation of the corporatized DOP, the company will experience heavy losses as it will now have to account for its own depreciation and financing costs, and will receive no budgetary support. However, with the additional revenues from wheeling charges being earned, particularly when power supply from the Tala plant becomes available for export in FY2005, DOP's financial position will improve, and it is expected that it will be able to achieve the financial targets by FY2005. At this time, the overall domestic tariffs and wheeling charges should be at least about Nu1.0 and Nu0.12 per kWh, respectively, bearing in mind that these tariff levels are based on the low energy supply presumably from the Chhukha plant. If the cost of supply from the generation companies increases, DOP will need to pass the increased costs to its consumers. The explicit tariff level will be further determined once the registration and valuation of DOP's assets are finalized in FY2001.

80. The current tariff of Nu0.6/kWh and even the proposed rate of Nu0.7/kWh are not sufficient to cover DOP's costs. Based on the findings under the institutional and financial development TA (footnote 2), the system average transmission and distribution cost for DOP to supply 1 kWh of energy in the country is approximately Nu1.30 per kWh. At present, these losses are not transparent because the sector as a whole is still profitable (80 percent of the energy produced in the country is exported to India at Nu1.5 per kWh, and the cost to generate this energy is less than Nu0.2/kWh). However, with the plan to corporatize DOP in the future, it is important to ensure that DOP will be financially self-sustainable and viable. Furthermore, as the Government intends to increase electrification in the rural areas, which is not commercially oriented, the Government will have to ensure that these marginal investments do not jeopardize DOP's financial condition. Therefore, DOP will need to continue to obtain long-term, low-cost funding for this type of investment. Given the large investments in the energy sector, the Government will need to carefully review the sector to ensure fair distribution of charges to the users to recover the investments.

## **H. Environmental and Social Measures**

### **1. Environmental Measures**

81. In view of the high reliance on fuelwood as a source of energy, the Government foresees benefits to accrue from the Project not only in terms of balanced development throughout the country but also in a reduction of the rate of forest depletion. The Project is expected to have a significant positive impact on the reduction of demand for fuelwood in the long term. Under the PPTA, as part of the feasibility study for the Project, an initial environmental examination was prepared and a summary is presented in Appendix 14. The Project is classified as category B, and a detailed environmental impact assessment is not necessary.

82. As part of project feasibility, an intensive field survey was undertaken for distribution line routing. Most of the distribution poles will run along the roadside and transformers will be pole-mounted. Apart from minor bush clearing along the road, no deforestation will take place. Based on the survey, the Project will have no impact on any rare or endangered flora and fauna species or habitat. There will be no discharge of polluting materials, given the nature of the Project. There are very few cultural features that fall within the project area, such as temples or

monasteries. With proper planning of the route, none of the cultural features will be disturbed other than by the minor visual appearance of distribution lines. Because most erection works are associated with poles, soil erosion and silt runoff will be insignificant. The construction activities of the Project will not have any significant impact on ecology.

## **2. Social Measures**

### **a. Targetting the Poor**

83. The Project, which targets the poorer areas of Bhutan, is the first of its kind in the Bank where the primary objective of poverty reduction is met by providing electricity to more than two thirds of project beneficiaries who live below the poverty line. It will improve the overall quality of life of rural people and reduce poverty by improving access to economic and social opportunities, including employment, schools, health services, and other social as well as government services. Women and children will benefit from the Project through a reduction of the incidence of respiratory diseases and of women's daily chores of collecting fuel, which will release their time and energy for more productive and socially beneficial activities. Construction works under the Project will require mostly unskilled labor and will generate direct income-earning opportunities, particularly for the poor. It is estimated the Project will provide 115,000 person-days of unskilled employment opportunities over a period of three and one half years. During the implementation phase, DOP will make the service connections to the poor households a priority. The poor households will be identified by DOP through consultations with community representatives, village leaders, and district administrations.

### **b. Land Acquisition and Resettlement**

84. The Project will require minimal land acquisition for the erection of transformers and poles. There will be no involuntary population resettlement. As agreed with the Government, attention will be given to establishing firm commitments for financing land acquisition well in advance of construction to ensure that delays in construction works do not occur. Compensation in cash will be provided by the Government to the owners for crops and trees located in the right-of-way of the erected poles. Bhutan has some ethnic minority groups such as Doya, Laya Lingzi, Merak Sektang, and Yak herders, who constitute less than 0.2 percent of the total population. Since the minority people live in areas that will not be covered by the Project, a minority people development plan is not required. Land acquisition was satisfactorily carried out for ongoing project without any disputes.

### **c. Participatory Project Performance Monitoring System**

85. A project performance monitoring system will be set up under the Project in association with DOP. Regular feedback will be provided by the project implementation units to the Bank regarding the effectiveness of the Project and any necessary changes that may be required during implementation. Regular monitoring reports will be included in quarterly reports prepared by DOP.

86. DOP will monitor the project benefits to enable postevaluation of the Project, and also to improve the planning of future rural electrification projects. The proposed project performance evaluation and measurement indicators will be prepared in accordance with the Bank's *Guidelines for Project Performance Management System*. DOP will establish, in consultation with the Bank, a set of performance indicators and performance targets to monitor project benefits at the time of loan inception.

87. The Bank expects to carry out a power sector review in 2002. As part of the review, consultants will conduct comprehensive social impact monitoring and evaluation before and after completion of the Project to determine (i) the total number of connected consumers in various categories, number of total potential consumers in those categories resident in the service area, and the connection ratios for those categories at various dates after commissioning; (ii) average consumption rates for consumers in each category; (iii) description of new economic activities induced by the introduction of electricity; (iv) description of existing economic activities that have switched to using electricity and thereby become more efficient and productive; (v) estimated total value of economic activities induced by the rural electrification; (vi) estimate of average income levels; and (vii) survey of the perceived importance of various types of benefits created by rural electrification, such as improved employment opportunities, increased income levels, improved quality of life and leisure activities, and improved health standards. It will also carry out concurrent surveys of average income levels in some representative and comparable communities that are not electrified to determine the incremental impact of rural electrification on income levels and economic activities. In addition, the consultants will conduct monitoring and evaluation of land acquisition activities, entitlements, time frames, and budget set out for this process. A social impact analysis of the Project is presented in Appendix 15.

## **I. Governance**

88. The Bank's operations in Bhutan are clearly addressing improvement of governance of the power sector of Bhutan as well as of DOP. For the governance of the overall power sector, the Bank is providing assistance for the policy and legal framework of the power sector, through which utility operation will be clearly segregated from policy making and regulation, and especially transparency and accountability of the tariff setting will be established. In addition, the Bank is assisting DOP to implement a commercial accounting system through its TAs for the transparent costing, efficient and sustainable operation of DOP, along with institutional strengthening in the technical fields. It will also enhance the corporate governance of DOP. Furthermore, the proposed Project was formulated following the participatory approach from the planning stage to the feasibility study stage. Such a participatory approach will also be followed during implementation.

## **J. Technical Assistance**

89. To assist DOP's transition from a Government division to a corporation, an advisory TA accompanying the present loan will be provided to the Government for the Corporatization of DOP. The major works will include (i) conducting asset registration and valuation of DOP by qualified international asset appraisers; (ii) formulating a recommendation on asset and liability and equity structures and other financial arrangement to ensure financial viability of the corporatized DOP; (iii) establishing tariff adjustment based on the long-run marginal costs and on the financial projection of the corporatized DOP; (iv) facilitating registration of the corporatized DOP including preparation of necessary documents as a company such as memorandum and articles of association as per the power sector legislation and companies act; (v) formulating the organizational structure of the corporatized DOP, such as delegation of powers, job description, necessary human resources, salary and fringe benefit structure, recruiting policy, etc.; (vi) finalizing a human resource development program, which is necessary for the corporatization of DOP in association with other aid agencies and in consultation with the Bank; and (vii) providing the necessary training on commercial accounting, corporate and financial management, and tariff setting methodology to DOP's staff by using training courses available at the Royal Institute of Management as a subcontractor to the selected consulting

firm. About 20 person-months of international consulting services will be necessary. The consultants will be recruited in accordance with the Bank's *Guidelines on the Use of Consultants*. The total cost of the TA is estimated at \$770,000 equivalent, of which \$600,000 will be financed by the Bank on a grant basis from the Japan Special Fund, funded by the Government of Japan. Terms of reference and cost estimates are indicated in Appendix 16.

## V. PROJECT JUSTIFICATION

### A. Economic Evaluation

#### 1. Load Forecast

90. The PPTA household survey results from nonelectrified and electrified households indicate that the preparedness of consumers and their willingness to pay for electricity is high. The response from the non-electrified consumers as to the level of monthly bill they are prepared to pay (average of Nu200 per month from purely domestic consumers) suggests both the willingness to pay a higher tariff and relatively high consumption levels for rural areas.<sup>16</sup> The average consumption by the project beneficiaries is expected to range from 80 to 120 kWh per month as most of the beneficiaries will fall under the lifeline consumption.<sup>17</sup> Most of the commercial activity in the villages is restricted to house-and-shop residences. The village industries, mainly comprising small rice, flour, and saw mills, are expected to convert to electricity (motor-driven), from their diesel-driven systems. Considering the domestic market and the current status of commercial activities in the rural areas, modest growth for such industries is expected.

91. The load forecast for domestic consumers in rural areas considers an overall growth of 3 percent per annum, commensurate with the population growth (2.4 percent) for the next 10 years. Beyond this period, the forecasted load was assumed to remain constant. Potential for higher consumption still exists, if proper and strict steps are taken to prevent excessive use of firewood for room heating, thereby conserving forest resources.

#### 2. Ability and Willingness to Pay

92. The survey results have indicated the consumers' willingness and ability to pay. The amount spent on fuel in nonelectrified villages and on electricity in electrified villages is very low compared with the total expenditure or income. The willingness to pay can also be gauged from the response of the surveyed households, with most (95 percent) respondents indicating their willingness to pay according to the billed amount. The survey also indicated that the villagers are keen to have electricity and are ready to pay for the initial cost of house wiring and the initial deposit.

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<sup>16</sup>The figure may be due more to their eagerness to obtain electricity, rather than the actual payment that they are going to spend, as the survey also showed that the consumption level of the poor households in rural areas is usually quite low.

<sup>17</sup>As recommended under the Bank's TA for institutional and financial development (footnote 2), completed in March 1997, a lifeline consumption block is set at 80 kWh per month, a middle block up to 200 kWh per month, and a third block over 200 kWh per month.

### **3. Least-Cost Alternative**

93. The Project represents the least-cost solution for supplying electricity to the project areas in a reliable manner to meet the expected demand. It includes a combination of grid-fed services and some isolated community-based solar systems.<sup>18</sup> The source of supply for the schemes is mainly indigenous hydropower. Power from these sources will be brought to consumers through extensions of the existing transmission and distribution network. The alternative with diesel power generation for the project areas is not considered viable, due to the difficulty with transportation in certain terrain, and the fact that the fuel cost and O&M cost for the diesel alternative would be costlier compared with the network extensions. Further, the proposed transmission and distribution extensions enable future expansion and can fit in the overall master plan for rural electrification. Some centers of local communities can not be electrified by the network expansion, although they comprise schools, hospitals, and other public facilities. For such local centers, electrification by solar panels or mini/microhydropower is applicable. Under the proposed Project, solar panels will be applied to three local community centers as the least-cost alternative.

### **4. Economic and Financial Analysis**

94. Benefits of the proposed Project have been estimated in terms of nonincremental and incremental benefits based on Bank guidelines. For residential and nonindustrial consumers, their nonincremental benefit is estimated by resource cost savings (about 80 percent of total load forecast), i.e., cost savings from the substitution of kerosene by electricity for lighting, and the incremental benefit for the new market (representing about 20 percent of load forecast) by willingness to pay, i.e., the benefit of increased consumption because of the availability of lower cost electricity. For the industrial/commercial consumers, or those motive power users, their willingness to pay is estimated by the cost (capital and O&M cost) of self-generation from a captive diesel plant. The Project will start accruing benefits progressively from FY2001 as the 16 districts in the rural areas are being electrified, and the full benefits will be in FY2003. The project economic internal rate of return based on this approach was calculated to be about 13 percent, as compared with the 10 percent discount rate for Bhutan. Further details of this analysis are given in Appendix 17. The sensitivity analysis shows that despite the high capital cost, the relatively low electricity consumption and the large gap between the export and domestic tariff, the Project remains economically viable. There would have to be more than a 14 percent increase in cost for the project economic internal rate of return to fall below 10 percent. Similarly, there has to be at least a 12 percent decline in benefits for the net present value to fall to zero. This provides sufficient cushion to guard against any fluctuation in the economic growth rate. Without the Project, the alternative would be to maintain the high kerosene and diesel oil consumption, all of which are imported from India, and in the longer term, the use of fuelwood. The nonquantifiable benefits of the Project are (i) improvement of the livelihood of the people in the rural area, (ii) provision of opportunities for cash-generating business, and thus promoting economic development, (iii) reduction of the use of fuelwood in the long term, which is hazardous to the health of the people, (iv) decrease in the pressure of deforestation, and (v) assistance to improve functioning of social and public infrastructure facilities such as hospitals and schools.

95. Given the nature of the Project, which caters mainly to poor rural consumers, the Project is financially marginal (financial rate of return is negative) as its investment cost is not fully compensated by the financial gain from the output. The tariff in the rural areas is also expected

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<sup>18</sup> The least-cost analysis is further complemented by the proposed UNDP/GEF-assisted mini/micro hydropower plants to remote villages.

to rise more slowly than urban and industrial tariffs. The Project largely represents the social obligation of the Government to its people. Therefore, the Government has to make sure that it will not adversely affect DOP's financial performance, especially once DOP is corporatized and becomes an independent entity. In this case, the Government agreed to ensure that DOP would achieve the financial targets (minimum 6 percent rate of return on net fixed assets, debt service ratio of 1.5, and self-financing ratio of 20 percent) through necessary tariff adjustments. DOP once corporatized will be able to meet these financial targets from FY2005 onward.

## **B. Environmental and Social Dimensions**

### **1. Environmental Dimension**

96. The Government is addressing environmental concerns and maintaining strict regulations to preserve a minimum 60 percent of the forest covering the total land area. In view of the high reliance on fuelwood as a source of energy in households, the Government foresees benefits to accrue from the Project not only in terms of balanced development throughout the country but also in a reduction of the pressure of deforestation in the long term. Fuelwood consumption in rural areas will be gradually replaced by electricity, which is indigenously generated from hydropower stations.

### **2. Social Dimension**

97. The surveys conducted under the PPTA were undertaken using a participatory approach and included a socioeconomic survey of over 466 households in electrified and nonelectrified villages. During fact-finding, full consultations with stakeholders were carried out involving communities, particularly the rural poor. Several meetings were held in the project areas with nongovernment organizations, community-based organizations, and members of civil society organizations. A social impact assessment was carried out and a summary is included in Appendix 15.

98. Provision of electricity under this Project will directly improve the quality of life for 5,437 rural households. The immediate tangible economic benefit is reducing expenditure on imported kerosene and to a smaller extent the use of fuelwood. It has been estimated that a 10 percent immediate decrease in fuelwood consumption will be achieved as a result of the Project. The Project also provides electricity to public facilities such as health centers, schools, and other public facilities for local communities. Therefore, the Project will increase the overall level of economic and social well-being of Bhutan's rural population.

99. Rural electrification will especially improve the living conditions of women and children. Electrification reduces the incidence of respiratory diseases among women and children as they usually stay in the house longer than do men. The Project, for instance, will benefit women substantially by reducing women's daily chore of collecting fuelwood. Reducing women's burden of collecting fuelwood would release their time and energy for more productive and socially beneficial activities. In addition, electrification of ricemills and other grain mills as well as food processing facilities also reduces women's workload.

100. In addition to direct enhancement of household welfare, policy objectives of rural electrification emphasize social impacts of the overall benefit to the community. The use of electricity by community services and positive impacts on reduction of population growth, rural-urban migration, and modern lifestyle are usually expected to be substantial. Rural electrification will be used by rural schools, and health clinics, and for street lighting and public buildings. The

fact that there is a wider range of goods and services available is also a benefit to the community. Less tangibly, the availability of electricity tends to provide rural communities with a psychological boost as it brings them into active contact with national and international perspectives (radio, television, Internet, etc.), thus improving the moral and civic pride of rural people.

### **3. Impact on Poverty**

101. The overall strategy of the Project for poverty reduction has been formulated in terms of two approaches: targeted interventions to meet the basic electricity needs of the poor and broadly based economic growth to generate income-earning opportunities for the poor. The Project is expected to reduce rural poverty and raise living standards of rural communities through increased access to electricity. The specific objectives are to (i) provide opportunity for income-generating activities, (ii) generate employment through expansion of cottage and small industries to mitigate rural poverty, (iii) improve the quality of rural life, and (iv) provide adequate and quality education and health services to rural people, particularly the poor and vulnerable groups through the supply of hydropower-generated electricity from existing local power stations and solar panels.

102. Approximately 6,038 customers in rural villages in 16 districts will be provided with access to electricity. The poverty profile of the population affected by the Project is such, that 4,217 households<sup>19</sup> or more than two thirds (69.8 percent) of the Project's beneficiaries live below the estimated poverty line level of Bhutan.<sup>20</sup> During the implementation phase, DOP will provide the service connection to poor households as a first priority. Poor households will be identified by DOP through consultations with community representatives, village leaders, and district administrations. In addition, construction of transmission lines, which mostly require unskilled labor, will generate direct income-earning opportunities, particularly for the poor. Over three and one-half years, the Project will provide approximately 115,000 person-days of unskilled employment opportunities, particularly for the poor.

103. The availability of electricity will become a stimulant to the creation of new rural industry and commerce. In Bhutan, agricultural processing is the main direct industrial productive use of electricity in rural areas, e.g., grain grinding, flour milling, rice husking, and production of seed oil. The productive use of electricity will increase employment opportunities and reduce rural to urban migration. Furthermore, the supply of electricity to the lower income households is expected to enhance their income-earning potential, as weaving and other cottage industry activities can continue at night.

## **C. Risks**

### **1. Macroeconomic Risks**

104. At the macroeconomic level, slower economic growth could result in growth of electricity sales lower than the assumed level. This would result in the project investment taking a longer time to realize full benefits, thereby adversely affecting the project returns. The projected 3 percent increase of demand is sufficiently lower than the actual increase of 5 percent of the

<sup>19</sup> Based on the PPTA report, the average number of household members is eight.

<sup>20</sup> Since no documented information on the poverty line of Bhutan is available, its assessment has been based on the same yardstick (primarily on food intake of 2,400 calories per person per day) as that followed in India, adjusted to consider nuances relevant to Bhutan, such as expenditure on transport, shelter, clothing, fuel, etc. This is estimated to be around Nu504 per person per month or \$144 per capita per year (December 1998 price level).

load growth in the last five years. Thus, the probability of even lower load growth is not considered high.

105. The risk from lower than assumed tariffs could be significant for DOP's viability. However, the Government already provided assurances to ensure that DOP will be financially sustainable, and that it will achieve the financial covenants through gradual overall tariff adjustment and introduction of the three-block tariff to low voltage customers prior to the corporatization of DOP. Therefore, the average tariff for low voltage customers will be higher than the overall tariff assumed for the evaluation of the Project. In this context, the probability of tariff increases falling significantly lower than the assumed increases is considered low. In addition, the Government will allow DOP to receive additional revenues from wheeling power to India.

106. As a major portion of the Project's investment is in foreign currency, it is sensitive to the ngultrum devaluation. Drastic devaluation of the local currency is unlikely to happen as the ngultrum is tied to the Indian rupee. This issue will be addressed as part of the ongoing dialogue on tariff structure and the scheduled private sector participation TA.

## **2. Institutional and Project Risks**

107. The Government is required to provide financing for 20 percent of the project cost from its budget. The risk of shortfall in this is low considering the current prudent Government policy for the budget. In addition, the power sector is a revenue-earning sector for the Government and the Project is provided priority because of its socioeconomic impact. The risk of institutional capability not being adequate to construct and operate the Project is minimal because of DOP's considerable experience with similar projects and the track record of the ongoing project funded by the Bank. Through the ongoing project, DOP's technical and institutional capability as the project executing agency was substantially strengthened.

108. Technical, environmental, and social risks are minimal. Implementation risks do exist due to the geographic difficulties. However, through the ongoing rural electrification project, DOP has enough managerial capability to execute the proposed Project as DOP has acquired sufficient logistic capability to cover all districts of Bhutan. In addition, advance procurement action will provide DOP with the benefit of continuity. There will be a foreign exchange risk for DOP after the planned corporatization. Therefore, higher debt service requirements and tariff adjustment to foreign currency fluctuation are covenanted.

## **VI. ASSURANCES**

### **A. Specific Assurances**

109. The Government has given the following assurances, in addition to the standard assurances, which has been incorporated in the legal documents:

#### **a. Corporatization of DOP**

The new legislation for the power sector will change DOP into a commercial corporation based on the recommendations of the two Bank TAs, Policy and Legal Framework for Power Sector Development and Corporatization of DOP in consultation with the Bank, and will be ratified by the end of FY2002.

**b. Administrative**

- (i) The Government and DOP will provide sufficient human resources to undertake the corporatization of DOP in consultation with the Bank.
- (ii) The Government will ensure that DOP will have the number of personnel to operate and maintain the corporatized DOP efficiently and effectively based on the findings of the Corporatization TA.

**c. Tariff Adjustment**

- (i) The Government, on 1 January 2000, will increase the urban and industrial domestic tariffs to Nu0.70 per kWh and on or prior to 1 July 2001 will further increase the urban and industrial domestic tariffs to Nu0.80 per kWh.
- (ii) In accordance with the recommendation of the tariff study of the Bank TA (TA BHU 2400), the Government will implement a two-part tariff for the transmission level and primary distribution level voltage consumers, and a three-block tariff for the secondary voltage consumers by end of FY2001.
- (iii) Following the corporatization of DOP, the Government will permit DOP to share export earnings from the sale of electricity to India by levying a wheeling charge for transmitting bulk power through the DOP's transmission system. The wheeling charge with revenue from domestic tariffs will together be sufficient to ensure that the newly corporatized DOP maintains the covenanted financial ratios starting from FY2005. The wheeling charge and the rate of increase of domestic tariffs to enable the corporatized DOP to meet the agreed financial ratios will be accurately determined through the two Bank TAs, Policy and Legal Framework for Power Sector Development and Corporatization of DOP, in consultation with the Bank. Should the findings of the two TAs require further adjustment of the tariff and wheeling charge, the Government/DOP will implement them.

**d. Financial**

- (i) Through the new legislation of the power sector, a transparent administrative tariff adjustment scheme will be implemented, such as a tariff adjustment to foreign currency fluctuation and domestic inflation prior to the corporatization of DOP.
- (ii) Upon the corporatization of DOP, the Government will provide adequate asset, equity, and liability structures with a maximum debt-equity ratio of 60:40, and other financial arrangements to maintain financial viability of the corporatized DOP.
- (iii) Starting from FY2005, the corporatized DOP will maintain a rate of return of at least 6 percent of the net revalued fixed assets, debt service ratio of at least 1.5, and self-financing ratio of at least 20 percent.
- (iv) Separate accounts will be maintained for the Project by DOP. Within the nine months of the close of the financial year, DOP will submit to the Bank detailed annual project accounts audited by an auditor acceptable to the Bank.

- (v) The corporatized DOP will submit to the Bank its financial statements, consisting of an income statement, balance sheet, and a statement on sources and application of funds, audited by an auditor acceptable to the Bank within nine months of the close of each financial year.

**e. Project Implementation**

- (i) DOP, and after the corporatization of DOP, the corporatized DOP will be the Executing Agency and will be responsible for implementing, monitoring, and coordinating all project activities.
- (ii) The Government and DOP will make adequate budgetary allocations for the Project for each related fiscal year to ensure timely and effective project implementation.
- (iii) DOP will maintain a project implementation unit in its O&M wing to ensure timely implementation of the Project, and to liaise with the Bank and consultants during implementation of the Project. The unit will be headed by a senior engineer or its equivalent, be staffed with adequate technical and administrative personnel, and be provided with adequate support facilities.
- (iv) The Government and DOP will take all necessary actions to ensure that all lands, rights-of-way, and other rights in land or privileges required for the Project are made available on a timely basis. The Government will offer adequate cash compensation or suitable alternative land sites to landowners affected by the land acquisition.
- (v) DOP will monitor project implementation with benchmark information to be agreed upon with the Bank. During the implementation period, DOP will furnish the Bank with a quarterly report including a description of physical progress, problems and difficulties encountered, and summary of a financial accounts for the project, which will consist of project expenditures during the period, year to date, and total to date. DOP will submit a Project completion report to the Bank within three months after completion of the Project.

**f. Environmental and Social Measures**

- (i) DOP will ensure that all environmental laws, regulations, guidelines, and standards are complied with during the project construction and operational stages. DOP will ensure that adverse environmental impacts related to the construction and operation of the Project are minimized through implementation of the environmental monitoring program and mitigation measures as specified in the initial environmental examination prepared for the Project, and as agreed with the Bank.
- (ii) DOP will perform the social and environmental monitoring activities. The result of the monitoring and mitigation measures will be reported to the Bank through the quarterly reports on Project implementation and an evaluation report after project completion.
- (iii) The Government will provide adequate funds in a timely manner for implementation of such mitigation measures as necessary.

- (iv) During the implementation phase, DOP will make the service connections to the poor households a priority. The poor households will be identified by DOP during implementation, through consultations with community representatives, village leaders, and district administrations.

**B. Conditions for Loan Effectivity**

110. The Government has agreed to undertake the following actions prior to loan effectivity.

Create a group in MTI that will act as a steering committee for the TA, Corporatization of DOP. The group will comprise at least four dedicated officers, one project manager, one financial specialist, one administrative officer, and one engineer at the initial stage.

**VII. RECOMMENDATION**

111. I am satisfied that the proposed loan would comply with the Articles of Agreement of the Bank and recommend that the Board approve the loan in various currencies equivalent to Special Drawing Rights 7,206,000 (\$10 million equivalent) to the Kingdom of Bhutan for the Sustainable Rural Electrification Project, with a term of 32 years, including a grace period of 8 years, and with an interest charge at the rate of 1 percent per annum during the grace period and 1.5 percent per annum thereafter, and such other terms and conditions as are substantially in accordance with those set forth in the draft Loan Agreement presented to the Board.

21 October 1999

TADAO CHINO  
President

## APPENDIXES

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## PROJECT FRAMEWORK

Design Summary	Project Target (Verifiable Indicator)	Project Monitoring Mechanism	Major Assumptions/Risks
<p><b>Ultimate Goals:</b></p> <p>Reduce poverty and increase economic growth in Bhutan, particularly in rural areas and sustainable power sector development.</p>	<p>a. Increase electrification in rural areas and improve quality of life.</p> <p>b. Increase Gross Domestic Product (GDP) per capita.</p>	<p>a. Annual monitoring based on national statistics and Division of Power's (DOP's) operation records</p>	<p>a. Continuous economic reform in accordance with the Eighth Plan</p>
<p><b>Objectives and Purposes:</b></p> <p>a. Facilitate rural electrification in a sustainable manner and provide access to electricity to the poor in remote villages.</p> <p>b. Improve the quality of life and provide business and job opportunities.</p> <p>c. Support a sustainable power sector restructuring.</p>	<p>a. Using a participatory approach to introduce comprehensive rural electrification by using renewable energy as well as a grid system.</p> <p>b. Segregate policy making and regulation from operation.</p> <p>c. Achieve financial and management autonomy of the corporatized DOP.</p>	<p>a. Participation of rural people in planning, installation benefits, monitoring to maximize the development impact of rural electrification.</p> <p>b. Close monitoring of the implementation of the recommendations of TA 3112: Policy and Legal Framework for Power Sector Development (Corporatization of DOP, transparent procedure of tariff revision)</p>	<p>a. Delay of rural electrification programs because of geographical difficulties</p> <p>b. Delay of the National Assembly approval of the bills (electricity act, secondary laws, and regulations)</p> <p>c. Inability of consumers to pay for connection</p> <p>d. Delay of load growth due to low economic growth</p>
<p><b>Outputs:</b></p> <p>a. Creation of a model project of sustainable rural electrification through</p> <ul style="list-style-type: none"> <li>• Provision of electricity to 6,010 customers in 15 districts (more than two thirds of the project beneficiaries live below the poverty line)</li> <li>• Electrification by solar panels in remote villages of three districts (schools, hospitals)</li> <li>• Efficient load dispatch in Thimphu area by introduction of Supervisory Control and Data Acquisition (SCADA).</li> </ul>	<p>a. Completion by September 2003</p>	<p>a. Close monitoring of the implementation of the project components by semiannual Bank review missions</p> <ul style="list-style-type: none"> <li>• Quarterly project report prepared by DOP</li> </ul>	<p>a. Delay of procurement due to lack of replies from international bidders</p> <ul style="list-style-type: none"> <li>• Delay of delivery of procured goods due to difficulties of transportation</li> <li>• Delay of physical implementation due to lack of sufficient number of technicians and local workers</li> </ul>

Design Summary	Project Target (Verifiable Indicator)	Project Monitoring Mechanism	Major Assumptions/Risks
<p>b. Corporatization of DOP</p> <ul style="list-style-type: none"> <li>• Management autonomy of DOP</li> </ul> <p>c. Tariff adjustment</p> <ul style="list-style-type: none"> <li>• Financial viability and autonomy of the corporatized DOP</li> </ul>	<p>b. Milestone events for corporatization of DOP</p> <ul style="list-style-type: none"> <li>• Asset valuation and registration (FY2001)</li> <li>• Financial planning (FY2002)</li> <li>• Registration of the company (FY2002)</li> <li>• Organizational setup (FY2003)</li> <li>• Management and staff training (FY2000-2003)</li> </ul> <p>c. Implement the tariff adjustment of TA 2400 by the end of 2001.</p> <ul style="list-style-type: none"> <li>• Increase overall tariff to meet the financial targets (Rate of Return=6%, Debt Service Ratio=1.5, Self Financing Ratio=20%)</li> <li>• Implement two-part tariff for high and medium voltage customers</li> <li>• Implement three-block tariff for low voltage customers</li> <li>• Gradual overall tariff increase to meet the financial targets by the end of FY2005</li> </ul>	<p>b. Confirmation through Bank review missions of the Governments commitment to the following major issues:</p> <ul style="list-style-type: none"> <li>• Sector structure, roles of Government and corporatized DOP</li> <li>• Tariff and licensing regulatory functions and procedure in the Government</li> <li>• DOP's corporate structure</li> </ul> <p>c. Confirmation through Bank review missions</p>	<p>b. Delay of creation of consensus in the Government, especially on the timing of corporatization of DOP.</p> <ul style="list-style-type: none"> <li>• Delay of smooth functioning of the corporatized DOP because of human resource constraints.</li> </ul> <p>c. Delay of tariff adjustment because of human resource constraints and decrease of competitiveness of electricity intensive industries or indecision by Government</p>
<p><b>Inputs:</b></p> <p>a. \$10.00 million by Bank \$2.5 million by the Government</p> <p>b. Corporatization of DOP <b>(Technical Assistance)</b> \$600,000 by Bank \$170,000 by the Government</p>			

## POWER SUPPLY AND ENERGY BALANCES OF DIVISION OF POWER (FY1991 TO FY1997)

Sl. No.	Particulars	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97
1.	Installed Capacity (MW)							
a.	Hydro	5.560	6.060	6.060	6.150	6.150	8.350	8.350
b.	Diesel	5.445	5.501	5.506	5.790	5.790	5.790	5.790
c.	Other Diesel Sets (Captive)	6.232	6.232	6.232	6.232	6.520	6.520	6.520
	Total	17.237	17.793	17.798	18.172	18.460	20.660	20.660
2.	Energy Generated (GWh)							
a.	Hydro	7.451	8.196	5.046	5.488	5.889	7.500	10.245
b.	Diesel	0.043	1.314	1.033	1.085	0.177	0.056	0.073
	Total	7.494	9.510	6.079	6.573	6.066	7.556	10.319
	Growth (% per annum)	188.120	26.902	(36.078)	8.126	(7.713)	24.563	36.562
3.	Energy drawn from CHP(GWh)	149.689	172.205	184.080	187.300	286.756	375.639	360.579
4.	Energy import from India:(GWh)							
a.	From PGCIL						3.977	3.925
b.	From WBSEB	0.883	0.982	0.643	1.217	0.722	0.539	0.425
c.	From ASEB	3.553	4.002	4.454	3.406	4.617	2.721	2.682
	Total Imports	4.436	4.984	5.097	4.623	5.339	7.237	7.032
5.	Total Energy							
	Supply (GWh)	161.619	191.402	200.445	203.97	303.677	395.689	383.253
	Growth (% per annum)	9.518	18.428	4.724	1.759	48.883	30.299	(3.143)
6.	Total Energy sales (GWh)	144.665	164.416	179.013	183.268	281.467	348.049	366.363
	Growth (% per annum)	8.936	13.653	8.878	2.377	53.582	23.655	5.262
7.	Energy Losses(GWh) <sup>a</sup>	16.954	26.986	21.432	20.702	22.210	47.640	16.890
	Losses as % of Supply	10.490	14.099	10.692	10.150	7.314	12.040	4.407
8.	Peak System Demand (MW)	22.800	22.000	23.000	33.000	70.416	70.416	72.000
9.	Length of HT lines (11 kV)							
a.	Overhead	751.040	765.139	764.781	820.140	841.220	872.257	927.823
b.	Underground	8.600	8.600	8.600	8.600	9.014	9.014	9.014
10.	Length of LT lines (cct-km)							
a.	Overhead	730.309	732.439	733.872	736.886	736.886	809.697	869.105
b.	Underground	28.000	28.000	28.000	28.000	29.046	29.046	29.046
11.	a. No. of Consumers	18806	19626	19501	19901	21797	21990	22905
	b. Nonregistered consumers <sup>b</sup>						7275	7416
	Total consumers						29265	30321
12.	No. of Towns Electrified	30	36	37.000	37	38.000	39	39
13.	No. of Villages Electrified	254	270	277.000	282	297.000	331	363
14.	Revenue earned from energy sale (million Nu)	36.875	41.780	49.323	69.641	108.239	182.599	178.743
15.	Per Capita Energy Consumption (kWh)	269.365 <sup>c</sup>	319.004 <sup>c</sup>	334.074 <sup>c</sup>	339.950 <sup>c</sup>	474.918 <sup>d</sup>	618.815 <sup>d</sup>	599.367 <sup>d</sup>

ASEB = Assam State Electricity Board; PGCIL = Power Grid Company of India Limited; WBSEB = West Bengal State Electricity Board;

CHP = Chhukha Hydropower Project; GWh = Gigawatt-hours; HT = High Tension; KWh = Kilowatt-hours; LT = Low Tension.

<sup>a</sup> Transmission/distribution losses and auxiliaries/free supply to contractors.

<sup>b</sup> Sub-consumers paying directly to bulk consumers of DOP.

<sup>c</sup> Based on population figure of 0.6 million from 7th plan document of Planning Commission.

<sup>d</sup> Based on population figure of 639,430 from Statistical Yearbook 1993 of Planning Commission.

## EXISTING POWER SYSTEM IN BHUTAN

Table A3.1: Details of Major Hydrogenerating Stations (1996-1997)

Sl. No.	Station	Installed Capacity (No. X MW)	Generating Capacity (MW)	Year of Commissioning	Peak Generation (MW)	Energy Generated (GWh)
1.	Chhukha	4 X 84.00	336.000	1986-88	363.000	1,828.062
2.	Chhume Bumthang)	3 X 00.50	1.000	1988	0.435	2.368
3.	Gidagom (Thimphu)	5 X 00.25	0.500	1973	0.000	0.000
4.	Chenari (T/Gang)	3 X 00.25	0.250	1972	0.000	0.000
5.	Rangjung (T/Gang)	2 X 01.10	2.200	1996	0.790	3.832
6.	Khaling (T/Gang)	3 X 00.20	0.400	1987	0.215	0.523
7.	Khalanzi (Mongar)	3 X 00.13	0.260	1976	0.256	1.040
8.	Jushina (Thimphu)	4 X 00.09	0.090	1967	0.000	0.000
9.	Wangdue Phodrang	3 X 00.10	0.200	1972	0.115	0.263
	<b>Total</b>	<b>343.35</b>	<b>340.900</b>			<b>1,836.088</b>

GWh = Gigawatt-hours; MW = Megawatt.

Table A3.2: Major Transmission Lines for Evacuating Chhukha Power (Line Lengths in km)

Sl. No.	Particulars	220 kV	66 kV
1	CHP – Birpara	71.000 (D/C)	–
2	CHP – Singhigaon	31.900	–
3	CHP – Simtokha (II)	54.900	–
4	CHP – Gedu	–	20.100
5	Gedu – Phuentsholing	–	17.700
6	CHP – Confluence	–	36.700
7	Confluence – Simtokha (I)	–	18.300
8	Confluence – Ha	–	33.522
9	Confluence – Paro	–	24.022
10	Simtokha – Wangdue Phodrang	–	26.023
11	Phuentsholing – Gomtu	–	27.002
12	Phuentsholing – Singhigaon	–	8.380
	<b>Total</b>	<b>71(D/C)::86.8(S/C)</b>	<b>211.749</b>

CHP = Chhukha Hydropower Project; D/C = double circuit, S/C = single circuit.

**EXTERNAL ASSISTANCE TO THE POWER SECTOR FROM 1993 ONWARD**  
(\$ million)

<b>Funding Agency</b>	<b>Name of Project</b>	<b>Start Date</b>	<b>End Date</b>	<b>Amount</b>
1. Asian Development Bank	Rural Electrification Project (loan)	1995	1999	7.500
	Power System Development (TA)	1993	1994	0.245
	Institutional & Financial Development DOP (TA)	1995	1996	0.400
	Second Rural Electrification (TA)	1997	1998	0.600
2. United Nations Development Programme	Rural Energy Development Project, Rangjung	1994	1996	0.037
	Mini/Micro Hydro Development feasibility study	1998	1999	0.364
	Decentralization of Rural Electrification			
3. Government of India	Rural Electrification	1993	1999	1.108
	Subtransmission & Distribution (urban areas)	1993	1999	0.625
	Semtokkha II	1993	1994	0.504
	Mini-hydel, Thimpu (Rehabilitation)	1994	1998	0.313
	Geytsa Pondage Scheme (Rehabilitation)	1996	1997	0.018
	Kurichhu Hydro Power Project (loan)	1994	2001	24.045
	Kurichhu Hydro Power Project	1995	2001	36.304
	Tala Hydro Power Project (loan)	1996	2004	132.768
	Tala Hydro Power Project	1997	2004	199.151
	Power Transmission Eastern Grid	1998	2002	18.859
	Power STD Phase II (Thimpu & Paro)	1998	2002	9.318
	Mini-hydels-Wangdue Phodrang	1998	2002	0.068
	Mini-hydels-Chhenary (Rehabilitation)	1998	2002	0.402
	Mini-hydels-Lhuentse (Rehabilitation)	1998	2002	0.212
	Mini-hydels-Gidagom (Rehabilitation)	1998	2002	0.641
	Mini-hydels-Khaling (Rehabilitation)	1998	2002	0.135
	Mini-hydels-Khalanzi (Rehabilitation)	1998	2002	0.270
	Mini-hydels-Chhume (Rehabilitation)	1998	2002	0.282
	Lhuentse Small Hydroelectric Project	1998	2002	2.829
	Improvement & Upgradation of Transmission Grid	1998	2002	4.479
	Rural Electrification Transmission Lines	1998	2002	1.031
	Urban Electrification	1998	2002	6.374
	Improvement & Upgradation of Electric Services	1998	2002	9.765
4. Austria	Detailed Planning to Basochhu Hydropower Project	1993	1994	1.383
	Basochhu Hydropower Project (Stage I)	1996	2000	14.435
	Basochhu Hydropower Project (Stage I) (loan)	1996	2000	13.633
	Rangjung Hydropower Project	1993	1996	6.415
5. Netherlands Government	Rural Electrification	1995	1999	1.373
	Solar Lighting	1995	1999	0.472

DOP = Division of Power; TA = Technical Assistance.

Source: External Resource Management Systems (ERMS), National Budget & Aid Coordination Division (NBACD), Bhutan.

**UPDATED ACTION PLAN FOR TARIFF ADJUSTMENT AND CORPORATIZATION OF DIVISION OF POWER**

Calendar Year	1996	1997	1998	1999	2000	2001	2002
<b>A. Government Policy</b> <b>1. Corporatization and Privatization</b> (i) Small-Scale Entities	7th Five-Year Plan		8th Five-Year Plan				
	Postal Services		: Completed				
	Urban Services		: Completed				
	(2) Medium-Scale Entities		Telecommunication				
	1. Organization Structure 2. Staff Training	1. Telecommunication Acts 2. Communication Regulation	1. Financial Planning 2. Corporate Planning				
<b>B. Power Sector</b> <b>1. Tariff Adjustment</b>	Preparatory Stage		Transition Stage			Implementation Stage	
	1. Uniform Tariff Nu0.40/kWh to Nu0.50/kWh 2. Tariff Study (TA BHU 2400) Revision and increase of tariff (i) Categorized tariff (Vologewise, Gov't. and Nongov't.) (ii) Two-part tariff (demand and energy) (iii) Three-blocked tariff (80 kWh, 200 kWh)	1. Phase 1 (1 July 1997) Industrial/Urban Customer Nu0.50/kWh to Nu0.60/kWh	Note: Tariff will be gradually revised so that the target financial criteria can be achieved by the end of FY2005.  2. Phase 2 (2000) Industrial/Urban Customer Nu0.60/kWh to Nu0.70/kWh			3. Phase 3 (2001) Industrial/Urban Customer Nu0.70/kWh to Nu0.80/kWh  Implementation of (i) Categorized Tariff - Vologewise (ii) Two-part Tariff - Demand and Energy (iii) Three Block Tariff for LT - 80 kWh/ 200 kWh	: Target Year of Full Implementation
	1. Target Financial Criteria (i) Rate of Return: 6% (ii) Debt-Service Ratio: 1.5 (iii) Self-Financing Ratio: 20% to be effective FY2005						
<b>2. Corporatization of DOP</b> (Detailed scope will be finalized in association with the Bank)	Preparatory Stage		Transition Stage			Implementation Stage	
	1. Pilot Accounting System (TA BHU 2400) 2. Corporatization Study (TA BHU 1729)	1. Human resource development (Engineering/Finance/Management): DOP 2. Full-scale commercial accounting system:(TA BHU 2912) 3. Power sector legal framework (Act, Standards, Hydropower Development Policy, and Guidelines): TA BHU 3112 4. Institutional strengthening (Engineering, Technical Standards, Investment Standards): (TA BHU 2912) 5. Overall structure of the power sector including DOP: TA BHU 3112			1. Assets evaluation and registration: TA-III 2. Corporate planning and financial planning: TA-III 3. Detailed organization structure and setup: TA-III 4. Staff transfer, recruitment, and training: TA-III		: Target Year of Corporatization
<b>3. ADB Technical Assistance</b>	TA BHU 2400 Insitutional and Financial Development of DOP		TA BHU 2912 Second Rural Electrification		TA BHU 3112 Policy and Legal Framework for Power Sector Development		TA-III Corporatization of Division of Power
							TA-IV: Private Sector Participation in Hydropower Dev.

DOP = Division of Power

## SUMMARY OF HUMAN RESOURCE DEVELOPMENT PROGRAM OF DIVISION OF POWER

### A. Management Level Training

No.	Name of Training	Style	Duration (months)	1999	2000	2001	2002	Necessary Slots	Aid Agencies
1	Policy and Legal Framework	Workshop	0.2	20				20	ADB (TA)
2	Financial Planning & Corporate Management	Seminar	1		10			10	ADB (TA), RIM
3	Electric Utility Management	Seminar	1		10			10	E7, RIM
4	BOO/BOT Hydropower Project	Workshop	0.2			20		20	ADB (TA)
5	Power System Studies and Load Dispatch	Seminar	3	1	1	1	1	4	ACB/E7
6	Distribution Planning and Operation	Seminar	3	2	2	2	2	8	ACB/E7

### B. Middle Management Training

No.	Name of Training	Style	Duration (months)	1999	2000	2001	2002	Necessary Slots	Aid Agencies
1	Financial Management of Electric Utility	Seminar	0.2		5			5	ADB (TA), RIM
2	Financial Management	OJT	12			5		5	ADB (TA)
3	Commercial Accounting for Accounting Officers	Seminar	1		5	5		10	ADB (TA), RIM
4	Commercial Accounting for Accounting Officers	OJT	11		5	5		10	ADB (TA)
5	Commercial Accounting for Non-accounting Engineers	Seminar	0.5			20		20	ADB (TA), RIM
6	Commercial Accounting for Non-accounting Engineers	OJT	11			20		20	ADB (TA)
7	Inventory and Material Management	Seminar	1		6		6	12	ACB/E7
8	Substation, Relay, and Control Engineering	Seminar	1	8	8	8	8	32	ACB/E7
9	Hydropower Engineering	Seminar	6	1	1	1	1	4	ACB/E7
10	Hydrology and Meteorology	Seminar	4	2	2	2	2	8	ACB/E7
11	Survey & Remote Sensing	Seminar	3		2		2	4	ACB/E7

### C. Staff Level Training

No.	Name of Training	Style	Duration (months)	1999	2000	2001	2002	Necessary Slots	Aid Agencies
1	Commercial Accounting for Technical Staff	Workshop	0.2		20	20		40	ADB (TA), RIM
2	Cable Joint Training	Seminar	1		10			10	ADB (TA)-
3	Substation Engineering	Seminar	1		10			10	ACB/E7
4	Hydropower Plant Engineering	Seminar	0.2			20		20	ACB/E7
5	Meteorology Observers Training	Seminar	6	3		3		6	ACB/E7
6	Hydro Meteorology Equipment training	Seminar	3	0	2	0	2	4	ACB/E7

ADB = Asian Development Bank; ACB = Austrian Coordination Bureau; RIM = Royal Institute Management; E7 = is a group of eight major electric companies composed of Electricite de France, RWE AG (Germany), ENEL S.p.A. (Italy), Hydro-Quebec (Canada), Ontario Hydro (Canada), Kansai Electric Power Co. (Japan), Tokyo Electric Co. (Japan), and Edison International (USA); BOO = Build-Operate-Own; BOT = Build-Operate-Transfer; OJT = on-the-job training.

## DETAILED PROJECT DESCRIPTION

### Part A. Rural Electrification by Distribution System

1. Approximately 6,010 new consumers primarily in the rural districts will receive electricity by expanding the existing distribution networks. The components have the following physical features:

- (i) civil works and installation of 182 circuit kilometers (cct-km) of single circuit and 65 cct-km of spur 33 kilovolt (kV) overhead lines;
- (ii) civil works and installation of 33 kV pole-mounted load break switches and auto-reclosers;
- (iii) installation of 30 cct-km of single circuit and 113 cct-km of spur 11 kV overhead lines plus replacement of 24 km of existing 11 kV conductors;
- (iv) installation of 11 kV load break switches and auto-reclosers;
- (v) installation of 6,103 kVA of 33 kV and 3,823 kVA of 11 kV pole-mounted distribution transformers; and
- (vi) installation of 354 km of low voltage (LV) bundled conductor.

2. Districts to be electrified in the western Bhutan are Chhukha, Dagana, Paro, Punakha, Samste, Thimphu, and Wangdue. The substations at Lobesa (for Punakha and Wangdue districts), Olathang (for Paro district), Jemina, Dechhencholing, and Olakha (for Thimphu district), and Gedu (for Chhukha district) will feed the project areas through 33 kV and 11 kV distribution network extensions. All these substations receive power through the Chhukha grid system. For Dagana district, as the only available power source is Dara Chhu mini hydro (2 x 100, 200 kW), the electrification plans under the Project for this area are constrained by its availability. When Basochhu hydro project is commissioned, 66 kV line extensions to these areas are planned subject to available funds, and further electrification in this district will be undertaken in future.

3. Districts to be electrified in central Bhutan include Bumthang, Sarpang, and Trongsa. Mini/Micro hydro stations, Chhume (for Bhumtang), and Tangsibji (for Trongsa) are available power sources for the Project. Network expansion for these areas has also been restricted by these power sources. Transmission network expansion plans for Tsirang from Basochhu grid extension and for Zhemgang through Kurichhu are under consideration by the Division of Power (DOP). Gelephu substation is planned as the main power source for Sarpang district.

4. Districts to be electrified in the eastern Bhutan are Lhuentse, Mongar, Pemagatshel, Trashigang, and Yangtse. The available power sources under the Project for the eastern region are mainly mini hydro plants (i.e. Khaling mini hydro plant for Pemagatshel, Khalanzi for Mongar, Gangzur for Lhuentse and Ranjung, and Chenari for Trashigang and Yangtse). Kurichhu hydropower plant will result in future grid expansion in these districts for further expansion.

**Part B. Rural Electrification by Solar Panels**

5. These systems intend to electrify schools, hospitals, monasteries, and community activities. Each unit comprises two solar panels (55 W peak), 12 V battery of 125 ampere-hours (AH) capacity, charge controller, and four 11 W lights. Local community centers in Lhuentse district (Dungkhar), Dagana district (Dujjaygaon), and Tsirang district have been identified as the candidate sites. The total number of consumers using solar panels will be 28.

**Part C. Small-Scale Pilot SCADA System**

6. This component is a supervisory control and data acquisition (SCADA) system within Thimphu City as the pilot system. The system includes monitoring Thimphu hydro station, a diesel station, and Dechhencholing, Motithang, and Olakha substations in Thimphu using power line carrier. While the system will be initially for data acquisition, Dechhencholing is designed for remote control.

## DETAILED COST ESTIMATES

Item	Unit	Quantity	Foreign Exchange (\$'000)	Local Currency (Nu'000)	Local Currency (\$'000)	Total (\$'000)	
<b>A. Base Cost</b>							
1.	33 kV Overhead Lines including Load Break Switches & Auto-reclosers	cct-km	247	2,224	20,612	485	2,709
2.	11 kV Overhead Lines including Load Break Switches	cct-km	167	998	10,540	248	1,246
3.	Distribution Substations						
	33/0.4 kV Transformers	kVA	6,103	663	4,207	99	762
	11/0.4 kV Transformers	kVA	3,823	390	2,550	60	450
4.	Low Voltage Distribution	cct-km	354	2,193	22,185	522	2,715
5.	Service Connections	Nos.	6,038	753	7,098	167	920
6.	DOP Administration and Overheads			0	12,750	300	300
7.	Consulting Services			250	3,613	85	335
8.	Solar Panels			100	0	0	100
9.	SCADA System			250	0	0	250
10.	Miscellaneous (Vehicles, Tools, Communication Equipment, Computers)			730	4,250	100	830
	<b>Subtotal (A)</b>			<b>8,551</b>	<b>87,805</b>	<b>2,066</b>	<b>10,617</b>
<b>B. Contingencies</b>							
1.	Physical Contingencies <sup>a</sup>			851	7,565	178	1,039
2.	Price Contingencies <sup>b</sup>			308	10,710	252	550
	<b>Subtotal (B)</b>			<b>1,159</b>	<b>18,275</b>	<b>430</b>	<b>1,589</b>
<b>C. Financial Costs</b>							
1.	Service Charge on Bank Loan			243			243
	<b>Subtotal (C)</b>			<b>243</b>			<b>243</b>
	<b>Total</b>			<b>9,953</b>	<b>106,080</b>	<b>2,496</b>	<b>12,449</b>
	Percent			80		20	100

DOP = Division of Power; kV = Kilovolt; SCADA = Supervisory Control and Data Acquisition System.

**Note:** \$1.00 = Nu42.50

<sup>a</sup> 10 percent

<sup>b</sup> 2.4 percent per annum for foreign exchange costs; 7.4% for local currency costs.





<b>TENTATIVE ICB CONTRACT PACKAGE LIST</b>				
<b>Bidding Document No.</b>	<b>Package No.</b>	<b>Items</b>	<b>Contract Type</b>	<b>Estimated Contract Value (\$ millions)</b>
		Consultancy Services (Tata Consulting Engineers)		
<b>Part B: RE by solar panels for schools, hospitals, and other local communities facilities</b>				
1	1	<b>Solar panels</b>		<b>0.1</b>
		These systems are to be used for schools, hospitals and monasteries in the following areas.		
		<u>District / Village</u>		
		Lhuentse / Dungkhar, Yangtse / Jangphu		
		Trashigang / Nanong, Dagna / Dujay		
		Paro / Shara Drangu, Kotheythangkha, Chincto		
		<u>NO.: 100, Unit Price: 850(US\$), in total around 0.1M\$</u>		
<b>Part C: Small-scale pilot SCADA system</b>				
1	1	<b>SCADA system</b>		<b>0.2</b>
		The system is within Thimphu city for the pilot system.		
		It includes monitoring the Thimphu hydro station,		
		Dechhencholing, Motithang and Olakha (Simtokha 1)		
		using PLCC and on a pilot basis hotline.		
			<b>Total</b>	<b>0.3</b>
<b>NOTE:</b>	S+E+C:	Supply and Erection and Commissioning		
	TBE:	to be estimated		

**TERMS OF REFERENCE FOR CONSULTING SERVICES  
FOR PROJECT IMPLEMENTATION**

1. Consulting services will be required to assist the Division of Power (DOP) with design, procurement, testing, and installation of the Project, and training.

**A. Procurement**

2. The consultant will assist DOP in carrying out bid evaluation and answering post-tender queries to finalize contracts with equipment suppliers.

**B. Detailed Design, Construction Supervision, and Training of DOP Staff**

3. The consultant will review the proposed design, technical specifications, and bills of quantities included in the bidding documents that have already been prepared at an earlier stage. The consultant will also check and technically approve designs submitted by the contracted suppliers and equipment manufacturers.

4. The consultant will assist DOP to plan the implementation program and provide technical advice whenever required for new equipment being used in Bhutan for the first time, and will supervise and adequately train DOP staff to erect, test, and commission these systems. The consultant will also be responsible for organizing the factory inspection and witnessing tests of equipment being supplied to the Project.

5. The consultant will carry out training programs on the use of new equipment and techniques adopted for the first time in Bhutan, and assist DOP to undertake a socioeconomic survey for the project completion report.

**C. Design Practices and Operational Procedures**

6. The consultant will prepare construction and design manuals in accordance with actual implementation practices to be followed in the field.

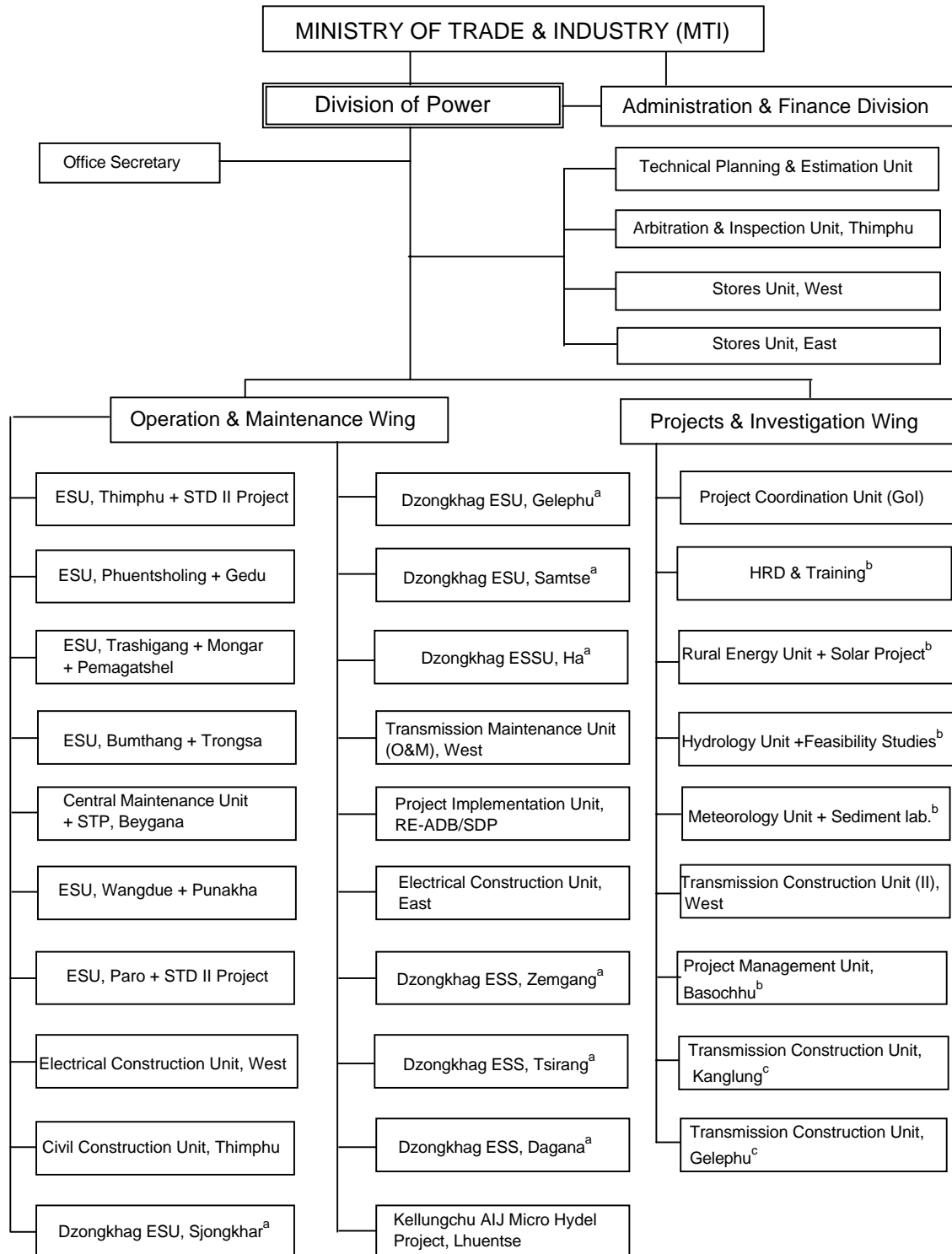
**D. Reporting**

7. In addition to the reports on bid evaluations and testing, the consultant will report monthly to the head of DOP and assist in preparing DOP's quarterly reports to the Bank on the progress being made. The consultant will present a final report on the Project to DOP and the Bank on completion of the services.

**Table A11: Consulting Requirements**

Item of Service	Person months
Detailed Design & Procurement: Bidding Documentation Review & Evaluation	2
Approval of Contractor's Drawings / Technical Design, New Equipment Training, Testing, & Familiarization	5
Design Practices & Operational Procedures: Construction & Design Manual, Site Supervision	3
<b>Total</b>	<b>10</b>

**ORGANIZATIONAL CHART OF DIVISION OF POWER**



Note: DOP Total No. of Employees = 722

<sup>a</sup> Decentralized/dzongkhag (district) administered supply unit/section.

<sup>b</sup> Units/projects directly supervised/monitored by Joint Secretary (Power).

<sup>c</sup> Additional new units.

ESU = Electric Supply Unit;

ESSU = Electric Supply Subunits;

SDP = Sector Development Program

## NOTES AND ASSUMPTIONS FOR THE FINANCIAL PROJECTIONS

### A. General

1. The financial projections for the Division of Power (DOP) have been prepared to see how its accounts will look as a corporate entity, separate from the Government budgetary system. As an independent entity, DOP will have its own assets and be responsible for its associated liabilities. The Bank consultant under TA 2400-BHU<sup>1</sup> estimated the value of assets, that are under the responsibility of DOP. The value of these assets (mainly transmission and distribution assets) as of FY1996 is used as the basis for DOP's financial projections. Additional assets during the period under review are based on DOP's firm investments during the Eighth Five-Year Plan (1998-2002) and planned investments up to FY2010. Included in the investment plans for the Eighth Plan are the Bank-financed first Rural Electrification Project (RE1) and the proposed Project. DOP is assumed to continue to purchase power from Chhukha Hydropower Corporation (CHPC) for the domestic market.

### B. Major Assumptions

2. Major assumptions for DOP's financial projections include the following.
- (i) The pro forma projected financial statements of DOP were prepared for the fiscal period 1999 to 2010 and are in current terms. DOP's fiscal year ends on 30 June.
  - (ii) The domestic inflation rates are assumed at 7.8 percent in FY1999, 7.6 percent in FY2000, 7.4 percent in FY2001, and 7.2 percent from FY2002 onward, in line with the Bank's Project Administration Instructions (PAI). The international inflation rate is assumed at 2.4 percent per annum during the period of analysis.
  - (iii) The exchange rate used is Nu42.5 to \$1.00 for 1999 adjusted during the forecast period based on the differential between the assumed domestic and international inflation rates.
  - (iv) Operating revenues will be derived mainly from sales of domestic electricity and wheeling charges from transmitting the bulk power to the Indian grid, and are projected based on load forecasts and the assumed tariff rates and wheeling charges per kWh. The domestic load forecast in FY1999/2000 is estimated at 400 GWh, and for the subsequent years, the overall load forecast is assumed to grow conservatively by 5 percent per annum as no major investments are expected to take place during the period under review.<sup>2</sup> The three generation plants, Basochhu, Kurichhu, and Tala will come into production starting from FY2002 for Basochhu and Kurichhu, and from FY2005 for Tala. With these plants, the total generation capacity of Bhutan will be about 1,500 megawatt (MW). Excess supply will be exported to India. In line with this, the wheeling charges will be realized only after DOP is corporatized in FY2002, and when all the transmission assets of CHPC are transferred to DOP.

<sup>1</sup> TA 2400-BHU: *Institutional and Financial Development of DOP*, for \$400,000, approved on 30 September 1995.

<sup>2</sup> The average annual growth during FY1992 to FY1997 was about 17 percent, however, this was mainly due to the commissioning of Bhutan Ferro Alloys Limited (a ferro silicon manufacturer).

- (v) The domestic tariff assumes the new rate proposed at Nu0.7 per kilowatt-hour (kWh) for urban/industrial consumers; it will be effective starting from 1 January 2000. As agreed by the Government, this rate will increase to Nu0.8 per kWh starting from 1 July 2001. The tariff for rural consumers will remain at the current level of Nu0.5 per kWh up to the end of FY2000 and rise slowly at half of the domestic inflation rate. To achieve the financial targets by FY2005, the overall average domestic tariff during this period will have to be increased to about Nu1.0 per kWh. The nominal wheeling charge is assumed at Nu0.10 per kWh for FY2002, this takes into consideration the current wheeling charges paid by the Government of Bhutan in using the Indian grid, i.e., ranging from Nu0.05 to Nu0.20 per kWh depending on the voltage level. Based on current assumptions, the wheeling charge will also need to reach at least Nu0.12/kWh to achieve the financial targets by FY2005. Beyond this time, the annual average tariff and wheeling charge were determined at a level sufficient to fulfill the Bank's financial covenants.
- (vi) Operating expenses consist of (i) power purchase, which comes mainly from CHPC, (ii) operation and maintenance (O&M) cost incurred by DOP, and (iii) depreciation of existing and newly acquired assets. Cost of power, currently at Nu0.30 per kWh, will increase in line with domestic inflation. The current O&M cost incurred by DOP is approximately 3 percent of its total historical capital costs. Depreciation of fixed assets is calculated on a straight-line basis with average life for transmission and distribution assets of about 25 years.
- (vii) In accordance to the prevailing tax rate, DOP will pay income or corporate taxes of 30 percent per annum on the net operating income after interest payment. DOP will be allowed to carry its losses for future tax payments.
- (viii) Overall system losses for domestic consumption are assumed at 9 percent based on the average historical losses in the past 5 years.
- (ix) As of FY1996, the total gross assets under DOP were estimated at Nu1,469 million with some adjustments made to bring them to their current value, and based on the usage life of these assets, the accumulated depreciation was derived. During the fiscal period 1996 to 1999, additional capital expenditure was incurred such as rehabilitation of the mini and micro hydels, improvement and upgradation of rural and urban transmission and distribution systems, including the Bank's RE1 project. For the purpose of this projection, it is assumed that the Government will be responsible for the overall budgetary allocation on the RE1 project, and only when it is completed and commissioned that the assets and their associated liabilities are transferred to DOP. The cost of the RE1 project is about \$9.5 million. For the proposed Project, which will commence in 2000 at an estimated cost of \$12.5 million, it is assumed that the capital expenditure will already be reflected on DOP's account.
- (x) The existing assets of Nu1,469 million are assumed to have a 40:60 debt to equity ratio based on the historical pattern of capital investment made in the power sector in Bhutan. The existing loan was assumed to carry a soft term of 10 percent annual interest rate and 15 year repayment period. This is in line with

the current financing terms in the power sector in Bhutan<sup>3</sup> although regular commercial loans are at about 16 percent per annum. For the two Bank projects, the Government will onlend the loans it receives from the Bank, and the balance is treated as a grant from the Government to DOP. The Bank loans are \$7.5 and \$10 million equivalent, respectively. The interest rates charged by the Government to DOP on these foreign loans are assumed at their actual rates, and all will have a repayment period of 15 years.<sup>4</sup> Interest and principal payments of these loans will start at the commissioning of these projects. DOP will bear the foreign exchange risks associated with these foreign currency loans.<sup>5</sup>

- (xi) Construction-in-progress during FY2000-FY2010 reflect the investment plans of DOP. The estimate given by DOP on its investments in the next 10 years amount to about Nu10.0 billion, this excludes the two Bank projects. These substantial investments include all the bulk and nonbulk transmission and distribution projects and several mini and micro-hydels. It is understood that the Government of Bhutan has received commitment, mainly from the Government of India to finance 65.1 percent of these investments on a grant basis. About 4.4 percent of total investments will be financed by loans (for the Kurichhu and Tala transmission projects), and the balance, about 30.5 percent will be funded by a combination of additional grants and own financing. For the purpose of this projection, for those investments to be implemented during the Eighth and Ninth five-year plans, it was assumed that 60 percent would be financed by grants and 40 percent by loans. At the end of these periods, DOP should be able to stand on its own to finance its future investments without getting further grants. DOP will pay about a 12 to 14 percent interest rate on the loans, which is higher than the loan, charged by the Government of India of about 9 to 10.75 percent per annum. All of these loans are assumed to have a repayment period of 10 years with a 5-year grace period.
- (xii) Gross fixed assets are revalued annually according to the domestic inflation rates. The calculation for the financial covenant, rate of return on revalued net fixed assets, is based on a three-year rolling average.
- (xiii) Accounts receivable were assumed at 45 days of total revenues, inventory at 30 days of O&M costs, and accounts payable at 30 days of total cost of power including O&M costs. DOP's accounts receivable are relatively low as more than 80 percent of its sales are to industrial and bulk consumers that usually pay within the 30-day billing period.

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<sup>3</sup> For CHPC, 40 percent of the investment was financed by a 15-year loan at 5 percent interest rate. For Kurichhu, 40 percent of the capital cost is financed at an annual interest rate of 10.75 percent per annum payable in 15 years. 40 percent of Tala Hydropower Project was financed by a loan with a 9 percent interest rate payable in 12 years.

<sup>4</sup> The loans from the Bank to the Government are on Asian Development Fund terms. For RE1, it was 1 percent service charge with 40 years repayment period including 10 years grace period. For the proposed Project, the service charge is 1.5 percent, 32 years repayment period including an 8 year grace period.

<sup>5</sup> The foreign currency fluctuation will be passed on to the customers through an automatic foreign currency adjustment in the billing system.

**Table A13.1: Pro forma Projected Income Statements of Division of Power - Bhutan**

(Nu. Million)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
<b>For the year ending June 30</b>												
Domestic Inflation	7.8%	7.6%	7.4%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%
Foreign Inflation	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%
Exchange Rate \$1 = Nu	42.5	44.7	46.9	49.2	51.6	54.0	56.6	59.3	62.2	65.2	68.3	71.6
Power Purchase (domestic)	399,175	419,502	440,856	471,441	495,253	520,262	546,529	574,116	603,092	633,523	665,485	699,054
Power Available for Export	1,399,272	1,380,498	1,359,144	1,956,532	1,933,673	1,909,664	4,323,757	6,504,267	6,592,609	7,318,419	7,287,735	7,255,510
Import from India	7,460	7,684	7,915	-	-	-	-	-	-	-	-	-
Other Own Generation	10,947	11,276	11,614	11,963	12,321	12,691	13,072	13,464	13,868	14,284	14,712	15,154
Total Energy Sources (MWh)	1,816,854	1,818,960	1,819,529	2,439,935	2,441,247	2,442,617	4,883,358	7,091,848	7,209,568	7,966,226	7,967,933	7,969,717
Domestic Energy Sales (MWh)	400,000	399,000	418,950	439,898	461,892	484,987	509,236	534,698	561,433	589,505	618,980	649,929
- Industrial and Bulk	331,938	331,108	347,664	365,047	383,299	402,464	422,587	443,717	465,903	489,198	513,658	539,341
- Residential	44,630	44,518	46,744	49,081	51,535	54,112	56,817	59,658	62,641	65,773	69,062	72,515
- Commercial & Others	23,432	23,374	24,542	25,770	27,058	28,411	29,831	31,323	32,889	34,534	36,260	38,073
Power Exported (MWh)	1,371,286	1,352,888	1,331,961	1,917,401	1,894,999	1,871,471	4,237,282	6,374,182	6,460,757	7,172,050	7,141,981	7,110,399
Total Energy Sales (MWh)	1,771,286	1,751,888	1,750,911	2,357,298	2,356,892	2,356,458	4,746,519	6,908,880	7,022,190	7,761,555	7,760,961	7,760,328
Electricity Tariffs (Nu/kWh)												
- Rural	0.50	0.50	0.52	0.54	0.56	0.58	0.60	0.62	0.64	0.66	0.69	0.71
- Urban/Industrial	0.60	0.70	0.70	0.80	0.86	0.92	1.00	1.07	1.15	1.23	1.41	1.50
- Average Domestic Tariff	0.60	0.69	0.69	0.79	0.85	0.91	1.00	1.06	1.13	1.21	1.39	1.48
Energy Cost (Nu/kWh)	0.30	0.30	0.32	0.35	0.37	0.40	0.43	0.46	0.49	0.52	0.56	0.60
Wheeling Charge for Export (Nu/kWh)	-	-	-	0.10	0.11	0.11	0.1200	0.1243	0.1288	0.13	0.14	0.14
Import from India	0.35	0.35	0.37									
Overall System Losses (Domestic)	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%
<b>Income Statement</b>												
Operating Revenues	238.8	276.9	291.0	540.2	595.1	656.0	1,017.7	1,358.4	1,468.7	1,673.2	1,846.6	1,977.8
Electricity Sales (Domestic)	238.8	276.9	291.0	348.4	391.9	440.9	509.2	565.9	636.6	716.2	859.4	959.5
Wheeling Charge from Export Sales	-	-	-	191.7	203.1	215.1	508.5	792.4	832.1	957.0	987.3	1,018.3
Operating Expenses	265.8	284.9	314.7	354.2	369.9	405.3	671.7	703.8	758.0	1,029.5	1,177.9	1,278.9
Power Purchase	122.4	128.5	145.0	162.8	183.4	206.5	232.6	261.9	294.9	332.1	374.0	421.1
O&M Costs	81.1	87.3	93.7	100.5	105.5	118.9	123.3	139.4	156.6	173.3	190.9	208.3
Depreciation	62.3	69.1	76.0	83.9	91.8	100.4	110.0	120.6	132.5	145.6	160.0	175.5
Net Operating Income	(27.0)	(8.0)	(23.7)	186.0	25.2	50.7	346.0	654.6	710.7	643.7	668.8	699.0
Interest Expenses	24.9	32.4	34.1	60.5	235.8	228.7	238.2	229.3	210.4	370.2	348.0	323.0
Foreign Exchange Gain (Losses)	0.0	(13.9)	(25.0)	(35.7)	(44.8)	(44.2)	(43.3)	(42.2)	(40.7)	(38.9)	(36.6)	(33.9)
Net Profit Before Income Taxes	(51.9)	(54.3)	(82.8)	89.7	(255.4)	(222.2)	64.4	383.2	459.6	234.7	284.7	342.0
Income Taxes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	114.9	137.9	70.4	85.2	102.6
Net Profit After Taxes	(51.9)	(54.3)	(82.8)	89.7	(255.4)	(222.2)	64.4	268.2	321.8	164.3	198.9	239.4

kWh = kilowatt-hour; MWh = megawatt-hour; O&M = Operation and Maintenance

Source: Staff Estimates

Table A13.2: Pro Forma Projected Cash Flow Statements of Division of Power - Bhutan

(Nu Million)

For the year ending June 30	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Net Operating Income	(27.0)	(8.0)	(23.7)	186.0	25.2	50.7	346.0	654.6	710.7	643.7	668.8	699.0
Depreciation	62.3	69.1	76.0	90.9	215.8	215.8	215.8	202.5	206.5	342.1	423.1	449.5
Total Sources from Operation	35.3	61.1	52.3	276.9	241.1	266.5	561.8	857.1	917.2	985.8	1,091.8	1,148.5
Transfer of Loans to DOP	0.0	318.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transfer of Grants to DOP	0.0	84.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loans (Others)	294.9	294.9	294.9	294.9	328.3	459.7	131.3	131.3	262.7	0.0	160.8	100.5
Loans (Bank)	0.0	133.1	187.3	148.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Short-Term Loan	0.0	0.0	25.0	0.0	0.0	110.0	0.0	0.0	0.0	0.0	0.0	0.0
Grants	504.7	455.2	508.0	684.9	492.5	689.5	197.0	197.0	394.0	0.0	0.0	0.0
Total Sources from Financing	799.6	1,286.0	1,015.3	1,128.2	820.9	1,259.2	328.3	328.3	656.7	0.0	160.8	100.5
Total Cash Inflow	834.9	1,347.1	1,067.6	1,405.1	1,061.9	1,525.7	890.2	1,185.4	1,573.9	985.8	1,252.6	1,248.9
Capital Expenditure	737.3	883.2	990.3	945.5	820.9	1,149.2	328.3	328.3	656.7	703.3	803.8	502.4
Transfer of Assets to DOP	0.0	402.8	0.0	182.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Debt Service	48.0	75.9	80.3	102.7	352.6	356.5	378.2	437.6	458.3	622.2	627.3	632.7
- Principal (Others)	23.1	24.3	25.5	19.9	61.4	68.4	76.1	84.7	94.3	172.9	194.3	218.4
- Principal (RE 1 - Bank)	0.0	19.2	20.7	22.3	24.0	25.9	27.9	30.0	32.4	34.9	37.5	40.4
- Principal (SRE - Bank)	0.0	0.0	0.0	0.0	31.3	33.6	36.0	38.6	41.3	44.3	47.5	50.9
- Interest Expenses	24.9	32.4	34.1	60.5	235.8	228.7	238.2	229.3	210.4	370.2	348.0	323.0
- Repayment of ST Loan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.0	80.0	0.0	0.0	0.0
Changes in Working Capital	26.0	4.7	0.9	29.8	10.9	6.6	45.8	34.0	19.2	30.3	20.0	14.6
Income Taxes Payment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	114.9	137.9	70.4	85.2	102.6
Total Cash Outflow	811.4	1,366.6	1,071.5	1,260.8	1,184.3	1,512.3	752.3	914.9	1,272.1	1,426.2	1,536.4	1,252.3
Net Cash Flow	23.6	(19.5)	(3.9)	144.3	(122.4)	13.4	137.9	270.5	301.8	(440.4)	(283.8)	(3.3)
Accumulated Cash Flow	23.6	4.1	0.2	144.5	22.1	35.5	173.4	443.9	745.7	305.4	21.5	18.2

DOP = Division of Power; RE1 = Rural Electrification I; SRE = Sustainable Rural Electrification

Source: Staff Estimates

**Table A13.3: Pro Forma Projected Balance Sheet of Division of Power - Bhutan**  
(Nu Million)

For the year ending June 30	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Cash	23.6	4.1	0.2	144.5	22.1	35.5	173.4	443.9	745.7	305.4	21.5	18.2
Accounts Receivable	29.4	34.1	35.9	66.6	73.4	80.9	125.5	167.5	181.1	206.3	227.7	243.8
Inventory	13.3	14.3	15.4	16.5	28.1	30.1	36.7	39.4	42.2	58.4	62.6	67.1
Gross Fixed Assets	1,850.9	2,386.9	2,558.8	2,925.8	6,098.3	6,537.4	7,979.9	8,554.4	9,170.4	12,695.4	13,609.5	14,589.3
Accumulated Depreciation	605.0	717.7	845.3	997.1	1,284.8	1,593.1	1,923.6	2,264.6	2,634.2	3,165.9	3,816.9	4,541.2
Net Fixed Assets	1,245.9	1,669.3	1,713.5	1,928.6	4,813.5	4,944.3	6,056.2	6,289.8	6,536.2	9,529.5	9,792.6	10,048.1
Construction in Progress	1,412.3	2,295.5	3,285.8	4,231.2	2,090.2	3,239.4	2,595.9	2,924.3	3,581.0	1,419.5	2,223.4	2,725.8
Total Assets	2,724.6	4,017.3	5,050.7	6,387.5	7,027.3	8,330.2	8,987.8	9,864.9	11,086.2	11,519.1	12,327.7	13,103.0
Current Liabilities	16.7	17.7	19.6	21.6	29.1	32.0	37.5	48.1	45.3	56.5	62.0	68.2
Short-Term Loan	0.0	0.0	25.0	25.0	25.0	135.0	135.0	80.0	0.0	0.0	0.0	0.0
LT Loans (Others)	1,065.1	1,335.8	1,605.2	1,880.2	2,147.1	2,538.4	2,593.7	2,640.3	2,808.7	2,635.8	2,602.3	2,484.4
LT Loans (RE1)	0.0	313.4	310.2	305.3	298.4	289.2	277.5	263.0	245.3	224.2	199.3	170.0
LT Loans (SRE)	0.0	133.1	327.8	494.6	491.0	484.9	476.1	464.2	448.9	429.7	406.3	378.2
Total Liabilities	1,081.8	1,800.0	2,287.9	2,726.8	2,990.6	3,479.5	3,519.7	3,495.6	3,548.2	3,346.3	3,269.9	3,100.7
Paid-up Capital	1,694.6	2,233.8	2,741.9	3,426.8	3,919.3	4,608.8	4,805.8	5,002.8	5,396.8	5,396.8	5,396.8	5,396.8
Retained Earnings	(51.9)	(106.2)	(189.0)	(99.3)	(354.7)	(576.9)	(512.5)	(244.2)	77.5	241.8	440.7	680.1
Revaluation Reserve	-	89.7	209.9	333.3	472.1	818.7	1,174.7	1,610.7	2,063.6	2,534.2	3,220.3	3,925.4
Total Equity	1,642.7	2,217.4	2,762.8	3,660.8	4,036.7	4,850.6	5,468.0	6,369.3	7,537.9	8,172.8	9,057.8	10,002.3
Total Equity and Liabilities	2,724.6	4,017.3	5,050.7	6,387.5	7,027.3	8,330.2	8,987.8	9,864.9	11,086.2	11,519.1	12,327.7	13,103.0
<b>Performance Targets Effective FY2005</b>												
- ROA (min 6 percent)	-1.8%	-0.5%	-1.3%	6.6%	0.6%	1.0%	6.0%	8.6%	7.7%	6.7%	6.0%	6.0%
- Debt Service Ratio (min 1.5 times)	0.7	0.8	0.7	2.7	0.7	0.7	1.5	1.7	1.7	1.5	1.6	1.7
- SFR (min 20 percent)	-8%	-4%	-5%	25%	-16%	-13%	23%	62%	46%	36%	54%	61%
- Debt-Equity Ratio (max 60%)	33%	47%	46%	47%	45%	48%	45%	42%	41%	37%	36%	34%

LT = Long-Term; RE1 = Rural Electrification 1; SRE = Sustainable Rural Electrification; ROA = Rate of Return; SFR = Self-Financing Ratio.

Source: Staff Estimates

## SUMMARY INITIAL ENVIRONMENTAL EXAMINATION

### A. Introduction

1. This summary initial environmental examination (SIEE) for the Sustainable Rural Electrification Project is based on the investigations and findings of the consultants in association with the Executing Agency, the Division of Power (DOP), under technical assistance (TA) 2912 BHU.<sup>1</sup> The intensive data gathering and field survey including distribution line routing were undertaken by the domestic consultant in cooperation with local community members of districts and villages. The SIEE follows the Bank's standard format for such reports and addresses potential environmental impacts resulting from the location, design, construction, operation, and maintenance of the Project.

### B. Description of the Project

#### 1. Type of Project

2. The proposed Sustainable Rural Electrification Project prepared by DOP under the Eighth Five-Year Plan (FY1998-FY2002), as an integral part of the rural electrification program, was originally created during the Sixth Plan (FY1987-FY1991) to electrify most villages in Bhutan using hydropower. Based on the subsequent feasibility studies and field experience, rural electrification is being upgraded and to become more comprehensive using distribution networks as well as renewable power sources such as solar panels and mini/micro hydropower generation. The Project is consistent with the Government's development policies and the Bank's focus on Bhutan's infrastructure development.

#### 2. Category of Project

3. The Project is classified under the Bank's Guidelines as Category B.

#### 3. Need for the Project

4. It is estimated that over 87 percent of the Bhutanese population lives in rural areas and more than 80 percent of the population leads an agrarian lifestyle. Most of the farmers do not have access to electricity. Over 95 percent of the energy consumed in the rural area is from fuelwood. This makes Bhutan's per capita consumption of fuelwood (2.4 cubic meters) one of the highest in the world and puts tremendous pressure on forest resources. Several Government-initiated projects aimed at reducing the dependency on fuelwood have not met with very much success. Kerosene cookers, smokeless stoves, solar panels, and nontaxable fuel-efficient electrical appliances are a few initiatives undertaken by the Government to decrease the consumption of fuelwood.

5. In rural areas, where electricity is not available, fuelwood is used for cooking and heating. Apart from the depletion of forest resources due to the excessive use of fuelwood, a large section of the rural population that does not have access to electricity suffers from respiratory problems. This can be attributed to the smoke emitted from use of kerosene lamps (wick type) for lighting and inefficient use of fuelwood for cooking and heating. Most of the rural

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<sup>1</sup> TA 2912-BHU: *Second Rural Electrification Project*, for \$500,000, approved on 19 November 1997.

areas are over 2000 meters above sea level, making the cold season extremely harsh, which leads to increased fuelwood consumption just for heating purposes. In general, however, fuelwood is mostly used for cooking purposes, except for a few wealthy citizens living in district headquarters who use liquefied petroleum gas (LPG). Most Government staff use LPG or kerosene stoves for cooking purposes. Kerosene lamps are used for lighting in almost all the rural areas where electricity is not available. Some farmers who cannot afford or have no access to kerosene, use resin and coniferous wood sticks for lighting.

6. To improve the standard of living, promote economic development, and improve health and sanitation standards, the Eighth Plan provides for the expansion of the rural electrification program. The existing electricity networks are proposed to be extended into rural areas wherever there is excess power available. The Project proposes extension of high voltage distribution systems from the nearest power sources to distribution transformers in designated villages, together with the associated low voltage networks and consumer connections. In addition, solar panels will be installed at local community centers that are far from a distribution network.

#### **4. Location**

7. The proposed Project covers the following districts in Bhutan: Bumthang, Chhukha, Dagana, Lhuentse, Mongar, Paro, Pema Gatshel, Punakha, Samtse, Sarpang, Thimphu, Trashigang, Trashy Yangtse, Trongsa, Tsirang, Wangdue Phodrang.

#### **5. Size of Operation**

8. The proposed Project intends to provide infrastructure for the supply of electricity to 6,038 new customers in 16 districts. In addition to distribution network expansion, solar panels will be provided to three local community centers located far from power sources. Apart from the construction of electrification network, some provisions will also be made for tools and vehicles.

#### **6. Proposed Schedule for Implementation**

9. The physical implementation of the Project will commence in March 2001 and be completed in September 2003.

#### **7. Description of Project**

10. The major part of the Project will involve construction of overhead electric lines at voltages of 33 kV, 11 kV, and 0.4 kV. The lines will be of pole-type construction. Distribution transformers and associated equipment will be mounted on the poles for supply of power into the low voltage lines, connecting from there to consumers' houses and premises. Solar panels and supervisory control and data acquisition (SCADA) system will be installed in premises of public facilities and substations respectively.

## **C. Description of the Environment**

### **1. Physical Resources**

#### **a. Topography**

11. Bhutan is wedged between India and the People's Republic of China along the Himalayan Mountains, and covers an area of approximately 46,000 square kilometers with an ecosystem ranging from subtropical to alpine. The altitude in Bhutan ranges from about 200 meters (m) in the south to over 7,000 m in the north. Most of the country is almost completely mountainous, with deeply incised river valleys. Even the Sub-Himalayan foothills, which is a zone ranging from 500 to 3000 m is very rugged and drops sharply to the plains of India. The Project will span most of the country from east to west and will include a few southern districts as well. Therefore, all topographical features such as plains, valleys, and mountain ridges will be encountered.

#### **b. Climate**

12. The huge extremes in elevation and topography of the country result in great diversity in climatic types, characterized by a wide range of temperatures and precipitation. With increasing elevation, the climate changes from subtropical humid and subhumid, to temperate monsoon humid and subhumid, to temperate alpine continental. Maximum temperatures reach approximately 40 degree Celsius ( C ) during summer in the plains, but in the mountainous regions, the temperature can fall to 20 degree C below zero during winter months.

### **2. Ecological Resources**

13. Over 72 percent of Bhutan's total land area is under forest cover. Bhutan has one of the richest floras in the world for a country of its size, due to a combination of climatic and topographic diversity, and its position on the interface between the Indo-Malesian and Palearctic biogeophysical regions. Natural areas not covered in forest are commonly covered by temperate grasslands. Over 26 percent of the country is under protected area, wildlife sanctuaries, national parks, and reserves. These were created to protect wildlife resources and endangered species. None of the areas to be electrified encroaches upon these protected areas and reserves.

### **3. Human and Economic Development**

#### **a. Population and Communities**

14. The population of Bhutan was estimated at around 0.6 million in 1996, while its land area is around 46,000 square kilometers. The population growth rate is 3.1 percent per year. About 90 percent of the population lives in small villages scattered along the mountain slopes and valleys. The areas to be electrified under the Project are some of the most populated in the country. The areas are characterized by houses that are widely scattered with a few shops, and some of the areas have small-scale industries. Some of the towns in the project area fall under administrative centers and have basic health units (BHUs), hotels, primary schools, guest houses, Royal Bhutan Police centers and small local government offices. Most of the project areas is linked by roads for vehicles.

15. Over 80 percent of the population in the project area are farmers by profession and work on their own land. The remaining 20 percent are either employed by the Government as field extension workers from various Government departments, or have small businesses of their own, or are employed by a few small-scale cottage industries. Many of the villages covered in the Project have access to BHUs, primary community schools, safe drinking water (through the Government rural water supply schemes), and vehicle roads or mule tracks.

#### **b. Industries/Infrastructure**

16. Chhukha and Samtse are the only districts in the project areas that have major industrial activity. Chhukha has three major industries that are the largest customers of DOP, namely, Bhutan Ferro Alloys Ltd., Bhutan Chemical, Calcium Carbide Ltd., and Bhutan Board Particle Ltd. Samtse has two major industries that also contribute to DOP's income, namely, Penden Cement Authority Ltd. and Bhutan Food Product Ltd.

17. In the project area, there are also a few small timber sawmills, flour/husk mills, hand-made paper units, small-scale weaving industries, handicrafts, small shops, and restaurants. A few places have general shops. The Government has initiated small industrial development and provides training in business management. Banking institutions, such as the Bhutan Development Finance Corporation (BDFC), have spearheaded rural economic development by providing easily available small loans to the farmers. Housing and truck loans have also been provided by the institution. BDFC has a branch office in all the districts covered under this Project. The Bank of Bhutan has also granted loans to small-scale businesses.

#### **c. Land Use Planning**

18. Under the forestry sector, development programs for plantations and their reinforcement, development of community and protected forestry, development and protection of critical watersheds and forest roads, and building of ranger offices have been initiated during the Seventh Plan period. Some areas within the Project have been irrigated.

#### **d. Agricultural and Mineral Development**

19. Agricultural extension centers have been established in several villages within the project area during the Seventh Plan period, which includes soil conservation, plant protection, seeds and seedling supply, farm mechanization, soil fertility development, cash crop development, and livestock and animal health improvement. Potential mineral resources and proposals for their development are as yet unknown.

### **4. Quality of Life Values**

#### **a. Socioeconomic Values**

20. Most of the people make their living by subsistence farming. Many of the farmers in the project area grow rice, maize, wheat, barley, buckwheat, millet, vegetables, chilli, and mustard. Potato, apple, orange, beetle nut, cardamom, chilli, and soybean appear to be the main cash crops. Some farmers in the project area combine crop production with small livestock husbandry. The main domestic animals are cattle, mules, horses, pigs, yak, sheep, donkeys,

and poultry. Cattle are kept for dairy products and to provide field manure. Horses are used primarily to transport agricultural produce from remote villages, pigs are kept for meat and to produce a cash income, and poultry are kept primarily for eggs.

21. About 93 percent of the farmers in the project area use the produce of the land for their own subsistence. Food products such as rice, wheat/barley flours, sugar, salt, spices, edible oils, milk products, and dry fish are imported through the Food Corporation of Bhutan and sold at the shops. Exports from the project area mainly consist of cash crops, if there is a surplus, handicrafts, woven garments, and a few dairy product such as cheese and butter.

22. Several people in each village have joined the local monk body or nunneries, as Bhutanese predominately follow Buddhism, and religion plays an important role in the lives of every family. These people are fed and clothed by the Government, and they are paid a small salary as well. Furthermore, monks are held in great respect and play an active part in community life.

#### **b. Public Health**

23. Many of the villages surveyed had a BHU or were close to having one. The establishment of BHUs in rural villages have made a positive impact, as the villagers no longer have to travel great distances to receive basic medical treatment. However, the efficiency of the BHUs is restricted due to lack of electricity. Photo-voltaic electricity, where available, provides only limited energy for lighting and equipment.

#### **c. Cultural and Religious Values**

24. It was found during the surveys that a lot of the family expenditure goes to perform religious ceremonies. In fact, every family performs a minimum of two religious ceremonies a year. Furthermore, a lot of the hard-earned money of the villagers is spent on undertaking religious pilgrimages. The seriousness with which the people take their religion can be seen from the presence of many religious monuments, symbols, and temples. Almost all villages have their own temple. Practically every house in the surveyed villages has an altar where daily religious observance is carried out by the family.

#### **d. Aesthetic Values**

25. As the low and high voltage lines will follow main roads and their supports will be of pole type, the reduction of aesthetic values resulting from this Project will be minimal compared with the largely unspoilt environment. Also most of the lines are in rural areas.

### **D. Screening of Potential Environmental Impacts and Mitigation Measures**

#### **1. Environmental Problems Related to Location**

##### **a. Resettlement Issues**

26. As most of the distribution poles will run along road sides, the Project will not require much private land for erection of poles. The villagers in the project area are willing to allot the necessary land required for the poles when it encroaches on their property. Small portions of

land may be required for transformers. Some of the land needed for this purpose is presently privately owned and will need to be acquired from its owners. Some of the land is cultivated and the Government will pay some compensation for this land. However, the presently cultivated land required for such permanent facilities will be minimal. No land value changes will occur from the location of the Project, and therefore social inequities will be minimal. There will be no resettlement of population due to the Project.

## **b. Ecological Impacts**

27. The Project will have no impact on any rare or endangered flora or fauna species or their habitat. This is because (i) the Project does not comprise a mass concentration of construction, (ii) the Project is not concentrated in a particular area but is spread over 16 districts, (iii) the Project does not encroach upon any precious ecological area or other valuable lands, and (iv) the project area has already been greatly modified by human activity. Site visits have indicated that construction activities in these areas will in no way have any negative impact on the ecology. Apart from minor brush clearing along the roadside, no deforestation will be required. Moreover, the Project does not trespass on any water source areas.

## **2. Environmental Problems Related to Design**

28. The Project will not interfere with other utilities, traffic, or access ways. The electricity will be distributed throughout the project area by means of overhead distribution lines and transformers. The lines will generally run along the side of the road and only minor bush clearing may be required for them. There will be no discharge of polluting materials, given the nature of the Project. There are very few cultural features that fall within the project area such as temples, monasteries, and the like. With proper planning of the route, none of the cultural features will be disturbed.

29. The impact of the lines and transformers will not have any impact on the ecology or cultural features, other than in terms of visual appearance and introduction of hazards arising from the presence of live wires and apparatus. There will be no blockages of wildlife passageways.

## **3. Environmental Problems Associated with the Construction Stage**

30. Most of the potential environmental impacts may occur during the construction stage. Due to the type of construction (mostly erection of poles and minor buildings) soil erosion and silt runoff will be insignificant. Other major nuisance to nearby properties such as noise and dust will also be insignificant because of the nature of the work and low population density of rural areas. Minor social impacts will arise as a result of the presence of installation work force during erection of the lines and connection of the houses to the network. This force is expected to number between 40 to 80 throughout the project area. However, this number could decrease if local people from the beneficiary villages are hired for manual labour. This would have a double benefit, firstly, the social impacts would be lower, and secondly these villagers would earn some cash income.

31. People from the villages to be electrified are willing to do the basic unskilled manual labor required for the Project in and around their villages. A substantial portion of the labor force may be recruited locally for unskilled work. A few foreign nationals may be required to assist during the initial phase of project supervision for newly introduced equipment, materials, and tools.

32. The construction phase of this Project will in no way hamper wildlife movement, nor will it have any effect on utilities, traffic, access ways, services, or land values. It is envisaged that the construction stage will not create any ecological impacts. Adequate and regular surveillance and supervision of construction activities will ensure that no significant damage occurs to ecology.

#### **4. Environmental Problems Resulting from Project Operations**

33. Since the beneficiary villages have not had electricity before, it is possible that they will be unaware of the dangers of electricity and the possibility of health hazards. Therefore, it is recommended that as areas get connected to the supply network DOP should continue a campaign to promote public awareness about public safety and proper use and management of electrical current and appliances, in order to prevent electricity-related accidents, which usually follow the introduction of electricity to new consumers.

34. The permanent labor force required for the maintenance of the network and collection of payments will be existing staff of DOP for such purposes in the given districts. The operational phase will, in fact, generate the least ecological impacts among any of the other phases. This phase will, instead, bring about benefits to the environment as the villagers will become less dependent on forestry resources as electricity will substitute for the use of fossil fuels or fuelwood.

#### **5. Potential Environmental Enhancement Measures**

35. The main potential environmental enhancement measures are local social impacts, which are considered to be significant and mostly positive. These include (i) improved electricity-dependent infrastructure, such as water pumping, telecommunications etc.; (ii) an improvement in the quality of life through pollution-free lighting, better educational opportunities, and social services for positive regional development arising through the availability of electricity; (iii) enhancement of income and creation of jobs in the medium term; and (iv) reduction of the dependency on fuelwood in the long term.

#### **6. Additional Considerations (Compensation)**

36. A factor that needs to be considered is that during the construction phase, poles will need to be erected. Some of the land required for this purpose may be privately owned. The landowners will need to be compensated. Where private property is required for this Project, the owners will be consulted by DOP to negotiate right of access. Consultation and compensation will need to be undertaken once the design of the Project has progressed to the next stage. Compensation in cash will be provided by the Government to owners for crops and trees located in right-of-way of the erected poles. The cash compensation for crops will be based on productivity of the land in the past, while for trees will be based on type, age, and diameter of trees.

## **E. Institutional Requirement and Environmental Monitoring Program**

37. Environmental monitoring programs associated with the Project will be conducted as part of DOP's regular monitoring programs. Regular inspection, especially during the rainy season, will have to be undertaken to monitor the effectiveness of site stabilization and revegetation measures, if any, and to identify problem areas for immediate treatment and maintenance operations. Particular emphasis will have to be given to erosion problems, if any, and timely remedial measures undertaken by minor civil work using cement and rocks as part of the monitoring program.

38. Monitoring of forest resources and other ecological resources is the responsibility of the Forestry Service Division (FSD), which has branch offices in all the districts covered by the Project. FSD will be notified and will be involved in the monitoring aspect. Nonetheless, DOP's monitoring units will also note relevant adverse effects on ecological resources, if any, during their regular inspection field visits and notify the relevant authorities accordingly. The same will be undertaken in the case of socioeconomic conditions, if required.

## **F. Findings and Recommendations**

39. The main findings and recommendations include the following:

- (i) There will be significant socioeconomic and quality of life benefits for people in areas under the Project.
- (ii) The impact on the environment will be minimal, as high and low voltage lines will mostly run along roads.
- (iii) The project area does not encroach on any wildlife sanctuary, park, or reserve. No rare or endangered species or their natural habitat will be affected. The Project does not trespass on any water source areas. Therefore, the ecological damage arising from the Project will be minimal or nil.
- (iv) The local residents will have to be consulted as to the planning of the works, and compensation should be paid where private land has to be used for the Project.
- (v) A public awareness/education program regarding health hazards and proper use and management of electricity and its appliances should be continued upon electrification of villages.

## **G. Conclusions**

40. The socioeconomic evaluation reveals that the proposed Project will definitely have a positive impact on the people living in the area concerned. The Project will have multiple benefits such as increase in their income, improvement of their living standards and quality of life, increase in employment opportunities, improvement of health standards, longer working hours, and access to social infrastructural development and educational opportunities.

41. Although the Government does not require the preparation of an environmental impact assessment (EIA) for such projects, the screening process for the Project has been thorough. Based on the field investigation and the previous experience with projects of this nature, the environmental impact of the proposed Project will be minimal and not affect any nationally or internationally endangered wild life and flora. Therefore, a full EIA is not required.

## SUMMARY SOCIAL IMPACT ANALYSIS

### A. Background

1. More than 87 percent of Bhutanese people live in rural areas, most do not have access to electricity. Almost all the energy consumed in rural areas is from fuelwood. This puts pressure on forest resources. Fuelwood is mostly used for cooking purposes, except for a few more wealthy households living in district headquarters which use liquefied petroleum gas (LPG). Kerosene is mostly used for lighting. Although forests occupy a dominant 72 percent of the total land area, one of the highest in the world, the supply of fuelwood is dwindling rapidly. The solutions to the emerging energy problems in rural areas of Bhutan through conventional supplies are difficult. Moreover conventional fuels also potentially cause serious environmental hazards when used on a large scale. The per capita consumption of fuelwood in Bhutan is estimated to be 1.22 tons, which is one of the highest in the world.

2. To improve the standard of living of the rural population, promote economic growth, reduce overdependence on imported fuels, and minimize fuelwood consumption, the Government's Eighth Five-Year Plan provides for an expansion of rural electrification. The Government plans to carry out rural electrification by either grid extension or isolated development of small hydropower plants and other renewable energy sources such as solar panels, as an alternative source of energy for lighting, cooking, and heating.

3. Stakeholder participation is a key to the success of rural electrification. Without strong and sufficient stakeholder participation, particularly the local community, the utility cannot operate a distribution system on a sustainable basis. The Project has been prepared using a participatory approach during the project preparatory technical assistance (TA).<sup>1</sup> Through this approach, the participation of all stakeholders including communities, nongovernment organization, other civil society organizations, and community-based organizations in the proposed project area were obtained. A social economic survey, consultations as well as community participation, were conducted. The needs for rural infrastructure services, particularly among the poor, as well as ways to improve the overall quality of life and prospects for economic development in rural area were identified.

### B. Socioeconomic Profiles

4. The present population is estimated at 600,000. A national health survey conducted in 1994 indicates that infant mortality has fallen since 1984, from 142 per 1,000 births to 70 per 1,000 births in 1994. With a crude birth rate estimated at 39.9 per 1,000 population, reduced mortality, and fertility remaining high at 5.6, the national population growth rate is estimated to have increased to 3.1 percent from a previous estimate<sup>2</sup> of 2.0 percent per annum.

5. The literacy rate is 54 percent. The situation has improved over the last decades, educational infrastructure has expanded dramatically since the start of the first Five-Year Plan in 1961. In 1959, there were only 11 primary schools in the entire country, and a student population of 440. There are now over 100,000 students in 322 schools (primary, junior, and high schools) representing a gross enrollment of approximately 72 percent.

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<sup>1</sup> TA 2912-BHU: *Second Rural Electrification Project*, for \$600,000, approved on 19 November 1997.

<sup>2</sup> Source: 1993 Central Statistical Office, Ministry of Planning.

6. While a systematic expansion of basic social infrastructure services throughout the country has achieved dramatic results over the past decades, approximately 80 percent of the population has no access to electricity. Over 50 percent of the population now has access to piped water and 80 percent to latrines.

7. The majority of the population is primarily located in the rural areas of Bhutan, and is dependent on employment in agricultural activities to meet basic needs. A policy of balanced regional development to direct investment into less-developed areas of the country forms another important component in the structure of employment patterns. Of particular significance is the policy to locate power plants to promote industrial development in the interior part of the country. Another chance that has emerged in recent years was that villagers have been offered a chance to join a national workforce to work for road construction, project, and construction sites.

8. A most important sector of the economically active population in Bhutan is women. Women already constitute 49.5 percent of the total population, and unlike many other countries, enjoy equal rights in law. Like men they play an important role both in the private and public sectors and own businesses. Practices related to inheritance make no differentiation between sexes, although in some communities daughters may inherit all the family possessions.

### **C. Clientele Groups and Project Beneficiaries**

9. The proposed Sustainable Rural Electrification Project will bring direct benefits to 5,437 rural household consumers or approximately 43,500 people in the selected 16 of 20 districts of Bhutan together with associated commercial, social, and government sector consumers (601) such as shops, hotels, schools, basic health units, monasteries, etc. The Project's benefits include (i) provide opportunity for income-generating activities, (ii) generate employment through expansion of cottage and small industries to mitigate rural poverty, (iii) improve quality of rural life and (iv) provide adequate education and health services to rural people, particularly the poor and vulnerable groups through electrification by indigenous generated hydropower from existing power stations and solar panels.

### **D. Poverty**

10. Bhutan's per capita gross national product (GNP) is approximately \$485 (1996) and the country ranks 155<sup>th</sup> among 175 countries in the United Nations Development Programme (UNDP) 1994 Human Development Index (HDI), published in 1997.<sup>3</sup> Bhutan's HDI ranks lowest among the eight South Asian countries and is lower than its real GDP per capita rank expressed in purchasing power parity dollars. Reliable data on poverty are not available. Most of the population depends on subsistence agriculture. On average, more than 60 percent of household expenditure accounts for food and beverages. A study to estimate the poverty line was conducted in 1998 based on the Indian yardstick for poverty. The expenditure required for 2,400 calories of daily intake in India was estimated at Nu229<sup>4</sup> per capita per month at 1993-1994 prices. This figure was increased to Nu322 to take into account the harsher climatic conditions existing in Bhutan. The increase pertained to clothing, shelter, transport, and fuel. This is considered appropriate to estimate the expenditure in case of Bhutan, as nearly 70 percent of the total import trade and

<sup>3</sup> GNP per capita for Bhutan is calculated based on the official population estimate of 600,000 (1996), which is different from the latest United Nations estimate of 1.7 million (1994). HDI is based on the UN estimate. Efforts are being made by the aid community in consultation with the Bhutanese authorities to reconcile the population estimates.

<sup>4</sup> This estimate was worked out by the Expert Group of the Planning Commission, India and accepted by the Government of India in 1997.

95 percent of the total export trade are with India. The consumer price index of Bhutan for food articles, at the end of 1993 was 313 (December 1979=100), which rose to 438.1 for the month of December 1997, a rise of 40 percent. Accordingly, the amount required to meet the expenditure per month per person that is equal to 2,400 calories per day is approximately Nu504 for December 1998.

11. From the field observations and the socioeconomic survey, it has been possible to distinguish the poor from the better-off in the rural villages by the structure of their houses, the size of their farm plots, and the nature of their economic activities. The villages to be electrified under the Project have on average 30 households of 5-10 people each. Based on the socioeconomic survey of the project preparatory TA (footnote 1) about 70 percent of the households are living below the poverty line (see profile of consumers in Table A15).

12. The higher income households have average incomes of about \$300-400 per annum, and live in large, traditionally built houses constructed of wood and concrete, with large wooden-frame windows. The houses have corrugated iron or tile roofing, and a large open area under the roof. These households permanently farm two or more hectares and have a dozen or more cattle, horses, and mules. Their farm incomes are supplemented by buying and selling village products and handicrafts or by making small loans to neighbors. The homes often have access to running water on or nearby the premises and an outside latrine. In villages already electrified, each household may have 10 or more light bulbs, space heating, a rice cooker, and a radio.

13. The poor households in a typical village covered by the Project have an average income of about \$144 per annum or Nu504 per person per month, derived almost exclusively from subsistence farming. They supplement their incomes through the production of handicrafts, mainly traditional weaving. The houses are of very low quality, constructed mainly of woven siding and thatched roofs. Unless a smokeless stove has been installed, cooking inside the house fills the interior with smoke. There are typically one or two small rooms with earthen floors, and no sanitation or water supply facilities are available on the premises. Water must be carried from a nearby stream or other source. The households cultivate less than one-half hectare and normally do not own any livestock.

#### **E. Impact on Poor Households**

14. Approximately 70 percent of the project beneficiaries are households below the poverty line and live in subsistence economy with small cash incomes from selling crops such as vegetables, mandarins, potatoes, asparagus, and apples. Some money also flows into rural communities as remittances from family members working in towns and from wage labor.

15. The survey on electrified households' shows rural electrification has a positive impact on the level of economic activity in electrified areas. Most businesses in these areas choose to electrify and use electricity primarily for lighting. Impressions collected by the Mission concerning the productive use of rural electrification in Thimphu district are generally consistent with the survey data. There was uniform evidence that rural electrification led to increases in economic activity. In several villages, small businesses such as shops, saw mills, and rice mills came into existence after electrification.

16. The availability of electricity will become a stimulant to the creation of new rural industry and commerce. In Bhutan, agricultural processing in fact is the main direct productive use of electricity in rural areas—grain grinding, flour milling, rice husking, and production of seed oil. The productive use of electricity will increase employment opportunities and reduce rural to

urban migration. Furthermore, the supply of electricity to these lower income households is expected to enhance their income-earning potential, as weaving and other cottage industry activities can continue at night.

## **F. Impact on Women**

17. Focus group discussions with women indicate that they benefit substantially from rural electrification, as they spend more time in the household and use improved lighting and any household appliances more. Electrification in flourmills and other grain and food processing facilities also reduce women's workload in the home. Furthermore, they also mentioned that electrification of health clinics, schools, as well as better security from street lighting, also benefited them and their children significantly.

18. Because collecting wood is mostly women's and children's work in each household, women will benefit substantially from rural electrification. Furthermore, using fuelwood for cooking and heating causes respiratory diseases among women and children as they usually stay in their houses longer than men do. In addition, electrification in ricemills and other grain and food processing facilities also reduce women's workload in the home.

19. To ensure that women and men are participating equally in the Project, gender consideration has been addressed during the socioeconomic survey and Fact-Finding Mission. The data collected during the socioeconomic survey of electrified and nonelectrified households included information regarding the ownership of households. The survey data show that over 30 percent of the household owners are women, indicating that women have social esteem and status (the property is by way of inheritance). Therefore, they have always enjoyed equal status and the same level of freedom as men, according to the laws of the land.<sup>5</sup>

20. It is pertinent to note that women's participation in household earning is significant. Both from the point of view of the quantum of work done, as well as income earned, women's involvement is equally present. As far as community participation and decision making is concerned, it is understood that women are actively involved. Their participation in the decision-making process, especially in grassroots community meetings (*zomdus*) is as high as 70 percent.<sup>6</sup> They also participate actively at the district and village development committees. Women's participation in decision-making process is reported to be significantly high at the community level and the Government is promoting it at the district and cluster of villages levels.

## **G. Impact on Community**

21. In addition to direct enhancement of household welfare, policy objectives of rural electrification emphasize social impacts of overall benefit to the community. The use of electricity by community services and positive impacts on reduction of population growth, rural-urban migration and modern lifestyle are usually expected to be substantial. Rural electrification will be used by rural schools, and health clinics, and for street lighting and public buildings. The fact that there is a wider range of goods and services available is also a benefit to the community. Less tangibly, the availability of an electricity supply tends to provide rural communities with a psychological boost, improving the moral and civic pride of local people.

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<sup>5</sup> Royal Government of Bhutan. 1998. The Middle Path: National Environment Strategy for Bhutan.

<sup>6</sup> Royal Government of Bhutan. Eighth Five-Year Plan document.

22. The Project will help extend the supply of electricity in rural areas to 16 out of 20 districts and thereby will contribute to a significant improvement in the quality of life of 5,437 rural households—children being primary beneficiaries. Furthermore, the Project will provide 100 solar panels to remote areas in 3 districts, particularly for public facilities such as schools, hospitals, and monasteries. Therefore, this Project will contribute to the development of rural areas by facilitating economic opportunity through consumptive as well as productive uses of electricity.

#### **H. Willingness to Pay and Affordability of Rural Electrification by Households**

23. Because the basic objective of the Project is to improve the welfare of the rural population, it was important to conduct an analysis on what fraction of rural households can afford electricity supply. The socioeconomic survey has been conducted to (i) analyze what nonelectrified households currently spend on energy sources that substitute for electricity; (ii) analyze expenditures on electricity by residential consumers in electrified areas; and (iii) conduct surveys of potential consumers to know the extent they are willing and able to pay for electricity.

24. Further insight into the affordability of electricity supply can be obtained by surveying households as to their willingness and ability to pay for electricity supply. This was done by the June 1998 survey (footnote 1) in at least two nonelectrified villages each in the Western, Central, and Eastern regions. Approximately 95 percent of the households indicated a willingness to pay for electricity based on the amount of the monthly bill.<sup>7</sup> While the rest have preferred a ceiling on the bill amount, which is much higher (3 to 4 times for metered consumers and still higher for unmetered ones). This percentage varied considerably between villages. Differences in average village income levels are clearly responsible for part of the observed variation in willingness to pay.

25. At the current level of consumption, the lowest income groups spend only about 3.2 percent of their income on electricity. Since the energy consumption pattern across the income groups is only marginally at variance, and constitute a low share of total income and/or expenditure, the higher income groups can pay at least four times the current tariff for their levels of consumption on parity with low income counterparts.

26. The survey indicates that 87 percent of households are ready to pay for the initial cost of house wiring, service connection, and the initial fee. The poorest households will only be required to pay Nu250 each for an electricity kit<sup>8</sup> as deposit, and the Government will provide the connection free of charge. A household that wants further extension of wiring may need to spend approximately Nu1,500. Thus a total cost of Nu1,750 needs to be spent by the consumers in the low-income group if they want extended house wiring. For poor nonelectrified households, these costs would represent a half to one month's income.

27. When asked whether they would require a loan, nearly 27 percent of households indicated that they would require loans ranging between Nu5,000 to Nu15,000 to buy electricity appliances as well as to meet house wiring. Villagers could apply for a loan from Bhutan Development Finance Corporation (BDFC) through the rural credit scheme if he/she has some land or other property as collateral. When applying for a loan, a villager will usually receive

<sup>7</sup> The amount of monthly electricity bill for poorest household without a meter depends on the number of power points and light points. One light point will cost Nu5 and one power point Nu25. A poor household usually has 3 light points and one power point. The total amount of monthly electricity bill will be Nu40.

<sup>8</sup> The actual cost for the kit is about Nu1,500.

around Nu50,000 per hectare of land or equivalent of other properties. The procedure for applying for credit is not difficult and it takes one to two months to get the credit.<sup>9</sup> The interest rate is 13 percent per year. However, during the focus group discussion, some women mentioned that for loans of small amounts (maximum Nu5,000), they can borrow from their relatives or neighbors.

### **I. Impact of Tariff Adjustment to Poor Households**

28. The Government's policy is to guarantee access to basic services to the entire population. Consequently, once a village is electrified, all houses are provided access to electricity albeit at different levels of services, with only one or two light bulbs for the poorer households.

29. The current electricity tariff for residential and industrial consumers is Nu0.60 per kWh for urban consumers and Nu0.50 per kWh for rural consumers. The Government plans to revise and increase the tariff gradually based on socioeconomic conditions, cost of power generation and supply, and impact on domestic industry. Such adjustments will give rise to the sustainable development of the power sector and facilitate the future corporatization of DOP. The next tariff adjustment is proposed at Nu0.70 per kWh and will be effective on 1 January 2000 for urban and industrial customers. The introduction of three-block tariff, which includes a lifeline tariff for poor consumers will create cross-subsidies within the electricity subsector (e.g., high income to low income and intersector) and it is likely to ensure proper social balance.

30. The present level of tariff for rural consumers is highly subsidized. Though there is a need to increase the tariff from the point of view of the sustainability of DOP, the tariff structure addresses the issue of poverty, by proposing a lifeline tariff for low-end consumers. A poor household uses the lifeline unmetered tariff, and each household could have maximum 3 bulbs and one power point. Regardless of electricity power being used under the current tariff structure using the kit, they pay a total of Nu40 per month (around 2.0 percent of household expenditure for the lowest income category).

31. Also, it is pertinent to note that the average amount spent on fuel (in nonelectrified areas) and on electricity (in electrified rural areas) is a very small proportion of the income as well as expenditure (around 1 percent). The household survey also indicated the consumer's willingness and ability to pay (the response showed that the consumers would not be reducing their present level of consumption even if the tariff were increased by 50 percent). It is thus felt that the recommended tariff increases and structure do not have a significant impact on rural and poor consumers.

### **J. Land Acquisition and Compensation**

32. Although small amounts of land will be acquired and disturbed for the installation of supporting poles, most of the poles will be implemented along the roadside for ease of future maintenance. The Project will not necessitate resettlement of any people. The survey indicates that the beneficiaries in the project area are willing to allot the necessary land for poles when it encroaches on their property. Small portions of land may be necessary for transformers. Some of the land needed for this purpose may be privately owned and acquired from its owners. Adequate market-based compensation will be paid for any disturbance to, or loss of, productive land.

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<sup>9</sup> The length of loan processing depends on the success rate of repayment from the fellow villagers who borrowed money from BDCF.

33. Presently the Project has no particular negative impact and requires no remedial action. DOP will maintain data and progress reports on implementation of land acquisition, a summary report will be sent to the Bank annually for review and comments.

#### **K. Indigenous People**

34. Bhutan has some ethnic minority groups, though insignificant in number, and they live in isolated areas. Prominent among them are the Yak herders, who temporarily migrate from their inhabitancy to lower altitudes during winter. These along with other ethnic groups like Doya, Laya Lingzi, and Merak Sektang, and constitute less than 0.2 percent of the total population. As the indigenous people live in areas that will not be covered by the Project, there will not be any negative impact of the Project on them. Therefore, an indigenous people's development plan is not required.

#### **L. Participatory Project Performance Monitoring System**

35. The project performance monitoring system will be carried out under the Project in association with DOP. The community-based organizations in the Gewok will verify the effectiveness of project activities and outputs, as well as the reactions of the intended beneficiaries. Regular feedback will be provided through the project implementation units regarding the effectiveness of the Project and the necessary changes that may be required mid course. Regular monitoring reports will be included in a quarterly report prepared by DOP.

36. DOP will conduct monitoring to enable postevaluation of the Project, and also to improve the planning for future rural electrification projects. The proposed project performance evaluation and measurement indicators will be prepared in accordance with the Bank's *Guidelines for Project Performance Management System*. DOP will confirm, in consultation with the Bank, a set of performance indicators and performance targets to monitor the benefits of the Project at the time of loan inception.

37. The Bank through its TA on Power Sector Review to be implemented in 2002 will conduct comprehensive social impact monitoring and evaluation after completion of the Project to determine (i) total number of connected consumers in various categories, number of total potential consumers in those categories resident in the service area, and the connection ratios for those categories at various dates after commissioning; (ii) average consumption rates for consumers in each category; (iii) description of new economic activities induced by the introduction of electricity; (iv) description of existing economic activities that have switched to using electricity and thereby become more efficient and productive; (v) estimated total value of economic activities induced by the rural electrification; (vi) estimate of average income levels; and (vii) survey of the perceived importance of various types of benefits created by rural electrification, such as improved employment opportunities, increased income levels, improved quality of life and leisure activities, and improved health standards. It will also carry out concurrent surveys of average income levels in some representative and comparable communities that are not electrified to determine the incremental impact of rural electrification on income levels and economic activities. In addition, the consultants will conduct monitoring and evaluation of the land acquisition activities, entitlements, time frame, and budget set out for this process.

Table A.15: Consumer Profile

District Name	Households in income category group				Industries, Commercial & Public Inst. (Grid)	Solar Panel Connections	Total
	0-2000	2001-4000	4001-8000	8001-25000			
<b>Western Region</b>							
Thimphu	209	374	16	-	146	-	745
Paro	101	130	36	5	22	-	294
Wangdue	11	128	100	23	53	-	315
Punakha	42	87	179	59	106	-	473
Chhukha	197	212	5	-	43	-	457
Dagana	60	26	4	-	4	9	103
Samtse	14	101	104	-	12	-	231
<b>Subtotal</b>	<b>634</b>	<b>1,058</b>	<b>444</b>	<b>87</b>	<b>386</b>	<b>9</b>	<b>2,618</b>
<b>Central Region</b>							
Bumthang	14	46	29	-	9	-	98
Trongsa	2	2	5	4	1	-	14
Sarpang	35	63	57	13	21	-	189
Tsirang	-	-	-	-	-	9	9
<b>Subtotal</b>	<b>51</b>	<b>111</b>	<b>91</b>	<b>17</b>	<b>31</b>	<b>9</b>	<b>310</b>
<b>Eastern Region</b>							
Mongar	273	411	111	-	33	-	828
Pemagatshel	318	234	118	130	28	-	828
Trashigang	221	406	88	9	15	-	739
Lhuentse	47	98	91	-	29	10	275
Trashiyangtse	170	185	34	-	51	-	440
<b>Subtotal</b>	<b>1,029</b>	<b>1,334</b>	<b>442</b>	<b>139</b>	<b>156</b>	<b>10</b>	<b>3,110</b>
<b>Total</b>	<b>1,714</b>	<b>2,503</b>	<b>977</b>	<b>243</b>	<b>573</b>	<b>28</b>	<b>6,038</b>

Household Poverty Line: Nu4,032 per month

Consumers below poverty line: 4,217 (1,714 + 2,503)

Ratio: 4,217/6,038=69.8%

Consumers above poverty line: 1,220 (977 + 243)

Industries, Commercial &amp; Public

Institutions: 573

Solar Panel Connections: 28

Total: 6,038

## **TECHNICAL ASSISTANCE FOR CORPORATIZATION OF DIVISION OF POWER**

### **A. Background**

1. The Division of Power (DOP) will be the Executing Agency for the technical assistance (TA). The TA will require about 20 person-months of international consulting from an international consulting firm. The international consultants' team will comprise a qualified asset appraiser, and experts in financial management and accounting of electric utilities, and institutional setup including human resource management. One of the international consultants will act as the team leader. The international consultants will be responsible for the total scope of the work.

### **B. Outline Terms of Reference**

2. The consultants will have the following responsibilities:
- (i) Make a presentation and conduct a workshop on the process of the corporatization of DOP and finalize the time-bound action plan for the corporatization, which will be completed in June 2002, in consultation with DOP, and other concerned Government officials, and the Bank.
  - (ii) Appraise and estimate the value of the assets being transferred from the Government to the corporatized DOP. The consultant's work will include
    - (a) a review of the asset register of DOP including generation, transmission, and distribution and others;
    - (b) a review of the financing of DOP's assets;
    - (c) an estimation of the outstanding revenue owed to DOP by consumers for supply of electricity prior to 1 July 2002;
    - (d) an estimation of the current value of DOP's assets based on asset registers, debt service liabilities, outstanding revenues due to DOP, the value of DOP's nonproductive assets, and the value of bad/doubtful debts incurred by DOP prior to 1 July 2002; and
    - (e) In conjunction with the findings of TA 3112-BHU, determine the optimum wheeling charge to be levied by DOP on generation companies for transmission of bulk power through its system and the rate of rise of domestic tariff to meet the financial covenants outlined in (iii) and (iv).
  - (iii) Recommend an adequate financial structure for the corporatized DOP, such as assets and liability structure, debt-equity ratio, and other financial arrangement to ensure financial viability of the corporatized DOP.
  - (iv) Create a financial projection for the corporatized DOP up to FY2010 and prepare a tariff adjustment plan to achieve a rate of return at least 6 percent on the net fixed assets, debt service ratio of at least 1.5, and self financing ratio of at least 20 percent by FY2005 and thereafter. An adequate lifeline tariff scheme for the poor will be proposed.

- (v) Assist DOP to become registered in accordance with the power sector legislation and Companies Act. The consultant will prepare necessary documents as a company such as memorandum and articles of association in association with DOP.
- (vi) Formulate an appropriate organizational structure for DOP including details on delegation of powers, job description, necessary human resource requirement, salary and fringe benefit structure, recruitment policy, etc.
- (vii) Finalize a human resource development program for the corporatization of DOP and assist DOP to coordinate with aid agencies in association with the Bank. In addition, the consultant will provide necessary training of commercial accounting system, corporate finance, and tariff setting such as a long-run marginal cost approach to DOP's staff by using training courses available in the Royal Institute of Management.
- (viii) Assist DOP to strengthen its finance and accounting section to enable them to implement the full commercial accounting system and procedures as necessary under the corporatized DOP. In addition, the consultant will develop methodology to improve billing and collection performance and implement it in the corporatized DOP.

## **B. Cost Estimates and Financing Plan**

3. The TA is estimated at \$770,000 equivalent, comprising \$557,000 in foreign exchange costs and \$213,000 equivalent in local currency costs (Table A16). The entire foreign exchange cost and \$43,000 equivalent in the local currency cost for a total of \$600,000 equivalent will be financed by the Bank on a grant basis from the Japan Special Fund, funded by the Government of Japan. The Government has agreed to finance \$170,000 equivalent in kind through DOP.

## **C. Implementation Arrangement and Reports**

4. The Bank will select the international consulting firm based on Simplified Technical Proposals in accordance with the Bank's *Guidelines on the Use of Consultants*. Royal Institute Management will be a subcontractor to the selected consulting firm for the training implementation only. DOP will establish a counterpart steering committee for the TA prior to the commencement of the consulting services. The committee will comprise members drawn from Ministry of Trade and Industry, DOP, and other Government agencies (Ministry of Finance, Ministry of Planning, and High Court) and will be headed by MTI. MTI will also provide a legal expert as counterpart staff of the consultants.

5. The TA will be completed from January 2000 to December 2001. The consultants will submit to the Government and the Bank an inception report, two interim reports, and a draft final report within 4 weeks, 24 weeks, 50 weeks, and 100 weeks, respectively, after the commencement of the study. The consultants will submit three quarterly reports to the Government and the Bank between the second interim report and the draft final report. The final report will be submitted 4 weeks after comments on the draft final report have been submitted. Tripartite meetings involving the Government, the consultants, and the Bank will be held three weeks after submission of the inception, interim, and draft final reports.

**Table A16: Cost Estimates and Financing Plan**

(\$)

<b>Item</b>	<b>Foreign Exchange</b>	<b>Local Currency</b>	<b>Total Cost</b>
<b>A. Bank Financing</b>			
1. Remuneration and Per Diem			
a. International Consultant	450,000	0	450,000
2. Training using RIM	0	33,300	33,300
3. Travel of Consultants			
a. International Travel	37,000	0	37,000
b. Domestic Travel	0	5,000	5,000
4. Communications and Reports	5,000	0	5,000
5. Contract Negotiations	4,000	0	4,000
6. Contingencies	61,000	4,700	65,700
<b>Subtotal (A)</b>	<b>557,000</b>	<b>43,000</b>	<b>600,000</b>
<b>B. Government Financing</b>			
1. Workshop	0	5,000	5,000
2. Counterpart Staff	0	100,000	100,000
3. Office Space and Accommodation and Local Communications, and Transportation	0	50,000	50,000
4. Contingencies	0	15,000	15,000
<b>Subtotal (B)</b>	<b>0</b>	<b>170,000</b>	<b>170,000</b>
<b>Total</b>	<b>557,000</b>	<b>213,000</b>	<b>770,000</b>

RIM = Royal Institute of Management

## ECONOMIC ANALYSIS OF THE PROJECT

### A. General

1. The economic rate of return (EIRR) was calculated based on scenarios with and without the Project, using constant 1999 prices covering the period from 2000 to 2025. The Project will commence in September 1999, and physical construction is expected to start in April 2001 and be completed by September 2003. The life of the network expansion plans is assumed to be 25 years.

### B. Cost Assumptions

#### 1. Capital and Operation and Maintenance Costs

2. The capital cost for the Project has been estimated in dollars for the foreign exchange component and ngultrum (Nu) for the local currency components at 1999 price levels. To calculate the project rate of return, the capital cost is net of interest during construction and provision for price contingency. The Project is not subject to any taxes.

3. The annual operation and maintenance (O&M) costs of the Project are estimated to be 1 percent of the capital costs. System losses (during transmission and distribution) are assumed to be 15 percent as the end consumption will be mainly at the low voltage level.

4. The economic cost of the Project is derived from its financial costs measured at the border prices where the nontradable components were converted to world price numeraire using a standard conversion factor of 0.9. The shadow wage rate for skilled labor is taken as 1.0 as skilled workers are generally in short supply in Bhutan, and the prevailing market wages in the project area are taken as corresponding to their supply price. The conversion factor for unskilled labor was assumed at 0.73. Based on the proportion of the traded and nontraded items and skilled and unskilled labor, the overall conversion factor comes to 0.955.

#### 2. Cost of Energy

5. The economic cost of energy has been estimated at about Nu1.37 per kilowatt-hour (kWh) calculated based on the weighted sum of the cost of energy generation at marginal costs (about Nu0.16/kWh) and lost exports to India (Nu1.50 per kWh). Bhutan exports its power to India after satisfying its domestic needs. At present, domestic consumption represents about 20 percent of energy generation, and the balance is exported to India. With the Project, extra power supply for domestic use will come from lower exports to India although the incremental power supply required with the Project is quite low, it accounts for only about 2-3 percent of total generation capacity. However, with the additional generation capacity coming on stream in the future, the ratio of domestic sales to export sales will be further reduced. Conservatively, it was estimated that the overall domestic sales would represent only about 10 percent of total energy sales. The economic cost of energy was assumed to remain constant in real terms.

## **C. Benefit Assumptions**

### **1. Domestic Consumers**

6. The proposed Project comprises 6,038 potential consumers in various districts. The market mix consists of predominantly household consumers together with associated commercial, social, and government sector consumers such as shops, schools, basic health units, and monasteries. The economic benefits composed of the nonincremental and incremental benefits. The nonincremental benefit represents the cost savings from the displaced use of alternative energy due to the Project. In this case, it is primarily kerosene for lighting, which is fully imported. This benefit was estimated at 80 percent of the total sales forecast and was valued at the economic cost of kerosene. The incremental benefits is benefit from induced electricity consumption (estimated at 20 percent of the sales forecast), which is valued based on willingness to pay, or the weighted average price of the prevailing electricity tariffs and financial price of kerosene.

7. The financial price of kerosene is Nu4.40 per liter as compared with the economic price of Nu8.6 per liter. At present, all the kerosene is obtained from India, and the price paid by the consumers in Bhutan is the same price paid in India, which is highly subsidized. Since the petroleum pricing of India (to Bhutan) is based on major cross subsidies across consumers, consumers of kerosene are actually cross-subsidized by other consumers of petrol and diesel used for transportation and liquefied petroleum gas (LPG). Therefore, as India is selling petroleum products at roughly the same rate in Bhutan, this cross subsidy impact also applies to Bhutan. The economic benefit calculation assumed that the kerosene subsidy (from India) will be phased out at the time the Project is commissioned. This is in line with Government of India plans to fully deregulate kerosene from 2002 onward. The replacement value derived from kerosene is obtained based on the assumption that a kerosene lamp is assumed to consume 0.025 liter per hour, which is equal to a 40-watt incandescent bulb. The cost of owning and maintaining the kerosene lamps and electric bulbs have been considered to be of the same order and excluded from the analysis.

### **2. Motive Power Users**

8. In case of motive power users like village rice mills and saw mills, other industries and agricultural pumping, which presently use diesel engine-driven devices, the economic benefit is estimated considering the net savings that accrue to the economy due to (i) reduction in use of diesel (import price) and (ii) reduction in capital (and maintenance) cost, i.e., electric motor cost versus diesel engine cost. The savings in fuel cost is estimated at Nu4.24 per kWh based on fuel consumption per kWh of 0.4 liters (including lubricant oil equivalent) and the cost of diesel per liter of about Nu10.60. Savings in capital and O&M cost is estimated at Nu0.34 per kWh based on the following assumptions: (i) the capital cost per kW for diesel engines is Nu5,500 as compared with Nu3,500 for an electric motor; (ii) a diesel engine has 10-year economic life, while an electric motor has about 15-year life; (iii) the O&M cost per kW of a diesel engine is higher at 10 percent of capital cost as compared with only 4 percent for an electric motor; and (iv) 2,400 hours of operation per annum. The standard rating of a diesel engine used is 7.5 horsepower (5.5 kW).

**Table A17: Economic Internal Rate of Return**  
(Nu million)

Fiscal Year	Capital Cost	Energy Cost	O&M Cost	Total Cost	Economic Benefits			Total Benefits	Net Cashflow
					Household	Ind'l/Comm	Public		
1999									
2000	42.92	0	0	42.92	0	0	0	0	(42.92)
2001	215.45	8.84	1.29	225.57	11.87	11.10	4.82	27.78	(197.79)
2002	172.53	18.43	2.15	193.12	25.15	22.86	9.92	57.93	(135.19)
2003		22.42	3.02	25.43	36.64	23.55	10.21	70.40	44.96
2004		24.57	4.31	28.88	42.35	24.25	10.52	77.12	48.24
2005		25.71	4.31	30.02	44.88	24.98	10.83	80.69	50.67
2006		26.91	4.31	31.22	47.56	25.73	11.15	84.44	53.21
2007		28.18	4.31	32.48	50.39	26.50	11.48	88.38	55.89
2008		29.50	4.31	33.81	53.40	27.30	11.82	92.52	58.71
2009		30.90	4.31	35.21	56.59	28.12	12.17	96.88	61.67
2010		32.37	4.31	36.68	59.97	28.96	12.54	101.46	64.78
2011		32.37	4.31	36.68	59.97	28.96	12.54	101.46	64.78
2012		32.37	4.31	36.68	59.97	28.96	12.54	101.46	64.78
2013		32.37	4.31	36.68	59.97	28.96	12.54	101.46	64.78
2014		32.37	4.31	36.68	59.97	28.96	12.54	101.46	64.78
2015		32.37	4.31	36.68	59.97	28.96	12.54	101.46	64.78
2016		32.37	4.31	36.68	59.97	28.96	12.54	101.46	64.78
2017		32.37	4.31	36.68	59.97	28.96	12.54	101.46	64.78
2018		32.37	4.31	36.68	59.97	28.96	12.54	101.46	64.78
2019		32.37	4.31	36.68	59.97	28.96	12.54	101.46	64.78
2020		32.37	4.31	36.68	59.97	28.96	12.54	101.46	64.78
2021		32.37	4.31	36.68	59.97	28.96	12.54	101.46	64.78
2022		32.37	4.31	36.68	59.97	28.96	12.54	101.46	64.78
2023		32.37	4.31	36.68	59.97	28.96	12.54	101.46	64.78
2024		32.37	4.31	36.68	59.97	28.96	12.54	101.46	64.78
2025		32.37	4.31	36.68	59.97	28.96	12.54	101.46	64.78

O&M = Operation and Maintenance

Source: Staff Estimates

**Economic Internal Rate of Return**      **13.0%**  
**Net Present Value (10%)**                      **75.2**

<b>Sensitivity Analysis</b>	<b>EIRR</b>	<b>NPV</b>	<b>Switching Value</b>
Base Case	13.0%	75.2	
1. Increase in Costs by 10%	10.8%	21.3	14.0%
2. Decrease in Benefits by 10%	10.6%	13.8	12.0%
3. Delay in Project Completion by One Year	12.3%	59.7	
4. Opportunity (Export) Cost as Energy Cost	12.2%	56.6	
5. Combinations:			
1+2	8.5%	(40.1)	
1+2+3	8.2%	(49.8)	
1+2+3+4	7.4%	(69.0)	