

## CHAPTER II

### THE ELECTRICITY SECTOR : SPATIAL & TEMPORAL DEVELOPMENTS

#### 2.1 Power : An Introduction

Energy development has become one of the mainstays of modern economic development processes, primarily because of the consumptive demands placed by 20th century technology. Growing demand for energy is an indicator of the quickening pace of development for which the energy sector is an important infrastructural constituent. Among the many economic indicators used in making international comparisons of the state of economic development in various countries is energy consumption per capita. Percentage average annual energy growth rates for commercial energy in India have increased from 5.6% (1965-80) to 8.1% (1980-87) for energy production and 5.8% (1965-80) to 6.0% (1980-87) for energy consumption. Energy consumption per capita (in kilogrammes of oil-equivalent) has more than doubled from 100 (1965) to 208 (1987). Along with this is seen a rise in energy inputs as a percentage of merchandise imports from 8% (1965) to 17% (1987).<sup>1</sup>

Comparison may be made with OECD countries such as the United States with 0.4% growth in energy production (1980-87) and 0.1% growth in energy consumption (1980-87), but a per capita energy consumption of 7265 kilogrammes of oil-equivalent. For the same time period, the respective rates for OECD members as a whole were 1.8%, 0.5% & 6573 kilogrammes in oil-equivalent.<sup>2</sup> The figures place India in perspective. The wholly developed countries have low percentage growth rates in energy production and consumption, but per capita energy consumption levels that are more than 35 times that of India. Even compared to other low-income economies, India shows per capita energy consumption much below their average 1987 figures of 297 kg, and below the middle-income economies which have an average of 1077 kg.<sup>3</sup> The growing level of energy imports in India is an indicator of the magnitude of its oil-dependence and of petroleum imports in a world scenario of rising petroleum prices.

Energy contributes to the economy in two ways: as an essential input for economic development and as a contributor to improving the quality of life. In India commercial energy accounts for only "a little over half the total energy used in the country, the rest coming from non-commercial resources, such as cowdung, fuelwood and agricultural waste".<sup>4</sup> These sources are renewable in nature but are still used in a primitive and inefficient way. "The indiscriminate use of non-commercial energy sources is leading to an energy crisis in rural areas. The latest Five Year Plan lays emphasis on the development and accelerated utilisation of renewable energy sources in rural and urban areas. A major policy of the Government is directed towards increasing the use of coal in households and of electricity in transport sector in order to reduce dependence on oil, which is becoming scarce gradually".<sup>5</sup>

However, usage of electricity has considerably expanded over the years with per capita figures of 14.1 kwh (kilowatt-hours) for domestic purposes and 73.4 kwh for industrial purposes in 1980-81, for the country as a whole.<sup>6</sup> Statewise break-up thereof is available below.

Table 2.1

All-India and Statewise Domestic & Industrial  
Per Capita Consumption of Electricity (kwh)  
(1980-81)

State	Domestic Consumption of Electricity Per Capita	Industrial Consumption of Electricity Per Capita
Andhra Pradesh	10.3	55.5
Assam	3.0	20.4
Bihar	1.8	38.4
Gujarat	19.9	142.6
Haryana	17.7	94.9
Himachal Pradesh	15.5	24.7
Jammu & Kashmir	14.5	21.6
Karnataka	18.8	108.4
Kerala	19.5	72.5
Madhya Pradesh	6.7	64.1
Maharashtra	28.4	129.6
Manipur	4.6	0.7
Meghalaya	8.5	11.0
Nagaland	7.9	1.2
Orissa	4.3	79.8
Punjab	29.8	141.3
Rajasthan	6.5	37.9
Sikkim	19.0	7.9
Tamil Nadu	18.1	92.4
Tripura	6.6	2.2
Uttar Pradesh	7.2	32.7
West Bengal	14.4	69.4
India	14.1	73.4

Source: The Economic Times' Statistical Survey of the  
Indian Economy, 1984, Hannan Ezekiel (ed), pp. 212-213.

Considering domestic consumption alone, large inter-state variation is noticed, with agrarian low-industry states showing very small quantum of consumption. More industrial states generally have high domestic consumption, probably because industry coincides with a higher rate of urbanisation. The observed pattern therefore indicates that regions of the country that are largely dependent on agriculture consume less electricity, although the lower consumption figures are probably the result of a lack of transmission facilities rather than lack of demand.

## THE NATIONAL SCENE

### 2.2 Organisation

With power as a subject in the Concurrent List of the Constitution organisational responsibilities vest with the Department of Power under the Ministry of Energy at the centre, and the State Electricity Boards in the States. The Department formulates policies, makes perspective plans and monitors project-planning and execution and various features thereof, in addition to administering legislation such as the Electricity (Supply) Act 1948, Indian Electricity Act, 1910,

etc. which relate to generation, transmission and distribution of power. The Central Electric Authority (CEA) constituted under the 1948 Act is responsible for development of a National Power Policy and for coordination of the activities of various agencies and the State Electricity Boards. The "Central Electricity Authority advises the Department of Power on technical, financial and economic matters. The construction and operation of generation & transmission projects in the Central sector are entrusted to the Central power corporations, namely, the National Thermal Power Corporation (NTPC), the National Hydro-Electric Power Corporation (NHPC) and the North-Eastern Electric Power Corporation (NEEPCO), under the administrative control of the Department of Power. The Damodar Valley Corporation (DVC) constituted under the DVC Act, 1948 and the Bhakra-Beas Management Board (BBMB) constituted under Punjab Reorganisation Act, 1966, are also under the administrative control of the Department of Power. In addition, the Department administers the Beas Construction Board (BCB) and the National Projects Construction Corporation (NPCC) which are construction agencies and the training and research organisations, the Central Power Research Institute (CPRI) and the Power Engineers Training Society (PETS). Programmes of rural electrification are within the purview of the Rural Electrification Corporation (REC), which is a financing agency".<sup>7</sup>

With increasing annual electricity consumption, there has been concomitant expansion of transmission & distribution (T&D) facilities. "The total length of transmission lines of 66 KV and above increased from 10000 ckt (circuit) kilometres in December 1950 to 1.80 lakhs ckt kilometres in March, 1988. The highest transmission voltage in the country at present is 400kv and about 14000 ckt kilometres of 400kv lines have been constructed upto March 1988 and about 13000 ckt kilometres of these are in actual operation. Fairly well inter-connected systems at voltage of 220kv with progressive overlay of 400kv are presently available in all the regions of the country except the North-Eastern Region. With the creation of two generation corporations, namely, National Thermal Power Corporation and National Hydro-Electric Power Corporation in 1975, the Centre has started playing an increasingly larger role in the development of the grid systems".<sup>8</sup>

Regional Electricity Boards were set up in 1964 to promote integrated operation of regional power systems in the Northern Region covering the States of Punjab, Haryana, Rajasthan, Uttar Pradesh, Jammu & Kashmir, Himachal Pradesh and Delhi (Union Territory); the Western Region covering Maharashtra, Gujarat, Madhya Pradesh and Goa; the Southern region covering Tamil Nadu, Kerala, Andhra Pradesh, Karnataka and Pondicherry; the Eastern Region covering the States of West Bengal, Orissa, Bihar; and the North-Eastern Region covering Assam, Meghalaya, Tripura, Nagaland, Manipur, Mizoram and Arunachal Pradesh. "In order to coordinate the operation of the regional grids of the constituent power systems and to optimise utilisation of the existing generation capacity, Regional Load Despatch Centres (RLDCs) have been set up in each region which function under the regional electricity boards. The Central Electricity Authority extends overall supervision over the RLDCs".<sup>9</sup> These have been commissioned in 1984 in the Western and the Northern regions, and 1986 in the Eastern Region. State Electricity Boards have been established in 18 out of 25 States, except for Arunachal Pradesh, Goa, Manipur, Mizoram, Nagaland, Sikkim and Tripura. The West Bengal State Electricity Board was constituted in 1955 under section 5 of the Electricity (Supply) Act, 1948, and is responsible for generation and distribution of electricity within the State.

It can thus be seen that with augmented power demand the Central sector has come to the fore, to an extent not envisaged in 1948. This has been through the incorporation of the public-sector NTPC & NHPC in 1975 with the objective of planning, promoting and organising the integrated development of thermal and hydel power, respectively, in the country. The NTPC is entrusted with the task of execution and operation of large pithead thermal power stations such as Rihand, Singrauli and Vindhyachal etc. and their associated transmission networks. The NHPC is presently engaged in the construction of "Uri and Dulhasti (both in Jammu & Kashmir), Chamera (H.P.), and Tanakpur (U.P.). NHPC is also responsible for the operation and the maintenance of Baira Siul Hydro-Electric Project (Himachal Pradesh), the Salal power station (Jammu & Kashmir) and Loktak Hydro-Electric Project (Manipur)".<sup>10</sup> Construction assistance to both Central & State power agencies is provided by the National Projects Construction Corporation (NPCC).

As such most of the generation facilities owned by private companies were nationalised in the 50s but three privately-owned utilities still serve major cities: the Calcutta Electric Supply Corporation (CESC) serves Calcutta and the Tata Power Company serves Bombay and Ahmedabad, all more competently than the neighbouring State Electricity Boards.

### 2.3 Generation & Consumption

Electricity as a source of energy has the advantages of convenience and versatility and electricity demand has therefore grown at a rate much faster than that for other sources. As a result the power industry "has recorded a phenomenal rate of growth both in terms of its volume and technological sophistication over the last few decades. Electricity plays a crucial role in both industrial and agricultural sectors, and therefore, the consumption of electricity in the country is an indicator of productivity and growth. In view of this, power development has been given high priority in the development programme".<sup>11</sup>

As a result capacity utilisation in electrical industries have been at high percentage levels of 56% to 90%. Generation capacities have been utilised at levels between 43% to 50% with a tendency to grow over time between 1970 to 1984.<sup>12</sup> Indices of industrial production reached levels of 202.6 for electrical machinery and 245.7 for electricity generated, with 1970 as base-year.<sup>13</sup> Percentage growth rates in electric generation were at high levels of 12% between 1983 and 1984 and 8.5% between 1984 and 1985.<sup>14</sup>

The principal sources of electric generation in the country are thermal, hydel and nuclear, in order of importance. Of these, hydro-electric generation is chronologically the oldest with the first hydel power station in Asia being set up at Rinchintong in the Darjeeling hills in 1897, a mere ten years after the first such station in the world had come into existence in Britain. Power generation however grew mainly through thermal technologies till independence, the rationale behind this being drawn from the country's large balance of coal resources. "The world-wide shift from coal to oil after World War II went less far in India than in most other countries: neither the domestic oil reserves nor the foreign exchange earnings could support the extensive replacement of coal by oil".<sup>15</sup>

In later years there has been some increase through oil-based generation, both from the establishment of utility power plants near oil refineries so that their fuel oil surpluses could be used, and from the growth of captive diesel-powered generation in industry. Growth of the former has been apace with growth of refining capacity whereas growth of the latter is the result of the need for emergency generation in face of the inability of grid-generated power to cater to peak electricity demand. In spite of this, dependence on coal-fired capacity has grown from 56.5% in 1974 to 58.7% in 1981,<sup>16</sup> mainly because of the balance of payments considerations involved in expanding oil-fired thermal generation.

Indian hydro-electric resources are fairly substantial although not evenly distributed geographically; a rough estimate in 1965 placed them at 50 GW (giga watts) at 60% load factor.<sup>17</sup> The latest CEA estimate is 84 GW at 60% L.F., which is said to be 2.9% of the world's potential.<sup>18</sup> Most of this potential is located in the mountain ranges of the Himalayas and the Eastern & Western Ghats, in proportion to the distribution of monsoon rainfall. Highest rainfall is at the points of entry of the south-west and south-east monsoons in the Southern peninsula tip, and the Eastern Himalayas, respectively. Since this is distributed well away from coal resources, it is ideally placed to supplement thermal generation. Studies by the Power Commission in 1962 and the Energy Survey of India Committee in 1965 recommended greater reliance on hydro-electric generation on grounds of its cheapness and its being a renewable energy resource. The Power Economy Committee (1971) recommended that the bulk of new generation capacity in the Fifth & Sixth Plans should derive from expanded hydel generation with the balance of this capacity being drawn from super-thermal power stations (STFS) implying the largest possible unit sizes and located at coal washeries and the pitheads of coal mines.

The third major source of electricity is nuclear generation comprising 2.6% of installed power capacity and 2.4% of total generation in 1984-85.<sup>19</sup> Nuclear power is recommended as the economic option for regions in Western & Southern India that lack significant hydel potential and where transportation of coal from mines involves long journey leads. Although enthusiasm for this technology has been dampened in the recent years because of the problems of refuelling and environmental considerations, the nuclear power option is still the only viable power resource in these regions. Nevertheless the growth of capacity has been slow and with construction lags and long gestation in installing hydel capacity, there has accordingly been great pressure on coal-fired capacity.

Generation figures within these three major constituents of the power industry, by source and by region are provided in the Table 2.2. The dominance of thermal generation in the all-India context is immediately apparent, with a nearly three-fold increase between 1975-76 and 1989-90. Hydel power shows a fall in proportion, despite plan emphases earlier alluded to; a number of hydel projects whose construction was initiated have yet to come on stream. Inter-regional variations by source are also visible: the South has the best inter-source generation, thermal dependence is heaviest in the West and high in the East. Hydel generation is highest in the North, and nuclear generation entirely absent in the East and North-East. Growth in generation has been between 7-10 percent between 1985-86 and 1988-89; of these thermal generation grew by high rates of nearly 15% except in the last-mentioned year and hydro-generation showed negative growth in 1985-86 and 1987-88.<sup>20</sup> Consumption figures for 1981, by region,

available in the National Power Plan, 1983,<sup>21</sup> indicate electricity consumption of 23229 GWh (Northern Region), 28259 GWh (Western Region), 24340 GWh (Southern Region), 13509 GWh (Eastern Region), 908 GWh (North-Eastern Region) and 7932 GWh from power produced under captive generation.

Table 2.2

## Generation of Electricity By Source &amp; Region in India

( Figures in GWh )

	1975-76	1980-81	1985-86	1988-89
<b>I. Thermal (includes Steam &amp; Gas)</b>				
Northern	9838	13691	25721	40493
Western	14295	25368	48934	64136
Southern	6557	9218	20445	30522
Eastern	12136	12529	18368	21232
North-Eastern	476	496	868	1127
All India	43302	61301	114336	157510
<b>II. Hydro</b>				
Northern	10110	15000	19478	23749
Western	6439	7812	6178	7328
Southern	13639	20283	21119	21809
Eastern	2932	2962	3174	3504
North-Eastern	182	406	1035	1323
All India	33302	46542	50984	57793
<b>III. Nuclear</b>				
Northern	533	1228	1283	1871
Western	2894	1774	1960	1900
Southern	-	-	1739	2051
All India	2627	3001	4982	5822
<b>IV. Utilities</b>				
All India (I thru III)	79231	110844	170302	-
<b>V. Self-Generation</b>				
in Industry & Railway	6695	8417	13365	-
<b>VI. Total</b>				
ALL India (IV & V)	85926	119261	183667	-

Source : Compiled from World Bank Country Study : India, 1989, Table nos. 8 & 9, pp. 303, and S. Rajgopal: Power Scenario - A Performance Review, Indian Journal of Power & River Valley Development, December 1989, pp. 295.

Another point of interest is sectoral demand for electricity, an idea of which may be had by examining figures for sectoral electricity consumption.

Table 2.3

Consumption of Electricity by Sectors  
(figures in GWh)

	1975-76	1980-81	1985-86
Mining & Manufacturing	43.46	55.35	n.a.
Transport	1.89	2.31	3.17
Domestic	5.82	9.25	17.11
Agriculture	8.72	14.49	23.53
Others	6.28	8.30	12.71
Total	66.17	89.70	n.a.

Source : Compiled from World Bank Country Study: India 1989, Table nos.8 & 10, pp.304.

The table shows that consumption in all sectors has been growing, with mining & manufacturing being dominant consumers. Growth in transport consumption is mainly the result of progressive electrification of railway running-track. Sectoral demands from domestic, agricultural and other consumers has also grown. However analysis of average compound growth rate of consumption (i.e. percentage growth per annum) reveals a rate between 4-9 percent for mining & manufacturing, 2-8 percent for transport and high rates of between 10-15 percent for domestic consumption and 5-17 percent for agricultural consumption. This is against average growth in total consumption by 5-9 percent. Analysis brings out the growing importance of electricity as a quality-of-life determinant through domestic consumption, although this is largely confined to the urban population segment, and the response of agriculture to technological thrusts in irrigation under Accelerated Foodgrain Production Programmes and the green revolution.

Overall growth in the power sector over the plan period can be assessed from the table below. The massive thrust in rural electrification through village electrification and pump energisation is evident in their C.G.F. Although installed capacity and generation have also increased significantly, burgeoning population has limited growth in per capita consumption. Installed generating capacity is expected to increase to 103000 MW over the Eighth Plan period of which 78% of capacity addition will be thermal, 19.4% hydel and 1.8% nuclear.<sup>22</sup>

Table 2.4

## Growth of Power Sector in the Plan Period

	1950	1989	Position in 1989-98	C.G.F	Annual Growth(%)
Installed Capacity(MW)	1700	64729	64729	38	9.72
Annual Energy Generation(GWH)	5100	244971	244971	48	10.37
Villages Electrified(lakhs)	0.03	4.7	4.7	154	13.69
Pumpsets Energised(lakhs)	0.21	82.8	82.8	394	16.45
No. of Connections(lakhs)	15	650	650	43	10.08
Per Capita Consumption(kwh)	15	225	225	15	7.14

\*Cumulative Growth Factor (CGF) = 1990 value/1950 value

Source : Compiled from Table in R.K.Narayan: 'Power Development in India - Problems & Prospects', Indian Journal of Power & River Valley Development, December, 1990, pp.395.

However, "most regions of India experience power shortages in most years .... the shortages are not perennial; for instance, they are less frequent after the monsoon, in August-December, when the rivers are full and hydro-electric generation is at its peak. Nor are they endemic, for some parts of the system - e.g., some cities and essential industries - are protected from shortages, whilst other parts - e.g. agriculture - bear the brunt of the shortages".<sup>23</sup> The shortages are symptomatic of generation chasing fast-increasing demand but never catching up with it. An indication of increasing demand is given by the GDP-elasticity of electricity consumption which was 2.27 between 1970-79, considerably higher than industrial countries, or LDCs like Brazil with 1.21 and Mexico, with 1.53 between 1970-79.<sup>24</sup> Weakness in power availability impedes industrial growth despite rapid growth of generation system. Thus a large and satisfied demand exists. Estimates of current total deficit range between 6% & 10% and peaking power deficits as high as 30% are estimated for the Northern Region. Planned rationing and unplanned cuts, commonly called "load-shedding", have to be resorted to and the quality of power supply is poor in terms of voltage & frequency. Captive generation in the manufacturing sector is over 15% of its total power consumption and continues to rise even though the cost of generation can easily be twice that of grid power.<sup>25</sup>

## 2.4 Critical Review

The need for massive thermal generation to cope with rising electricity demand, which resulted in the establishment of super-thermal power stations in the Central sector, arose because of technological obsolescence in the older coal mines and transport bottlenecks. However, the setting up of large pithead thermal stations with the objective of bypassing both older mines and railways has not been without pitfalls. Although the SEBs dominate the power system, generating and distributing nearly 70%<sup>26</sup> of the output, and are entrusted with the extension of the grid to rural areas, the 1973 decision to operate large pithead stations in the Central sector put them under considerable strain; "they had to buy electricity from the pithead stations and distribute it, they had to set up high-voltage transmission networks, and they had to participate in complex arrangements for sharing power among states. All these arrangements became matters of fierce political bargaining between the Central and the State governments",<sup>27</sup> particularly over payments to be made to the Central sector and their realisation from SEBs.

"This interminable bargaining over an indeterminate price is due to the bilateral monopoly in which NTPC and the SEBs find themselves inextricably tied. NTPC can not undertake distribution of power and therefore has to sell it to SEBs; the SEBs, on the other hand, are refused permission to build new plants by the central government and can get power only from NTPC. Neither can do without the other".<sup>28</sup> Resolution of the conflict "could take the form of delivery power to the consumer without squabbling over the cost i.e. regardless of cost. If it took that form, NTPC would become as loss-ridden and as dependent on the Central and State governments as the SEBs are today. NTPC has removed the twin constraints on power development set by the limited coal transport capacity on the one hand and the limited maximum size of power plant that can be absorbed by the SEBs on the other; but it is powerless to carry out the implications of large-scale generation for distribution to the consumer. Whether NTPC will succumb to the outdated organisational structure, or whether it will create the imbalance that topples the structure, remains an increasing subject for speculation".<sup>29</sup>

Furthermore, the over-dependence on coal-fired generation concomitant on installation of pithead stations "has further distorted the hydro-thermal mix in all the regional power grids which for optimal energy utilisation should be in the ratio of 40:60. The hydro-thermal mix will be of the order of 32:68 by the end of the Seventh Five Year Plan and will further go down to 28:72 by the end of Eighth Five Year Plan. Regionwise hydro-thermal mix will, by the end of Eighth Five Year Plan, be as follows":<sup>30</sup>

Northern Region	28:72
Western Region	16:84
Southern Region	42:58
Eastern Region	15:85

Source :R.K.Narayan, 'Power Development in India - Problems & Prospects', Indian Journal of Power & River Valley Development, December, 1990, pp.395.

Other disturbing features are low plant load factor (PLF) and transmission & distribution (T&D) losses. All-India average PLF for 1989-90 was 56.5% as against 68% for NTPC plants; "some of the SEBs

are operated as low as 35%.<sup>31</sup> The World Bank Report on India, Power Sector Efficiency Review (1989) comments that 10-15 percent capacity gain could be economically obtained by efficiency improvement. Average T&D losses in India are of the order of 22-23 percent as against 7-8 percent or less in developed countries.<sup>32</sup> These comprise technical losses (from low-voltage, transmission networks) as well as actual pilferages. With the SEBs having to bear the brunt of fluctuating power demands within an extensive distribution network catering to large numbers of low-voltage consumers, much of the commercial losses on this account have also to be borne by them.

## 2.5 Transmission & Distribution

With the growth of generation in the Central sector and increase in unit-size to the present 500 MW unit in operation at NTPC super-thermal installations, substantial sophistication has entered into the transmission network. The National Power Plan envisages integration of all subsystems into regional power grids, closer integration of which is to lead to evolution of the national power grid. Salient features of transmission network established by the regional grids can be assessed from the overhead power map of India. The regional grids have EHV (extra high voltage) lines of 220KV (kilovolts) and 400KV, the latter of which is the maximum transmission voltage at present. These lines facilitate exchanges of power between the States and the regions and are in the Central sector, with construction responsibilities, which were previously assigned to NTPC, NHPC and NEEPCO now having devolved on the newly-constituted National Power Transmission Corporation (NPTC).<sup>33</sup> Besides these, the SEBs maintain HT (high tension) lines of 132KV/66KV which are radial feeds carrying power from major grid substations to HT consumers. These voltages are further stepped down on the 33KV/11KV transmission lines that link the distribution network for low-tension consumers.

For grid integrity, it is necessary that the sub-systems within the power sharing agreement operate at system voltages compatible with the transfer of power. For this, generation scheduling for the region as a whole is necessary through the RLDCs. Under operational conditions however "the existence of generation deficiency in many system, possibility of over-loading tie-lines, low frequency condition prevailing over long periods, opening out of tie-lines by individual systems to break away from the grid"<sup>34</sup> are some of the other problems encountered, which in extreme conditions lead to cascade tripping of units and consequent system shut down.

The five Regional Power Grids facilitate exchange of power from surplus to deficit areas and assist in the optimum utilisation of the power available in the country. Available figures for inter-regional power-transfer in the year 1986-87 serve also to indicate relative surplus-deficit positions in the different regional grids. Total inter-regional exchanges at 2196MU have been increasing from 1671MU (1983-84) and 1849MU (1984-85), thus indicating efficiency of the grid system. Taking ratios of outward to inward power-transfers it is seen that whereas Western and Northern Regions are in a generally surplus position with ratios of 7.71 and 1.56, respectively, the Southern and Eastern Regions are generally deficit with respective ratios at 0.09 and 0.01. However, volume of transfer is higher for Eastern Region, which is only to be expected from earlier figures and low consumption demand in the latter. The North-Eastern Region still remains an island within the grid with power transfers at nil. This can be seen from the data on inter-system power-exchange tabulated below.

Table 2.5

## Inter-Regional Transfers of Power (1986-87)

(million units)

Supplied from	Received by				Total
	Northern Region	Western Region	Southern Region	Eastern Region	
Northern Region	-	166	-	48	214
Western Region	135	-	1382	341	1858
Southern Region	-	75	-	45	120
Eastern Region	2	-	-	-	2
North-Eastern Region	-	-	-	-	-
Total	137	241	1382	434	2194

Source : Power 1986-87 - A Status Report (Extracts from the Report of the Department of Power, Ministry of Energy, Government of India), Indian Journal of Power & River Valley Development, October 1987, pp.277.

## 2.6 Rural Electrification

From the sectoral figures and inter-state figures on power consumption, previously reproduced in Table 2.1 the role of agricultural demand as a hidden player in the electricity scenario can be surmised. Since the same transmission networks cater to domestic, industrial and agricultural demand, states with higher per capita consumption generally record higher agricultural consumption too. The occasional exception to this rule is however found in states like West Bengal where the urban and industrial concentration is localised around a mega-city i.e. Calcutta, leading to wide ranging internal differentials between districts.

The rural electrification (RE) programme was initiated in the early 1950s as part of the normal activities of the SEBs, though emphasis then was "mainly on village electrification rather than energisation of pumpsets".<sup>35</sup> Until the late 60s progress was haphazard and unrelated to criteria of economic development or financial viability. Financial constraints on SEBs further militated against any significant achievements in the programme. The All-India Rural Credit Review Committee constituted under the Reserve Bank in its report<sup>36</sup> recommended an accelerated programme for rural electrification, and in view of the resource crunch confronting the SEBs, recommended creation of a special national fund for an autonomous agency to administer the rural electrification programme. This was accepted during the Fourth Plan and the Rural Electrification Corporation (REC) was constituted, under the overall control of the Ministry of Energy, in July 1979.<sup>37</sup> The philosophy behind its establishment was to bring rural electrification within a project-based development approach comprising:

- a. modernisation of agriculture through water resources;
- b. promotion of agro-based industries;
- c. decentralisation of non-farm occupations through mechanisation of household industries; and

- d. bringing in, directly or indirectly, other services in the form of amenities such as electrification of houses, educational institutions and health centres, energisation of pumps for drinking water, street-lighting, etc."<sup>38</sup>

The REC provides finance to SEBs for rural transmission networks, on conditions of financial viability, and ensures dovetailing of rural electrification projects with technological initiatives like pumpset energisation, with the participation of the Agricultural Refinance & Development Corporation (ARDC) and the commercial banks and State rural development agencies. REC programmes currently underway include the Minimum Needs Programmes (MNP) and Special Projects Agriculture (SPA), besides its normal loan programmes. Recent projects targeted towards energy efficiency come under Conservation of Energy: Network (CEN) and Conservation of Energy: Pumpsets (CEP) projects. Total financial assistance in 1987-88 amounted to Rs. 1027.87 crores.

Table 2.6

All-India Figures for Rural Electrification  
(1977-78 to 1987-88)

(Figures in Thousand)

Year	Villages Electrified		Pumpsets Energised		REC-Sanctioned Financial Assistance (Rs. in Crores)
	Annual	Cumulative	Annual	Cumulative	
1977-78	9.85	49.81	8.80	318.97	145.14
1981-82	19.57	91.37	194.82	752.88	209.28
1984-85	19.04	171.62	335.22	1798.29	514.98
1987-88	20.36	230.86	543.10	3145.51	1027.87

Source : Annual Report, 1987-88, Rural Electric Corporation, pp.6.

Achievements under rural electrification are normally quantified in terms of number of villages electrified and pumpsets energised, figures for which, spanning 15 years, are tabulated above. The table indicates annual performance and gross achievements of the RE programme. Increasing figures for villages electrified and pumpsets energised emphasise the importance attached to RE after the Fourth Plan. Starting with a percentage figure of villages electrified which was as low as 0.54%, during the period upto commencement of Fourth Plan in 1969, the figure rises to 12.94%. Corresponding figures for subsequent periods are 27.5% (Fourth Plan-end), 43.88%<sup>39</sup> (Fifth Plan-end), 64.02%<sup>40</sup> (Sixth Plan-end) and approximately 81.03%<sup>41</sup> (Seventh Plan-end).

However consideration of ratios of annual-to-cumulative figures in the table for both villages electrified and pumpsets energised points to thrust and consolidation in the village-electrification programme in the ten-year period upto 1981-82, and a thrust in the pumpset energisation programme in the five-year period between 1977-78 and 1981-82; the initial impetus seems to have worn off thereafter. Examination of 1980 inter-state figures on villages electrified as mentioned in the REC bulletin reveals that states recording highest percentage electrification such as Haryana, Kerala and Karnataka (all 100%)<sup>42</sup> also show appreciably high consumption figures in Table 2.1. Because of the slowdown in village electrification thereafter, states that had lagged behind in the initial phase will not have made sufficient headway over the subsequent decade, because of the slowdown

as also smaller increments in REC assistance. In a state like West Bengal which had 34.9%<sup>43</sup> village electrification in 1980, the 1990 figure is 69.4%,<sup>44</sup> symptomatic of the deceleration of the RE programme in its later phases.

As to the reason for the slowdown, the REC Chairman's Report states that "the villages now being taken up for electrification are more disadvantageously located than those taken up earlier",<sup>45</sup> which does not afford satisfactory explanation of why the consequent RE programme should be subject to inter-state variation. The true reason might lie elsewhere. RE projects, in general, are a losing proposition and, for long periods, the revenues they generate can hardly meet the liabilities of operation, maintenance, and financial charges. Nevertheless, even though they are uneconomical for the SEBs, they constitute an important means of fulfilling socio-economic objectives in rural development. Since REC sanctions are tied to financial viability of projects, there is low offtake, especially from SEBs within the power-deficit Eastern grid.

"Long distribution lines, low load density, poor load factors and poor power factor are some of the causes which make RE a bad financial proposition."<sup>46</sup> "Losses in rural distribution system pose a serious challenge to the SEBs. The energy losses which occurred in the rural distribution systems are as high as 25-30 percent in parts of the country."<sup>47</sup> "Various studies have revealed that most of the losses in the distribution system of the rural electrification are in the LT network. In certain cases their losses were found to be as high as 25-30 percent of the energy supplied".<sup>48</sup>

Another set of problems pertains to the nature of the agricultural power demand, which is seasonal. "Because of the characteristic load pattern of the irrigation pumpsets, the system having a large proportion of agricultural load may have a serious problem in meeting the peak demand of the system".<sup>49</sup> Pumpsets are generally not worked during the monsoon when hydel generation capabilities are higher. At other times, the pumping load is concentrated during the day, leading to peaking of system demand that is often beyond transmission capabilities of the SEBs. Load-factors for the agricultural load are low and seasonal and "for the rest of the year, the transmitters consume power without a load to transmit"<sup>50</sup> resulting in the high T&D losses of the rural network. As against this, it is widely recognised that investment in the RE sector brings manifold returns in the form of increased agricultural production and agro-industrial activity; thus financial viability of RE projects should be judged not merely from direct investment and returns, but with full cognizance of these benefits.

Much of the debate on the pros and cons of RE centers around its impact on the financial position in the SEBs, with recent arguments being for rationalisation of power tariffs to ensure commercial profits. Following acceleration in the RE programme "the rates of return decline sharply in the seventies owing to the losses incurred on rural electrification. The central government provided finance for the transmission and distribution lines to rural areas, but the recurring costs had to be borne by the SEBs. Most SEBs charge rural communities a fixed sum irrespective of their power consumption. In April 1979 this charge worked out to 12-17 paise per kwh against 33-48 paise for urban consumers of low-tension power; the cost of supplying electricity to rural areas was, of course, much higher. In 1976 the boards earned a net revenue surplus of Rs.450 million, but it was wiped out by losses of Rs.1,568 million on rural electrification".<sup>51</sup>

Efficiency priorities expectedly differ between system-engineers, economists and government. An example is the question of regulation of transmission in a situation of power-shortage, where rural feeders are the first to be disconnected and where agricultural loads are staggered into the night-hours even as industry is supplied by day. Even though the position taken by the power industry is for raising agricultural tariffs to obviate losses on the rural network, in some cases the agricultural tariff is found to be already higher than the industrial tariff.<sup>52</sup> At the same time the range of benefits accruing from RE are much more real and significant than from consumption of equivalent power by industry,<sup>53</sup> even though generation and T&D costs for the latter are lower; hence the RE programme needs to be evaluated on benefit-cost rather than commercial profit lines. As against this are opinions on more commercial lines such as those of the Planning Commission Sub-Group on "Energy Pricing, State Electricity Boards finances and related Issues"<sup>54</sup> which document the imperative of keeping the SEBs financially viable so that they generate internal resources as required under the 1948 Act. "SEBs tariffs and average realisation per unit sold has always lagged behind the average cost of generation and supply. Tariffs for agricultural consumers have been kept at abysmally low levels due to socio-economic considerations while even the tariffs for non-agricultural consumers are lower than the actual cost of generation and supply. This has to be set right".<sup>55</sup>

In reality, with combined operation of Central and State sectors, power problems have compounded. "If a board is making abnormal losses, the central government can deny new loans to its state government unless the board achieves a better balance between revenue and costs. Thus an errant SEB can be 'punished' by the central government by being starved of new plants - though the punishment is in reality borne by consumers. Part of the reason for the slow growth of capacity in eastern India in the seventies and eighties was that construction periods lengthened, and the central government delayed sanctioning new projects. But this type of inducement to efficiency is fitful (and).... has therefore not been very effective in promoting efficiency".<sup>56</sup>

In view of the problems attendant on RE which have been alluded to above, rural electrification in India has often been accused of having degenerated into bureaucratic 'targetism'. In very many states where power deficits exist, it is the urban industrial sector that is accorded priority; however since RE is a part of socio-economic policy-making each administration and electricity authority trots out impressive statistics. It is a moot point whether the poor state of power supply can actually sustain the targets reported to have been achieved.

## THE EASTERN REGION

### 2.7 Grid Features

The Eastern Regional Electricity Board (EREB) provides grid linkage between the State Electricity Boards of Bihar, Orissa and West Bengal i.e. BSEB, OSEB and WBSEB and the other generating agencies of the region, namely, the NHPC, NTPC and the Damodar Valley Corporation (DVC) in the central sector, Durgapur Project Limited (DPL), West Bengal Power Development Corporation Limited (WBPDC) and the Calcutta Electric Supply Corporation Pvt. Ltd. (CESC). Sikkim, which is yet to have an SEB of its own, is included under the EREB. The three SEBs and

CESC are generating and distributing agencies; the others mainly produce bulk power for transmission and sale. The attached T&D chart shows inter-system linkages for the EREB. Grid-linkage between NTPC and WBSEB is over 400kv EHV S/C (single circuit) lines with another 400kv linkage with OSEB contemplated; between WBSEB and BSEB over 220kv and 132kv S/C EHV lines. DVC is linked to OSEB by 220kv S/C and to BSEB by 132kv D/C (double circuit) and S/C lines. WBSEB is also linked to DVC by 220kv and 132kv lines. Linkage of the Eastern Region with the Northern grid is via the Moghalsarai-Dehri UPSEB-BSEB line and the Rihand-Sonnagar NTPC-BSEB lines.

Table 2.7

## Sub-Systemwise Installed Capacity of EREB Constituents (as of 1987)

Board/ Agency	Generating Stations	Installed Capacity (MW)	Stationwise Total
BSEB	Patratu(T), Barauni(T), Muzaffarpur(T), Kosi(H), Subarnarekha(H)	840 + 365 + 220 + 20 + 130	1425(T) + 150(H) = 1575
DVC	Bokaro(T), Bokaro 'B' (T), Durgapur(T), Chandrapura(T), Maithon(H), Panchet(H), Tilaiya(H)	247.5 + 210 + 500 + 780 + 60 + 40 + 4	1737.50(T) + 104(H) = 1841.50
OSEB	Talcher I(T), Talcher II(T), Hirakud I(H), Hirakud II(H), Balimala(H), Rengali(H)	250 + 220 + 198 + 72 + 360 + 100	470(T) + 784(H) = 1254
WBSEB	Bandel(T), Santaldih(T), Kolaghat(T), Gouripur(T), Jaldhaka(H), Messanjore(H), Kasba(GT), Haldia(GT), Siliguri(GT)	540 + 480 + 420 + 35 + 35 + 4 + 40 + 40 + 20	1475(T) + 35(H) + 100(GT) = 1610
DPL	DPPS(T)	395	395(T)
CESC	Mulajore(T), New Cossipore(T), Southern(T), Titagarh(T)	625	625(T)
SIKKIM	Gangtok(D), Lower Lagyap(H)	17	1.70(D) + 15.30(H) = 17.00
NTPC	Farakka(T)	400	400(T)
NHPC	Chukha H.E.P. (in Bhutan)	270	270(H)
TOTAL EREB			6529.20(T) + 1358.30(H) 100(GT) = 7987.5

Note: H=Hydel, T=Thermal, GT=Gas Turbine & D=Diesel.

Source: Monthly Progress Report, EREB, CEA, Government of India, Calcutta, April-1987.

Sub-systemwise installed capacity for all constituent subsystems of EREB are tabulated above.

Installed generating capacity in the region as in 1987 was 7717.50 MW<sup>97</sup> with BSEB, OSEB and WBSEB accounting for 1575MW, 1254 MW and 1610 MW, respectively. Hydro-to-thermal ratios for the three SEBs were 0.11(BSEB), 1.67(OSEB) and 0.02(WBSEB); this is against 0.17<sup>98</sup> for the Eastern Region. Of the constituents, WBSEB therefore has the lowest hydro generation component. Actual generation lags behind unrestricted electricity demand over the region, giving rise to a shortage in energy (in MV terms) of 22.94% which varies between constituents at 27.69% (BSEB) 17.26% (OSEB) and 31.55% (WBSEB).<sup>99</sup>

Exchange of power on the EREB grid takes place via the system inter-connections in the T&D chart. The two Central sector agencies NTPC and NHPC are purely generating agencies whereas DVC has a service network of its own covering the core areas of coal, steel and railways. DPL has a industrial network comprising large industrial units in the Durgapur-Asansol region and a small LT network of 262.4 circuit-km (CKM). Data on power transfer between EREB constituents for the quarter November '86 to January '87 is illustrative of the exchanges after NHPC generation via the Chukha Hydel Project in Bhutan had entered the system, and is reproduced below :

Table 2.8

Exchange of Power Between EREB Constituents  
(Quarter : November '86 - January '87)

From	To						TOTAL
	BSEB	OSEB	WBSEB	DPL	CESC	DVC	
BSEB	-	292	-	-	-	305	597
OSEB	126	-	-	-	-	45	171
WBSEB	76	-	-	382	650	570	1878
DPL	-	-	112	-	-	447	559
CESC	-	-	-	-	-	-	-
DVC	345	259	130	-	203	-	937
NTPC	-	-	514	-	-	-	514
NHPC	96	-	398	-	-	-	494
TOTAL	643	551	1154	382	1052	1367	-

Note: OSEB receipts from NALCO & NPEB are included in the OSEB system.

Source: Monthly Progress Report, EREB, CEA, Government of India, Calcutta, April-1987.

Column totals represent imports by constituents and row totals refer to exports. CESC is a gross importer while NHPC/NTPC are gross exporters; other constituents exhibit two-way exchange. Of the EREB constituents the major agencies in grid power exchange are WBSEB and DVC; CESC imports considerably without export. WBSEB exports include 1232MW within the State itself comprising exports to DPL and CESC, leaving a balance 646MW as power exported to BSEB and DVC. Compared to the two other SEBs, the WBSEB exports a larger amount of electricity outside its own command region (although contractually bound to do so in the case of CESC and DPL) than its imports; however a large part of this is accounted for within the State and does not flow into

neighbouring grids. Nevertheless, even after including all exchanges internal to West Bengal within the combined State-system, the position in West Bengal is still the opposite of that of OSEB and BSEB. This is brought out in the following table :

Table 2.9

Power & Energy Exchanges Between EREB  
Constituents : Import:Export Ratios  
(Quarter : November '86 to January '87)

Board/ Agency	Power MW : MW	Energy MU : MU
BSEB	1.88	2.31
OSEB	3.22	156.71
WBSEB	0.61	0.83
DPL	0.68	0.22
CESC	∞	(Exp=nil, Imp=422.99)
DVC	1.45	1.72

Source: Monthly Progress Report, EREB, CEA,  
Government of India, Calcutta, April-1987.

Comparison of the above ratios by Board/Agency reveals similar patterns for both power and energy exchanges. For WBSEB and DPL, the ratios are less than unity indicating that they are net exporters, whereas the other agencies are net importers having import-export ratios greater than unity for both power and energy. CESC is exceptionally so, with imports of 1052MW(power) and 422.99MV(energy), and exports=nil, raising its ratio to infinite levels.

The foregoing analysis brings out the major problems confronting the Eastern Regional grid. The WBSEB is linked via tie-lines to two neighbouring SEBs that are net importers of power without getting back-up support other than from Central Agencies. OSEB and WBSEB, on the other hand, have tie-lines with the Northern grid, and the Southern grid respectively. "At present DVC, DPL-WBSEB and CESC are operating in parallel. Bihar State Electricity Board and Orissa State Electricity Board are not in the inter-connected system in Eastern Region. Bihar State Electricity Board remains with Northern grid most of the time and Orissa State Electricity Board with Andhra Pradesh State Electricity Board for utilising the help they receive from them. This has put great strain on the system management as because the truncated Eastern Region of DVC-WBSEB-CESC-DPL system remains predominantly thermal where standby hot running reserves is extremely difficult to maintain".<sup>40</sup> "With Orissa State Electricity Board remaining out from rest of the agencies the benefit of hydro-thermal mix is lost to both. In spite of sincere efforts from all participants, it has not yet been possible to bring Orissa State Electricity Board into the Eastern Region integrated operation".<sup>41</sup>

## POWER IN WEST BENGAL

### 2.8 System & Organisation

Of the eight generating agencies that together constitute the Eastern Regional grid four belong to the West Bengal power system. These are, CESC which serves metropolitan Calcutta, DPL which serves the industrial and colliery belt in and around Durgapur-Asansol, the WBSEB which serves the rest of the State, and the DVC which is linked to BSEB and OSEB as well, but specifically meets the power demands of the steel plants, the collieries and the railway industry as also of railway traction in the region. With the transfer and upgradation of the Kolaghat Thermal Power Station (KTPS) from WBSEB another publicly-owned generating agency has been formed in 1987; this is the WBPDC. Besides there are two small companies such as DPSC (Dishergarh Power Supply Company) which have small generating capacities of their own.

Power generation in West Bengal started with the passing of the Calcutta Electric Lighting Act, 1895.<sup>62</sup> The Indian Electric Co. Ltd., incorporated in London, became the licensee in January 1897<sup>63</sup> and later changed its name to Calcutta Electric Supply Corporation Ltd. (CESC) with commercial generation starting in 1899.<sup>64</sup> The company was Indianised in 1971 and is now incorporated in Calcutta.<sup>65</sup>

The CESC now has under it the generating stations mentioned in Table 2.7 in previous section. It caters to a service network spread over 567 sq.km.<sup>66</sup> with a T&D network of 9,990 CKM<sup>67</sup> and its load, besides public utilities, is from domestic, commercial and industrial consumers, with a high percentage bulk load. CESC installed capacity, at 553.5 MW, is less than its system demand and it is presently a net importer of power from the WBSEB/WBPDC/DPL and DVC systems, accounting for 24.3% of total West Bengal power generation but 46.3%<sup>68</sup> of total sales of energy in 1989-90; it accounts, however, for 46.7% of total industrial sales of energy in the State.

DPL, when set up in 50's as a public undertaking, "was initially conceived as a captive plant of the coke-oven and by-product plants set up the State government; further expansion of the power plant in Durgapur was authorised for power supply to outside the [Damodar] valley",<sup>69</sup> where it is situated. DPL "is responsible for supply of power to all consumers as authorised by DVC"<sup>70</sup> and after meeting local demand at Durgapur, surplus power flows into the WBSEB system at Bandel, even though the original intent in setting up DPL was to provide standby power to DVC in times of distress.<sup>71</sup> The agency has a small T&D network of 463.63 CKM of which most is 11 KV or below in capacity. Installed generation capacity of DPL is 395 MW and it accounted for 6.1%<sup>72</sup> of energy generated in West Bengal in 1989-90 against 2.6%<sup>73</sup> of total energy sales, the reason being captive supply; industrial sales amount to 4.0% of total industrial energy sold in the State. DPL, is under the Public Undertakings Department of the State Government unlike WBSEB which is under the Department of Power;<sup>74</sup> the WBSEB is the subject of elaborate discussion in the forthcoming section and hence no special mention is made here. The WBSEB has a contractual arrangement to supply a minimum quantum of power to CESC, outside its system.

The DVC, set up in 1948 as a river-valley project on the lines of the Tennessee Valley Authority in the USA, was among the first major infrastructural projects in independent India.<sup>75</sup> The project spans areas on the catchment of the Damodar river falling in the states of

Bihar and West Bengal with a command area of 25235 sq.km. It comprises four major dams and one barrage for irrigation purposes along with a canal network of 2495 km. Hydel and thermal installed generation capacities in DVC add upto 1549 MW,<sup>76</sup> of which 410 MW<sup>77</sup> is at power stations located within West Bengal. The T&D network for evacuation, including inter-state tie-lines, amounts to 4575 CKM,<sup>78</sup> 1790.80 CKM<sup>79</sup> falls within the West Bengal system which are mostly transmission lines; however through grid linkages at Santaldih and Durgapur the DVC serves the needs of Kharagpur, Kolaghat, Belmuri, Durgapur projects and the Alloy Steel Plant at Durgapur, Chittaranjan Locomotive Works and the Howrah sector of CESC, all of which are in West Bengal.<sup>80</sup> For these local supplies distribution networks of the grid-linked systems are used. DVC generation is 15.4% and sales of energy in West Bengal amount to 13%<sup>81</sup> of total energy sold and energy sold to the industrial sector is 12.11%<sup>82</sup> of total HV industrial sales; no direct DVC sales are made to L&M voltage industrial consumers, although power drawn by other agencies from DVC obviously would reach such consumers, both in the industrial and agricultural sectors, on their own respective service networks.

The thermal power station at Kolaghat, which now belongs to WBPDC (West Bengal Power Development Corporation Ltd.) has installed capacity of 420 MW but generation is entirely absorbed through the WBSEB system; hence no separate T&D network or account of sales exists for it. Nevertheless WBPDC accounted for 21.1%<sup>83</sup> of generation of energy in West Bengal. The three other minor generating agencies account for about 1% of generation and 6.13%<sup>84</sup> of sales of energy mostly in commercial, industrial and railway sectors; their combined T&D network amounts to 1017.45 CKM.<sup>85</sup> This leaves 32% generation and 38.6%<sup>86</sup> energy sales in the State to the account of WBSEB.

## 2.9 The WBSEB

The WBSEB, constituted in 1955, is the principal generation and distribution agency in West Bengal. The "WBSEB operates in about 85,000sq.km. area out of the 89,000sq.km. for the state as whole. The rest of the area, about 4,000sq.km., is served by DVC, DPL and CESC. WBSEB maintains 5114 CKM of transmission lines and 84220 CKM of distribution lines serving the industry, agriculture and households sprawled all over the state".<sup>87</sup>

"Unlike most electricity boards in the country, the WBSEB does not enjoy a monopoly of either generation or transmission and distribution of power. There are also transmission lines outside its control within the State. There were in the state generating and distributing agencies from dates prior to the constitution of WBSEB, and three of them have continued their operations. The most important of these was and is the Calcutta Electric Supply Corporation which has preceded the WBSEB by more than half a century. Then there was the DVC formed in 1984 as multi-purpose development agency which ultimately became a power company and almost coeval with the WBSEB was the Durgapur Projects Limited which generated massive power along with the production of cokes, gas and basic chemicals. There were also a score of local electric supply companies in the smaller towns which were acquired by the WBSEB except for the Dishergarh Power Company and its associated unit".<sup>88</sup> Subsequently, the WBPDC was separately constituted in 1987 with Kolaghat Thermal Power Station (KTPS) under its control.

"Till the WBSEB's own power house was installed at Bandel in 1965, the WBSEB was buying power in bulk from the CESC, DVC, and DPL. This power was distributed by the WBSEB in the towns whose electric supply companies had been absorbed into the WBSEB. The number of generating stations belonging to the WBSEB have increased - three thermal power houses at Bandel, Santaldih and Kolaghat, gas turbine installations at Kasba, Haldia and Siliguri and few small hydel installations at Jaldhaka, Bijanbari, Messanjore, Kurseong etc."<sup>89</sup> In addition to these the WBSEB has in its charge a small diesel capacity coming mainly from the local electric supply companies that were taken over by it. Power received under the state-quota from NTPC/NHPC is also distributed through the WBSEB network.

## 2.10 Generation & Demand

Rich reserves of coal in the Raniganj-Asansol belt were the predominant factor in deciding installation of thermal power plants in the state. As a result generation in the state is highly thermal-dependent, as earlier seen. Installed generation capacity directly under WBSEB is tabulated below in the Table 2.10.

Table 2.10

### Capacity of Generators Installed (MW) in WBSEB System

Type	Stations	Unit	As on(31.3.92)	
THERMAL	1.Bandel	Unit - I	82.50	
		Unit - II	82.50	
		Unit - III	82.50	
		Unit - IV	82.50	
		Unit - V	210.00	
		Sub Total :		540.00
	2.Santaldih	Unit - I	120.00	
		Unit - II	120.00	
		Unit - III	120.00	
		Unit - IV	120.00	
	Sub Total :		480.00	
	Total Thermal		1020.00	
GAS	1.Haldia	Unit - I	20.00	
		Unit - II	20.00	
	2.Siliguri	Unit - I	20.00	
		Total Gas		60.00
	HYDEL	1.Jaldhaka	Unit - I	9.00
Unit - II			9.00	
Unit - III			9.00	
Unit - IV			4.00	
Unit - V			4.00	
		Sub Total		35.00
2.Messanjore		Unit - I	2.00	
		Unit - II	2.00	
		Sub Total		4.00
		3.Other Hydel Stations		7.31
	Total Hydel		46.31	
DIESEL	1.All Stations		22.36	
		Solar Photovoltaic Panels	0.04	
	TOTAL		1188.71	

Besides this, installed generating capacity of the other systems serving the State has been mentioned in the earlier Table 2.7. New capacity addition to the state system, excluding central sector power agencies, is expected to come on stream according to the following table:

Table 2.11

		Addition to Generating Capacity in West Bengal (excluding DVC & NTPC)					
Stations		90-91	91-92	92-93	93-94	94-95	Total (90-95)
Thermal	KTPP	420	210	210	-	-	840
	CESC(Southern)	67.5	67.5	-	-	-	135
	Bakreswar	-	-	-	420	210	630
	Gouripur	-	-	-	-	120	120
Hydel	Teesta	-	45	22.5	-	-	67.5
	Rammam	-	-	51	-	-	51
	Mongpoo	-	-	-	5	-	5
TOTAL		487.5	322.5	283.5	425	330	1848.5

Source : Power Scene in West Bengal, WBSEB, pp.3.

Bakreswar and Gouripur are new thermal power projects under WBSEB, while the CESC (Southern) station will augment CESC capacity. Two new medium scale hydel power projects are being executed on the Teesta and Rammam rivers of which the Teesta Canal Falls Project is of a technologically-ingenious low-head variety. The Mongpoo (or Marma) H.E. Project is in the micro/mini hydel category.

As against these generation capacities demand projections for West Bengal prepared by the CEA are :

Table 2.12

## Demand Projections for West Bengal (excluding DVC)

Year	Demand		Supply	
	Peak Power (MW)	Energy (MKWH)	Peak Power (MW)	Energy (MKWH)
1989-90	1904	10450	1516	11417
1990-91	2027	11079	1811	13030
1991-92	2193	11932	1932	14355
1992-93	2371	12836	2104	15831
1993-94	2565	13816	2387	17834
1994-95	2772	14882	2642	19730

Source : 13th Annual Power Survey, CEA, 1987.

"It can be seen that the state power system is going to be augmented by 487.5 MW of new thermal power capacity by 1990 and another 277.5 MW by 1991. Between 1990 and 1993, there will be addition of 975 MW of thermal capacity to the state system. There is also a proposal under examination for installation of 2 x 60 MW Fluidised Bed Boiler units in the Eighth Plan period".<sup>90</sup> These additions are to be made on a total installed capacity within the state in 1989-90 of 2583.54 MW (excluding NTPC/NHPC and DVC) derated to 2556.49 MW. "An ambitious

project for harnessing hydro power at Ajodhya Hills in Purulia has been approved by the Planning Commission. The project for 1050 MW aided by a loan from OECF, will be executed by a Japanese team of experts. The project, expected during Ninth Plan, will provide firm hydel support for the thermal power base in the State which it lacks now".<sup>71</sup>

Downward adjustment of the CEA figures for "supply" needs to be made, however, particularly because of shortfall in capacity creation resulting from delays in commissioning 2 x 210 MW units at KTPS. Demand figures represent unrestricted power demand in a situation where all presently imposed restrictions on power off-take have been removed; the gap between supply and unrestricted demand consistently shows a peaking deficit, even though its magnitude is expected to lessen with the addition of capacity over projected years.

"Demand in CESC area has been increasing at a rate of about 3.61 percent and at 11.89 percent per annum in WBSEB area. The combined growth rate for the State as a whole comes to 7.26 percent per annum. Maximum peak demand reaches 1227 MW in 1988-89 in the graph presented below. In November 1989 it touched 1427 MW".<sup>72</sup> The demand for power exhibits strong seasonality. "While the seasonal demand in the CESC area shows a steady pattern, maintaining a regular growth over the years, the pattern for WBSEB area does not show similar regularity. The difference in the nature of the two curves arises from the difference in the composition of the consumers in the two areas. While the distribution of the consumers in different categories in CESC areas remains largely unchanged over the years, the same for the WBSEB area has been undergoing rapid change. Energisation of pumpsets, which has been recorded a significant rise in recent years, has been generating heavy pressure on load during boro season in the months of February to May".<sup>73</sup>

The graph<sup>74</sup> shows how in the months of March and April in 1989 coinciding with the boro season, demand for power increased by 90 MW and 110 MW respectively in the rural areas. The CESC system, being an urban-industrial feeder shows a more or less flatter monthly system demand curve whereas the WBSEB system which covers the entire rural Bengal shows peaking coinciding with boro and rabi agricultural seasons.

Details of 400/220/132 KV EHT lines in the WBSEB T&D network have already been included in T&D chart. In addition, a total route-length of 806.20 CKM comprises 66 KV EHT transmission lines. The 400 KV KTPS-Jeerat line of 134 CKM linking the NTPC feeder from Farakka is already operational alongwith the newly commissioned WBSEB-OSEB link through the KTPS-Talcher 400 KV transmission line, of which WBSEB maintains 124 CKM within the state of West Bengal. Thus WBSEB transmission lines consist of 259 CKM:400 KV, 1402 CKM:220 KV, 3036 CKM:132 KV, 806 CKM:66 KV, 5761 CKM:33 KV and 64290 CKM:11 KV to 3.3 KV and of 65778 CKM:LT lines.<sup>75</sup> Although each of the power agencies in West Bengal, besides WBSEB, has a command area of its own, their systems cannot really be considered to be independent because of the large volume of inter-system exchange of power.

## POWER IN NORTH BENGAL

## 2.11 Regional Demand

The districts of Darjeeling, Jalpaiguri, Cooch Behar, Malda and West Dinajpur (recently bifurcated into North Dinajpur & South Dinajpur) constitute the region north of Ganges called North Bengal. The region is entirely within the WBSEB T&D circle. Transmission of power to North Bengal takes place via the North Bengal grid, details of which are presented in the attached T&D system chart. Outward linkage of the North Bengal grid with the South Bengal grid is at Gokarna 132/66 KVA Sub-Station in the WBSEB network and at Farakka Super-Thermal Power Station (STPS) on 220 KV NHPC-NTPC transmission. Besides these, other outward linkages of the North Bengal grid are with BSEB on the 220 KV Dalkhola-Purnea lines, and with ASEB at Gosaigaon and Bongaigaon on the Birpara-Bongaigaon 220KV NHPC line. Inward linkage with the Chukha H.E. Project in Bhutan is at Birpara, and with the NTPC at Farakka. The chart below presents a schematic picture of the entire EHT network in the region comprising 220/132/66 KV & 33 KV lines.

Table 2.13

Power stations/generation facilities locally located are at:

Hydel	Jaldhaka H.E. Project	
	Stage I	3 Unit x 9 MW = 27 MW
	Stage II	2 Unit x 4 MW = 8 MW
	Little Rangit/Bijanbari	= 2 MW
	Rinchington	= 2 MW
	Kurseong(Fazi)	= 1.2 MW
	Sidrapong	= 0.8 MW
	Singtaa	= 1.2 MW
Gas	Siliguri	1 Unit x 20 MW = 20 MW
Diesel	Darjeeling	= 11.8 MW
	Jalpaiguri	= 1.37 MW
	Cooch Behar	= 1.47 MW
	West Dinajpur	= 2.3 MW
	Malda	= -

Source : Annual Statistics 1989-90, WBSEB.

Besides this, the Farakka STPS with installed capacity of 630 MW has a feed-in to the North Bengal grid at Malda. Hydel stations in North Bengal account for 91.36% of the total hydro back-up available within the WBSEB system and 36.35% of the total hydel installations of WBSEB & DVC, combined.

First attention to the hydel potential of the hill-rivers in the North Bengal region dates back to 1919 when J.W. Meares included the Jaldhaka scheme in his report on "Water Power Resources of India".<sup>96</sup> The first techno-economic feasibility survey was undertaken by the Swiss consulting firm of Edward & George Gruner of Basle.<sup>97</sup> Their report estimates the total hydro-potential for three suggested schemes, namely Jaldhaka (77.3 MW), Jayanti & Katalung (11.1 MW) and Raidak (150 MW) at 238.4 MW.<sup>98</sup> Although the schemes were to be located at topographically more favourable sites at elevation on the Bhutan-

India border in Jalpaiguri district, generation from them was to feed the power demand of Cooch Behar district. Cooch Behar itself did not reveal suitable sites for the construction of a power plant because of the character of its rivers, flat topography and low heads on its rivers.<sup>99</sup>

The report states that the Jaldhaka and Raidak schemes were more economical compared to the Jayanti & Katulum scheme. The proposed power plants would be at "distances of 30-70 miles [48-113 km] away from Cooch Behar" and "quite close to the railway lines".<sup>100</sup> This would permit use of the energy generated for urban purposes, for tea-gardens and for railway electrification. An earlier report on the Jaldhaka H.E. Scheme had estimated total power demand of the tea sector to be more than 100 MW. With this energy being required between mid-March to November-end, it would be possible to cater to the tea load from the maximum monsoon generation of the suggested schemes. Besides this, other reasons cited in favour of the installation of the scheme were electrification of towns & villages and meeting industrial demands from tobacco factories.<sup>101</sup>

At the time of formulation of the Jaldhaka Scheme by the WBSEB justification provided was that "the development of hydro-electric power in West Bengal has not been proceeding on par with other States of India. This is due to comparatively high cost of development of water-power sites; and also because of the proximity of coalfields. In West Bengal where both hydro and thermal power resources are available, the two sources of power may be considered as complementary rather than competitive and ways and means should be found to develop hydro power in those regions of the State far removed from coalfield areas where the possibility of installation of thermal power plants is ruled out due to the difficulty and cost of transport of coal. Thus the hydro power will have to be regarded as the primary source of power in the northern districts of the State".<sup>102</sup> The stress at the time was on industrialisation which would ensure greater mobility of labour & materials and steady flows of investment, thus breaking "the insularity of the North"<sup>103</sup> i.e. North Bengal. A day was envisaged when South Bengal will be getting large blocks of electricity from the hydel stations of North Bengal through long transmission lines. The rate of depletion of the coal reserves available for thermal generation will determine how soon this will be a reality".<sup>104</sup>

The project in its ultimate form envisaged "supply of 1800 KW [18 MW] of firm power to the urban and rural areas of North Bengal, from Darjeeling and Siliguri in the west to Cooch Behar-Dinhata in the east, covering an area of about 2000 sq. miles, and about the same amount of seasonal power to the various tea estates of the Dooars area".<sup>105</sup> The project was, as such, to cater to the following electrical loads:

"1. Rural & Urban Firm Demands:

- a. Domestic
- b. Commercial
- c. Industrial
- d. Water works
- e. Street lighting

2. Special demands for Tea Industries.

3. Other industrial demands."<sup>106</sup>

It is thus seen that rural electrification was not very high on the scale of priorities then. It was stated that supply to rural areas is not likely to be economic and that, "pending any governmental decision of subsidies for purely rural supplies, electrification on an economic basis can only be provided for the town-loads".<sup>107</sup> Thus no estimate was made of projected R.E. agricultural loads.

Subsequently, the Project Report on Jaldhaka Stage-I states that "the existing demand of North Bengal can hardly be made with only Jaldhaka Hydro-Electric project even with full utilisation of its river potential. Wide gap exists between the demand and supply position".<sup>108</sup> Justification again centered around urban-industrial and tea loads.

At a more recent date, in the Project Report of Teesta Canal Falls Development Project, it is observed that "owing to inadequacy of power and lack of their infra-structural facilities, the northern part of West Bengal could not develop. In fact, the load-development in the area had been kept suppressed. Rate of progress in Rural Electrification and agricultural growth is also slow due to shortage of generation although potential need for such load is there".<sup>109</sup>

"If adequate power supply can be assured, demand for power from industries and other sectors will increase at a rapid rate. Tea gardens are pressing hard for release of more power. In fact a number of them are operating with their captive generating units and are eager to switchover to the grid of WBSEB system because of economical as well as operational problem associated with such small captive units. An interesting feature of the tea-industry is that its working season and demand for power synchronise with that of the secondary power generation available from Hydro Power stations during monsoon months. These features all the more are in favour for hydro-electric power development. The demand for power in this region (northern part of West Bengal) inspite of keeping it suppressed, is increasing and during 10th Annual Power Survey it has been estimated to exceed 175 MW by 1983-84. If and when an atmosphere is created of the prospects of availability of adequate and stable supply of power, the rate of increase in demand will be faster and is likely to well exceed the present forecast".<sup>110</sup> Elsewhere, it is stated that "in comparison to the southern part of West Bengal, the northern part viz. the districts of Darjeeling, Jalpaiguri, Cooch Behar, West Dinajpur and Malda have lower rate of growth, particularly in the industrial field. Beside inadequate road and rail connection with other parts, shortage of power is one of the factors contributing such retarded[sic] growth rate".<sup>111</sup> "Timber and tea are abundant in this area, the latter is foreign exchange earner also. The tea industry is now run mostly from their captive generating station with diesel drive and are eager to be connected to the power grid of North Bengal because of the uneconomical operation in isolated captive diesel stations. Quite a good number of industrial schemes such as paper pulp industries and other big/small industries are kept in abeyance for non-availability of adequate power in this region".<sup>112</sup> "Being situated away from the coal fields or oil fields and due to inadequacy of transport facility, power generation with only fossil-fuel is not an attractive proposition of this area".<sup>113</sup> "The Himalayan region is rich in hydro-power potential. In this respect northern part of West Bengal and particularly Darjeeling District is favourably placed. A number of rivers like Teesta, Jaldhaka, Torsa, Raidak, Rammam, Balason, Rangit, Mahananda and their numerous tributaries are flowing from the high Himalayan range to the flat terai region across the districts of

Darjeeling, Cooch Behar, Jalpaiguri. On a rough assessment the feasible power potential of North Bengal rivers stands at 1324.26 MW approximately", details of which are furnished in the table below:<sup>114</sup>

Table 2.14-13(A)

## Power Potential of North Bengal

Name of the River	Potential in MW
Jaldhaka	48
Raamaa	190
Balason	66
Teesta Canal Drop	67.5
Mahananda	28
Raidak - Jayanti	161
Great Rangit	100
Teesta (High Dam)	600
Other small Kholas	63.76
Total	1324.26

Source : Project Report, Teesta Canal Fall Development  
Hydro-Electric Project, Fall Nos.- 2 & 3 Combined  
Planning & Engineering Wing, WBSEB, 1979, pp.1/2.

This is against figures for installed capacity and capacity to be added in Tables 2.13(A) and Table 2.11, respectively.

The last category of schemes in the table above are micro-mini hydel projects. It is said of them that "micro-mini hydel projects in the isolated areas of hills may serve not only the rural population but at the same time will decrease the amount of pique generated among them in comparison to their urban counter part, so far as development is concerned".<sup>115</sup> RE extension is to improve general conditions of living in rural areas as well as to provide cold-storing facilities for agricultural produce. The concept thus evolves of RE in remote hill areas through micro-mini hydel generation having small transmission networks independent of in grid; such a concept is the best-fitted economic solution in the easy availability of perennial water resources which are renewable sources of energy,<sup>116</sup> and these schemes being short gestation schemes compared to large-scale power plants. Although their economic vitality has been subject to a certain amount of debate, since "in comparative terms the cost per unit kilowatt installed on cost per unit generation is higher than the conventional hydro projects",<sup>117</sup> their actual strength lies in their being viable options against conventional diesel or gas turbine technologies that are the only alternatives in remote non-accessible areas. Another consideration is that their existence frees grid power which can then flow to deficit-areas where energy options are much more limited. "Out of the assessed approximate potential of high and medium head micro-mini small hydel development in India (5000 MW) only a small fraction (260 MW) has so far been developed".<sup>118</sup> With financial assistance to micro-mini power generation schemes having been brought into the sphere of activities of the REC,<sup>119</sup> quicker progress may now be achieved.

The schemes recommended in North Bengal are listed below. Of these the Mongpoo H.E. Scheme has received sanction for inclusion under the Eighth Five Year Plan.

## Proposal for WBSEB's Micro-Mini Hydel Schemes

1. Naxal Micro H.E. Scheme	Naxal Khola	4 x 125 = 500 KW
2. Neora Micro H.E. Scheme	Neora khola	3 x 225 = 675 KW
3. Dudhia Micro H.E. Scheme	Dudhia	4 x 200 = 800 KW
4. Marma Micro H.E. Scheme	Marma Khola	4 x 50 = 200 KW
5. Bhim Micro H.E. Scheme	Bhim Khola	4 x 200 = 800 KW
6. Teesta Bazer H.E. Scheme	Giel Khola	4 x 300 = 1200 KW
7. Bagora Sittong H.E. Scheme	Rayong N.	4 x 255 = 1020 KW
8. Gaiobatham Jogitar H.E. Scheme	Chel & Kali Khola	4 x 480 = 1920 KW
9. Rishi H.E. Scheme	Rishi & Rongbong	4 x 700 = 2800 KW
10. Mirik H.E. Scheme.	Rongbong Khola	4 x 360 = 1440 KW
11. Tindharia Gabayari H.E. Scheme	Mahanadi & Jhoti Khola	4 x 160 = 640 KW
12. Tonglu-Manebhangang H.E. Scheme	Chota Rangit & Kali Khola	4 x 390 = 1460 KW
13. Dilpa-Barahatta H.E. Scheme	Dilpa Khola & Rithu Khola	4 x 900 = 3600 KW
14. Rangu H.E. Scheme	Rangu Khola	4 x 480 = 1920 KW
15. Jhepi H.E. Scheme	Jhepi Khola	4 x 180 = 720 KW
16. Mangpu H.E. Scheme	Kali Khola & Rambhi Khola	4 x 1400 = 5600 KW
17. Payong H.E. Scheme	Relli Khola	4 x 540 = 2160 KW
18. Pedong H.E. Scheme	Mandum Khola	4 x 390 = 1460 KW

Source: Feasibility Report of Micro-Mini Hydel Schemes, WBSEB,  
Survey & Investigation Circle Hydel Civil Planning &  
Design Division Kurseong, 1984.

## 2.12 Transmission & Distribution

Given the profiles on generating capacity and T&D network in North Bengal it is instructive now to consider features of generation and sale of power/energy over the region. At the regional level the WBSEB is organised into six administrative divisions namely, Siliguri, Kurseong, Malda, West Dinajpur, Jalpaiguri and Cooch Behar, all falling within the Siliguri zone of the WBSEB. Local generation in North Bengal consists of the operational hydel installations earlier mentioned, the Siliguri Gas Turbine installation at Shivmandir and the small diesel installations of civic undertakings that had been taken over by the WBSEB. Of these the Gas Turbine is the largest single generating unit (20 MW), although the cost of generation through oil-fired gas turbines is much more than from hydel/thermal generation. Diesel generation is also uneconomic but inescapable because of the power deficit situation.

Since the study has special focus on Cooch Behar, some description of the advent of electricity in the district would be in order. Prior to the merger of Cooch Behar State with West Bengal, there were two civic electric supply undertakings at Cooch Behar and Dinhata towns. These were taken over by the WBSEB and electricity was supplied thereafter by a central diesel generating station at Cooch Behar having an aggregate installed capacity of 740 kw.<sup>120</sup> Subsequent additions augmented the installed diesel capacity of the Cooch Behar Power House to 2.8 MW of which 600 kw was taken away by the Jalpaiguri division for Alipurduar Electric Supply. In addition, there was another diesel power station at Changrabandha of 575 KW capacity which supplied 240 KW to Jalpaiguri for Mainaguri Electric Supply.<sup>121</sup> After the WBSEB takeover an 11 KV T&D line was built linking Dinhata, Alipurduar, Tufanganj, Bhetaguri and Dewanhat to the Cooch Behar diesel station, vestiges of which still survive. Following commissioning of the Jaldhaka H.E.P. the transmission system underwent a change, although diesel generation continued, mainly for domestic consumption, as a supplement to Jaldhaka power. Average monthly

consumption of energy in the district was 401.68 MWH in 1971 but there was an acute power shortage with power deficit being estimated at 4.5 MW.<sup>122</sup> Since then a number of the older diesel generation units have been put out of service although 1.97 MW of diesel capacity is still installed and operational in Cooch Behar division.

Changes in the T&D network following establishment of WBSEB's North Bengal grid have given rise to the local T&D network in the chart attached.

Transmission is now through the Birpara NHPC-WBSEB 220/132 KV linkage on the NHPC transmission line which is the feed-in for power from Chukha H.E.P. After step-down to 132 KV at the Birpara 132/66 KV Sub-Station(S/S) a 66 KV feed extends to the Birpara 66/33 KV S/S near Mainaguri. The 66 KV transmission from Mainaguri S/S enters Cooch Behar at the Mathabhanga 33/11 KV S/S from where two 11 KV distribution lines serve Mathabhanga and Sitai-Sitalkuchi. On the NHPC-ASEB 132 KV link from Birpara another 132 KV transmission is drawn from the Alipurduar-Gossaigaon (ASEB) EHT line for the Alipurduar 132/66 KV S/S. From this point a 66 KV transmission feeds the Cooch Behar 66/33/11 KV S/S. From Cooch Behar, the old WBSEB 11 KV link line carries power to Dinhata, Tufanganj, Mathabhanga (Deep Tubewell Feeder), Cooch Behar local (two feeders) and one feeder to Patlakhowa at the northern border with Jalpaiguri district. From these points there are separate LT networks. However the 11 KV feeder has been rendered more or less redundant after construction of 33 KV HT T&D network from Cooch Behar S/S which feeds, separately, the Tufanganj and Dinhata 33/11 KV S/Ss, besides being linked in closed circuit to the Birpara(Mainaguri)-Mathabhanga feeder. 11 KV feeders from Tufanganj S/S serve Tufanganj Local, Chilakhana and Bakshirhat with separate LT networks at each of the three points. Similarly, 11 KV feeders from Dinhata S/S feed the LT networks of Dinhata Local, Gitaldah, Sahebganj and Balarampur. Of the twelve development blocks, Mekhliganj and Haldibari are served by the Jalpaiguri Division of WBSEB and the rest by Cooch Behar Division. The existing 66 KV line between Alipurduar and Cooch Behar is however considered inadequate to deal with future projected demand, and a 132 KV extension will eventually be required for Birpara S/S to Cooch Behar.<sup>123</sup>

### 2.13 Generation & Sale of Electricity in North Bengal

Recent figures for monthwise generation for the North Bengal power installations are presented below in the Table 2.14. It is seen that total generation for the year amounted to 105.95 GWH as against total WBSEB generation of 3223.35 GWH; this amounts to North Bengal generation of 3.28% out of total WBSEB generation:

Hydel generation in the North Bengal installations peaks in the month of August and is high over the monsoon months. The Gas Turbine is pressed into service during the months of April and May when electricity demand from boro cultivators is high; through the rest of the year it plays a supplementary role although other minor peaks are found in November and February, during the rabi season. The monthly-generation profile is however slightly different for North Bengal than for the whole WBSEB system in that except for the boro peak, seasonal generation in the WBSEB system is less intensified during the rabi months, an indicator of the more industry-oriented character of generation in the WBSEB system compared to North Bengal. Diesel generation patterns echo the same character for North Bengal. Diesel

generation mostly feeds the LT networks of urban centres. During the months when agricultural demand for electricity is expected to be high, urban power needs appear to be met increasingly from diesel sources even though at higher generation costs. Even though the generation statistics only refer to power supply from WBSEB sources and exclude such power flows into North Bengal which originate from NHPC/NTPC, the above pattern is so strongly delineated that the conclusion drawn relating monthwise generation to seasonal agricultural power-demands is only likely to be strengthened, were gross figures readily available.

Table 2.14

## Monthwise Generation Statement for the Year 1989-90 in kwh

	April-89	May-89	June-89	July-89	Aug-89	Sept-89	Oct-89	Nov-89	Dec-89	Jan-90	Feb-90	March-90	Total
Jaldhaka I			7274790	8917780	10372920	9208540	8955910	7278350	5748200	6506500	5660100	5985400	75988490
Jaldhaka II			1966032	2631168	3438648	2513016	2861664	2205812	1594872	2042397	1775800	1885600	22915025
Kurseong					17184	101968	142996	96176	82956	103512	67300	86674	698846
Bijonbari	25630	40905	79575	34935	94200	147560	114420	164745	72420	40575	72350	78890	965405
Sidrapong	48624	33792	45540	81000	82000	83000	81000	86000	74400	67000	26400	89000	797756
Singtom	2010	8190											10200
Rinchington													
Subtotal	76264	82887	9365937	11664883	14004952	12054084	12155990	9831083	7572848	8759984	7602038	8124772	101295722
Siliguri (Gas)	1286000	799000	108000	483000	261000		271000	429000	162000	159000	519000	90000	4487000
West Dinajpur													
Jalpaiguri	2890	6760	4240	2860	2700	4040	2510	2230	2470	4840	550	1510	37600
Cooch Behar	5960	2020	200	600	2100	0				2060	870	7100	20910
Barjeeling	45118	11068	1220		118	1725	194	607	9937	14330	10040	13366	107723
Subtotal	1412496	984622	18845534	23816226	28275902	24113933	24585684	20094003	15320103	17700198	15734536	16361520	207244757
Grand Total	305208839	302490935	262035419	296006100	294343600	304006034	328220148	278536912	257547475	104425966	175993590	234456185	3223351283

Source : Annual Statistics 1989-90, WBSEB.

The next table pertains to divisionwise sales of electricity over the six North Bengal WBSEB divisions, within the different categories of low- & medium-voltage(L&MV) consumers. Separate figures for each division are given for rural consumers and total (rural+urban) consumers.

7.28% of WBSEB sale of energy for agricultural purposes are accounted for by North Bengal. Domestic consumption is at 11.03%, industry at 12.05%, and 16.76% of energy for commercial purposes is sold to North Bengal consumers; this is against 11.70% of total WBSEB sales to all categories of L&MV consumers which are accounted for by North Bengal. The percentage-patterns show that North Bengal demand is particularly low in the agricultural category and higher industrial and commercial categories. In rural areas, North Bengal sales amount to 11.27% of total WBSEB sales and domestic sales are proportionately higher at 13.7% against 7.28% agricultural sales for North Bengal against aggregate WBSEB sales in these categories. Once more, this reveals that power supply and therefore sales patterns are biased away from agriculture.

Table 2.15

District wise Sale of Energy (Rural - L&MV) for the year 1989-90  
(in MWh)

	Domestic	Commercial	Industrial	Utilities	Agriculture	Total
Siliguri	2166.549	2075.025	1084.719	21.55	15.337	5363.18
Kurseong	710.745	589.153	548.672			1848.57
Malda	5311.467	1040.693	3197.867	160.824	8524.036	19234.887
W. Dinajpur	2051.389	1632.749	3972.14	179.83	3582.785	11418.893
Jalpaiguri	2938.265	1853.335	771.525	73.622	734.622	6371.369
Cooch Behar	2381.609	1216.738	826.253	155.865	152.743	4733.208
NBTotal	15560.024	8407.693	10401.176	591.691	13009.523	47978.107
WBTotal	113563.89	50639.679	78042.677	4928.057	178618.159	425793.271
%CB/NB	15.31	14.47	7.94	26.34	1.17	9.87
%NB/WB	13.70	16.60	13.33	12.00	7.28	11.27

Source : Annual Statistics 1989-90, WBSEB, pp.20-21.

Table 2.16

District wise Sale of Energy (Urban + Rural - L&MV) for the year 1989-90  
(in MWh)

	Domestic	Commercial	Industrial	Utilities	Agriculture	Total
Siliguri	13648.989	12332.97	4350.519	149.913	15.337	30497.728
Kurseong	1916.415	1785.38	2124.972	27.08		5853.847
Malda	14954.267	5016.213	8324.567	1495.9	8524.036	38314.983
West Dinajpur	10058.914	7550.114	9817.44	796.352	3582.785	31005.605
Jalpaiguri	13304.524	9110.243	5046.925	861.004	734.622	29057.318
Cooch Behar	7525.969	4102.478	2701.315	478.415	152.743	14960.92
NBTotal	61409.078	39897.398	32365.738	3808.664	13009.523	150490.401
WBTotal	556722.95	238050.143	268692.649	44186.323	178618.159	1286270.232
%CB/NB	12.26	10.28	8.35	12.56	1.17	9.94
%NB/WB	11.03	16.76	12.05	8.62	7.28	11.70

Source : Annual Statistics 1989-90, WBSEB, pp.20-21

Cooch Behar patterns are even more or less than those of North Bengal: sales to agriculture account for only 1.17% of North Bengal sales, domestic sales are at a much higher 12.26% while industry is low at 8.26%, for rural+urban L & MV consumers. Within the rural group the proportion of domestic sales is even higher at 15.31%. Total sales of energy in Cooch Behar, compared to those for North Bengal stand at 9.87% for rural consumers and 9.94% for rural+urban consumers, indicating no particular rural/urban bias in the L&MV distributional flows.

Comparing Cooch Behar to the whole of North Bengal, energy sold for agricultural purposes is much lower leaving a higher balance proportion for domestic use; this points to weakness in pump energisation and in rural T&D networks for the district. Industrial sales also being low, the district would appear to face more severe electricity constraints than the region.

Two further tables are appended which detail the divisional features of the number of L&MV consumers and connected loads thereof.

Table 2.17

## Districtwise Consumers (L&amp;MV) for the year 1989-90

	Domestic	Commercial	Industrial	Utilities	LokDeep	Agriculture	Total	Rural Electrification
Siliguri	34071	9517	884	19	12	633	45136	645
Kurseong	14083	3168	198	8	-	4	17461	4
Malda	29520	6745	1679	70	2651	978	41643	3629
West Dinajpur	22904	8050	1639	55	2447	1265	36360	3712
Jalpaigur	26275	8433	905	46	397	-	36056	397
Cooch Behar	16565	7456	807	93	430	1351	26702	1781
NBTotal	143418	43369	6112	291	5937	4231	203358	10168
WBTotat	984405	277179	51550	1331	58468	19440	1392373	77988
%CB/NB	11.55	17.19	13.20	31.96	7.24	31.93	13.13	17.52
%NB/WB	14.57	15.65	11.86	21.86	10.15	21.76	14.61	13.05

Source : Annual Statistics 1989-90, WBSEB, pp.28-29

Table 2.18

## Districtwise Connected Load (MW) in Respect of (L&amp;MV) Consumers for the year 1989-90

	Domestic	Commercial	Industrial	Utilities	LokDeep	Agriculture	Total	Rural Electrification
Siliguri	20.44	7.42	9.73	0.24	0.05	0.09	37.98	0.15
Kurseong	7.61	2.06	1.88	0.07	-	-	11.61	-
Malda	15.64	4.11	16.79	0.91	0.08	21.21	58.75	21.29
West Dinaj.	11.45	4.67	15.41	0.60	0.10	19.58	51.81	19.68
Jalpaiguri	14.19	5.40	9.05	0.63	-	3.57	32.92	3.57
Cooch Behar	7.95	4.10	7.66	0.83	0.11	3.44	24.10	3.55
NBTotal	77.28	27.85	60.52	3.28	0.34	47.90	217.17	40.24
WBTotat	516.60	172.39	511.53	21.63	1.56	457.13	1600.83	458.68
%CB/NB	10.29	14.73	12.66	25.40	31.87	7.18	11.10	7.36
%NB/WB	14.96	16.15	11.83	15.17	21.98	10.48	12.92	10.52

Source : Annual Statistics 1989-90, WBSEB, pp.26-27

Coverage of the rural segment in Cooch Behar is again seen to be weaker than in the North Bengal region: as against 14.61% consumers and 12.92% connected loads in all categories for North Bengal against

the entire WBSEB service network, Cooch Behar accounts for 13.13% of North Bengal consumers but only 11.10% of its connected load. The REC-funded schemes of pump energisation and Lokdeep (electrification of rural households) constitute the RE segment; here too the same position is repeated with Cooch Behar having 17.52% of the North Bengal consumers in the RE category but only having 7.36% of the connected RE load. This distortion is even more glaring for agriculture where 31.93% of consumers of energy for agricultural purposes, belonging to Cooch Behar, account for only 7.18% of the connected North Bengal agricultural load. Electricity appears, once again, to be primarily directed to household electrification, both in the "Domestic" and "Lokdeep" categories.

Two conflicting possibilities could conceivably emerge from the foregoing: either Cooch Behar is characterised by low power-demands other than for domestic and commercial purposes, or that power-demands in the district are suppressed by restricted availability. Proper evaluation of these is to be made shortly through a study of demand and load projections, but a brief resumé of divisionwise power availability in the WBSEB's North Bengal grid gives preliminary insight. The T&D network in the district through 66 KV feed is weaker than in the other divisions where 132 KV NHPC/NTPC/WBSEB transmission is available; this is particularly so in the two other agricultural districts of North Bengal namely, West Dinajpur and Malda which also fed by South Bengal power through the FTPS-WBSEB transmission link at Malda (Malda also has access, for agricultural purposes, to the canal network of the Farakka Barrage). Figures for sales of energy and connected loads for these two divisions are also seen to be high in the above tables. Cooch Behar on the other hand, though also a district with an agricultural complexion, lies at the tail-end of WBSEB North Bengal grid. Furthermore, while Malda and West Dinajpur are located on arterial sections of the regional grid, Cooch Behar is basically a rural feeder-network and is thus prone to being shut out from the power supply during power-deficit periods. As a result penetration of electricity towards productive agricultural and industrial purposes has been slow for the district.

## PROJECTIONS OF POWER DEMAND

### 2.13 A Critical Appraisal

After having defined the power scenarios, it is now necessary to go into their dynamic aspects which are relevant to an ongoing process of development. Additions to generating capacity have to keep pace with anticipated power demands if bottlenecks to development are to be avoided. For the purpose of the study, the short time-horizon is more appropriate during which no major industrial thrust might emerge which would change to basic sectoral profiles that presently exist in the economy; in the case of North Bengal and of Cooch Behar, potential demands for electricity have thus to be assessed in an economic framework where no major sectoral reorganisation occurs, even while recognising that in an interlinked power grid, electricity demand in other regions can still affect availability in the region considered.

Two important projective studies on the future of power in West Bengal and in the WBSEB system specifically, have recently been conducted. The report of the Perspective Power Planning Committee<sup>124</sup> (PPPC) results from a perspective study sponsored by the State Department of Power and comprehensively assesses projected power demand in the State alongwith phased additions to installed generating

capacity necessary to meet it. The WBSEB Report on Load Projection of West Bengal<sup>125</sup> is a system-cum-load study exclusively within the WBSEB system, excluding the licensed area of CESC and distribution areas of WBPDC, DVC, DPL and miscellaneous other undertakings. As earlier stated, North Bengal falls entirely within the WBSEB T&D network and thus regional load projections in the latter study are fully relevant to it.

In West Bengal, a reasonable rate of growth in both power supply and industrial production was evident in the period upto 1965; the industrial slowdown that occurred thereafter presented a power deficit from emerging upto 1972<sup>126</sup> even though no addition to generating capacity took place during the inter-regnum.<sup>127</sup> The apparent perception during that period was that the State had surplus capacity in power generation. Following 1972, serious imbalances between demand and supply came to the fore, leading to intensive loadshedding, and figures for consumption from 1972 onwards indicate restricted rather than real demand for electricity in the face of stringent restrictions imposed on power drawal. The shortages were further aggravated by the wide gap between installed capacity and generation of existing power stations<sup>128</sup> which led to very low plant load factors (PLF). Disruptions in power supply visibly acted as a constraint to industrial development in the state.<sup>129</sup>

Despite this, 60% of energy consumption in the State is by the industrial sector, even after 15% restriction on power drawal by it. In North Bengal, development of many identified industries have been stalled because of power constraints; the region also has a large of pent-up demand for electricity from the tea industry which if met would permit substitution of diesel-operated equipment by electrically-operated units.<sup>130</sup> "The load potential of North Bengal is much better than would appear on superficial examination".<sup>131</sup>

The PPC Report also recognises that "in an economy dominated by the rural sector, urban centres can emerge around the rural market places and centres for commercial transactions quite unrelated to location of industries"<sup>132</sup> and that "the demand for electricity follows the development of these centres in the rural areas".<sup>133</sup>

With the extension of RE, pressure is gradually building up for electrically-driven STWs even though electricity consumption for agricultural purposes is still low at present in the State because of supply constraints. "With free availability of electricity the demand for energisation of pumpsets and for conversion of diesel units is expected to rise rapidly in the state contributing to a high rate of growth of agricultural load",<sup>134</sup> thereby saving about  $15 \times 10^4$  kilolitres of petroleum products, annually.<sup>135</sup> For RE schemes the power requirement is assessed to be 100 MW for the state at cent-percent electrification of its 39,000 mouzas (villages), on the assumption of an average load of 5 KW<sup>136</sup> per mouza. Feasible programmes for installation/conversion of electrified minor irrigation schemes are projected to lead to 1500 MW connected load and 770 MW<sup>137</sup> demand at the end of the Eighth Plan, which can only be met by staggering agricultural drawals into the night hours to ensure a flatter system-demand curve. In keeping with these and the projected demands of other major sectors, the Desired Level of Demand (DLD) is projected to rise to around 4070 MW at the turn of the century with an annual growth rate of 6.8%.<sup>138</sup>

The power-perspective study uses the regression co-efficient approach to power projection, relating power demands to other economic factors that influence the consumption of electricity; it is critical of the 'past-trend' approach because of possible distortion on account of the appearance of restricted demand in the power scenario of West Bengal arising out of continuing power deficits since 1972. Projection for the agricultural segment of the new-priority RE programme was however on the assumption of 10% growth p.a. in the absence of previous trends. Actual consumption of energy by agriculture which was 1.26% in 1980-81 grew to 1.88% (1986-87), 2.31% (1987-88) and 4.28% (1988-89).<sup>139</sup> This was against an all-India average of 16.22% in 1981, and against 12.15% for an industrial state like Maharashtra in the same year. Agricultural consumption of energy in West Bengal, which was projected to reach around 10% by 1988-89, did not however materialise, giving indication of the constraints operating because of power shortfall; thus the ultimate projection to 15%<sup>140</sup> by 2000 A.D. must necessarily be scaled down. Similarly, projected per capita consumption of energy which was expected to reach 307.67 kwh,<sup>141</sup> is not likely to be maintained either. The share of industry in total consumption of energy was projected to decline from 64.58% in 1980-81 to 61.53% in 2000 A.D. with an assumed industrial growth rate of 7% p.a., mainly because of sharp focus on energisation of agricultural operations to make use of West Bengal's natural endowments of water resources and to obviate the situation where most of the State's agriculture was monsoon-dependent and 60% of cultivated land was mono-cropped. Although the RE thrust has led to accelerated energisation of pumpsets, supply constraints in electricity have dampened the impact, and accelerated expansion of thermal generating capacity combined with the curtailment of T&D losses would provide the short-term solution. Besides this, greater drawal of surplus power from neighbouring power grids, especially after linkage of the EREB grid with the NEEPCO grid via Salakuti in Assam, would provide some relief once the Loktak H.E.P. and Kopili H.E.P. under NEEPCO were commissioned.<sup>142</sup>

The load-projection study by the WBSEB covers the WBSEB system within the state. The utility of the study is that sub-station load projections by district are available as against the previous report where projection is on gross-basis. Nevertheless, the projective methodology which is of 'past-trend' type is subject to methodological criticism because of the problems of extrapolating the trend of *unrestricted* load from time-series where power constraints have been under operation since 1972. Three scenarios are however sketched out: the *optimistic* projection is on the *maximum* growth of demand exhibited in the past; the *pessimistic* scenario is on the basis of the *minimum* growth recorded in the past; and the *likely* scenario is on the basis of growth exhibited in the immediately-previous time-period. In the case of RE, projection for load growth on account of rural household demand is made on the targeted objective of 90% coverage by 2010 A.D., while estimation of the irrigation load is on the basis of 'past-trend' in RLI and DTW installation in the absence of a futuristic programme of pump energisation for STWs schemes. Hence no explicit targeting of projections is made on the basis of estimated potential of identified groundwater and surface-water resources. The categories of electrical load for which projection is made are: Domestic, Commercial, LT Industrial, HT Bulk Consumption, Agricultural, and Railway Traction. In the case of industry too, 'past-trend' projection is avoided because of instability of industrial growth rates and the

standard CEA formulation of 10% growth p.a. has been adopted as optimistic. System losses are expected to be reduced gradually over the time-horizon with the overall system power factor rising from 0.78 to 0.80 and then 0.85, eventually with improvements in the T&D system.<sup>143</sup>

The Table 2.19 below projects aggregate load over all districts within the WBSEB command area upto the year 2010 A.D.. Aggregate system load for the WBSEB system is expected at the least, under the pessimistic scenario, to increase to 3646.74 MW from a 1989-90 level of 723.44 MW in terms of overall simultaneous demand; for districtwise projection, where system demand for each district is treated as an isolated T&D load, the aggregate simultaneous district-demand is projected to increase, at the least, from 832.33 MW to 4194.48 MW over the same time-horizon. The difference between the two demands is because within an integrated grid transmission of power to an isolated district on 66/33 KV T&D lines is via trunk-lines of 132 KV and hence actual system demand is less than if the loads of different districts were to be met separately. Thus under the optimistic scenario, with maximum assumed load-growth rate, the corresponding figures for overall simultaneous demand rise from 768.09 MW to 6566.70 MW and, for aggregated simultaneous district-demand, from 883.69 MW to 7555.08 MW.

Taking overall simultaneous demand as being the more realistic appraisal of overall system load, it is found that the WBSEB load on account of the North Bengal districts would increase from around 75-80 MW in 1989-90 to between 450-987 MW in three scenarios over the projected periods, with the percentage share of North Bengal in the total WBSEB load rising from around 10.5 percent to between 12-15 percent; the lower figures represent least-growth pessimistic scenarios. Percentage share of Cooch Behar in overall WBSEB system load would rise from around 0.9% to 2%, under most optimistic assumptions; the corresponding share of Cooch Behar in the total North Bengal system load would rise from around 9 percent to between 12-13 percent. It is interesting to contrast the WBSEB projection with the projection of the PPPC; the latter projects power demand (unrestricted) of North Bengal to rise to 404 MW<sup>144</sup> by 2000 A.D., compared to WBSEB figures between 220-335 MW - thus even at most optimistic projections of restricted demands, the power shortfall in the region would be in the neighbourhood of 69-70 MW by that year. Similarly, unrestricted power demand for Cooch Behar in the PPPC projection would reach 76 MW<sup>145</sup> in 2000 A.D.; load projections of restricted demand are around 44 MW at the most optimistic and hence power shortfall in the district is 32 MW or more. In percentage terms, the share of Cooch Behar in North Bengal power demand would be around 18.81% as against WBSEB projections of between 10.5 -11.5 percent.

Table 2.19

Electricity load projections for WBSEB Command Areas in West Bengal  
Aggregate Projected Load over All Districts  
Demand In MW

Pessimistic

	1989-90	1994-95	1999-2000	2004-2005	2009-2010
24 Parganas	166.78	292.00	427.11	598.44	796.56
Howrah	65.46	100.80	134.37	178.51	232.00
Hooghly	152.75	240.00	305.52	555.94	758.30
Burdwan	70.92	127.20	177.56	244.82	322.19
Birbhum	31.95	62.40	92.78	136.86	184.48
Nadia	93.52	165.60	244.75	347.68	470.96
Murshidabad	45.98	90.40	134.37	197.21	275.44
Midnapur	76.37	130.40	203.95	293.27	404.66
Bankura	17.15	34.40	49.59	69.71	94.36
Purulia	24.16	48.00	70.39	101.16	136.02
Maldah	18.70	36.80	51.99	74.81	102.01
West Dinajpur	16.37	34.40	51.93	79.91	114.77
Cooch Behar	7.79	17.60	26.39	41.65	62.05
Jalpaiguri	25.72	43.20	71.98	106.26	147.92
Darjeeling	18.70	32.00	50.39	70.56	92.66
All Bengal asmw	832.33	1463.20	2175.14	3096.78	4194.48
osmw	723.44	1271.78	1888.84	2691.65	3645.74
S Bengal asmw	745.04	1299.20	1920.39	2723.60	3675.05
osmw	647.57	1129.24	1669.16	2967.29	3194.27
N Bengal asmw	87.29	164.00	252.75	373.18	519.42
osmw	75.87	142.55	219.68	324.36	451.47
NB:AB asmw	10.49	11.21	11.63	12.05	12.38
CB:AB asmw	0.94	1.20	1.21	1.35	1.48
CB:NB asmw	0.95	10.73	10.44	11.16	11.95

(continued next page)

asmw - aggregate simultaneous Mega watt

osmw - overall simultaneous mega watt

AB - All Bengal

NB - North Bengal

CB - Cooch Behar

Electricity load projections for WBSEB Command Areas in West Bengal  
Aggregate Projected Load over All Districts

Optimistic	Demand In MW				
	1989-90	1994-95	1999-2000	2004-2005	2009-2010
24 Parganas	180.17	404.00	604.42	355.44	1430.44
Howrah	67.08	128.00	175.15	263.51	380.77
Hooghly	161.45	353.26	547.04	914.64	1355.65
Burdwan	74.88	172.00	247.93	371.47	556.71
Birbhum	35.10	93.60	146.36	238.01	361.22
Nadia	99.05	241.60	347.10	437.77	706.30
Murshidabad	49.14	128.00	197.54	317.06	469.16
Midnapur	81.12	188.00	283.92	462.42	717.35
Bankura	17.34	48.80	75.18	123.26	191.24
Purulia	24.96	63.20	95.97	158.11	251.58
Maldah	19.50	50.40	78.38	126.66	190.39
West Dinajpur	17.94	52.00	87.97	165.76	273.68
Cooch Behar	8.58	24.80	43.99	83.30	148.74
Jalpaiguri	27.30	67.20	109.57	192.11	310.23
Darjeeling	19.50	44.80	67.18	105.40	211.63
All Bengal asMW	883.89	2065.60	3104.68	4914.93	7555.08
OSMW	768.09	1795.37	2698.52	4271.95	6566.70
S Bengal asMW	790.88	1826.40	2717.59	4241.70	6420.41
OSMW	687.41	1567.47	2362.07	3686.79	5580.48
N Bengal asMW	92.82	239.20	387.09	673.23	1134.66
OSMW	80.67	207.91	336.45	585.16	986.22
NB:AB asMW	10.50	11.58	12.47	13.70	15.02
CB:AB asMW	0.97	1.20	1.42	1.69	1.97
CB:NB asMW	9.24	10.37	11.36	12.37	13.11
Likely	1989-90	1994-95	1999-2000	2000-2005	2009-2010
24 Parganas	173.13	355.86	501.55	752.40	1058.22
Howrah	66.29	118.35	153.59	216.79	294.09
Hooghly	157.53	403.84	467.96	713.29	1024.22
Burdwan	73.31	147.94	203.98	297.56	404.59
Birbhum	33.53	73.57	109.59	169.18	237.14
Nadia	97.48	196.72	283.97	419.13	566.08
Murshidabad	48.35	101.56	155.19	237.20	335.74
Midnapur	79.55	163.94	231.18	347.72	497.23
Bankura	17.94	39.98	56.79	85.02	118.15
Purulia	24.19	51.98	83.19	126.67	184.44
Maldah	19.50	40.78	59.99	90.12	125.00
West Dinajpur	17.94	40.78	67.99	112.22	174.24
Cooch Behar	8.58	19.99	33.60	58.66	97.75
Jalpaiguri	26.52	56.79	85.59	134.33	198.04
Darjeeling	19.50	35.19	57.59	83.32	118.15
All Bengal asMW	863.30	1847.28	2551.77	3843.60	5433.88
OSMW	750.36	1605.61	2217.94	3340.77	4723.00
S Bengal asMW	771.28	1653.75	2247.00	3364.95	4719.90
OSMW	670.38	1437.41	1953.04	2924.74	4102.43
N Bengal asMW	92.02	193.52	304.77	478.64	713.98
OSMW	79.98	168.21	264.90	416.03	620.57
NB:AB asMW	10.66	10.48	11.94	12.45	13.14
CB:AB asMW	0.99	1.08	1.32	1.53	1.80
CB:NB asMW	9.32	10.33	11.02	12.26	13.69

Since the focus of the study is on agricultural demand for electricity, WBSEB system projections of agricultural load are the subject of the Table 2.20.

Table 2.20

## Aggregate Agricultural Projected Load over All Districts

Pessimistic	Demand In MW				
	1989-90	1994-95	1999-2000	2004-2005	2009-2010
24 Parganas	14.09	29.77	41.83	62.73	88.85
Howrah	1.15	2.04	2.59	3.59	4.71
Hooghly	10.79	21.23	28.67	41.61	57.36
Burdwan	11.24	22.52	30.70	44.95	62.43
Birbhum	5.66	11.95	16.77	25.16	35.53
Nadia	26.68	56.12	70.33	116.85	164.82
Murshidabad	15.67	51.69	49.46	69.88	89.85
Midnapur	9.70	19.88	27.48	40.66	56.99
Bankura	5.29	6.59	8.99	13.15	18.25
Purulia	0.81	0.81	0.82	0.84	0.85
Maldah	5.65	11.36	15.54	22.81	31.73
West Dinajpur	3.69	7.54	10.40	15.37	21.52
Cooch Behar	1.22	2.59	3.68	5.68	8.00
Jalpaiguri	1.27	2.00	2.82	4.23	6.01
Darjeeling	0.18	0.29	0.41	0.62	0.90
All Bengal asaw	110.20	225.58	311.70	461.32	546.21
osaw	95.85	196.07	270.92	400.97	561.76
S Bengal asaw	98.27	201.80	278.85	412.61	578.15
osaw	85.42	175.40	242.37	358.63	502.52
N Bengal asaw	12.00	23.78	32.85	48.70	681.16
osaw	10.45	20.67	28.55	42.33	59.24
NB:AB asaw	10.89	10.54	10.54	10.56	10.55
CB:AB asaw	1.11	1.15	1.18	1.23	1.24
CB:NB asaw	10.16	10.91	11.22	11.66	11.73
%ABAG/AB asaw	13.25	15.42	14.34	14.90	15.41
%SBAG/SB asaw	13.19	15.33	14.52	15.15	15.73
%NBAG/NB asaw	13.75	13.50	13.80	13.85	13.12
%CBAG/CB asaw	15.65	14.74	13.96	13.63	12.89

(continued in next page)

## Aggregate Agricultural Projected Load over All Districts

Likely	1989-90	1994-95	1999-2000	2004-2005	2009-2010
24 Parganas	15.45	13.16	50.88	76.41	96.80
Howrah	1.21	2.09	2.99	4.15	5.07
Hooghly	12.13	22.68	34.88	50.67	63.19
Burdwan	12.62	24.02	37.48	54.89	68.74
Birbhum	6.39	12.76	20.72	31.00	39.22
Nadia	29.48	58.74	95.08	142.00	179.67
Murshidabad	16.87	32.71	51.86	76.63	96.36
Midnapur	11.16	21.58	34.10	50.33	63.24
Bankura	3.54	6.81	10.74	15.76	19.77
Purulia	0.01	0.01	0.02	0.04	0.05
Maldah	6.08	11.74	18.52	27.33	34.32
West Dinajpur	4.41	8.42	13.18	19.35	24.24
Cooch Behar	1.37	2.90	4.43	6.82	8.63
Jalpaiguri	1.04	2.10	3.44	5.15	6.54
Darjeeling	0.18	0.28	0.47	0.71	0.91
All Bengal asMW	121.95	237.39	378.79	561.33	706.73
OSMW	106.00	206.85	329.23	487.98	614.27
S Bengal asMW	108.87	212.55	338.74	501.97	632.05
OSMW	94.63	184.75	294.43	436.38	549.37
N Bengal asMW	13.08	25.44	40.05	59.36	74.68
OSMW	11.37	22.11	34.81	51.60	64.91
NB:AB asMW	10.72	10.69	10.57	10.57	10.57
CB:AB asMW	1.12	1.22	1.17	1.22	1.23
CB:NB asMW	10.47	11.40	11.07	11.50	11.60
%ABAG/AB asMW	14.13	12.88	14.84	14.60	13.81
%SBAG/SB asMW	14.12	12.85	15.08	14.92	13.39
%NBAG/NB asMW	14.21	13.14	13.14	12.40	10.46
%CBAG/CB asMW	15.97	14.51	13.19	11.63	8.86

Source : Load Projection of West Bengal upto 2010 AD Perspective  
& Analysis, WBSEB, 1988.

Agricultural load in the WBSEB system is projected to rise from 95-106 MW in 1989-90 to 562-855 MW in 2010 A.D., the range being accounted for by pessimistic versus optimistic scenarios. It may be mentioned that as agricultural load in West Bengal is entirely catered to by the WBSEB system, the figures are representative of the whole state. In percentage terms the agricultural load in North Bengal is expected to stay around 10.5 -11.5 percent of the total agricultural load in the WBSEB projection as against 17.5 percent<sup>146</sup> in the PPPC projection. Projected North Bengal demands for agricultural power vary from 154 MW (PPPC) to 29-51 MW (WBSEB) in 2000 A.D. which raises the agricultural power shortfall in the region to 103-125 MW. It is thus clear that power restrictions in North Bengal presently fall disproportionately heavily on agriculture; extrapolation of present

## Aggregate Agricultural Projected Load over All Districts

Optimistic	1989-90	1994-95	1999-2000	2004-2005	2009-2010
24 Parganas	15.17	48.62	76.73	115.85	147.15
Howrah	1.19	2.81	4.71	7.44	10.24
Hooghly	11.91	33.07	49.99	73.67	98.54
Burdwan	12.41	35.60	54.36	80.66	101.63
Birbhum	6.28	19.79	31.07	46.81	59.38
Nadia	28.96	90.75	127.76	171.75	194.03
Murshidabad	16.57	49.37	76.27	113.89	143.92
Midnapur	10.98	32.46	50.05	74.66	94.29
Bankura	3.48	10.18	15.64	23.29	29.39
Purulia	0.01	0.01	0.02	0.04	0.05
Maldah	5.97	17.64	27.17	40.52	51.16
West Dinajpur	4.33	12.53	19.18	28.43	35.91
Cooch Behar	1.32	4.43	6.91	10.38	13.23
Jalpaiguri	1.37	3.32	5.18	7.82	9.94
Darjeeling	0.18	0.29	0.47	0.70	0.90
All Bengal asom	120.13	360.86	545.51	795.96	983.76
osom	104.42	313.65	474.14	691.83	855.06
S Bengal asom	106.96	322.65	466.60	708.06	872.61
osom	92.97	280.44	422.94	615.43	758.47
N Bengal asom	13.17	38.21	58.91	87.90	111.15
osom	11.45	33.21	51.20	76.40	96.65
NB:AB asom	10.96	10.59	10.80	11.04	11.30
CB:AB asom	1.10	1.23	1.27	1.20	1.34
CB:NB asom	10.05	11.61	11.72	11.80	11.90
ZABAG/AB asom	13.59	17.47	17.57	16.11	13.02
ZSBAG/SB asom	13.52	17.67	17.91	16.69	13.59
ZNBAG/NB asom	14.19	15.97	15.22	13.06	9.80
ZCBAG/CB asom	15.43	17.88	15.71	12.46	8.83

(continued in next page)

restricted scenarios as has been done by the WBSEB's projective methodology is responsible for the alarming shortfall noted above. In the WBSEB projection, Cooch Behar's share in total North Bengal agricultural demand is expected to be around 11-11.7 percent in 2000 A.D. whereas the PPPC projects Cooch Behar share at around 23 percent. It is noticed that with power restrictions still operative a disproportionately large agricultural power shortfall of around 29-32 MW would devolve on Cooch Behar, the sole reason being that the 'past-trend' method of projection is biased in favour of districts where substantial electrification of agricultural facilities has already taken place in the past; thus Cooch Behar where energisation was constrained earlier by weak T&D networks must continue to suffer if policy making is done on the basis of WBSEB projections.

Table 2.21

Cooch Behar District : Distribution of Projected Loads By Category:  
Pessimistic, Likely & Optimistic Scenarios

	Demand In MW														
	Pessimistic					Optimistic					Likely				
	1989-90	1994-95	1999-2000	2004-05	2009-10	1989-90	1994-95	1999-2000	2004-05	2009-10	1989-90	1994-95	1999-2000	2004-05	2009-10
Domestic & Commercial	2.15	4.95	7.96	13.96	22.29	2.36	6.53	12.62	26.79	55.04	2.35	5.85	10.28	20.57	37.96
	27.62	29.18	30.60	33.23	35.95	27.73	26.10	28.69	32.28	36.27	27.68	29.27	31.14	34.67	39.13
LT Industrial	3.63	8.32	12.04	18.83	26.80	3.96	11.97	21.19	40.28	72.77	3.94	9.44	15.73	27.51	44.36
	46.54	48.91	46.32	44.84	43.22	46.82	47.89	48.17	48.52	48.84	46.33	47.22	47.67	46.62	45.73
Agricultural	1.22	2.59	3.68	5.68	8.00	1.32	4.43	6.91	10.38	13.23	1.37	2.90	4.43	6.82	8.66
	15.89	15.26	14.17	13.52	12.90	15.58	17.74	15.71	12.58	8.88	16.12	14.51	13.43	11.57	8.93
HT Bulk Demand	0.80	1.14	2.32	3.53	4.90	0.84	2.07	3.27	5.55	8.97	0.84	1.80	2.56	4.09	6.02
	10.21	6.73	8.91	8.41	7.93	9.87	8.27	7.44	6.69	6.02	9.87	9.01	7.77	6.94	6.21
Total	7.80	17.00	26.00	42.00	62.00	8.50	25.00	44.00	83.00	149.00	8.50	20.00	33.00	59.00	97.00

Cooch Behar District : Distribution of Projected Loads By Category:  
Pessimistic, Likely & Optimistic Scenarios (percentage share)

	Demand In MW														
	Pessimistic					Optimistic					Likely				
	1989-90	1994-95	1999-2000	2004-05	2009-10	1989-90	1994-95	1999-2000	2004-05	2009-10	1989-90	1994-95	1999-2000	2004-05	2009-10
Domestic & Commercial	27.62	29.18	30.60	33.23	35.95	27.73	26.10	28.69	32.28	36.27	27.68	29.27	31.14	34.87	39.13
LT Industrial	46.54	48.91	46.32	44.84	43.22	46.82	47.89	48.17	48.52	48.84	46.33	47.22	47.67	46.62	45.73
Agricultural	15.63	15.26	14.17	13.50	12.90	15.58	17.74	15.71	12.58	8.88	16.12	14.51	13.43	11.57	8.93
Railway Traction															
HT Bulk Demand	10.21	6.73	8.91	8.41	7.93	9.87	8.27	7.44	6.63	6.02	9.87	9.01	7.77	6.94	6.21
ASBWA	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source : Load Projection of West Bengal upto 2010 AD Perspective  
& Analysis, WBSEB, 1988.

The upshot of the comparison of WBSEB restricted-demand projections to PPPC unrestricted-demand is to bring out the fact that weaknesses in the power profile of North Bengal and of district-constituents of it will be perpetuated and even exacerbated if perspective approaches to power planning are not followed in their rigour. In the interest of equity and balanced regional development a more intensive effort needs to be made to nullify the power-differentials that have plagued backward regions.

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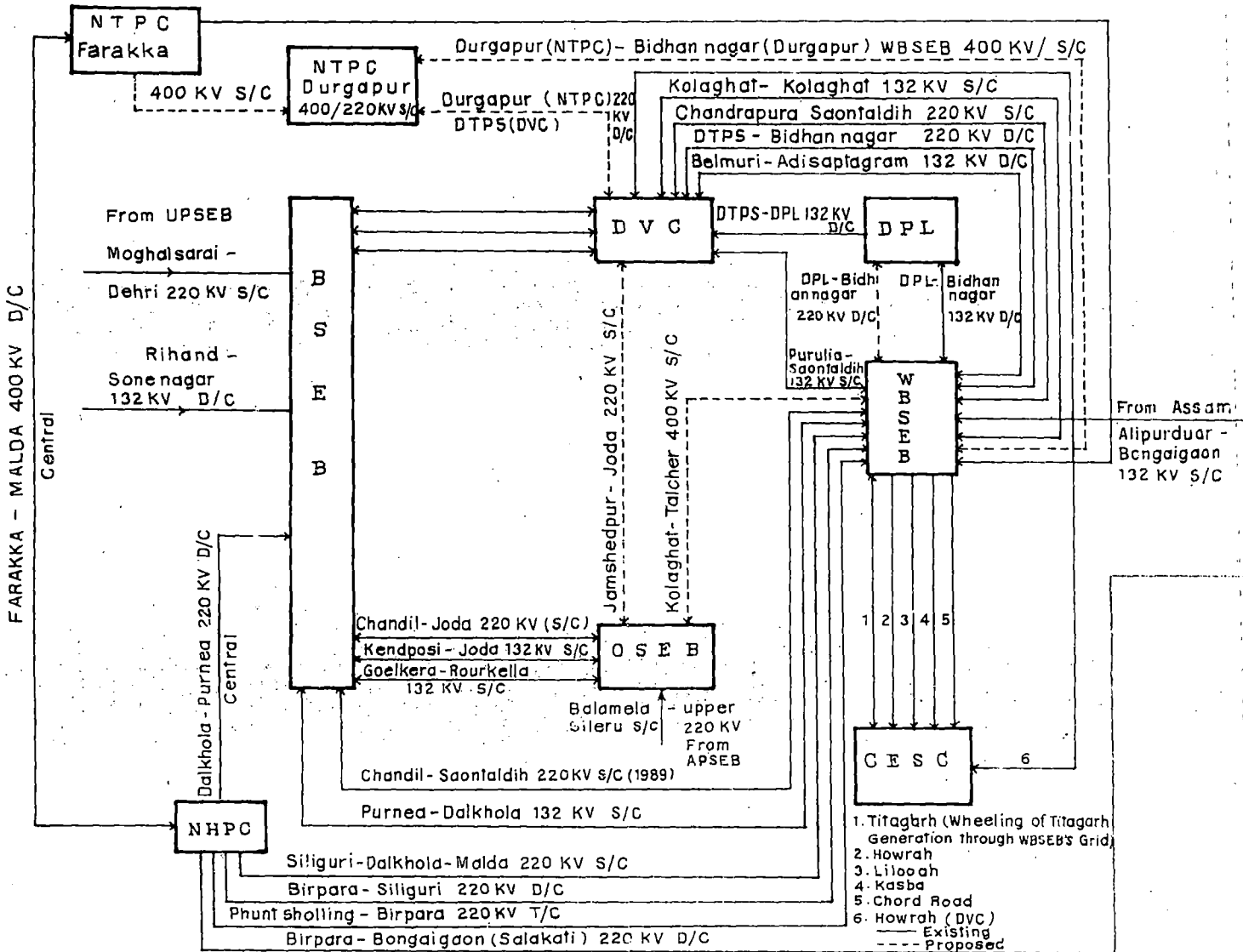
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**POWER CHARTS**

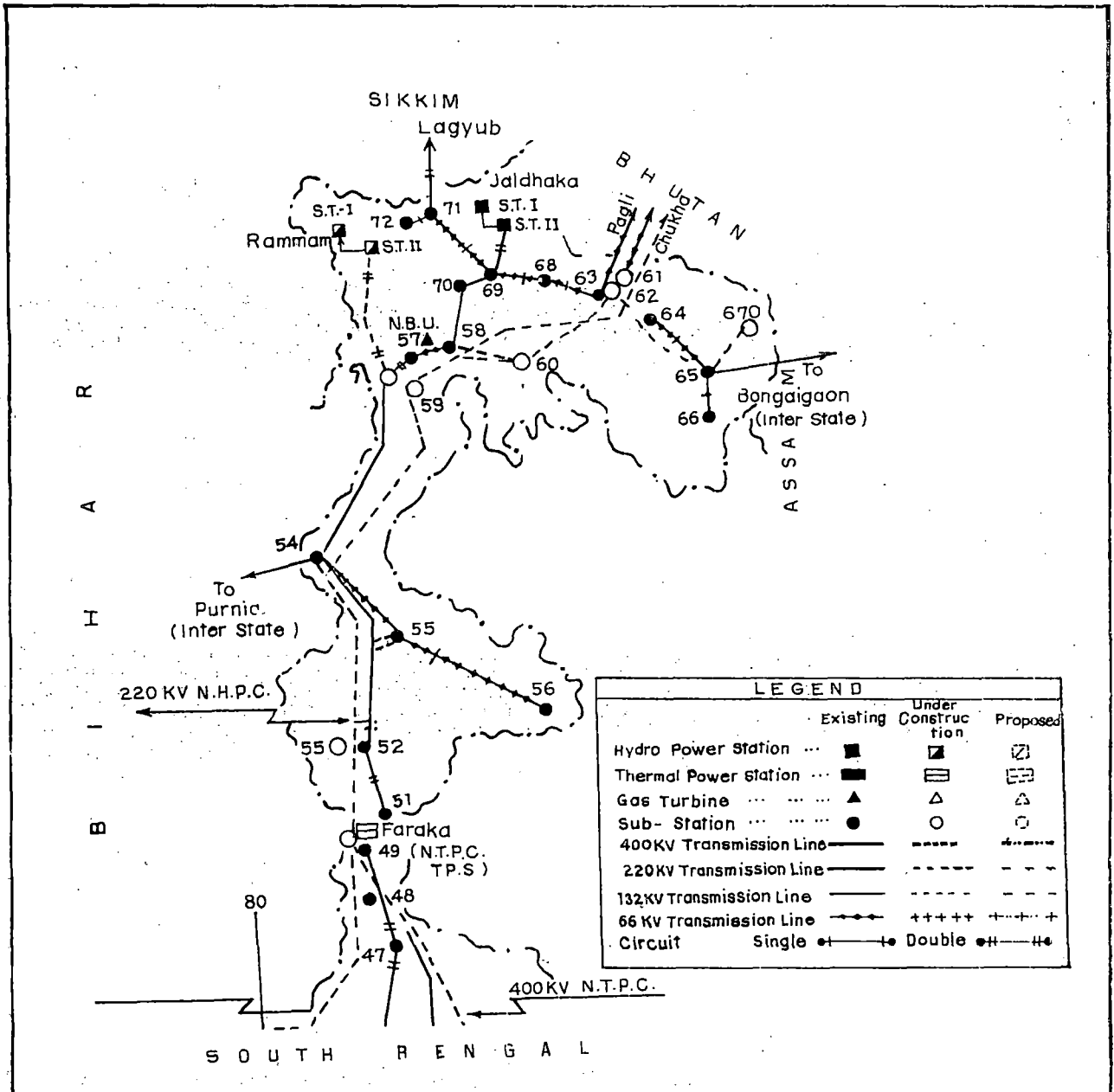
# EHT INTERCONNECTION OF EREB

## Farakka - Geerat 400 KV S/C

THE LINES IN INTEGRATED SYSTEM OF EASTERN REGION

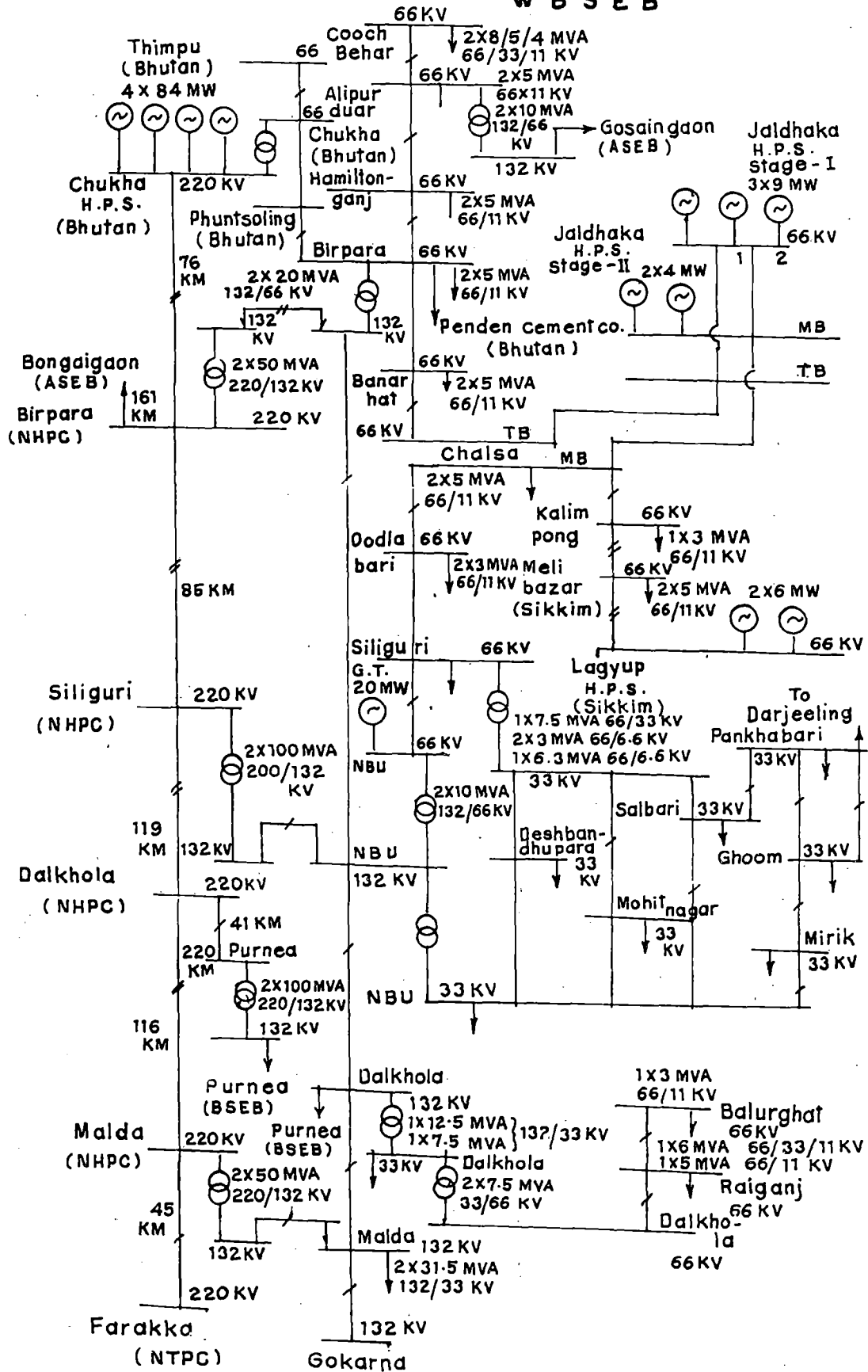


# TRANSMISSION LINES - NORTH BENGAL



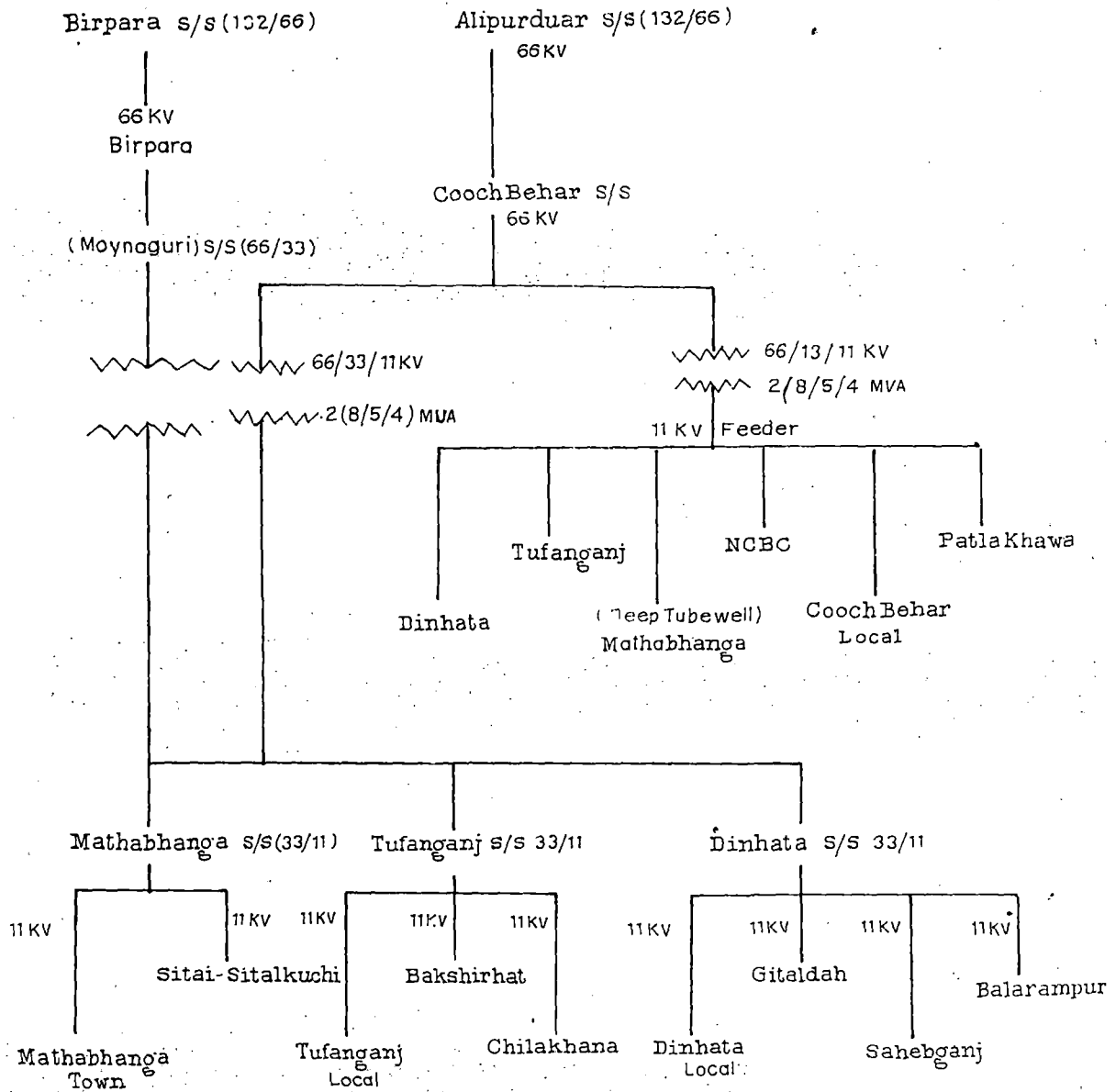
# POWER SYSTEM OF NORTH BENGAL

W B S E B





# POWER SYSTEM OF COOCH BEHAR.



# Average System Demand.

WBSEB & CESC

