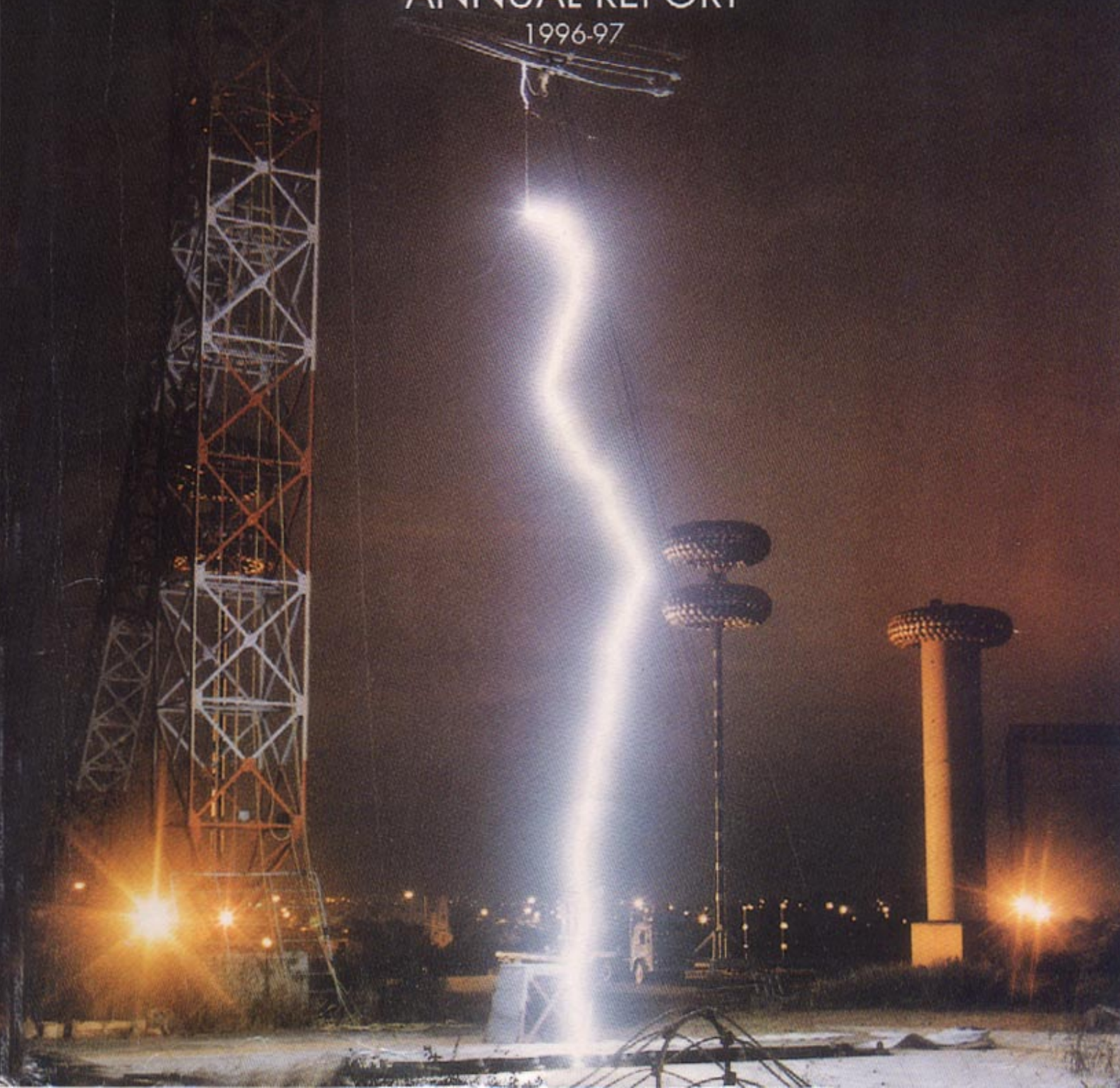




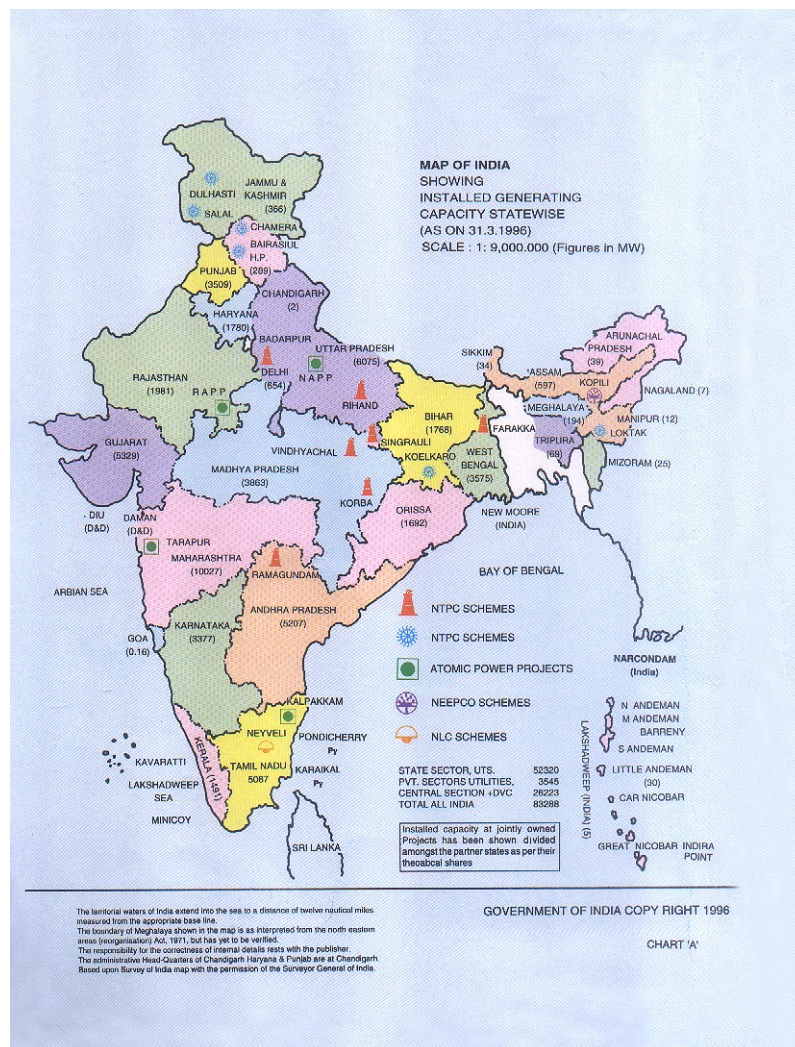
MINISTRY OF POWER  
GOVERNMENT OF INDIA, NEW DELHI

# ANNUAL REPORT

1996-97







# **ANNUAL REPORT**

## **1996-97**



**MINISTRY OF POWER**  
**GOVERNMENT OF INDIA, NEW DELHI**



**630 MW Mejia TPS, DVC**

# CONTENTS

	Page No.
1. MINISTRY OF POWER	1-2
2. POWER SECTOR-HIGHLIGHTS AND MAIN ACHIEVEMENTS	3-11
3. TRANSMISSION	12-15
4. RURAL ELECTRIFICATION PROGRAMME	16-18
5. ENERGY CONSERVATION, RENOVATION & MODERNISATION	19-22
6. CO-OPERATION WITH NEIGHBOURING COUNTRIES IN HYDRO POWER	23
7. PRIVATE SECTOR PARTICIPATION	24-27
8. CENTRAL ELECTRICITY AUTHORITY	28-30
9. BADARPUR THERMAL POWER STATION	31
10. <b>PUBLIC SECTOR UNDERTAKINGS:</b>	
1. NATIONAL THERMAL POWER CORPORATION	32-37
2. NATIONAL HYDRO ELECTRIC POWER CORPORATION	38-40
3. RURAL ELECTRIFICATION CORPORATION	41-43
4. NORTH-EASTERN ELECTRIC POWER CORPORATION	44-45
5. POWER FINANCE CORPORATION	46-49
6. POWER GRID CORPORATION	50-56
<b>JOINT VENTURE CORPORATIONS:</b>	
7. TEHRI HYDRO DEVELOPMENT CORPORATION	57-58
8. NATHPA JHAKRI POWER CORPORATION	59-61
<b>STATUTORY BODIES:</b>	
9. DAMODAR VALLEY CORPORATION	62-65
10. BHAKRA BEAS MANAGEMENT BOARD	66-68
<b>AUTONOMOUS BODIES:</b>	
11. CENTRAL POWER RESEARCH INSTITUTE	69-70
12. NATIONAL POWER TRAINING INSTITUTE	71-72
13. ENERGY MANAGEMENT CENTRE	73

Cont...

## **11. OTHER IMPORTANT ACTIVITIES:**

1. CONSULTATIVE COMMITTEE OF MEMBERS OF PARLIAMENT	74
2. IMPLEMENTATION OF OFFICIAL, LANGUAGE POLICY	74
3. CHIEF MINISTERS' CONFERENCE ON POWER AND EVOLUTION OF COMMON MINIMUM NATIONAL ACTION PLAN	74-75
4. VIGILANCE/DISCIPLINARY CASES	75-76
5. WELFARE OF MINORITIES	76
6. RECREATION ACTIVITIES	76
7. GRIEVANCES CELL	76
8. CONTROLLER OF ACCOUNTS	76
9. INTERNAL AUDIT WING	76-77
10. AUDIT OBSERVATIONS	77

## **CHARTS & DIAGRAMS**

- A. MAP OF INDIA SHOWING INSTALLED GENERATING CAPACITY
- B. GROWTH OF ELECTRICITY GENERATION (UTILITIES)
- C. GROWTH OF INSTALLED CAPACITY - UTILITIES
- D. CAPACITY ADDITION DURING 1996-97 (PROGRAMME ACHIEVEMENT)
- E. ALL INDIA INSTALLED GENERATING CAPACITY

## **APPENDIX**

1. POWER SUPPLY INDUSTRY IN INDIA - HIGHLIGHTS	78-82
2. ELECTRICITY STATISTICS AT A GLANCE	83

## **FRONT COVER**

(Breakdown of 14.6m Rod-Plane Air Gap with 2.4 MV Peak, 400/2500 ms)  
Switching Surge Generated by 5 MV Impulse Generator (C.P.R.I)

## **INSIDE BACK COVER**

URI Project in Jammu & Kashmir (NHPC)

## **BACK COVER**

Underground excavation in progress in the Power House area of 1500 MW Nathpa Jhakri Power Project.



# 1. MINISTRY OF POWER

## 1.1 FUNCTIONS

The Ministry of Power started functioning independently with effect from the 2nd July, 1992. Earlier it was known as the Ministry of Energy comprising the Department of Power, Coal and Non-Conventional Energy Sources.

Electricity is a concurrent subject at Entry 38 in the list III of Seventh Schedule of the Constitution of India. The Ministry of Power is primarily responsible for the development of electrical energy in the country. The Ministry is concerned with perspective planning, policy formulation, processing of projects for investment decision, monitoring of the implementation of power projects, training and manpower development and the administration and enactment of legislation in regard to Thermal and Hydel Power generation, transmission and distribution.

The Ministry of Power is responsible for the administration of the Indian Electricity Act, 1910 and the Electricity (Supply) Act, 1948 and to undertake such amendments to these Acts, as may be necessary from time to time, in conformity with the Government's policy objectives.

The Ministry of Power is mainly responsible for evolving general policy in the field of energy. The main items of work dealt with by the Ministry of Power are as below:

1. General Policy in the Electric Power Sector and issue relating to Energy Policy.
2. All matters relating to hydro-electric and thermal power except mini, micro hydel projects and below 3 MW capacity and geo-thermal energy and transmission system network.
3. Research development and technical assistance relating to hydro-electric & thermal power and transmission system network.
4. Administrations of the Indian Electricity Act, 1910, (9 of 1910), and Electricity (Supply) Act, 1948 (54 of 1948).

5. All matters relating to Central Electricity Authority and Central Electricity Board.
6. Rural Electrification, power schemes in UTs and issues relating to power supply in States and UTs.
7. All matters concerning energy conservation and energy efficiency pertaining to power sector.
8. Matters relating to following Public Sector Undertakings/Organisations, etc.
  - a) Damodar Valley Corporation
  - b) Bhakra Beas Management Board (except irrigation matters)
  - c) National Thermal Power Corporation Ltd.
  - d) National Hydro Electric Power Corporation Ltd.
  - e) Rural Electrification Corporation Ltd.
  - f) North Eastern Electric Power Corporation
  - g) Power Grid Corporation Ltd.
  - h) Power Finance Corporation
  - i) Tehri Hydro Development Corporation
  - j) Nathpa Jhakri Power Corporation
  - k) Central Power Research Institute
  - l) National Power Training Institute
  - m) Energy Management Centre.

## 1.2 ORGANISATIONS UNDER MINISTRY OF POWER

In all Technical and Economic matters, Ministry of Power is assisted by the Central Electricity Authority (CEA) constituted under the Electricity (Supply) Act, 1948.

Badarpur Management Control Cell (BMCC), a subordinate office of this Ministry, is responsible for administering the Badarpur Thermal Power Station (BTPS), Management Contract between the Government of India and the NTPC.

The construction and operation of generation and transmission projects in the Central Sector are entrusted to Central Sector Power Corporations, viz., the National Thermal Power Corporation (NTPC), the National Hydro Electric Power Corporation (NHPC), the North Eastern Electric Power Corporation (NEEPCO) and the Power Grid Corporation of India Ltd. (PGCIL). The Power Grid is responsible for all the existing and future transmission projects in the Central Sector and also for the formation of the National Power Grid. Two Joint Venture Power Corporations namely Nathpa Jhakri Power Corporation (NJPC) and Tehri Hydro Development Corporation (THDC) are responsible for the execution of the Nathpa Jhakri Power Project in H.P. and Projects of the Tehri Hydro Power Complex in U.P. respectively. Two statutory bodies i.e., the Damodar Valley Corporation (DVC) and the Bhakra Beas Management Board (BBMB) are also under the administrative control of the Ministry of Power. Programmes of rural electrification are provided financial assistance by the Rural Electrification Corporation (REC). The Power Finance Corporation (PFC) provides term-finance to projects in the power sector. Further, the autonomous bodies (Societies) i.e., Central Power Research Institute (CPRI), the National Power

Training Institute (NPTI) and the Energy Management Centre (EMC) are also under the administrative control of the Ministry of Power.

### 1.3 ORGANISATIONAL SET-UP

During 1996-97 Shri N.K.P. Salve and Dr. Urmila C. Patel were the Minister for Power and the Minister of State for Power respectively, upto 16.5.1996. With the change in the Government at the Centre, Dr. S. Venugopalachari has become the Minister of State for Power with effect from 3.6.1996. The Ministry of Power is under the overall charge of the Prime Minister. Shri. P. Abraham continues as the Secretary (Power). He is assisted by an Additional Secretary and Six Joint Secretaries, including the Financial Adviser. There are six wings in the Ministry of Power, each headed by a Joint Secretary. These are :

- i) Administration
- ii) Hydel & Systems
- iii) Thermal & Energy Conservation
- iv) Policy Planning; Coordination & External Assistance
- v) Investment Promotion
- vi) Internal Finance.





## 2. POWER SECTOR-HIGHLIGHTS AND MAIN ACHIEVEMENTS

### 2.1 POWER GENERATION

The overall generation in the country has increased from 264 BUs during 1990-91 to 291 BUs in 1996-97 (April-December, '96) (Chart-B). The year-wise generation is as follows:

Year	Generation (BUs)
1990-91	264
1991-92	287
1992-93	301
1993-94	324
1994-95	351
1995-96	380
1996-97 (Upto Dec.'96)	291

Generation during April, 1996 - December, 1996 was 291 BUs which was 3.5% more than the generation of the previous year in the same period.

**2.3.1 The achievement during the year 1996-97 (April, 1996 to December, 1996) against the programme is as under:**

(Figure in BUs)

Type	Programme for 1996-97 (April-Dec. 1996)				Achievement during 1996-97 (April-Dec. 1996)			
	CS	SS	PS	TOTAL	CS	SS	PS	TOTAL
Hydro	16.06	41.81	1.15	59.02	15.89	37.63	0.94	54.46
Thermal	87.53	128.60	14.71	230.84	90.30	125.36	15.17	230.82
Nuclear	5.61	0.00	0.00	5.61	6.21	0.00	0.00	6.21
<b>TOTAL</b>	<b>109.20</b>	<b>170.41</b>	<b>15.86</b>	<b>295.47</b>	<b>112.40</b>	<b>162.99</b>	<b>16.11</b>	<b>291.49</b>

CS : Central Sector; SS : State Sector; PS: Private Sector

### 2.3.2 Capacity Addition (Last Four Years)

In the last four years as well as during 1996-97 (April-December, 1996), the following new capacities have been added.

(Figures in MW)

Year	Centre	State	Total
1992-93	2475.00	1062.27	3537.27
1993-94	2340.00	2198.75	4538.75
1994-95	1531.50	3067.00	4598.50
1995-96	987.00	1136.55	2123.55
1996-97 (Apr.-Dec '96)	323.50	476.10	799.60

### 2.2 INSTALLED CAPACITY

The All India installed capacity of electric power generating stations under utilities was 83287.96 MW as on 31.3.1996 consisting of 20976.09 MW hydro, 60086.87 MW thermal and 2225 MW nuclear, which has increased to 84087.56 MW (Statement-I) as on 31.12.1996 consisting of 21281.59 MW hydro, 60580.97 MW thermal and 2225.00 MW nuclear (Chart-C).

### 2.3 GENERATING CAPACITY ADDITION

The aggregate capacity of 2868.50 MW consisting of 835.00 MW hydro, 2033.50 MW thermal was targetted for commissioning during the year 1996-97. Against the targetted capacity, the total generating capacity commissioned/rolled during the year 1996-97 (upto December '96) was 799.60 MW consisting of 305.50 MW hydro, 494.10 MW thermal (Statement II and Chart-D).

**2.3.3** A capacity addition programme of 2868.50 MW consisting of 835 MW hydro and 2033.50 MW of thermal has been fixed for the year 1997-98 (Statement-III).

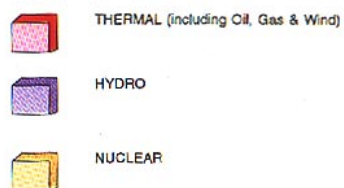
### 2.4 PLANT LOAD FACTOR (PLF)

The actual All India PLF of thermal power utilities during April, 1996 to December, 1996 was 62.5% which was 0.8% higher than the target of 61.7%.

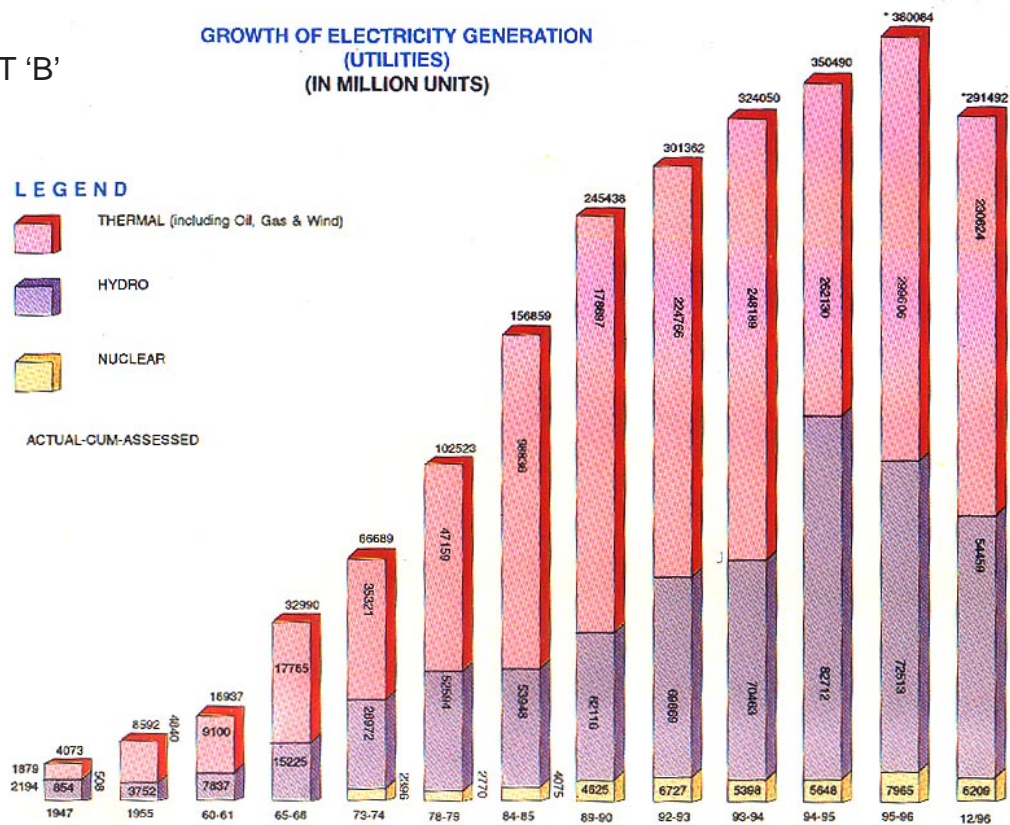
CHART 'B'

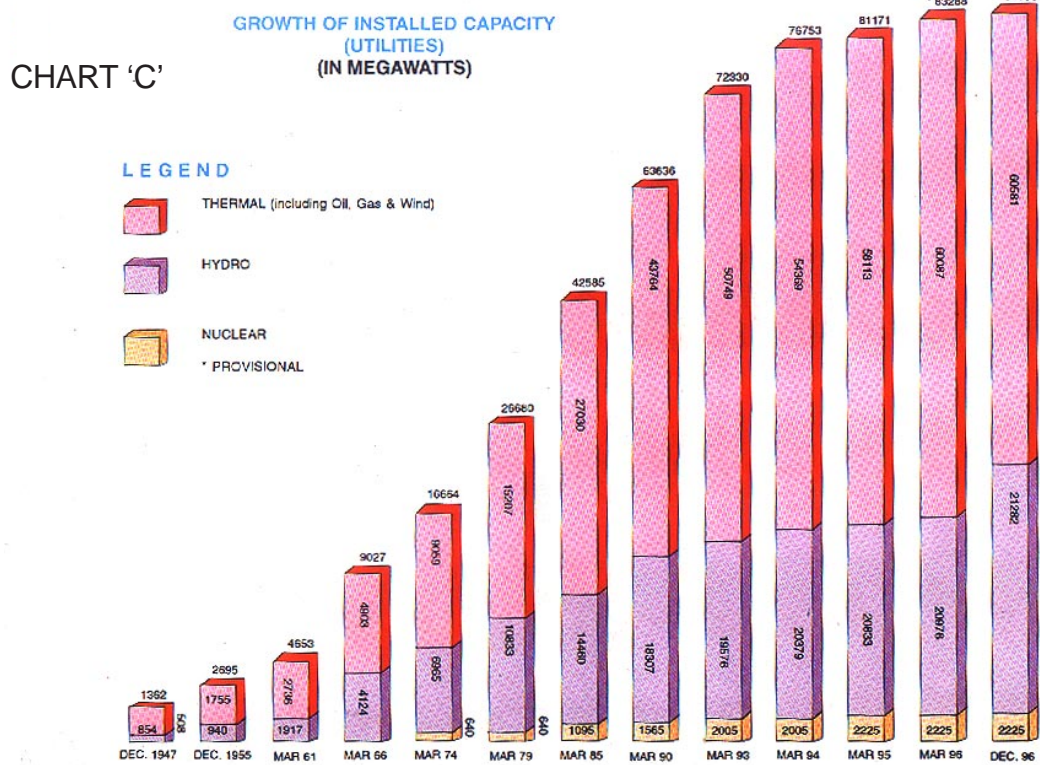
GROWTH OF ELECTRICITY GENERATION  
(UTILITIES)  
(IN MILLION UNITS)

## LEGEND



ACTUAL-CUM-ASSESSED





## INSTALLED CAPACITY AS ON 31.12.96 (PROVISIONAL)

STATEMENT - I

SI. NO.	REGION/ STATE/U.T.	HYDRO	THERMAL				NUCLEAR	TOTAL
			STEAM	GAS	DSL/WIND	SUB-TOTAL		
N. REGION								
1.	HARYANA	883.90	892.50	0.00	3.92	896.42	0.00	1780.32
2.	H.P.	299.07	0.00	0.00	0.13	0.13	0.00	299.20
3.	J&K	184.06	0.00	175.00	6.76	181.76	0.00	365.82
4.	PUNJAB	1798.94	1710.00	0.00	0.00	1710.00	0.00	3508.94
5.	RAJASTHAN	967.58	975.00	38.50	0.00	1013.50	0.00	1981.08
6.	U.P.	1504.55	4564.00	0.00	6.19	4570.19	0.00	6074.74
7.	CHANDIGARH	0.00	0.00	0.00	2.00	2.00	0.00	2.00
8.	DELHI	0.00	439.60	214.00	0.00	653.60	0.00	653.60
9.	CEN. SEC. (Total)	1770.00	4980.00	1882.00	0.00	6862.00	895.00	9527.00
	-NTPC	0.00	4980.00	1882.00	0.00	6862.00	0.00	6862.00
	-NHPC	1770.00	0.00	0.00	0.00	0.00	0.00	1770.00
	-NPC	0.00	0.00	0.00	0.00	0.00	895.00	895.00
S. TOTAL		7408.10	13561.10	2309.50	19.00	15889.60	895.00	24192.70
W. REGION								
1.	GOA	0.05	0.00	0.00	0.11	0.11	0.00	0.16
2.	GUJARAT	487.00	4179.00	772.00	35.47	4986.47	0.00	5473.47
	-SEB	487.00	3729.00	198.00	35.27	3962.27	0.00	4449.27
	-AECo.	0.00	450.00	99.00	0.00	549.00	0.00	549.00
	-SURAT	0.00	0.00	0.00	0.20	0.20	0.00	0.20
	-ESSAR	0.00	0.00	330.00	0.00	330.00	0.00	330.00
	-GIPCL	0.00	0.00	145.00	0.00	145.00	0.00	145.00
3.	M. P.	845.86	3017.50	0.00	0.00	3017.50	0.00	3863.36
4.	MAHARASTRA	1780.22	7155.00	1092.00	0.00	8247.00	0.00	10027.22
	-MSEB	1354.22	5505.00	912.00	0.00	6417.00	0.00	7771.22
	-TEC	426.00	1150.00	180.00	0.00	1330.00	0.00	1756.00
	-BSES	0.00	500.00	0.00	0.00	500.00	0.00	500.00
5.	D&N HAVELI	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.	DAMAN & DIU	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.	CEN. SEC. (Total)	0.00	3360.00	1292.00	0.00	4652.00	860.00	5512.00
	-NTPC	0.00	3360.00	1292.00	0.00	4652.00	0.00	4652.00
	-NPC	0.00	0.00	0.00	0.00	0.00	860.00	860.00
S. TOTAL		3113.13	17711.50	3156.00	35.58	20903.08	860.00	24876.21
S. REGION								
1.	A.P.	2655.94	2452.50	204.60	0.00	2657.10	0.00	5313.04
	-SEB	2655.94	2452.50	99.00	0.00	2551.50	0.00	5207.44
	-JVK	0.00	0.00	105.60	0.00	105.60	0.00	105.60
2.	KERALA	1491.50	0.00	0.00	0.00	0.00	0.00	1491.50
3.	KARNATAKA	2409.55	840.00	0.00	127.92	967.92	0.00	3377.47
	-KEB	102.35	0.00	0.00	127.92	127.92	0.00	230.27
	-KPCL	2289.20	840.00	0.00	0.00	840.00	0.00	3129.20
	-SHIVPUR	18.00	0.00	0.00	0.00	0.00	0.00	18.00
4.	TAMIL NADU	1947.70	2970.00	130.00	19.35	3119.35	0.00	5067.05
5.	PONDICHERRY	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.	CEN. SEC. (Total)	0.00	4170.00	0.00	0.00	4170.00	470.00	4640.00
	-NTPC	0.00	2100.00	0.00	0.00	2100.00	0.00	2100.00
	-NLC	0.00	2070.00	0.00	0.00	2070.00	0.00	2070.00
	-NPC	0.00	0.00	0.00	0.00	0.00	470.00	470.00
S. TOTAL		8504.69	10432.50	334.60	147.27	10914.37	470.00	19889.06





INSTALLED CAPACITY AS ON 31.12.96 (PROVISIONAL)

SI. NO.	REGION/ STATE/U.T.	HYDRO	THERMAL				NUCLEAR	TOTAL
			STEAM	GAS	DSL/WIND	SUB-TOTAL		
E. REGION								
1.	BIHAR	169.90	1813.50	0.00	0.00	1813.50	0.00	1983.40
	-BSEB	151.65	1393.50	0.00	0.00	1393.50	0.00	1545.15
	-BHPC	18.25	0.00	0.00	0.00	0.00	0.00	18.25
	-TVNL	0.00	420.00	0.00	0.00	420.00	0.00	420.00
2.	SIKKIM	30.89	0.00	0.00	2.70	2.70	0.00	33.59
3.	ORISSA	1271.92	420.00	0.00	0.00	420.00	0.00	1691.92
	-OHPC	1271.92	0.00	0.00	0.00	0.00	0.00	1271.00
	OPGC	0.00	420.00	0.00	0.00	420.00	0.00	420.00
4.	W.BENGAL	96.51	3356.38	100.00	22.50	3478.88	0.00	3575.39
	-WBSEB	96.51	1020.00	60.00	22.50	1102.50	0.00	1199.01
	-WBPDC	0.00	1260.00	0.00	0.00	1260.00	0.00	1260.00
	-DPL	0.00	395.00	0.00	0.00	395.00	0.00	395.00
	-CESC	0.00	655.00	40.00	0.00	695.00	0.00	695.00
	-D.GARHSC	0.00	26.38	0.00	0.00	26.38	0.00	26.38
5.	CEN.SEC.(Total)	144.00	6127.50	90.00	0.00	6217.50	0.00	6361.50
	-NTPC	0.00	3910.00	0.00	0.00	3910.00	0.00	3910.00
	-DVC	144.00	2217.50	90.00	0.00	2307.50	0.00	2451.50
S. TOTAL		1713.22	11717.38	190.00	25.20	11932.58	0.00	13645.80
NE. REGION								
1.	ASSAM	2.00	330.00	244.50	20.69	595.19	0.00	597.19
2.	AR. PRADESH	23.55	0.00	0.00	15.81	15.81	0.00	39.36
3.	MEGHALAYA	186.71	5.00	0.00	2.05	7.05	0.00	193.76
4.	NAGALAND	186.71	0.00	0.00	3.62	3.62	0.00	6.82
5.	MIZORAM	3.37	0.00	0.00	21.07	21.07	0.00	24.44
6.	MANIPUR	2.60	0.00	0.00	9.41	9.41	0.00	12.01
7.	TRIPURA	16.01	0.00	48.50	4.85	53.35	0.00	69.36
8.	CEN.SEC. (Total)	305.01	0.00	201.00	0.00	201.00	0.00	506.01
	-NHPC	105.00	0.00	0.00	0.00	0.00	0.00	105.00
	-NEEPCO	200.01	0.00	201.00	0.00	201.00	0.00	401.01
S. TOTAL		542.45	335.00	494.00	77.50	906.50	0.00	1448.95
ISLAND								
1.	A&N	0.00	0.00	0.00	29.47	29.47	0.00	29.47
2.	LAKSHADWEEP	0.00	0.00	0.00	5.37	5.37	0.00	5.37
S. TOTAL		0.00	0.00	0.00	34.84	34.84	0.00	34.84
	CEN.SEC. (Total)	2219.01	18637.50	3465.00	0.00	22102.50	2225.00	26546.51
	-NTPC	0.00	14350.00	3174.00	0.00	17524.00	0.00	17524.00
	-NHPC	1875.00	0.00	0.00	0.00	0.00	0.00	1875.00
	-DVC	144.00	2217.50	90.00	0.00	2307.50	0.00	2451.50
	-NLC	0.00	2070.00	0.00	0.00	2070.00	0.00	2070.00
	-NEEPCO	200.01	0.00	201.00	0.00	201.00	0.00	401.01
	-NPC	0.00	0.00	0.00	0.00	0.00	2225.00	2225.00
	STATE SEC.	18618.58	32338.60	2119.50	339.19	34797.29	0.00	53415.87
	PVT. SEC.	444.00	2781.38	899.60	0.20	3681.18	0.00	4125.18
	SS+PS	19062.58	35119.98	3019.10	339.39	38478.47	0.00	57541.05
ALL INDIA		21281.59	53757.48	6484.10	339.39	60580.97	2225.00	84087.56
		25.31	63.93	7.71	0.40	72.05	2.65	100.00

The PLF figures during the first four years as well as during 1996-97 (April-December, 1996) of the 8th Plan are as under :-

(Figures in %)

Year	Centre	State	Overall
1992-93	62.7	54.1	57.1
1993-94	69.2	56.5	61.0
1994-95	69.2	55.0	60.0
1995-96	71.0	58.1	63.0
1996-97	69.7	57.8	62.5

(April-December '96)

A target of 63.6% has been fixed for the year 1996-97 (tentative).

Vijaywada TPS of APSEB achieved the highest PLF of 91.5% during April, 1996 to December, 1996.

## 2.5 TRANSMISSION AND DISTRIBUTION LOSSES

Presently, the Transmission and Distribution losses in the country are on the higher side. Due to concerted efforts, the transmission and distribution losses for the country have been coming down. They have come down from 22.83% during the year 1991-

92 to 21.41% during the year 1993-94, (resulting in a reduction of 1.42%) and to 21.13% (Prov.) during 1994-95. The year-wise details of transmission and distribution losses in the country are given below:

Year	T&D Losses (%)
1991-92	22.83
1992-93	21.80
1993-94	21.41
1994-95	21.13 (Prov.)

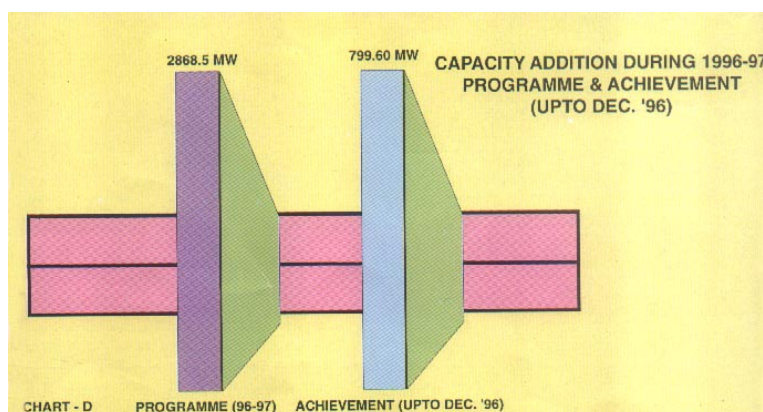
The reduction has been only 1.98% in the first four years of the 8th Plan.

## 2.6 RURAL ELECTRIFICATION

Rural Electrification Programme has picked up in the country and now more than 86% of the total villages have been electrified. Upto December, 1996, 502721 village have been electrified and 11332767 pumpsets energised. In the Kutir Jyoti Programme, about 22 lakhs connections have been released upto November, 1996.

## 2.7 POWER SUPPLY POSITION

In spite of significant growth in power generation, the shortage remains. The present shortage is mainly on account of growth in demand for power





STATEMENT - II

**CAPACITY ADDITION DURING 1996-97**

S.No.	Name of Project/Unit No.	State/ Organisation	Capacity (M.W.)	Actual Commissioning Date/Rolling
<b>THERMAL</b>				
I.	Centaral - Sector North-Eastern Region			
	1. Kathalguri CCGT-6	Assam NEEPCO	33.50	15.10.96
II.	State Sector			
	1. Tenughat-2	Bihar TVNL	210.00	10.10.96
III.	Private Sector			
	1. Jegrupadu GTCC-1	Andhra Pradesh GVK Ind.	52.80	4.7.96
	2. Jegrupadu GTCC-2	Andhra Pradesh GVK Ind.	52.80	26.10.96
	3. GIPCL	Gujarat GIPCL	145.00	
		Total (Th):	494.10	
<b>HYDRO</b>				
I.	Central Sector Northern Region			
	1. Uri - 4	Jammu & Kashmir	120.00	12.10.96
	2. Uri - 3	Jammu & Kashmir NHPC	120.00	18.12.96
	North-Eastern Region			
	1. Kopili	Assam NEEPCO	50.00	1.11.96
II.	State Sector Northern Region			
	1. Gaj - 1	HP/HPSEB	3.50	22.6.96
	2. Gaj - 2	-do-	3.50	30.7.96
	3. Gaj - 3	-do-	3.50	26.6.96
	Eastern Region			
	1. East Gandak	Bihar/BHPC	5.00	22.6.96
		Total (Hydro):	305.50	
		Grand Total :	799.60	

\* Outside the programme

STATEMENT-III

CAPCACITY ADDITION PROGRAMME (1997-98) (PROVISIONAL)				(In MW)
	Central	State	Private	Total
Hydro	195	425	-	620
Thermal	363	1620	402	2385
Nuclear	-	-	-	-
<b>ALL INDIA</b>	<b>558</b>	<b>2045</b>	<b>402</b>	<b>3005</b>

outstripping the growth in generation and generating capacity addition. The power supply position in the last four years as well as during 1996-97 (April-December, 1996), was as under:-

Energy (Million Unit net)				
Year	Requirement	Availability	Shortage	(%)
1992-93	305266	279824	25442	(8.3)
1993-94	323252	299494	23758	(7.3)
1994-95	352260	327281	24979	(7.1)
1995-96	389721	354045	35676	(9.2)
1996-97	303854	270834	33020	(10.9)

(Upto Dec. 1996)

Peak (MW)				
Year	Peak Demand	Peak Demand Met	Deficit	Shortage (%)
1992-93	52805	41984	10821	20.5
1993-94	54875	44830	10045	18.3
1994-95	57530	48066	9464	16.5
1995-96	60981	49836	11145	18.3
1996-97	62367	51852	10515	16.9

(Upto Dec. 1996)

## 2.8 STEPS BEING TAKEN TO MEET THE POWER SHORTAGE

### 2.8.1 THRUST IS ON GETTING MORE OUT OF EXISTING INVESTMENT:

- Improving PLF:
- Higher generation - Emphasis on better managerial practices, improving liquidity of SEBs and CPSUs, better coordination of the fuel supply-coal and many hydrocarbons put on O.G.L. and duties lowered to facilitate use of imported fuel which are locally scarce, case of reduction of import duty as coal is underactive coal, renovation & modernisation of old plants-priority area for PFC lending and private participation being encouraged.
- Better load management - For higher availability better load management sought to be achieved through establishment of inter-regional grids through HVDC and other lines to allow for optimal exchange of power, optimising system operations through Regional Electricity Boards/Regional Load Despatch Centres.
- Demand side management - The current initiatives include rationalising energy prices, general awareness build up and promotional campaigns about end use efficiency, establishment of a network of energy management advisory service centres to undertake energy audit services, reducing consumptions in energy intensive

industries through R&D efforts and pilot plant/demonstration plants, formulation of a selective legislation for energy conservation.

### 2.8.2 CREATION OF NEW CAPACITY

Several new projects have been taken up in the State and Central Sector. As a long-term measure Private Sector is being encouraged to set up generating stations. Higher emphasis is being given on (i) exploitation of hydro potential with an aim to reduce peak shortage (ii) transport of coal by ships for coastal power stations and use of self unloading ship (iii) coal beneficiation plants for new coal mines (iv) energy conservation and co-generation.

## 2.9 STATE ELECTRICITY BOARDS - RATE OF RETURN

Restoration of financial health of SEBs and improvement in their operational performance continues to remain the most crucial issue in the power sector. In terms of Section 59 of the Electricity (Supply) Act, 1948, SEBs are required to earn a minimum rate of return (ROR) of 3 per cent on their net fixed assets in service, after providing for depreciation and interest charges. In 1990-91 after taking into account RE subsidy as provided in the accounts, only 8, SEBs had a positive rate of return with five SEBs, having a ROR of about 3%. During 1994-95 after taking into account RE subsidy as provided in the accounts, out of 17 SEBs all except those of Bihar, Haryana, Punjab, Assam and Meghalaya have achieved the minimum prescribed ROR of 3%. The position has been improving. Only four SEBs now have a negative rate of return i.e. Bihar, Punjab, Assam and Meghalaya during 1994-95.

### 2.10 RESTRUCTURING OF SEBs.

A process of restructuring of the SEBs has been initiated in several states.

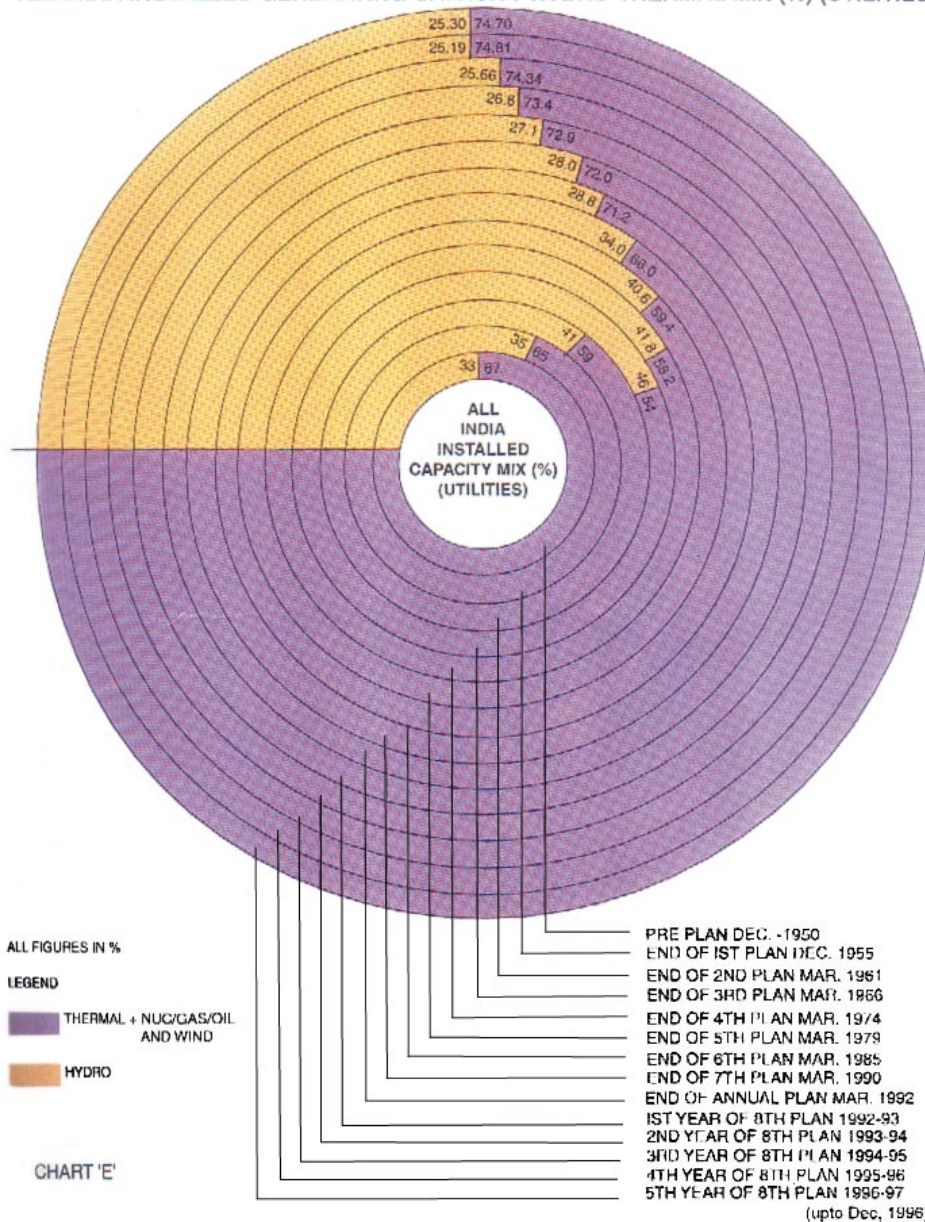
Organisational restructuring aims at:

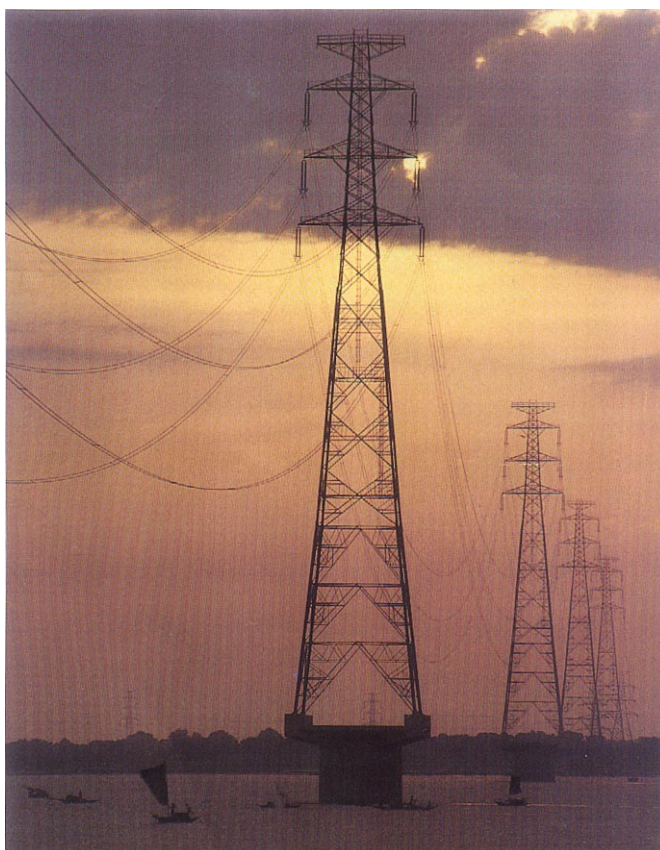
- Unbundling of Power Industry by separating generation, transmission and distribution.
- Bringing in competitiveness by allowing private participation in generation and distribution.
- Development of regulatory framework.

Restructuring of Orissa SEB has been carried out and from 1.4.96 it has been replaced by two corporations namely Grid Corporation of Orissa Ltd., and Orissa Hydro Power Corporation Ltd., to look after the functions of distribution and generation respectively.



ALL INDIA INSTALLED GENERATING CAPACITY HYDRO-THERMAL MIX (%) (UTILITIES)





*A panoramic view of transmission tower across the river  
(POWERGRID)*

### 3. TRANSMISSION

Transmission Line projects continue to be accorded a high priority in the context of the need to evacuate power from the Central Generating Stations to the beneficiary states. The programme for 1996-97 in the Central and State Sector included construction of 20 Ckm of 800 KV lines, 360 Ckm of  $\pm$  500 KV HVDC line, 3968 Ckm of 400 KV lines, and 3251 Ckm of 220 KV lines alongwith the associated substations.

The progress achieved during the year 1996-97 (upto November, 1996) in the construction of Central Sector transmission lines and substations executed by the Power Grid is summarised below :

800 KV lines	Nil
$\pm$ 500 KV HVDC lines	Nil
400 KV lines	1223 Ckm
220 KV lines	1327 Ckm
400 KV substations	315 MVA
200 KV substations	2851.5 MVA

#### 3.1 CENTRAL SECTOR TRANSMISSION

Central Sector transmission lines/substations completed during the year 1996-97 (upto November, 1996) are listed in the following table:

Transmission line	Executing Agency	Length (in Ckm)
1. Hissar-Jaipur	400 KV D/C	278
2. Bawana-Bhiwani	400 KV D/C	198
3. Gandhar-Gandhar	400 KV S/C	18
4. Dimapur-Imphal	132 KV S/C	177
5. Agartala-Agartala	132 KV D/C	16
Total :		687

At the time of Fourth Five Year Plan several Inter-State and Inter-Regional Transmission Lines were planned to facilitate the integrated operation of the

State Systems within the region. Loan assistance equivalent to the full cost of the scheme is extended to State Governments under the Centrally Sponsored Programme for construction of such Inter-Stage Lines.

Upto the end of Financial Year 1995-96, a cumulative sum of Rs. 34,899 Lakhs were released to the States under the Programme and stringing of over 7000 Ckm. of 400, 220, 132 and 66 KV transmission lines have been completed.

For the year 1996-97, the approved budget provision for releasing loan to utilities for Centrally Sponsored Inter-State Transmission Lines is Rs. 550 lakhs. With release of a loan of Rs. 1121.25 lakhs during 1996-97, an outlay of Rs. 250 lakhs has been proposed for the programme for 1997-98.

#### 3.2 NATIONAL POWER GRID

The Union Cabinet in 1980 approved in principle the establishment of a Centrally owned and operated National Power Grid. The National Power Grid would eventually comprise strong Regional networks with suitable asynchronous (HVDC) links between the regions. Already 22,740 Ckt. Kms. of 400 KV lines and 6424 Ckt. Kms. of lines at 220 KV level have been constructed in the Central Sector upto November, 1996. An Inter-regional link (Vindhyachal 2 x 250 MW HVDC back-to-back) connecting Western and Northern Regions is also in operation. These as well as other AC links between regions form the important components of the National Power Grid today.

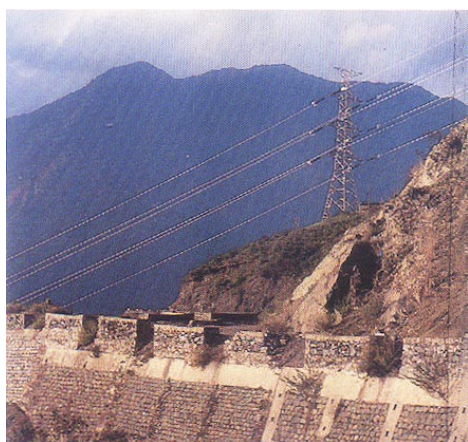
In October, 1989 Government of India established the Power Grid Corporation of India Limited (POWERGRID) to further accelerate the development of the National Power Grid. The POWERGRID have already taken over most of the existing Central Sector transmission systems. The POWERGRID also propose to take up schemes for further strengthening of the Regional Power Grids and establish HVDC back-to-back inter-regional links.



Although the Regional Grids have already been inter-connected, paving way of formation of a National Grid, further strengthening of intra-regional and inter-regional tie lines would be needed to enable increased power exchanges and achieve improved economy and reliability. This is a continuous process and projects are being taken up during each plan period depending upon the requirements of inter-regional power exchanges and the funds availability.

### **3.3 NATIONAL HIGH VOLTAGE DIRECT CURRENT (HVDC) PROJECT**

The first stage of HVDC project between Lower Sileru (A.P.) & Barsoor (M.P.) has been in continuous operation since its commissioning in October, 1989. The energy transmitted so far in 1996-97 amounts to 29.62 MUs upto September, 1996. The second stage of uprating the link to 200 MW at + 200 KV was approved in September '93 at a cost of Rs. 103.98 Crores (Since revised to Rs. 95.40 Crores). The works are in progress. The second stage is likely to be completed by 1997. The third stage which envisages addition of another pole to convert the monopole DC system to a bipole operation with voltage level of  $\pm 200$  KV DC and



*(POWERGRID), Chamera-Moga transmission line*

power transfer level of 400 MW, will be taken after completion of Stage-II.

### **3.4 FLEXIBLE AC TRANSMISSION SYSTEM (FACTS)**

The flexible AC transmission system (FACTS) technology is intended to improve the dynamic performance of the power transmission system and achieve regulated power flow across AC transmission network. An Expert Committee to take up the FACTS projects was constituted in 1992. The Committee constituted a Working Group for preparing a draft project report for indigenous development of FACTS technology and identification of transmission corridor for its implementation.

### **3.5 AWARDS FOR REDUCTION IN TRANSMISSION AND DISTRIBUTION LOSSES**

There has been a further reduction of 0.39% in the transmission and distribution losses for the country as a whole as these have come down from 21.80% during 1992-93 to 21.41% during 1993-94 and further to 21.13% (Prov.) during 1994-95.

Under the Incentive Scheme, launched by the Government of India in the year 1987-88, the SEBs/EDs and their Distribution Divisions/ Cities/ Towns are awarded with shields on the basis of their performance in reduction of Transmission & Distribution losses. Cash awards are given to Distribution Division/Cities/Towns of the Power Utilities which achieve a prescribed minimum reduction in T&D Losses. Individuals as well as institutions & organisations also qualify for grant of incentive for developing scientific devices or presenting new ideas which prove to be effective in saving energy by optimal utilisation of T&D system or better quality of power supply or improved efficiency of electrical appliances.



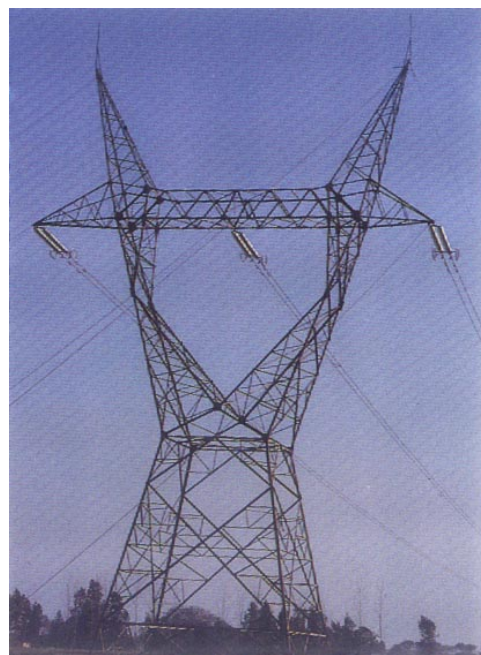
### 3.6 INTEGRATED GRID OPERATION

The Regional Power Grid in the Northern, Western, Southern, Eastern and North-Eastern Regions of the country have been established to make optimum utilisation of the unevenly distributed power resources in the country by facilitating flow of power within the Region and between two Regions to the extent feasible depending upon day-to-day availability and load conditions.

During 1996-97, all the constituent systems in the Northern, Western, Southern, Eastern and North-Eastern Regions were by and large operating in parallel. Northern Region operated in asynchronous mode with Western Region (over Vindhyachal-Singrauli HVDC back-to-back link) enabling transfer of power in both the directions depending on system conditions. Madhya Pradesh in Western Region received considerable assistance in radial mode from Northern Region through Auraiya Power Station. Karnataka and A.P. in Southern Region availed assistance in radial mode from Maharashtra in Western Region and Orissa/Eastern Region respectively through bilateral arrangement. A part of North-Eastern system consisting of lower Assam, Meghalaya, part of Tripura, Manipur, Mizoram, Arunachal Pradesh, Loktak HEP and NEEPCO's generating stations operated in parallel with Eastern Region throughout the year. Efforts were, therefore, made to maximise the exchange of energy within the region/and between regions to the extent practically feasible in the prevailing scenario of shortages in all the regions.

There are a number of power stations of Central generating companies and joint sector projects in all regions, the power of which was shared by all constituent in accordance with their shares thereby promoting integrated operation.

Monitoring of system frequency, tie line flows, maximisation of inter-state/regional exchanges of power, proper allocation of shares to the beneficiary states/systems from Central Sector generation/Joint projects daily/monthly scheduling of generation, preparation of load generation balance report including coordination of annual/capital overhauling of generating units, energy accounting on daily basis, energy accounting on monthly basis for billing purpose, facilitation of commercial arrangements for inter-utility trading of power, and formulation of policies for safe, secure and economic operation of the Regional Grid were some of the important functions carried out by the Secretariats of the five REBs.



*Maler-Kotla Service Station POWERGRID*

## 4. RURAL ELECTRIFICATION PROGRAMME

Rural Electrification involves supply of energy for two types of programmes :

(a) production oriented activities like minor irrigation, rural industries, etc and (b) electrification of villages.

While the emphasis is laid on exploitation of ground water potential and energisation of pumpsets/tubewells, which has a bearing on agricultural production, the accent in respect of areas covered under the Revised Minimum Needs Programme (RMNP), is on village electrification.

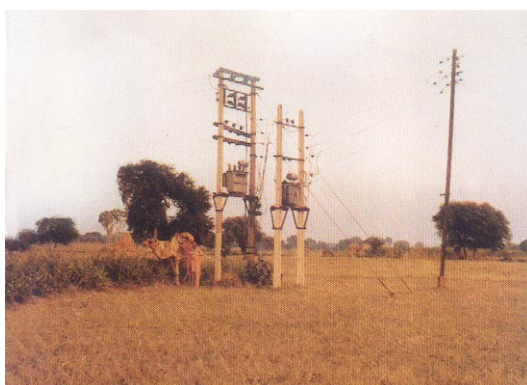
During the year 1996-97, 8901 inhabited villages were electrified and 228677 irrigation pumpsets/tubewells energised as on 30.11.1996. Cumulatively

502721 villages have been electrified and 11332767 pumpsets have been energised as on 30.11.1996.

As regards the electrification of tribal villages, out of a total of 111886 tribal villages in the country 80284 (provisional) villages constituting 71.8% have been electrified as on 30.09.1996. Similarly, 288043 (provisional) Harijan Bastis have been electrified.

The Kutir Jyoti Scheme also continued during 1996-97. The scheme is financed from Central Grant which is routed through Rural Electrification Corporation.

Progress report in respect of electrification of villages and energisation of pumpsets has been indicated in the Statements.



*View of distribution transformers in a remote area*



## STATEMENT

**PROGRESS REPORT IN RESPECT OF ELECTRIFICATION OF VILLAGES  
UPTO NOVEMBER, 1996**

Sl. No.	States/UTs	Total No. of villages (1981 Census)	Achievement as on 31.3.96	% age of Villages Electrified	Achievement (Provisional during 1996-97 upto Nov. '96)	Total Achievement at the end of Nov. '96
1.	Andhra Pradesh	27379	27358	100.0	-	27358
2.	Arunachal Pradesh	3257	2270	69.7	10	2280
3.	Assam	21995	21887	99.5	NA	21887
4.	Bihar	67546	47805	70.8	17	47822
5.	Goa	386	377	100.0		377
6.	Gujarat	18114	17892	100.0		17892
7.	Haryana	6745	6745	100.0		6745
8.	Himachal Pradesh	16807	16761	100.0		16761
9.	J&K	6477	6274	96.9	5	6279
10.	Karnataka	27028	26483	100.0		26483
11.	Kerala	1219	1219	100.0		1219
12.	Madhya Pradesh	71352	67741	94.9	133	67874
13.	Maharashtra	39354	39106	100.0		39106
14.	Manipur	2035	2016	91.1	22	2038
15.	Meghalaya	4902	2407	49.1	60	2467
16.	Mizoram	721	727		Nil	727
17.	Nagaland	1112	1099	98.8	Nil	1099
18.	Orissa	46553	33871	72.8	416	34287
19.	Punjab	12342	12342	100.0		12342
20.	Rajasthan	34968	30620	87.6	167	30787
21.	Sikkim	440	405	100.0		405
22.	Tamil Nadu	15831	15822	100.0		15822
23.	Tripura	856	3640	77.0	2	3642
24.	Uttar Pradesh	112566	86639	77.0	26	86665
25.	West Bengal	38024	29205	76.8	32	29237
Total (States)		578009	500711		890	501601
Total (UTs)		1123	1120	100	1120	
Total		579132	501831	745	890	502721
<b>(All India)</b>		<b>(583003)</b>	<b>(502969)</b>	<b>86.3</b>		

**PROGRESS REPORT IN RESPECT OF ENERGISATION OF PUMPSETS  
UPTO NOVEMBER, 96**

Sl. No.	States/UTs	Estimate Ultimate potential in terms of electrical pumpsets	Achievement as on 31.3.96	% age	Achievement (Provisional) during 1996-97 upto Nov., 96	Total achievement at the end of Nov., 96
1.	Andhra Pradesh	1600000	1642993	102.7	94053	1737046
2.	Arunachal Pradesh					
3.	Assam	200000	3675	1.8		3676
4.	Bihar	1000000	267371	26.7	686	268057
5.	Goa		5732		189	5921
6.	Gujarat	700000	568858	81.3	11339	580197
7.	Haryana	430000	406612	94.6	1179	407791
8.	Himachal Pradesh	10000	4441	44.4	207	4648
9.	J&K	15000	4716	31.4	372	5088
10.	Karnataka	850000	1014918	119.4	13022	1027940
11.	Kerala	300000	304904	101.6	4508	309412
12.	Madhya Pradesh	1300000	1131435	87.0	18995	1150430
13.	Maharashtra	1800000	2025973	112.6	35086	2061059
14.	Manipur	10000	45	0.5		45
15.	Meghalaya	10000	65	0.7		65
16.	Mizoram					
17.	Nagaland	10000	176	1.8		176
18.	Orissa	500000	69184	13.8	159	69343
19.	Punjab	700000	709916	101.4	9833	719749
20.	Rajasthan	600000	514758	85.8	19577	534335
21.	Sikkim	5000				
22.	Tamil Nadu	1500000	1528807	101.9	17760	1546567
23.	Tripura	10000	1764	17.6	Nil	1764
24.	Uttar Pradesh	2400000	761272	31.7	54	761326
25.	West Bengal	500000	101232	20.2	955	102187
Total (States)		14450000	11068847	76.6	227974	11296821
Total (UTs)		50000*	35243	70.5	703	35946
Total (A-1)		14500000	11104090	76.6	228677	11332767

\* Includes the potential of Arunachal Pradesh, Goa and Mizoram States



## 5. ENERGY CONSERVATION AND RENOVATION & MODERNISATION

### 5.1 ENERGY CONSERVATION

Conservation and efficient use of energy have been accorded high priority by the Government considering the need to bridge the gap between the demand and availability of various forms of commercial energy. Measures to conserve energy are being devised and implemented both on the supply side and the end-use (demand) side. A budget provision of Rs. 9.84 Crores (including Rs. 55 lakhs for the Energy Management Centre) has been made in 1996-97 for promoting energy conservation activities.

#### 5.1.1 SUPPLY SIDE ENERGY CONSERVATION : GENERATION

The measures adopted consist of studies for reduction of secondary fuel oil consumption in thermal power stations and detailed energy audit studies to identify measures for improving the efficiency of the generating stations. As a result of the measures implemented so far, the specific secondary fuel oil consumption in thermal power stations on all India basis has come down from 6.77 ml/kwh in 1991-92 to 4.53 ml/kwh in 1995-96. During the year 1996-97, detailed energy audit studies have been carried out by the Central Electricity Authority at Ukai, Durgapur, Panipat, Indraprastha, Neyveli and Raichur Thermal Power Stations. In addition, during 1996-97 the CPRI has completed the energy audit study at Nasik TPS and plans to carry out the energy audit at Chandrapur and Korba West Thermal Power Stations. A project on performance enhancement in Thermal Power Stations through tuning of equipments during Annual/Capital Overhaul is also under implementation through CPRI. The renovation and modernisation programme undertaken by the various utilities for their thermal power stations has also contributed to increased availability of energy.

#### TRANSMISSION AND DISTRIBUTION

A number of pilot projects/demonstration projects have been taken up for load management on energy conservation through reduction of T&D losses in

the system. The schemes under implementation/taken up for implementation during the year 1996-97 are as follows:

- A pilot project for energy audit of the Distribution Network of West Bengal SEB has been completed during 1996-97 and similar pilot projects for the Distribution Networks of Kerala SEB and Haryana SEB are under implementation.
- A pilot project for installation of 3000 LT Switched Capacitors is under implementation in Andhra Pradesh, Haryana, Punjab and Tamil Nadu.
- A pilot project on installation of 3000 Amorphous Core Transformers in the Distribution Network of various SEBs is under implementation.
- Two projects on Remote Controlled Load Management are under implementation in the Distribution Networks of Rajasthan and Punjab State Electricity Boards.
- A pilot project on reduction in T&D losses by conversion to high voltage single phase distribution is being taken up for implementation in three states.
- A pilot project on peak load reduction in the evening through conversion to energy efficient fluorescent tubes, with electronic ballasts, is being taken up for implementation in the Distribution Network of Andhra Pradesh State Electricity Board.
- An energy conservation-cum-system improvement project, involving installation of Amorphous Core Transformer and LT capacitors is under implementation in the distribution network serviced by the Cooperative Electrical Supply Society, Sirsilla (Andhra Pradesh).

- A demonstration project on energy conservation through (a) restructuring the existing low voltage distribution network to high voltage network through installation of Amorphous Core Transformers, (b) Conversion of three-phase motors by single phase motors, and (c) providing compact fluorescent lamps for street lighting, is under implementation in Chandi Village, Medak Distt. of Andhra Pradesh.
- A pilot project for introduction of 500 Electronic Meters with Time of the Day (TOD) facility has been sanctioned for implementation by the WBSEB.
- A project on setting up of Energy Meter Testing Facility is under implementation at CPRI, Bangalore.
- A R&D project on reduction of losses in electricity distribution system through Suitable Capacitors using a Solid State Switch is under implementation through Electric Research Development Association, Vadodara.
- A R&D project on development of integrated energy efficient Stirling Engine Battery/ Inverter system for Remote Area Power Generation is under implementation through CPRI.
- A R&D project on Statcon Dynamic Voltage Restorer is under implementation through IIT, Delhi.

#### **5.1.2 DEMAND SIDE ENERGY CONSERVATION: AGRICULTURE SECTOR**

- Demonstration/Pilot projects on improvement of energy efficiency of agricultural pumpsets are under implementation in Punjab, Haryana, Gujarat and Andhra Pradesh. Rectification of 1000 pumpsets in Andhra Pradesh has been completed during 1996-97.
- A project for training of 1000 officers from Banks, SEBs and other organisations in energy efficient pumping system is under implementation.

#### **INDUSTRY SECTOR**

- A project for evolving energy consumption norms in respect of foundries and mini-steel

industries has been implemented through the Confederation of Indian Industry (CII) and the Energy Management Centre.

- A project for preparation of DPR for rapid displacement heat pulping process in paper industry is under implementation through Confederation of Indian Industry.
- A feasibility study for co-generation in small and medium agro-paper mills is under preparation through the Indian Agro Paper Mills Association.
- An application oriented training programme for the first-line engineers of process and engineering industries is under implementation through Andhra Pradesh Productivity Council.
- A research-cum-demonstration project on energy conservation in aluminium electrolysis by bringing down the operating temperature of electrolyte is under implementation through Central Electro-Chemical Research Institute, Tamil Nadu.

#### **5.1.3 AWARENESS PROGRAMME :**

The programme to spread awareness and educate consumers through dissemination of information on efficient use and conservation of energy was continued during the year. Apart from the multimedia campaign in Press, TV and Radio, the message of energy conservation is being spread through pamphlets, brochures and hoardings, etc. Seminars and workshops are also being sponsored/held on aspects relating to efficiency of energy use in specific areas.

#### **5.1.4 ENERGY CONSERVATION AWARDS :**

Industrial units which have taken initiatives in implementation of energy conservation measures and shown commendable achievements in energy savings, are chosen by the Government for national recognition through grant of awards. Since 1991, National Energy Conservation Awards are being given to entrepreneurs on the National Energy Conservation Day (14th December) every year. The 1996 awards have been won by 25 industrial units in Aluminium, Chemicals, Chlor-Alkali, Fertiliser, Integrated Steel Plants, Refineries, Petrochemicals, Pulp and Paper, Sugar and Textile Sub-Sectors.

### 5.1.5 INSTITUTIONAL FRAMEWORK :

Though a number of agencies at the Government and non-governmental level all over the country are involved in the task of promoting/facilitating conservation of energy the task of evolving and implementing a coordinated strategy in this area is being pursued by the Ministry of Power, with the assistance from the Energy Management Centre and other organisations including the Central Electricity Authority, the Central Power Research Institute and the Rural Electrification Corporation.

## 5.2 RENOVATION AND MODERNISATION

In order to improve the performance of the existing Thermal Power Stations, a massive renovation and modernisation (R&M) programme (Phase-I) was launched by the Government of India all over the country in Sept., 1984 for completion during the Seventh Plan period.

The programme covered 163 Thermal Units (13570.50 MW) in 34 selected stations. Total sanctioned cost of various renovation schemes was Rs. 1165 crores, out of which Rs. 423.34 crores was under Central Loan Assistance (CLA) and Rs. 741.66 crores was proposed to be financed by the State under State Plan/Own resources. The Government of India had approved an amount of Rs. 500 crores in 1984 for providing Central Loan Assistance to various State Electricity Boards/Organisations to supplement their efforts for R&M of old stations.

The R&M Programme has since been completed in 3/96 and total amount of Rs. 1066 crores (CLA Rs. 401.62 crores and State Plan Rs. 664.38 crores) has been spent.

After the completion of R&M programme, considerable benefits by way of additional generation of more than 10,000 MU/Year has been achieved against the targeted benefits of 7000 MU/Year.

### 5.2.2 R&M (PHASE-II) PROGRAMME :

In view of the encouraging results achieved from the implementation of Phase-I of R&M programme

of selected old thermal units during the 7th Plan, the Phase-II programme for R&M of thermal power stations was taken up in the year 1990-91 by the Government of India for implementation during the 8th Plan. Under this programme, 44 nos. of thermal power stations consisting of 198 nos. thermal units aggregating to a total capacity of 20,869.435 MW are covered. The total sanctioned cost of all the schemes is Rs. 2,383.03 crores.

After the completion of the programme the benefits expected are : (i) additional generation of 7,864 MW/Year (ii) increase of 100 MW peaking capacity (iii) life extension of 24 nos. of thermal units by 15-20 years.

### 5.2.3 PROGRESS :

**Physical :** Out of a total 1629 activities (revised) 657 have been completed and balance 425 are under progress. Also 75 MW of peaking capacity has been successfully re-captured after completion of works on some of the units.

**Financial :** An amount of Rs. 715.17 crores has been incurred till November, 1996 with the financial assistance provided by PFC/World Bank as per details given below :

	(Rs. in Crores)
PFC	121.68
World Bank	129.63
State Plan Own Resources	463.86
Total expenditure upto March 1996	651.12
Revised outlay for 1996-97	366.54
Funds Requirement for 1997-98	400.00

**Constraints in implementation :** Out of a total of 44 approved schemes, 23 are being partly funded by PFC/World Bank, 5 schemes are funded from Project authorities' own resources. The progress of remaining 16 schemes pertaining to UPSEB, BSEB, WBSEB, ASEB, DVC, etc. is very tardy because of paucity of funds with these SEBs/SGCs and their ineligibility for availing loan from Power Finance Corporation.

**Programme for 1997-98 :** During the year 1997-98, 200 nos. of R&M activities are expected to be completed. Also R&M works on ESP of 11 nos. of thermal units are likely to be completed during the year. However, the above targets will be achieved provided sufficient funds are made available to the concerned SEBs/Power Stations. To achieve the same, an amount of about Rs. 400 crores will be required during the year.

#### **5.2.4 RENOVATION, MODERNISATION AND UPRATING OF HYDRO-ELECTRIC POWER STATIONS :**

Based on the recommendations of the national committee and subsequent reviews, a programme for renovation, modernisation and uprating of Hydro

Power Stations was formulated by CEA in which 55 schemes were identified with an aggregate capacity of 9653 MW (211 generating units). The total estimated cost of these schemes is Rs. 1493 crores and expected benefit is 2531 MW/7180 MU. Out of these 55 schemes, work on 10 schemes have already been completed at a total estimated cost of Rs. 84.97 crores which have accrued a benefit of 223 MW/931 MU.

The work relating to renovation, modernisation and uprating of Hydro Electric Power Stations in the country is being handled by the Hydro Engineering Division of CEA.





## 6. COOPERATION WITH NEIGHBOURING COUNTRIES IN HYDRO POWER

The development of the water resources of the common rivers of India and neighbouring countries of Nepal and Bhutan for mutual benefits has been under discussions with these countries. There is regular exchange of electric power between India and the above neighbouring countries for the supply of surplus power and meeting the power requirements in the border areas.

India has been assisting Nepal in the utilisation of its hydro power potential and four HE schemes viz. Pokhara, Trisuli, Western Gandak and Devighat have been implemented with assistance from Government of India. Three major water resources projects in Nepal viz. Karnali, Pancheshwar and Saptakoshi are presently under discussions. The feasibility report of Karnali Multi-purpose Project (10800 MW) was prepared in 1989. The key parameters of the project are to be finalised after mutual discussions. Pancheshwar MPP (Stage-I : 2000 MW) has been investigated by the two countries in their respective territories and DPR is presently under preparation/finalisation, jointly. The development of this project is covered under Integrated Mahakali River Treaty signed between HMG, Nepal and India in February, 1996. India had offered financial and technical assistance for investigation of Saptakoshi (3300 MW) Multi-purpose project. Joint technical expert groups have been constituted for each of the above projects for joint guidance for investigation and preparation of detailed project reports (DPRs). The exchange of power between India and Nepal is presently taking place at 17 points along Indo-Nepal border. The voltage level for new inter-connections has been agreed to be 132 KV to enable increase the quantum of exchange of power. Two joint Indo-Nepal Committees viz. Power Exchange Committee and Power Exchange Coordination Unit are looking into the matter concerning the exchange of power between the two countries. India has also agreed to provide 70 MW of energy to Nepal annually free of cost from Tanakpur HE Project in India.

In Bhutan, Chukha, H.E. Project (336 MW), implemented with Indian financial and technical assistance and operating in an excellent manner is a shining example of cooperation between the two countries for mutual benefits. The surplus power

from the project is being imported by India. Kurichu H.E. Project (45 MW) in Eastern Bhutan is presently under implementation on turnkey basis with Indian financial and technical assistance. For the implementation of another project viz. Tala H.E. Project (1020 MW) an agreement has been signed by the two Governments. The investigation of Shankosh Multi-purpose Project (4060 MW) has been completed by CWC and DPR was finalised in December, 1995.

Two other hydro-electric projects namely Wangchu and Bunakha with a total installation of 1080 MW have been investigated and their DPRs are presently under various stages of preparation. India is also providing technical assistance for rehabilitation of hydro projects in Bhutan.

Hydro Engineering Division of CEA is rendering Design and Engineering Consultancy to Hydro Electric Projects and for rehabilitation of 8 nos. mini/micro Hydro Electric Projects in Bhutan.

### ASSESSMENT OF SMALL HYDRO POTENTIAL IN THE COUNTRY

India possesses sizeable resource of small hydro potential and the attention of the planners of the country has therefore, been focussed on its exploitation. Implementation of small hydro stations requires comparatively lesser capital investment, shorter gestation period and obviates the need for providing major transmission lines and, therefore, results in substantial savings. Recognising the benefits of Small Hydro Plants (SHP), particularly in the development of remote and isolated areas. Central Electricity Authority has taken up the study for assessment of Small Hydro Electric Potential of the country.

The study identifies small schemes in different river systems and canal systems of the country. The inventory of schemes also include existing, on-going and proposed schemes. Such a detailed and systematic study has been attempted for the first time in the country.

Statewise draft reports of studies were finalised after incorporating the comments/suggestions of State Authorities. According to the studies, small hydro potential of the country has been assessed as 6182 MW from a total of 1512 nos. of schemes.

## 7. PRIVATE SECTOR PARTICIPATION

### 7.1 INTRODUCTION

In the context of paucity of resources with Central/ State PSUs and SEBs and to bridge the gap between the rapidly growing demand for electricity and supply, a policy to encourage greater investments by private enterprises in the power sector with the objective of mobilising additional resources for capacity addition in power generation and distribution, had been formulated in 1991 and is currently under implementation.

### 7.2 THE PRIVATE POWER POLICY OF THE GOVERNMENT OF INDIA

The package of incentives in the policy which complements the amended provisions in the electricity legislation comprehensively cover the legal, administrative and financial environment to make private investments in the sector attractive. A two-part tariff system for power projects, to be put up by the Independent Power Promoters to cover

the fixed costs and variable energy cost in electricity pricing, has been formulated. This, inter-alia, provides for 16% Return on Equity at 68.5% PLF for thermal plants (coal/lignite/gas) and 90% availability for hydro-plants. To encourage efficiency in plant operation, an incentive scheme based on capacity utilisation has also been formulated.

### 7.3 RESPONSE FROM THE PRIVATE SECTOR

The response to Government of India's policy has been encouraging. As on 31.12.96, interest has been expressed in putting up more than 124 power projects (requiring CEA clearance) for a total capacity of 67281 MW involving an investment of about Rs. 246472 crores. In addition, there are several projects (MoU/Lol projects costing up to Rs. 100 crores and projects awarded through competitive bidding and costing up to Rs. 1000 crores) which are being set up by the private sector with the approval of the State Governments.



*A view of the project works at Jegurupadu (by GVK)*

## 7.4 PROJECTS INVOLVING FOREIGN INVESTMENT

About 54 power project proposals have been considered for approval from the foreign investment angle and out of these, 26 projects costing approximately Rs. 54870 crores of 12706 MW have been cleared.

## 7.5 NEW POLICY INITIATIVES

### I. FLEXIBILITY TO NEGOTIATE PPAs AND LIBERALISED TARIFF NORMS FOR HEPs.

The State Electricity Boards (SEBs) have been provided flexibility to negotiate the Power Purchase Agreements (PPAs) through the August, 1994 amendment to tariff notification, which allows determination of tariff in deviation of the norms laid down in the two-part tariff notification, provided the tariff is less than the normative tariff. The notification was further amended on 12.1.95 wherein liberalized tariff norms for hydro-electric projects have been notified.

### II. PPA GUIDELINES

Based on the experience gained with the initial batch of Power Purchase Agreements (PPAs), the Government took note of the necessity of strengthening the hands of the SEBs in negotiating PPAs with the private promoters. Detailed principles for negotiating PPAs for Indian Private Power Projects have been issued to the State Governments / SEBs. A model PPA for thermal power projects and model PPA for hydro-electric power plants were also circulated to the State Governments/SEBs.

### III. COMPETITIVE BIDDING FOR AWARDED PROJECTS

The initial batch of projects have been awarded generally on the basis of negotiations between the SEB and a single developer. The SEBs and State Governments have been advised to introduce a more competitive element in the process of

selection of developers and award of projects, and consider awarding new projects only on the basis of competitive bidding. The Government is committed to a transparent system of finalising private power projects; hence it was decided in January, 1995 that generally, no private power project proposal would be considered by CEA, if the project is not awarded through competitive bidding. Detailed guidelines have also been issued to the State Governments for adopting competitive bidding. The RFP/RFQ documents developed by some of the State have been circulated to other states so that these would act as model documents for adopting competitive bidding by them.

### IV. GUIDELINES FOR PRIVATE SECTOR PARTICIPATION IN RENOVATION AND MODERNISATION

A need was felt to develop detailed guidelines for encouraging private participation in renovation & modernisation (R&M) sector. Based on discussions with SEBs and State Governments, a detailed policy framework for R&M has been formulated. The policy details out various options available for promoting R&M programmes. While deciding on the available options, the policy emphasises on adherence to competitive bidding route.

The States have also been advised that R&M schemes costing upto Rs. 500 crores need not be submitted to the CEA for appraisal. The necessary notification in this regard has been issued on 9/1/1997.

### V. CAPTIVE/CO-GENERATION PLANTS

As an alternative to meet the rapidly increasing industrial demand for power, encouragement to captive/co-generation plants by industries has been suggested. The policy suggests, *inter-alia*, sale of excess power to the grid as per mutually agreed rates, access to transmission grid of the State on payment of wheeling charges, third party access for direct sale of power, etc.

A clarification has been issued to the State Governments that captive power/co-generation plants require the approval of the SEB only, who have to simply refer the proposal to the CEA for consultation in cases where the capacity of the generation station exceeds 25 MW. It is expected, this clarification will accelerate the process for setting up of larger captive/co-generation plants in various States in order to tide over the current power crisis. A resolution for promotion of co-generation has been issued on November 6, 1996. The resolution details the definition of co-generation, mode of fixation of tariff and mode of deiding co-generation status for the power plants. It has also been decided to permit setting up of captive power plants fully dedicated to an industry or group of industries by an independent power company without having to go in for competitive bidding for selection of the IPP. The States have been apprised of the decision vide letter dated 9th January, 1997, from Secretary (Power).

## **VI. LIQUID FUEL POLICY**

Even though the response of the private sector to set up coal/lignite, gas and hydel projects has been encouraging, it has been recognised that in view of the long gestation period these projects would take three to five years to come on stream. Hence, a

quick capacity addition is essential in order to avert a severe power crisis. Many States have also approached in this regard. After detailed examination of the matter in consultation with Ministry of Petroleum and Natural Gas and Planning commission, and a detailed study through computer modelling, it was felt that there is economic wisdom in setting up liquid based power plants in certain areas of the country. It was, therefore, decided to also permit setting up of power projects based on heavy fuel oils such as, Naptha, Heavy Petroleum Stock (HPS), Low Sulphur Heavy Stock (LSHS), Heavy Furnace Oil (HFO), Furnace Oil (FO) and natural gas, wherever available, as primary fuel. A resolution has been issued in this regard. The Government of India tariff notification has also been amended allowing use of Naptha as primary fuel as well. As amendment to the resolution dated 6.11.1995 has also been issued, which permits the usage of petroleum coke and vacuum residue in addition to the above mentioned fuels.

## **VII. SETTING UP OF MEGA POWER PROJECTS**

To facilitate setting up of large sized thermal power plants in the Country, in order to derive the economy of scale, consideration of projects having a capacity of 1000 MW or above and supplying power to more than one State, as a mega project has ben



*Dahanu TPP (BSES Project). First Power Station in the country having 250 MW sets, supplied by BHEL*



suggested. The Government policy proposes identification of such project sites by the CEA, preparation of feasibility reports by NTPC and Powergrid to facilitate measures for selection of promoters and finalisation of Power Purchase Agreements between the promoters and the SEBs.

#### **VIII. ENHANCING THE CEA LIMIT**

A notification has been issued in October, 1995 enhancing the limit of capital expenditure of the schemes requiring concurrence of the Central Electricity Authority from Rs. 100 crores to Rs. 400 crores in case of generating station schemes put up by generating company which was selected through a process of competitive bidding by the competent Government. The limit has been further enhanced to Rs. 1000 crores in September, 1995. It is expected that this measure will enable the States to plan medium projects for quick capacity addition from the private sector in most economical manner.

#### **IX. SIMPLIFICATION OF CEA CLEARANCE**

CEA has introduced two stage clearance, viz., in-principle clearance followed by Techno Economic Clearance (TEC). In-principle clearance is normally expected to be granted within one month and TEC between four to six months provided the promoters make available all necessary information. The guidelines for obtaining 'in-principle' clearance and for submission of Detailed Project Report (DPR) to CEA for their appraisal have also been issued. This has helped in faster clearance of private power proposal. The number of clearances required to be obtained for the purpose of appraisal of the private power projects by CEA has been substantially reduced and necessary Office Memorandum (OM) in this regard has been issued in January, 1996 to all the State Governments/SEBs.

#### **X. BARGE MOUNTED POWER PLANTS**

Since barge mounted projects have the inherent advantage of making available power in a short

period to the Coastal States and also such projects would reduce the burden of inland transportation of fuel, the State Governments had been advised that such power plants may be encouraged in the Coastal States to meet the immediate energy shortages for a short time.

#### **XI. DEADLINE FOR PROJECTS BASED ON MoU/Lol ROUTE**

To set a deadline for a serious expression of interest on part of the IPPs and the State Governments/SEBs, instructions were issued that projects on the MoU/Lol route should obtain in-principle clearance of CEA latest by 31.3.1996, after which they will not be entertained by CEA. A deadline of 31.3.1997 has also been set for projects on the MoU/Lol route for submission of complete proposals for obtaining techno-economic clearance of the CEA.

#### **XII. BIDDING FOR EPC CONTRACTS**

The states have been advised to impress upon the promoters of IPPs to go in for International Competitive Bidding (ICB) in the selection of their EPC contracts in cases where the promoters have not yet finalised such contracts.

#### **XIII. POLICY REGARDING EXPANSION OF POWER PROJECTS IN THE PRIVATE SECTOR**

While competitive bidding for award of power projects have been made mandatory from 18.2.1995, in the expansion schemes of private power projects, it has been recognised that in order to have the benefit of the already existing infrastructure facilities, which results in reduced project cost, it would be preferable for the same project developer to be allowed to undertake the expansion project rather than to undergo the bidding process. The States have been accordingly advised vide letter dated 10.1.1997 from Secretary (Power) to encourage such expansion plants.

## 8. CENTRAL ELECTRICITY AUTHORITY

### 8.1 ORGANISATION OF CEA

The Central Electricity Authority (CEA) is a statutory organisation constituted under Section 3(1) of the Electricity (Supply) Act, 1948. It was established as a part-time body in 1951 and made a full-time body in 1975. It is an attached office of Ministry of Power, Government of India.

In all technical, financial and economic matters, the Ministry of Power is assisted by the CEA. CEA is responsible for technical coordination and supervision of programmes and is also entrusted with a number of statutory functions. CEA is headed by a Chairman, who is also Ex-Officio Secretary to the Government of India and has six full-time members, who are of the rank of Ex-Office Additional Secretaries to the Government of India. These are Member (Thermal), Member (Hydro), Member (Economic & Commercial), Member (Power Systems), Member (Planning) and Member (Grid & Operations).

### 8.2 FUNCTIONS OF THE CEA

The Authority is generally to exercise such functions and perform such duties and act in such a manner as the Central Government may prescribe under the Rules framed under Section 48 (1) of the Electricity (Supply) Act, 1948 or by issue of written directions in the matters of policy involving public interest under Section 4 A (I) of the said Act. Under Section 3(1) of the Act, the CEA is particularly charged with the following functions :

1. To develop a sound adequate and uniform national power policy, formulate short-term and perspective plans for power development and coordinate the activities of planning agencies in relation to the control and utilisation of national power resources;
2. To act as arbitrators in matters arising between the State Government or the Board and a licensee or other person as provided in the Act;
3. To collect and record the data concerning generation, distribution and utilisation of power and carry out studies relating to cost, efficiency, losses, benefits and such like matters;
4. To make pubic from time to time information secured under the Act and to provide for the publication of reports and investigation;
5. To advise any State Government, Board, Generating company or any other agency engaged in generation or supply of electricity on such matters as will enable such Government, Board, Generating company or Agency to operate and maintain the power system under the ownership or control in an improved manner and where necessary in coordination with any other agency owning or having the control of another power system;
6. To promote and assist in the timely completion of schemes sanctioned under Chapter V of the Act;
7. To make arrangements for advancing the skill of persons in the generation and supply of electricity;
8. To carry out or make arrangement for any investigation for the purpose of generating or transmitting electricity;
9. To promote research in matters affecting the generation, transmission and supply of electricity;
10. To advise the Central Government on any other matter on which its advice is sought or make recommendations to that Government on any matter, if in the opinion of the Authority the recommendation would help in improving the generation, distribution and utilisation of electricity, and
11. To discharge such other functions as may be entrusted to it or under any other law;
12. Under the provision of Electricity (Supply) Act, 1948, the Central Government has further added few more functions to the Central Electricity Authority. These are:

- a. Co-ordination of research and development in the power generation field;
- b. Evaluation of financial performance of the SEBs, constituted under Section 5 and undertaking of studies concerning the economic and commercial aspects of the power industry as well as an analysis of the tariff structure in the power industry;
- c. Techno-economic appraisal of power projects;
- d. Promotion of inter-state and joint sector power projects.

Apart from the above function provided under the Electricity (Supply) Act, the CEA also undertakes design and engineering of power projects with a view to develop in-house technical know-how and also to assist the State Electricity Boards, Generating Companies & State Authorities requiring such assistance under Section 3 (1) (V) of the Electricity (Supply) Act, 1948.

### **8.3 SUBORDINATE OFFICES**

Following are the subordinate offices of the CEA:-

1. Northern Regional Electricity Board, New Delhi.
2. Western Regional Electricity Board, Mumbai
3. Eastern Regional Electricity Board, Calcutta
4. Southern Regional Electricity Board, Bangalore
5. North-Eastern Regional Electricity Board, Shillong
6. Power System Training Institute, Bangalore
7. Hot Line Training Centre, Bangalore
- 8-11. Regional Power Survey Organisations at New Delhi, Bangalore, Mumbai and Calcutta
- 12-15. Regional Inspectional Organisations at Chennai, Goa, New Delhi and Shillong.

### **8.4 TECHNO-ECONOMIC APPRAISAL OF POWER DEVELOPMENT SCHEMES**

Power development schemes estimated to involve a capital expenditure exceeding Rs. 100 crores are

required to be submitted to CEA for its techno-economic appraisal and concurrence under Section 29(1) of the Electricity (Supply) Act, 1948 as amended in 1991. Further, as per Section 44 of the Act, Schemes of Captive Power Plants, etc. with a capacity exceeding 25 MW are also required to be referred to the CEA for its consultation by the concerned SEBs.

### **8.5 TECHNO-ECONOMIC APPRAISAL OF SCHEMES**

During the year 1996-97 (Upto 30.11.1996), CEA accorded techno-economic clearance to 9 Nos. of new power schemes comprising 7 generation schemes, one T&D scheme and one R&M scheme involving new capacity addition of 4650 MW and 560 Ckt. Kms.

#### **8.5.1 CAPTIVE SCHEMES**

During the year 1996-97, (Upto 30.11.1996), CEA's consultation was issued to 14 Nos. of Captive Power Plants aggregating to 904.37 MW to the various State Electricity Boards.

### **8.6 NEW ITEMS**

#### **8.6.1 POWER & TELECOM COORDINATION COMMITTEE (PTCC)**

CEA's Telecommunication Division continued to follow up cases for expeditious PTCC clearance of transmission lines of 220 KV and above through discussions with the Department of Telecom., Railways and Power Utilities. The Telecommunication Division also rendered assistance to the State Electricity Boards for complex PTCC cases of voltage level 132 KV and below.

During the year 1996-97 (Upto Nov., 1996), 115 new cases were received for PTCC clearance.

Studies are also being carried out for finalising norms for PTCC clearance of multiple circuit EHT transmission lines from MSEB.

#### **8.6.2 NATIONAL ELECTRIC POWER SYSTEM INFORMATION CENTRE**

A National Electric Power System Information Centre (NEPSIC) established during 1991-92 to collect vital power system operational data from different Electricity Boards for use in CEA/MOP has become fully operational.

### 8.6.3 SUB-GROUP FOR NINTH PLAN ON GENERATION, TRANSMISSION AND NATIONAL POWER PLAN FOR THE PERIOD 1997-2012

- i) Approach Paper for National Power Plan covering the period from 1997 to 2012 has been prepared;
- ii) Studies have been carried out using the sophisticated 'EGEAS' and 'ISPLAN' computer-models for the assessment of the following based on Fifteenth Electric Power Survey projections for demand and energy;
  - a) Additional Generating capacity requirement during the Ninth Plan period (1997-2002) and the Tenth Plan period (2002 - 07) and Eleventh Plan period (2007 -12) for the targetted reliability levels of 2% Loss-Of-Load-Probability (LOLP) and Energy-Not-Served (ENS) less than 0.15% have been assessed.
  - b) Transmission Network requirement in various power regions of the country during the periods of Ninth Plan (1997-2002), Tenth Plan (2002-07) and Eleventh Plan (2007-12) has been worked out.
  - c) Assessment of Funds requirement for the corresponding generating capacity additions and additional transmission and distribution facilities in various power regions of the country during Ninth Plan, Tenth Plan and Eleventh Plan periods has been worked out.

### 8.6.4 FIFTEENTH ELECTRIC POWER SURVEY COMMITTEE

The Fifteenth Electric Power Survey Committee was constituted by the Ministry of Power in March, 1994 with the Chairman, Central Electricity Authority as its Chairman. The Committee was required 'to review the electricity demand projections in detail during the 9th Plan period i.e. upto 2001-02 and to project the perspective demand upto 2011-12'. The Committee's Report was submitted to the Government of India in July, 1995. According to the report, the projected power demand in public utilities for the county as a whole should as follows :

	All India		
	(At Power Station Bus-bars)		
	2001-02	2006-07	2011-12
	End of	End of	End of
	9th Plan	10th Plan	11th Plan
Energy Requirement (MKWh)	569650	781863	1058440
Peak Load (MW)	95757	130944	176647

### 8.6.5 STANDING COMMITTEE FOR DERATING/UPRATING/RETIREMENT OF GENERATING UNITS

The Standing Committee to examine the proposals for derating/uprating and retirement of generating units was reconstituted, with Member (Planning), CEA as Chairman and Director (Power Survey) as Member-Secretary. Three meetings of the Committee were held to examine the proposals for Derating/Uprating and Retirement of generating units. Nine proposals have been received during the year so far, out of which three proposals for derating and one for uprating of units were accepted.

### 8.6.6 REGIONAL ELECTRICITY BOARDS

In order to promote the integrated operation of the power systems, the country has been divided into five regions namely North, West, South, East and North-East. Regional Electricity Boards have been set in each of these regions. These Boards have been functioning under the control of CEA.

### 8.6.7 DESIGN AND ENGINEERING OF H.E. PROJECTS

Design & Engineering Consultancy is being rendered to 23 nos. Hydro-Electric (HE) Projects having installed capacity of over 9200 MW. Some of the major projects where consultancy is being rendered are Nathpa Jhakri HEP (6 x 250 MW), Sardar Sarovar HEP (6 x 200 MW + 5 x 50 MW), Tehri HEP (4 x 250 MW), Ranjit Sagar HEP (4 x 150 MW), Indira Sagar HEP (8 x 125 MW), Srisailem HEP ( 6 x 150 MW) and Koyna HEP (4 x 250 MW).



## 9. BADARPUR THERMAL POWER STATION

### PERFORMANCE

Badarpur Thermal Power Station consists of 3 x 100 MW and 2 x 210 MW coal-fired units with an installed capacity of 720 MW. However, the 3 units of 100 MW each have been derated to 95 MW w.e.f. 11.1.1990. The station is owned by Government of India and is being managed by NTPC since 1st April, 1978. During the year 1996-97, till 30.11.1996, the station generated a total of 2586.505 MUs at a PLF of 62.67% against the target of 2882 MUs (PLF 69.81%). Other parameters like specific furnace oil consumption, auxiliary power consumption, DM Water consumption, during the year upto November, 1996 are 2.25 ml/kwh, 8.66% and 3.47% respectively. BTPS has lost 608 MUs due to shortage of coal. BTPS has got a target of 4400 MUs at a PLF of 71.25%.

### ASH UTILISATION

BTPS has been making sincere efforts for productive utilisation of ash generated for constructive purpose. M/s Bilaspur Industries has set up a fly ash evacuation system for its use for manufacture of auto claved concrete blocks and beams utilising fly ash to the tune of 250 MTI day. BTPS has started on experimental basis manufacture of ash based bricks using FAL-G technology. During current year BTPS has utilised

9520 MT ash against annual target of 14239 MT.

BTPS has also invited entrepreneurs for setting up industries to manufacture ash based products and also for free lifting of pond ash for development of low lying area.

### RENOVATION & MODERNISATION

BTPS is one of the thermal power stations, identified under the centrally sponsored scheme for Renovation & Modernisation of the Thermal utilities in India. Under R&M scheme Phase-I various works in the area of boiler pressure parts modification, control ad instrumentation, additional electrostatic precipitator, mill reject handling system, ash handling system etc. have been carried out. Encouraged by the achievements after the implementation of first phase of R&M programme, CEA undertook the second phase of R&M of thermal utilities in the country. BTPS has submitted proposal valuing Rs. 187.77 crores approximately covering all units of BTPS. The proposal has been techno-economically cleared by CEA and Pre PIB and is to be considered by PIB.

Position of outstanding audit paras		No. of respective reports	
BTPP	49	BTPP	7
BTPS	141	BTPS	9

## 10. PUBLIC SECTOR UNDERTAKINGS AND OTHER ORGANISATIONS

### 10.1 NATIONAL THERMAL POWER CORPORATION LTD. (NTPC)

National Thermal Power Corporation (NTPC) was set up in 1975, as a central sector generating company for the development of thermal power. The Corporation is at present engaged in operating/setting up of several thermal power projects and gas based power projects. The total approved investment of the corporation as on end November, 1996 stands at Rs. 31343.46 crores (excluding the investment on Transmission Systems which have since been transferred to Power Grid). The NTPC is at present placed in Schedule "A".

The approved capacity of NTPC Projects is 19115 MW. The capacity commissioned upto November, 1996 is 16795 MW. This includes acquisition of Unchahar (420 MW) and Talcher (460 MW). Presently, NTPC has to its credit 11 coal based thermal power projects and 6 gas/liquid fuel based

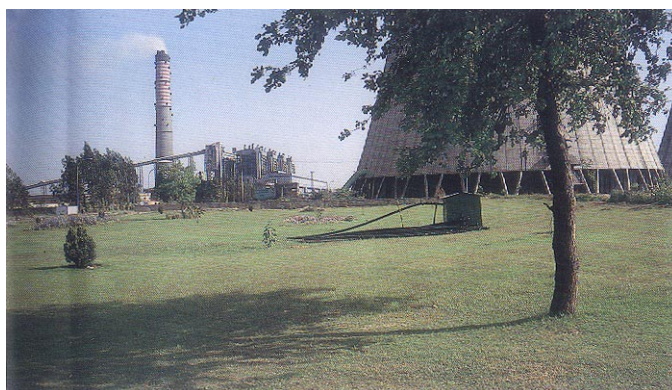
combined cycle projects with an aggregate approved capacity of 19115 MW. Besides its own stations, NTPC also manages the Badarpur Thermal Power Station in Delhi (705 MW) and BALCO'S Captive Power Station near Korba, Madhya Pradesh (270 MW), which was also constructed by NTPC.

#### 10.1.1 GENERATION

As on 30.11.96 a total capacity of 16335 MW (Excluding Talcher TPS - 460 MW) was under operation at various NTPC stations. This comprises of 30 units of 200/210 MW each at Singrauli, Korba, Ramagundam, Farakka, Vindhyachal, NCTPP Dadri, Unchahar, Kahalgaon, 14 units of 500 MW at Singrauli, Korba, Ramgundam, Rihand, Farakka and Talcher and 26 gas/steam turbine units of various capacities operating at gas based combined cycle plants at Anta, Auraiya, Kawas, Dadri and Jhanor Gandhar gas power projects.



*A view of NTPC's Jhanor Gandhar Gas based power project*



*National Capital Thermal Power Project, Dadri, Uttar Pradesh*

The generation performance of NTPC stations has consistently been at high level. Against the target of 56,666 MUs upto November, 1996 (Pro-rata MoU target) for the year 1996-97, the gross generation from NTPC stations was 63175 MUs upto November, 1996.

Till the end of November, 1996, the coal based units under commercial operation generated 51376 MUs at a plant load factor of 76.62%.

#### **10.1.2 HIGHLIGHTS FOR THE YEAR 1996-97**

NTPC coal stations achieved a PLF of 76.62% upto November, 1996 which is 2.12% higher than the PLF of 75.03% for the corresponding period of 1995-96.

The Government of India accorded investment approval for Kayamkulam CCPP on 18.9.1996. The award for Main Plant Package have been placed immediately after the receipt of Government approval. Infrastructural development activities have been taken up at the project.

#### **10.1.3 ADB LOAN FOR FEROZ GANDHI UNCHAHAR TPS (2x210 MW)**

The Asian Development Bank has approved NTPC as the implementing agency for stage-II of Feroz Gandhi Unchahar Thermal Power Project under loan for US \$ 160 million consequent to takeover of the project by NTPC. The transfer of the loan has been made effective from 14.11.1995 and an amount of US \$ 4.89 million has been utilised upto the end of November, 1996 during financial year 1996-97.

#### **10.1.4 BADARPUR THERMAL POWER STATION (BTPS), DELHI**

Badarpur Thermal Power Station (BTPS), Delhi consists of 3 x 100 MW and 2 x 210 MW coal fired units with an installed capacity of 720 MW. However, the 3 units of 100 MW each have been derated to 95 MW w.e.f. 11.1.90. The station is owned by Government of India and is being managed by NTPC since 1st April, 1978. 100% power from this station is supplied to DESU. During the year 1996-

97 the station generated a total of 2587.51 MUs at a PLF of 62.67% upto end of November '96 against the target of 2753 MUs. The generation was low due to non-availability of coal.

### 10.1.5 JOINT VENTURE PROJECTS

The 208 MW Combined Cycle Power Project at Kakinada being executed by Spectrum Power Generation Ltd., is co-promoted by NTPC along with Spectrum Technology, USA and Jaya Food Industries. NTPC has taken legal action against SPGL for non-implementation of Promoters Agreement signed among three co-promoters.

Utility Powertech Ltd., a joint venture company of NTPC, and BSES have agreed to undertake construction, erection and project management activities in power and other industrial sectors in India and abroad. BSES & NTPC have contributed in equity capital of JV company.

NTPC has also signed an MoU with Indian Oil Company for setting up petrol fuel based power station.

### 10.1.6 MEMORANDUM OF UNDERSTANDING

The Memorandum of Understanding (MoU) for the year 1996-97 was signed between NTPC and the Ministry of Power. Targets for the year 1996-97 in respect of major performance parameters are given below :

SI. NO.	Target	
	V. Good	Excellent
1. Generation (MUs)	85,000	93,000
2. Availability Factor %	81	83
3. PLF %	74	76
4. Heat Rate (Kcal/Kwh)	2510	2490
5. Gross Margins (Rs. Cr.)	3699.13	3722.28
6. Net Profit to Capital employed %	4.36	4.45

### 10.1.7. CENTRE FOR POWER EFFICIENCY AND ENVIRONMENTAL PROTECTION (CENPEEP)

Centre for Power Efficiency & Environmental Protection (CENPEEP) was established in pursuance to the protocol of intent signed between USDOE, USAID, Ministry of Power and NTPC in July '94 for implementing Greenhouse Gas Pollution Prevention Project (GEP). The Advisory Board for CENPEEP has identified eight tasks covering areas such as, comprehensive efficiency improvement, environmental monitoring and control, predictive preventive maintenance, life extension, ash utilisation and fuel quality impacts. The Centre has prioritised the tasks and current thrust is on efficiency improvement to facilitate improved performance of existing power stations, effect fuel savings and to decrease green house gas pollution per unit of electricity generated. The tasks are progressing as per schedule. In the initial phase, Singrauli and Dadri Projects of NTPC and Wanakbari Power Station of GEB have been identified for carrying out trials. The first series of demonstration tests covering several new technologies and practices for efficiency improvement and combustion optimisation have been successfully completed at NCTPP, Dadri with active involvement of TVA, USDOE and USAID. The benefits are proposed to be passed on to all thermal plants in India by dissemination of knowledge regarding new technologies and practices through seminars, workshops, newsletters, etc.

A Centre for Power Efficiency & Environmental Protection (CENPEEP) has been established by NTPC at NOIDA Office.

### 10.1.8 NTPC'S PROJECTS

Details of NTPC's Projects/Units are given in the Statement.





**DETAILS OF NTPC PROJECTS SHOWING AGGREGATE  
APPROVED CAPACITY 19115 (MW)**

**A. UNITS COMMISSIONED UPTO NOV. '96**

S.No.	Name of the Region/ Project/State	Approved Capacity in MW	Actual date of commissioning
<b>NORTHERN REGION</b>			
1.	Singrauli STPP Uttar Pradesh	2000 Stage-I (3x200)  Stage-II (2x200 + 2x500)	Unit-1 (200) Feb. 82 Unit-2 (200) Nov. 82 Unit-3 (200) Mar. 83  Unit-4 (200) Nov. 83 Unit-5 (200) Feb. 84 Unit-6 (500) Dec. 86 Unit-7 (500) Nov. 87
2.	Rihand STPP Uttar Pradesh	1000 Stage-I (2x500)	Unit-1 (500) Mar. 88 Unit-2 (500) July 89
3.	National Capital Thermal Power Project (Dadri) Uttar Pradesh	840 Stage-I (4x210)	Unit-1 (210) Oct. 91 Unit-2 (210) Dec. 92 Unit-3 (210) Mar. 93 Unit-4 (210) Mar. 94
4.	Dadri GBPP Uttar Pradesh	817 Stage-I (4x131+2 x146.5)	Gas Turbine Unit-1 (131) Feb. 92 Unit-2 (131) Mar. 92 Unit-3 (131) June 92 Unit-4 (131) Oct. 92  Steam Turbine Unit-5 (146.5) Feb. 94 Unit-6 (146.5) Mar. 94
5.	Unchahar TPP Uttar Pradesh	420 Stage-I (2x210)	Unit-1 (210) Nov. 88 Unit-2 (210) Mar. 89
6.	Auraiya GBPP Uttar Pradesh	652 Stage-I (4x112+2x102)	Gas Turbine Unit-1 (112) Mar. 89 Unit-2 (112) July 89 Unit-3 (112) Aug. 89 Unit-4 (112) Sept. 89  Steam Turbine Unit-5 (102) Dec. 89 Unit-6 (102) June 90
7.	Anta GBPP Rajasthan	413 Stage-I (3x88+1x149)	Gas Turbine Unit-1 (88) Jan. 89 Unit-2 (88) Mar. 89 Unit-3 (88) May 89  Steam Turbine Unit-4 (149) Mar. 90

**SOUTHERN REGION**

8. Ramagundam STPP Andhra Pradesh	2100 Stage-I (3x200 + 1x500)	Unit-1 (200) Nov. 83 Unit-2 (200) May 84 Unit-3 (200) Dec. 84 Unit-4 (500) June 88
	Stage-II (2x500)	Unit-5 (500) Mar. 89 Unit-6 (500) Oct. 89

**EASTERN REGION**

9. Farakka STPP West Bengal	1600 Stage-I (3x200)	Unit-1 (200) Jan. 86 Unit-2 (200) Dec. 86 Unit-3 (200) Aug. 87
	Stage-II (2x500)	Unit-4 (500) Sept. 92 Unit-5 (500) Feb. 94
10. Kahalgaon STPP Bihar	840 Stage-I (4x210)	Unit-1 (210) Mar. 92 Unit-2 (210) Mar. 94 Unit-3 (210) Mar. 95 Unit-4 (210) Mar. 96
11. Talcher STPP Orissa	1000 Stage-I (2x500)	Unit-1 (500) Feb. 95 Unit-2 (500) Mar. 96
12. Talcher TPP (taken-over from OSEB on 3.6.95)	460 (4x60 + 2x110)	

**WESTERN REGION**

13. Korba STPP Madhya Pradesh	2100 Stage-I (3x200 + 1x500)	Unit-1 (200) Mar. 83 Unit-2 (200) Oct. 83 Unit-3 (200) Mar. 84 Unit-4 (500) May 87
	Stage-II (2x500)	Unit-5 (500) Mar. 88 Unit-6 (500) Mar. 89
14. Vindhyachal STPP Madhya Pradesh	1260 Stage-I (6x210)	Unit-1 (210) Oct. 87 Unit-2 (210) July 88 Unit-3 (210) Feb. 89 Unit-4 (210) Dec. 89 Unit-5 (210) Mar. 90 Unit-6 (210) Feb. 91
15. Kawas GBPP Gujarat	645 Stage-I (4x106 + 2x110.5)	Gas Turbine Unit-1 (106) Mar. 92 Unit-2 (106) May 92 Unit-3 (106) June 92 Unit-4 (106) Aug. 92
		Steam Turbine Unit-5 (110.5) Feb. 93 Unit-6 (110.5) Mar. 93
16. Gandhar GPP Gujarat	648 (3x131+1x255)	Gas Turbine Unit-1 (131) March 94 Unit-2 (131) March 94 Unit-3 (131) May 94
		Steam Turbine Unit-4 (255) Mar. 95

**Sub - Total****16795 MW**

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## B. SCHEDULED TO BE COMMISSIONED BEYOND 1996-97

Sl.No.	Name of the Region/ Project/State	Approved Capacity in MW	Scheduled date of commissioning
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### NORTHERN REGION

1. Unchahar TPP Uttar Pradesh	420 Stage-II (2x210)	Unit-3 (210) Jan. 2000 (Ant.) Unit-4 (210) July 2000 (Ant.)
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### SOUTHERN REGION

2. Kayamkulam CCPP Kerala	400	Gas/Steam Turbine G.T. Unit-1 Mar. 99 (Ant.) G.T. Unit-2 May, 99 (Ant.) S.T. Unit-3 Mar. 2000 (Ant.)
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### WESTERN REGION

3. Vindhyachal STPP Madhya Pradesh	1000 Stage-II (2x500)	Unit-7 (500) Feb. 2000 (Ant.) Unit-8 (500) Feb. 2001 (Ant.)
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<b>Sub-Total</b>	<b>1820 MW</b>	
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## C. UNITS YET TO BE DECIDED

### EASTERN REGION

1. Farakka STPP West Bengal	500 Stage-III (1x500)	Unit-6 (500) Yet to be decided. The project not taken up due to low demand of electricity in Eastern Region.
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<b>Total</b>	<b>500 MW</b>	
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**GRAND TOTAL (A+B+C) = 19115 MW (APPROVED CAPACITY)**

**NB :** Capacity commissioned upto November, 1996 is 16795 MW.

## 10.2 NATIONAL HYDRO ELECTRIC POWER CORPORATION (NHPC)

The National Hydro Electric Power Corporation Limited (NHPC) was incorporated in 1975 under the Companies Act, 1956. The main objectives of the Corporation are to plan, promote and organise an integrated development of hydro-electric power in the country. The Authorised Share Capital of the Corporation is Rs. 2500 crores which is fully subscribed by the Government. NHPC is a Schedule 'A' Enterprise of the Government of India.

### 10.2.1 ACHIEVEMENTS IN 1996-97

NHPC power stations generated 4664.62 MUs energy against the target of 4929 M.U.s upto November, 1996. It is targeted to generate 5860 MUs of energy in full year of 1996-97.

In Uri Project (480 MW), 97% work has been completed. Two machines have been spun so far and other machines are under final stage of completion.

In Salal Stage II (345 MW), with the completion of Tail Race Tunnel 2, the project has been fully completed and all the three units of Stage II have started generation utilising TRT-2.

In respect of Dulhasti Project (390 MW), tender evaluation for award of balance civil works for execution by contractor has been completed and Letter of Intent was issued in September, 1996. Contract is likely to be awarded on receipt of clearance from Government of India, pending which some of the works are being carried out departmentally.

In Rangit Project (60 MW), concreting of Dam upto EL 600 M has been achieved. Out of the total length of 2857 M of HRT, a progress of 1672 M has been achieved. The erection of draft tube and scroll casing for Unit 3 alongwith concreting has been completed.

In Dhauliganga Project Stage I (280 MW), the first tranche of loan assistance from OECF amounting to 5665 M yen (Rs. 211 crores) has become effective from 23.5.96 from part financing of major civil works of this project. Letter of Invitation with

bid documents for consultancy have been mailed to various empanelled consultants and a pre-bid Conference was held on 28.10.1996.

In respect of Kalpong Project (2.25 MW) in A&N Islands, which is being executed as a deposit work by NHPC, prequalification documents received from various contractors for Dam works and Water Conductor System including Civil works of Power House, have been evaluated and process of issue of tenders to prequalified contractors is in progress.

In Kurichu Project (45 MW) in Bhutan, another work of deposit basis, contract for diversion tunnel has been awarded and a progress of 48 M has been achieved. The work of detailed survey of 132 KV transmission line has been completed to the extent of 20%.

Concrete lining of the Jawahar Tunnel in J&K has been completed.

### 10.2.2 STATUS OF ON-GOING PROJECTS

#### URI HYDRO-ELECTRIC PROJECT (4x12 MW), J&K

The Project is being executed through a Swedish-UK Consortium on turnkey basis. 97% of the total work of the project has been completed. All civil works in respect of surface works and underground structures have been completed. Unit No. 3 and 4 were spun in October/December 1996. Unit No. 2 is ready for rotation. In unit No. 1 Generator erection works have been completed. Associated works are in progress. The project is scheduled for completion by May, 1997 (1st Unit-Dec. '96, 2nd Unit-Feb. '97, 3rd Unit-April '97 and 4th Unit-May '97). Attempts are being made to rotate all the 4 Units before March, 1997.

#### RANGIT HYDRO-ELECTRIC PROJECT (3x20 MW), SIKKIM

All the infrastructure works have been completed. Concreting of Dam upto EL 600 M has been completed. 703 M tunnelling of HRT from upstream side has been done against the total length of



1625M. 969M tunnelling from downstream has been completed against the total length of 1232M. Out of the total length of 2857M of HRT, a progress of 1672M has been achieved. Excavation and concrete lining of surge shaft have been completed. EOT crane has been erected in service bay. The erection of draft tube, scroll casing of Unit 3 alongwith concreting has been completed. Most of the turbine and generator equipment have reached at site. The project is scheduled to be completed by March 1999.

### **DULHASTI HYDRO-ELECTRIC PROJECT (3x130 MW), J&K**

The Project was entrusted to a French Consortium for execution on turnkey basis. However, the civil contractor of the French Consortium suspended the work w.e.f. 24.8.92 on the plea of increased militant activities in the project area. To restart the work, a rescission agreement and overall amendment contract were signed in June 1995, for terminating the civil contract with M/s DSB, a partner of French Consortium. Thereafter global tenders were invited by NHPC for appointing new contractor and contract will be awarded after compliance of procedural formalities. Meanwhile, some works at the project have been taken up by the Corporation departmentally and a cumulative progress of 250M excavation in HRT D/S by DBM (Conventional method) has been achieved. Out of the total length of 10.6 Km., 2.75 Km, of Head Race Tunnel has been excavated. Cumulative progress of 25550 cum. and 7850 cum. in excavation in transformer cavern and switchyard has been achieved respectively. The project is expected to be completed in March 2001.

### **DHAULIGANGA HYDRO-ELECTRIC PROJECT STAGE-I (4x70 MW), UTTAR PRADESH**

The infrastructure and pre-construction activities are progressing satisfactorily at the project. To part finance the project, a loan agreement with OECF for 5665M yen (Rs. 211 crores) was signed and the loan has been made effective w.e.f. 23rd May, 1996

following submission of guarantee by Government of India. For appointing a consultant, Letters of Invitation have been issued to the short-listed firms and pre-bid conference has also been held in October, 1996. For appointment of architect for colony development, bid documents were issued to the empanelled firms and bids received have been opened on 15.11.96. The project is scheduled to be completed by September, 2004.

### **KOEL KARO HYDRO-ELECTRIC PROJECT (710 MW), BIHAR**

Major work of the project could not be started due to paucity of funds and resistance. The project was posed to OECF for their financial assistance during 1996-97 and details of the project execution were presented to OECF Fact Finding Mission. The response from OECF in the matter has not been favourable.

### **KALPONG HYDRO-ELECTRIC PROJECT (2x1.125 MW), A&N**

The execution of the project has been entrusted to NHPC as a deposit work with the funds to be provided by A&N Island authorities.

Pre-qualification document received from various contractors for Dam works and Water Conductor System including civil works of Power House have been evaluated and process of issue of tenders to pre-qualified contractors is in process. Contour survey, excavation of trench, infrastructure works, hydro-meteorological observation are under progress.

## **10.2.3 FOREIGN PROJECTS**

### **KURICHU HYDRO-ELECTRIC PROJECT (3x15 MW), BHUTAN**

NHPC has been entrusted with the execution of Kurichu Hydroelectric Project in Bhutan as a deposit work and an agreement was signed between KPA and NHPC in September, 1995. The infrastructure and other construction activities are under progress.

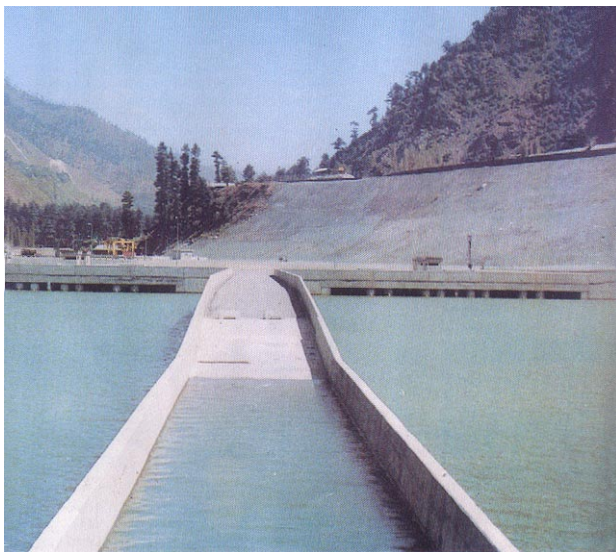
The land acquisition is also under progress. The work of open excavation for outlet portal of diversion tunnel and prequalification of tenders for Dam work are in progress. The engineering for Dam Power House works are progressing as per schedule. The work of detailed survey of 132 KV transmission line has been completed to the extent of 20%. The engineering of electrical packages are progressing satisfactorily.

#### **10.2.4 NEW SCHEMES**

##### **CHAMERA HYDRO-ELECTRIC PROJECT, STAGE-II (3x100 MW), H.P.**

The project has already been cleared by CEA.

However, due to paucity of funds, global tenders were invited for turnkey execution of the project with 100% financing. The tenders received for turnkey execution with financial assistance and the several rounds of negotiations did not result in an acceptable project cost and the Board of Directors of NHPC considered the offers as unacceptable. Efforts are on to negotiate an acceptable project cost. Further negotiations are expected to bring down the cost.



*Silt ejector - URI Project (J&K)*

## 10.3 RURAL ELECTRIFICATION CORPORATION LIMITED (REC)

Rural Electrification Corporation (REC) was set up in 1969, with the primary objective of providing financial assistance for rural electrification in the country. REC was declared a Public Financial Institution under Section 4-A of the Companies Act in 1992. Rural Electrification Programmes financed by the Corporation cover electrification of villages, including tribal villages and Dalit Bastis, energisation of pumpsets, provision of power for small, agro-based and rural industries, lighting of rural households and street lighting. The Corporation has been providing assistance to the State Electricity Boards for taking up System Improvement Projects for strengthening and improving of Sub-Transmission and distribution system and small generation projects like wind energy and hydel projects. The REC is a scheduled "B" Organisation.

The authorised share capital of the Corporation is 600 Crores. The paid-up capital of the Corporation as on 31.3.1996 was Rs. 534.60 crores which is entirely subscribed by the Government of India. During the year 1996-97, the Central Government has contributed Rs. 48 Crores towards the share capital of the Corporation increasing its paid-up capital to Rs. 582.60 crores as on 30.11.1996.

The Corporation has (Cumulatively upto November, 1996) sanctioned 30637 Rural Electrification

projects involving a financial assistance of Rs. 12,374 crores for electrification of 3.19 lakh new villages and energisation of over 64 lakh pumpsets besides provision of electricity to other categories of services and electrification of Dalit-Bastis and hamlets etc. During the year 1995-96, REC approved 1224 new projects (revised and excluding 49 projects sanctioned but withdrawn subsequently) involving a loan assistance of Rs. 1028 crores for electrification of 1537 new villages, energisation of 2.03 lakh pumpsets besides provision of electricity to other categories of services and electrification of Dalit-Bastis and hamlets etc. During the current financial year 1996-97 (upto November, 1996), REC has disbursed Rs. 221.31 crores.

### 10.3.1 DISBURSEMENT OF LOAN

Loan advanced by REC to SEBs, State Governments and Rural Electrification Co-operative Societies during the year 1995-96 amounted to Rs. 829 crores. The cumulative loan amount outstanding at the end of 1995-96 was Rs. 6629 crores. During the year 1996-97, the Corporation disbursed Rs. 221 Crores as loans.

### 10.3.2 PHYSICAL ACHIEVEMENT

During the year 1995-96 against the target of electrification of 3562 villages and energisation of 3.00 lakh irrigation pumpsets, 3728 villages were



*View of electrified dalit basti*

reported electrified and 3.35 lakh pumpsets energised. The annual plan targets of village electrification and pumpset energisation were exceeded by 5% and 12% respectively. During the year 1996-97, electrification of 597 villages and energisation of 1.63 lakh pumpsets (Prov.) have been completed upto November, 1996.

Cumulatively, upto November '96 over 2.93 lakh villages have been electrified and 66 lakh pumpsets energised under REC schemes. The level of rural electrification in the country which stood at 12.8% at the time of establishment of the Corporation has risen to 87% at the end of November-96. Similarly, the number of pumpsets energised which stood at 10.9 lakhs at the time of setting up of the Corporation in 1969 has sharply risen to over 111 lakhs representing a ten-fold increase.

### **10.3.3 KUTIR JYOTI PROGRAMME**

Kutir Jyoti Programme which provides for release of single point light connections to the households of the rural poor below the poverty line, including Dalit and Adivasi families continued to be given special thrust. On the request of several States and proposal submitted by REC, the Government enhanced the target from 1.25 lakh connections to 6.25 lakh connections for 1995-96 with corresponding increase in grant amount from Rs. 5 crores to Rs. 25 crores. REC released a grant of Rs. 20.78 crores during 1995-96 and a record number of over five lakh single point light connections were released under the programme. Over 83,000 connections are released by various SEBs/State Governments till November, 1996. Cumulatively, upto November, 1996 about 22 lakh connections have been released under Kutir Jyoti Programme since the inception of programme in 1988-89.

### **10.3.4 SYSTEM IMPROVEMENT PROJECTS**

To improve the quality and reliability of power supply in the rural areas and reduce high line losses, the Corporation laid more emphasis on promotion and financing of System Improvement and Energy Conservation projects. During 1995-96, the Corporation sanctioned 214 new System Improvement projects, involving a financial

assistance of Rs. 260.78 crores. These sanctioned projects envisage installation of 245 new substations.

An amount of Rs. 189.28 crores was disbursed to the SEBs/State Governments under System Improvement projects. Upto the end of the year, 1522 System Improvement projects for financial assistance of Rs. 1429.17 crores were sanctioned. 857 new Substations, including 83 Extra High Voltage Substations, have been commissioned in 795 projects which have been completed. It is estimated that 850 million units of electricity will be saved per annum in the completed projects.

### **10.3.5 RURAL ELECTRIFICATION COOPERATIVES**

Out of 41 Rural Electric Cooperatives sanctioned by REC, 34 Rural Electric Cooperatives are in operation as on November, 1996. While six societies, have been liquidated, one Society is in the process of being set-up. As on November, 1996, Rural Electric Cooperative Societies have electrified 4160 villages, 1825 hamlets and have released 10.32 lakhs services, which include 2.12 lakhs pumpsets, 0.19 lakhs industries and 8.01 lakhs domestic/commercial and other services.

### **10.3.6 OECF ASSISTANCE**

The Overseas Economic Cooperation Fund (OECF), Japan had sanctioned assistance of Rs. 24.4 Billion Yen (equivalent to Rs. 760 crores as per current exchange rate). Under this assistance, 21 power system Improvement Sub-projects for strengthening of transmission and distribution net work have been taken up for implementation on turnkey basis in the States of Andhra Pradesh, Haryana, Karnataka and West Bengal. In addition, one Small Hydro-Electric sub-project of 2 x 6 MW capacity in Karnataka is also under OECF assistance. These sub-projects involve an outlay of Rs. 131 crores or utilisation of 4 Billion Yen.

Cumulative disbursement under these sub-projects till 31st March, 1996 has been 33.37 crores. During the financial year 1996-97 (upto 30th November, 1996) an amount of Rs. 10.65 crores has been disbursed under these sub-projects.



To utilise the assistance in full, OECF has approved financing of 29 Additional System Improvement sub-projects for the different States and 2 Small Hydro Electric sub-projects in Tamil Nadu and Kerala.

### **10.3.7 CENTRAL INSTITUTE FOR RURAL ELECTRIFICATION**

The Central Institute for Rural Electrification (CIRE) at Hyderabad expanded its activities and organised 48 programmes during 1995-96. These training programmes are aimed at the professional development of engineers and managers from power utilities, financial institutions, manufacturing industry, academic and research and development organisations. A programme on "Management Development" and two programmes for OECF projects were also conducted during the year for executives in power sector. CIRE is now gearing up itself to embark on Consultancy, Research and Development and Standardisation in all areas of Rural Electrification and allied fields.

### **10.3.8 STANDARDISATION OF EQUIPMENT, CONSTRUCTION PRACTICES AND RESEARCH AND DEVELOPMENT**

The Corporation continued its drive towards standardisation of equipment, materials and construction practices for RE programmes including introduction of innovative technologies with special emphasis on energy conservation.

### **10.3.9 COMMITTEE ON TRANSFORMERS**

A National level Committee was constituted under the Chairmanship of CMD, REC to suggest ways and means for reduction of failure rate of transformers and improve their performance in a time bound manner. The Committee includes top

ranking technical experts and representatives from research institutions, BIS, SEBs and transformer manufacturers.

### **10.3.10 FAIL SAFE TRANSFORMERS**

During the year, the Corporation after extensive field trials released the design for a new type of "fail-safe transformer" for use in the country. This transformer automatically restores the supply soon after the temporary fault is cleared.

### **10.3.11 MEMORANDUM OF UNDERSTANDING (MoU) WITH AES AND CRESTA OF AUSTRALIA**

Though 87% of the villages in India have been electrified there are still about 80,000 unelectrified villages. Around 18,000 villages are located in hilly, desert, tribal, forest and other backward areas. Extension of the conventional grid may not be either techno-economically feasible or the least cost option for many of these villages. It may, however, be possible to supply electricity to these villages through use of renewable energy sources and decentralised power distribution systems. This could be done through a mix of hydel, bio-mass, wind, SPV and back up diesel sets in hybrid mode. Advance Energy System (AES), Australia and the Centre for Renewable Energy System Technology (CRESTA), Australia of Curtin University, Perth have expressed willingness to cooperate with REC to set up demonstration-cum-pilot projects through hybrid mode remote power systems. Keeping in view the national need to supply electricity to remote and far-flung areas, an MoU listing out the areas of cooperation between the three parties viz. REC, CRESTA and AES has been signed. REC set up an Appraisal Division to develop expertise needed for formulation and appraisal of Renewable Energy and other risk venture/innovative projects.

## **10.4 NORTH EASTERN ELECTRIC POWER CORPORATION (NEEPCO)**

The North Eastern Electric Power Corporation Ltd. (NEEPCO) was constituted in 1976 under the Company's Act, 1956 with the mission to harness the power potential of the North Eastern Region through planned development of power generation projects which in turn would effectively promote the development of the region. Since then NEEPCO has grown into one of the pioneer public sectors with an authorised share capital of Rs. 1,500.00 crores. It is Scheduled 'B' organisation.

The North Eastern Region of the country is blessed with highest hydro potential of the country which is estimated at 48,000 MW constituting about 33% of the total reserves of the country. The region has abundant natural gas reserves. There is ample scope of development in this under developed region, where the main infrastructure has been identified as power.

The Corporation has achieved a total installed capacity of 351 MW upto 1995-96. Out of this 150 MW is from Hydro and 201 MW from Thermal (Gas Based) Power Stations. During 1996-97 the Corporation would ensure further capacity addition of 100 MW from Hydro and 174 MW from Thermal Power Stations totalling a capacity of 274 MW. The Corporation also proposes to add another 200 MW during the first year of 9th Plan from its on-going thermal and hydro power projects. With the above generation, the Corporation will meet more than 50% demand of the region.

### **10.4.1 PROJECTS UNDER OPERATION AND MAINTENANCE (COMPLETED)**

#### **KOPILI HYDRO ELECTRIC PROJECT (150 MW), ASSAM**

This project, having an installed capacity of 150 MW, is located in North Cachar Hills District of Assam was commissioned in March, 1988 at a cost of Rs. 243.82 crores.

#### **ASSAM GAS BASED POWER PROJECT (291 MW), ASSAM**

All the six nos. of Gas Turbine Generating Units totalling 201 MW have already been commissioned

upto July, 1996. Three nos. of Steam Turbine Units (total 90 MW) will be commissioned and synchronised with the grid during 1997-98. The Project has an estimated cost of Rs. 1347.58 crores and is covered under OECF loan assistance.

#### **KOPILI HYDRO ELECTRIC PROJECT - 1ST STAGE EXTENSION (100 MW), ASSAM**

The 1st Unit of 50 MW of the Project has been commissioned in November, 1996 and the 2nd Unit will also be synchronised with the grid by March, 1997. The estimated cost of the Project is Rs. 134.48 crores.

### **ON-GOING PROJECTS**

#### **DOYANG HYDRO-ELECTRIC PROJECT (3x25 MW), NAGALAND**

All the works of the Project are going on as per revised schedule inspite of continuous law and order problems and all the three Units are expected to be completed by October, 1998. The estimated cost of the Project is Rs. 384.78 crores.

#### **RANGANADI HYDRO-ELECTRIC PROJECT (405 MW), ARUNACHAL PRADESH**

All the three Units are scheduled to be completed by January, 1999. The estimated cost of the project is Rs. 774.12 crores.

#### **AGARTALA GAS TURBINE PROJECT (84 MW), TRIPURA**

The project is financed through external assistance routed through Deutsche Bank, Germany. The CCEA clearance for the project has already been obtained and Units are scheduled for commissioning by December, 1997. The estimated cost of the project is Rs. 294.05 crores.

### **PROJECTS UNDER CONSIDERATION IN THE NINTH PLAN**

#### **TUIRIAL HYDRO-ELECTRIC PROJECT (60 MW) MIZORAM**

The estimated cost of the project is Rs. 371.02 crores. Funding of the project has been tied up with OECF, Japan. An allocation of Rs. 7.50 crores and Rs. 9 crores has been made for the years 1996-97 and 1997-98 respectively and the 9th Plan provision has been kept as Rs. 213.14 crores.

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### **TUIVAI HYDRO-ELECTRIC PROJECT (210 MW), MIZORAM**

The estimated cost of the project is Rs. 684.42 crores. Funding of the project is being tied up with OECF, Japan. Total 9th Plan requirement is Rs. 314 crores.

### **KOPILI HYDRO-ELECTRIC PROJECT-STAGE-II (25 MW), ASSAM**

The estimated cost of the project is Rs. 102.01 crores. Detailed Project Report is under preparation. The project is expected to be completed within 9th Plan.

### **LOWER KOPILI HYDRO-ELECTRIC PROJECT (150 MW), ASSAM**

The anticipated cost of the project is Rs. 618.18

crores and the 9th Plan provision has been kept at Rs. 515.89 crores.

### **KAMENG HYDRO-ELECTRIC PROJECT (600 MW), ARUNACHAL PRADESH**

The anticipated cost of the project is Rs. 1758.89 crores. An amount of Rs. 720 crores has been proposed for 9th Plan.

North Eastern Electric Power Corporation is also engaged in investigation of five nos. of hydro projects totalling to 925 MW for consideration in future which will help in improving the hydro thermal mix in the country.

The total investment by the Corporation during 8th Plan is Rs. 23338.52 crores and in the 9th Plan, the proposed outlay is Rs. 2272.31 crores.



*View of Assam Gas based combined Cycle Power Project (NEEPCO)*

## 10.5 POWER FINANCE CORPORATION LIMITED

The Power Finance Corporation Limited (PFC) was incorporated on July 10, 1986 with the objective of providing term-finance to Power Utilities and to bring about improved efficiencies and institutional development of its borrowing entities. It started its lending operations from the last quarter of the year 1987-88. The borrower-portfolio of PFC mainly comprise the State Power Utilities i.e. State Electricity Boards (SEBs), State Generation Corporations (SGCs) State Power Departments, Municipality-run power utilities besides the central and private sector power utilities. As on the 30th November, 1996 the Authorised Capital and the paid-up (equity) Capital of the Corporation stood at Rs.2000 crores and Rs. 1030.45 crores respectively. The PFC is placed under "B" schedule.

The funds provided by the Corporation are in the nature of additionality to Plan Allocation (in respect of SEBs, etc.) and based on the merits of the individual projects.

The following major areas have been identified by the Corporation for providing financial assistance on priority basis :

### 1. PROJECT FINANCES :

- (i) a. Capacitors
- b. LT less systems
- (ii) Urban Distribution
- (iii) a. R&M of Transmission
- b. Transmission
- (iv) R & M of Generation Projects
- (v) Generation Projects
  - a. 3 - 15 MW
  - b. Upto 100 MW
  - c. Bridge loans for Hydro Projects
  - d. Bidge loans for Thermal Power Stations
  - c. Feasibility Survey Studies

## II. INSTITUTIONAL DEVELOPMENT

aimed at :

- (i) Effective Financial Management
- (ii) Enhancing Productivity
- (iii) Upgradation of skill & training of HR
- (iv) Assisting in Restructuring process of the borrowing entities.

### 10.5.1 PERFORMANCE HIGHLIGHTS

The operations of the Corporation, as on 30th November, 1996 included new Loan Sanctions during the year 1996-97 of the order of Rs. 1752.06 crores, for a wide variety of Power Projects in the various parts of the country, and progressive disbursements of loan instalments.

The Corporation has declared a dividend of Rs. 40 crores for the year 1995-96 to the Government of India which owns all its equity.

### 10.5.2 RESOURCE MOBILISATION

In order to meet its increasing fund requirements, PFC stepped-up its efforts to tap External Commercial Borrowings (ECB) Market during 1996-97. It has planned to raise about US \$ 150 Million in 1996-97 under ECB. Out of this, PFC went into ECB Market for a syndicated loan of US \$ 50 Million. This maiden issue of PFC received overwhelming response and PFC got a price of 0.50% over LIBOR, which is considered to be the most competitive price. PFC has been able to raise US \$ 65 Million against the original target of US \$ 50 Million. In view of this encouraging response received from international market, PFC is planning to approach the syndicated market again.

In addition to the above, PFC has finalised a line of credit with IKB Deutsche Industry Bank of Germany under which various imports by power sector utilities in India can be financed by PFC. PFC has also submitted proposals for another line of credit from World Bank and Asian Development Bank for US \$ 500 Million each.

### 10.5.3 LENDING RATES

The lending rates of the PFC are currently the most competitive. The Corporation has a differential



lending rate structure favouring the critical areas of investment requirements with a view to ensure that the projects do not get exposed to cost escalation for want of prompt and timely infusion of funds.

#### **10.5.4 EMCAT PROJECT**

A Project for Energy Management Consultation and Training (EMCAT) is under implementation by PFC with the assistance from USAID. An allocation of US \$ 16 Million has been made to the Corporation. Under the project, the Corporation has so far organised 54 short-term and long-term training programmes for personnel of State Power Utilities and PFC within the country as well as in the USA, besides holding 22 seminars and workshops on critical issues pertaining to power sector at regular intervals. EMCAT has been recently reoriented to focus assistance under the project on a selected few reform minded SEBs.

#### **10.5.5 INSTITUTIONAL DEVELOPMENT OF BORROWERS**

Consistent with its role as a Development Financial Institution, PFC continued its endeavours to improve the operational and financial health of the borrowing entities through formulation and implementation of Operational and Financial Action Plans (OFAPs) for them. Such action plans, accepted by respective State Governments, PFC and the concerned state utility, are in place for 13 SEBs and 6 SGCs and 1 Municipality-run utility. Efforts are on for formulation of OFAPs of the remaining utilities, including Power Departments of States which do not have SEBs. Having identified that efficiency improvement and institutional strengthening as the key areas which need to be given impetus in the State Power Utilities, PFC has been monitoring regularly progress made by utilities towards effective implementation of OFAPs by way of periodical visits to utilities for detailed review and through quarterly progress reports obtained from utilities. PFC remains in constant dialogue with these utilities and the State Government concerned for resolving areas of concern having a bearing on utility's performance.

#### **10.5.6 LENDING TO PRIVATE POWER UTILITIES**

PFC had, in line with its recent decision to extend financial assistance to private power projects, sanctioned an amount of Rs. 47.50 crores to

Bombay Suburban Electricity Supply Company (BSES). This is the maiden loan sanctioned by PFC to a private sector entity. The loan would be invested by BSES for improvement in Transmission and Distribution network in the critical areas covering 32-22 KV system and associated distribution works in Mumbai city.

#### **10.5.6.1 LEASE FINANCING**

Under the recently introduced "Lease Finance" scheme, PFC has sanctioned an amount of Rs. 5.47 crores to Maharashtra State Electricity Board (MSEB) for the purpose of the acquisition of 56.40 MVAR series and 30 MVAR shunt capacitor banks alongwith their respective switching equipments and associated accessories. MSEB is the second beneficiary of this scheme, first one being the Kothagundem Thermal Power Station owned by Andhra Pradesh State Electricity Board.

Under this scheme, all entities in state, central, private, municipal and joint sectors engaged in power generation, transmission and distribution, energy conservation, renovation and modernisation etc. are entitled to seek financial assistance. Any equipment/machinery essential for power projects and associated works can be covered under the scheme. Lease rentals are competitive and will depend upon the type of borrower/project, nature of equipment, period of lease, periodicity of payment of rentals and other relevant factors. The rental programme will be related to the cash flow needs of the clients. PFC may also arrange participative/syndicated lease.

#### **10.5.7 EXPANSION IN THE FINANCIAL FACILITIES**

##### **10.5.7.1 BILL REDISCOUNTING SCHEME**

In addition to the schemes such as Bill Discounting and Lease Finance, PFC has also recently launched a scheme of "Bill Rediscounting" for entities in power sector. This scheme offers the facility of acquiring machinery/equipment on deferred payment terms. The facility for sale of machinery under this scheme is available to all manufacturers in power sector. Under the scheme, the annual limit for a power utility will be fixed based on its requirement of funds and also budget availability of PFC.

**10.5.7.2 GUARANTEE SERVICES**

As the fund requirements for the power sector are enormous and many funding agencies insist on guarantee by an Indian FI, PFC has started providing guarantee services subject to its satisfaction about the borrowers based on the same parameters as applicable to term-loans.

**10.5.7.3 LOAN SYNDICATION**

For effective arrangement of funds and appraisal, PFC has started considering loan syndication with other leading Financial Institutions such as IFCI, ICICI, etc.

**10.5.7.4 CONSORTIUM ARRANGEMENTS WITH FIs**

PFC would actively promote consortium based financing, especially for large power project, in collaboration with other Financial Institutions.

**10.5.7.5 EXCHANGE RISK MANAGEMENT**

The Corporation manages the exchange risk fluctuations through a separate Exchange Risk Administration Fund operated as a Trust distinct from the operations of PFC and has obtained the required notification under the Income Tax laws to insulate the income of the fund from tax. Through this mechanism, the Corporation takes care of the exchange rate variations for the reduced burden of financial outgo.

**10.5.8 MAJOR POLICY INITIATIVES TAKEN BY PFC DURING THE LAST ONE YEAR****10.5.8.1 CONSTITUTION OF HIGH LEVEL COMMITTEE :**

The Corporation had, during the year, constituted two high level Advisory Committees, with experts from financial services and power industry, to advise and guide on future thrust areas and diversification plans. The Committees viz. Power Sector Operations and Financial Operations headed by Sri V.G. Rajadhyaksha and Shri M. Narasimham respectively, would recommend new areas of business and financial instruments, keeping in mind emerging trends in the power sector, and finalise modus operandi for loan syndication with other financial institutions in view of large fund requirements in power sector.

**10.5.8.2 REVISION OF OPS**

Power Finance Corporation has initiated the process of revising its Operational Policy Statement (OPS) to include priority areas of funding for associated sectors and expand the types of instruments for financial assistance as well. The revised OPS guidelines will specify criteria for assessing the financial health of the borrowers and provide for wider options in regard to repayment guarantee by the borrowers including charge on assets/ hypothecation. The proposed changes include increase in financing for various categories of projects, waiver of the condition of achieving the stipulated minimum ROR by State Utilities in the case of environmental schemes, R & M schemes, installation of capacitors, technical assistance projects and pre-investment fund.

**10.5.8.3 STRENGTHENING CUSTOMER FOCUS**

To reinforce the Corporation-Client relationship, the Corporation has restructured its Projects Division into four Regional Groups, each having State co-ordinators, to interact closely with the borrowing entities and also to identify and appraise potential investment areas.

**10.5.8.4 EXTENDING HELP IN REFORM PROCESS**

PFC has been having a dialogue with different State Governments and the SEBs and assisting them in initiating the reform process apart from providing financial assistance for reform-related studies. In order to promote reform and to bring about improvement in the performance of SEBs, the Board of Directors in their recent meeting, have decided to accept release of subsidy by adjustment against State Government loans as a last alternative, for clearance of arrears of subsidy for the years upto 1995-96 provided the State Governments undertake to substantially revise tariff and pay subsidy cash, where necessary, for achieving 3% ROR for the year 1996-97 onwards and commit to reforms and restructuring.

**10.5.8.5 RELAXATION IN CONDITIONALITIES**

The Corporation had relaxed the pre-condition of achieving the stipulated minimum Rate of Return (ROR) in the case of environmental schemes, R&M

schemes, installation of capacitors and meters for financial assistance under PFC's Technical Assistance Project and Pre Investment Fund (PIF). Rebate on penal interest is announced to encourage prompt payment of dues by SEBs. As a major step to cut down delays in disbursements, PFC has started making payment direct to suppliers for bills of over Rs. 10 lakhs.

### 10.5.9 FUTURE PERSPECTIVE

**10.5.9.1** By the year 2006-2007 A.D., PFC plans to enhance its lending portfolio from present level of 5% to 20% of the total investment in the power sector. PFC would also endeavour to facilitate structural reforms in the State Power Sector to make it commercially viable and efficient.

**10.5.9.2** As against a disbursement of Rs. 1500 crores expected in the terminal year of the 8th Plan, PFC envisages to reach a disbursement level of Rs. 5000-6000 crores annually by the end of 9th Plan, and Rs. 10,000 – 12,000 crores annually by the end of 10th Plan.

**10.5.9.3** Besides providing term finance to its borrowers, PFC has added lease finance, bill discounting, bill rediscounting, guarantee services, and consortium/syndicate financing to its portfolio. The range of financial services would be progressively broadened in future to include fund-based services such as suppliers' credit, bridge finance, venture capital, equity participation, etc. and non-fund based services such as project consultancy, credit rating and financing advisory services.



*View of 110 KV sub-stationss at Gummidi-Poondi, a TNEB Project (Financed by P.F.C.)*

## 10.6 POWER GRID CORPORATION OF INDIA LIMITED

Presently, Power Grid Corporation of India Limited (POWERGRID) the only High Voltage transmission organization in the country, was incorporated as a Government of India enterprise on October 23, 1989 under the Companies Act, 1956 as a limited company with an authorised capital of Rs. 5,000 crores. The mandate of the Corporation, in terms of corporate mission, is establishment and operation of Regional and National Power Grids to facilitate transfer of power within and across the Regions with reliability, security and economy, on sound commercial principles. In line with the mission, POWERGRID has set following objectives :

- Efficient operation and maintenance of transmission systems
- Strengthen Regional Power Grids and establish Inter Regional links leading to formation of National Power Grid
- Establish/augment Regional load despatch centres and communication facilities
- Introduce rational tariff structure for exchange of power
- Establish Power Pools to facilitate exchange of power between States/Regions leading to formation of National Power Grid
- Achieve constructive cooperation and build professional relations with stake-holders, peers and other related organisations.

As per the Government of India decision, the transmission systems and its associated manpower from Central Power Sector Organisation like NTPC, NHPC, NEEPCO, etc. were transferred to POWERGRID. Subsequently, Load Despatch & Communication assets and manpower were also transferred from CEA. Since the outset of POWERGRID's business operation it has excelled in all the spheres of performance. With distinguished achievements in terms of construction, financial and commercial management for previous years, POWERGRID is poised for the same this year.

### 10.6.1 SIGNIFICANT ACHIEVEMENTS

#### 10.6.1.1 OPERATIONAL

As on November, 1996, POWERGRID operates a total of 27,421 CKms., transmission lines consisting of 19,902 CKms of 400 KV; 4,946 CKms of 220 KV; 943 CKms of 132 KV and 1,630 CKms of HVDC system distributed over 53 sub-stations with 23,378 MVA of transformation capacity. The operational performance of POWERGRID transmission system has been impressive in all the five power regions. Overall average availability of transmission lines during the period of April to November, 1996 was maintained well above the MoU target of 97.5%, which is comparable with international standards. POWERGRID has completed 687 CKms transmission lines out of which 177 CKms are commissioned (details as Annexure-I) alongwith 630 MVA of transformation capacity till the end of November, 1996. The state-of-the-art Hotline maintenance technique adopted by POWERGRID has facilitated in high availability of transmission system.

#### 10.6.1.2 CONSTRUCTION

Like the previous years, construction performance has also been commendable. For the period from April to November, 1996 POWERGRID has constructed 1,354 CKms of transmission lines matching the MoU target of 1,354 CKms. Other performance pertaining to construction are given below :

#### CONSTRUCTION PROGRAMME

Sl. No.	Activity	Target till Nov.	Achievement till date
1.	Stringing (CKM)	1,354	1,354
2.	No. of Transformer	1	2
3.	Trans. Capacity (MVA)	315	630

#### STEPS TAKEN TO REDUCE OUTSTANDING DUES

With POWERGRID launching major drive for timely recovery of monthly bills, it has been possible to stall the accumulation of arrears. The vigorous follow up at various level and constant efforts by Regional



Offices and Corporate Centre, have yielded favourable results. This is clearly reflected in the trend of monthly collections which have gradually improved and sustained at 100% from December, 1994 onwards for undisputed billings. The marked improvement in realisation has also been acknowledged by various agencies and commended by International Financial Institutions like World Bank, ADB, etc.

In order to contain the building up of arrears, certain concrete actions including issue of notices and regulation of power supply to major defaulters were taken. These measures have been fruitful in establishment of LCs by the beneficiaries as well as liquidation of arrears. A strategy to keep constant check on the defaulting States has been evolved to ensure maximum realization on a sustained basis. Continuous efforts are being made to get the full LC coverage for monthly billing amount.

#### **10.6.1.3 BUSINESS DEVELOPMENT**

POWERGRID has made great strides in the consultancy area. Today POWERGRID is executing total turnkey consultancy contract of worth about Rs. 24 crores of West Bengal Power Development Corporation (WBPDCL) for design, engineering, procurement & supervision of the transmission system for evacuation of power from Bakreshwar Thermal Power Project, which is being funded by OECF, Japan. POWERGRID has also been engaged as sub-consultant by Merz & Maclellan, UK for Power Sector Reform project being undertaken by Government of Orissa with assistance of ODA, UK.

Further, POWERGRID has bagged consultancy projects from Delhi Electric Supply Undertaking (DESU), Karnataka Electricity Board (KEB) and Andhra Pradesh State Electricity Board (APSEB) for various projects of turnkey execution of substation Design & Engineering of EHV substations and Quality Assurance & Inspection services of 400/220/132 KV sub-station & equipments. Negotiations are on with KEB for a contract for operation & maintenance of 400 KV transmission line and with DESU for total turnkey consultancy contract for SCADA systems. Few more projects from various utilities are also under various stages of negotiations.

### **10.6.2 POWERGRID PROJECTS**

The projects undertaken by POWERGRID are broadly classified as Generation Linked Projects Power Evacuation and Grid Strengthening Projects, Inter-regional links and Unified Load Despatch & Communication Schemes, etc. Further, in view of the entry of the various large Independent Power Producers in the Power Sector, POWERGRID is also contemplating possible investments towards implementation of transmission projects related to IPP projects. The details of the specific projects being undertaken by POWERGRID under various categories, are as follows :

#### **10.6.2.1 EXISTING PROJECTS**

Presently POWERGRID operates about 27,421 CKms of EHV transmission lines consisting of 400 KV, 220 KV, 132 KV and HVDC system, alongwith over 53 sub-stations having a total transformation capacity of 23,378 MVA. This EHV transmission network is spread across the entire length and breadth of the country, and today, POWERGRID possess one of the largest EHV power transmission systems in the world.

#### **10.6.2.2 ON-GOING PROJECTS**

At present, 12,333 CKms of transmission lines are under construction by POWERGRID, consisting of 569 CKms of 800 KV; 8,966 CKms of 400 KV; 1,624 CKms of 220 KV; and 1,174 CKms of 132 KV lines, to be distributed over 25 sub-stations. Some of the important generation linked transmission projects, under implementation by POWERGRID include, Nathpa-Jhakri (400 KV), Kathalguri (400 KV), Vindhyachal Stage-II (400 KV), Kayamkulam (220 KV), RAPP-B (220 KV), Unchahar (220 KV) and Ganga Valley (Tehri) (800 KV), etc. The Grid Strengthening schemes include Kishenpur-Moga (800 KV), Vindhyachal additional (400 KV) and NER Augmentation (132 KV) transmission systems.

The inter-regional links will facilitate to integrate the regional grid systems into the national grid, establish inter-regional flow of surplus power, avoid frequent grid collapses and lead to the achievement of a nationwide optimal hydro-thermal mix. Keeping in view the importance of these inter-regional links in the development of the National Power Grid, POWERGRID has drawn up a programme for inter-connecting the various power regions of the country

through these links. Presently POWERGRID has an existing HVDC back-to-back link at Vindhyachal (2 x 250 MW), which connects the Northern and the Western grid systems. The other HVDC inter-regional link projects, under execution, (i) Chandrapur HVDC back-to-back project (2 x 500 MW), connecting Western and Southern Regions, (ii) Vizag HVDC back-to-back project (1 x 500 MW), connecting Eastern and Southern Regions.

Load Despatch and Communication facilities is one of the basic pre-requisites for economic despatch of power between Regions/States leading to effective and efficient on-line management of Regional and National Power Grids. POWERGRID has undertaken implementation of state-of-the-art Unified Load Despatch and Communication (LD & C) facilities in all the Power Regions of the country. At present the implementation of LD & C facilities is in progress in Southern & Northern Regions.

#### **10.6.2.3 FUTURE PROJECTS**

Keeping in pace with the development of Indian economy vis-a-vis the ever increasing demand of power, POWERGRID has drawn up its investment plans to enhance Regional and National Power Grids.

In the endeavour, some of the crucial generation linked transmission projects proposed to be undertaken by POWERGRID, which are presently at various stages of approval, include the transmission system associated with Talcher-II (400 KV), Dhauliganga (400 KV), Kawas-II (400 KV), etc.

The inter-regional HVDC back-to-back projects, likely to be undertaken by POWERGRID in the near future, include the Biharshariff-Rihand HVDC back-to-back (1 x 500 MW) inter-regional link between Northern and Eastern Regions and a synchronous inter-regional link between Eastern and Western Regions.

The North-Eastern Regional Load Despatch and Communication (NE-RLDC) project is at an advance stage of investment approval. In addition, POWERGRID also plans to undertake the

implementation of the Western (W-RLDC), Eastern (E-RLDC) and National Load Despatch & Communication (National-LDC) schemes, in the near future.

POWERGRID has drawn out ambitious investment plans in the coming plan periods. The estimated 9th Five Year Plan investment scenario works out to about Rs. 11,000 crores. Further, with the investment requirements in developing the associated power system of the forthcoming IPP power stations, POWERGRID is also contemplating additional investment to the tune of about Rs. 12,000 crores during the 9th Five Year Plan.

### **10.6.3 PROJECTS OF OTHER UTILITIES**

In addition to the above POWERGRID has also developed a few transmission system projects which include, CEPA Project (6 x 660 MW), Kayamkulam Project, Cogentrix project (1000 MW) and Nagarjuna Fertilizer TPP 500 MW at Mangalore, Inter-regional transmission system between Eastern and Northern Regions.

#### **10.6.3.1 STATE-OF-THE-ART TECHNOLOGIES**

POWERGRID is contemplating to induct the state-of-the-art technology in power transmission which includes series compensation and static var compensation on existing lines to increase the power transfer capabilities, phase shifting transformers to adjust flow of power in parallel circuits to improve the transient & dynamic performance of the system, flexible A.C. transmission systems, upgrading and uprating the existing transmission system, etc.

POWERGRID is going ahead with change in scenario for adopting latest tools & techniques in all the field of power transmission such as, use of OPGW for data transmission and communication, application of numerical relays for protection of lines and transformers, AAAC conductors, emergency restoration system and composite insulators.

In the mid stream of Godavari pile foundation of

400 KV Vijaywada-Gazuwaka transmission line got damaged. POWERGRID for the first time, accomplished this under-water rectification work successfully in July 1996 avoiding major breakdown of the line.

## **10.6.4 STRATEGIC STUDIES**

With a view to effectively utilise the accrued benefit on implementation of the ambitious projects, POWERGRID is also actively involved in its various long-term strategic studies, so as to ensure that the management-structure-systems are in place to cater to the changing needs while implementing the various crucial projects of POWERGRID. This would call for establishment of the most optimal corporate structure, compatible systems & process, rationalised commercial principles, refined role for POWERGRID, alongwith formulation of a long-term POWERGRID's organisational development plan, including adoption of appropriate technology and development of system planning softwares. To accomplish this, POWERGRID has undertaken Strategic Studies, funded and supported by the World Bank, ADB, etc. in the area of "Rationalisation of Power Tariff & Regulatory Framework", "Institutional Development Study of POWERGRID" keeping the Indian Power Sector in the background, and "System Study for Long Term Transmission System Planning". Some of the recommendations of the already-completed studies are at various stages of implementation.

## **10.6.5 SOURCES OF FUNDS**

### **10.6.5.1 INTERNATIONAL SOURCES**

The International Financial Institutions have actively supported POWERGRID since its very inception. Financial Institutions, viz., the World Bank, Overseas Economic Cooperation Fund (OECF) of Japan, European Investment Bank (EIB), the Asian Development Bank (ADB) and others have already committed around Rs. 5,766 crores, which includes the loans transferred from the transferer organizations, and have further earmarked about Rs. 6,000 crores for financing new projects of POWERGRID.

The World Bank loan commitment today amounts to about US \$ 1.5 billion for financing various

projects of POWERGRID. This includes the World Bank direct loan to POWERGRID for an amount of US \$ 350 million for POWERGRID System Development Project (PSDP) and the World Bank loans transferred from the transferer generating organisations to POWERGRID. The major loan which stands transferred to POWERGRID, and are being drawn, include loan for Northern Region Transmission Project (NRTP) amounting to US \$ 475 million.

Further, the World Bank has agreed "in principle" to extend the 2nd loan to POWERGRID on a time slice concept, amounting to around US \$ 1.20 billion, in three tranches of US \$ 300 - 400 million each, against a basket of projects, spread in a time slice of 5 - 7 years. The various projects proposed to be covered under the funding of the 2nd loan of the World Bank include, RLDC Schemes of Eastern & Western Regions; Inter-Regional Links, namely, East-West & East-North Inter-Connectors; System Improvement Programmes in the Western and the Southern Regions and associated transmission systems of the Ramagundam-III, Rihand-II and other associated transmission systems of the Private Generation Projects, namely, the CEPA (6 x 660 MW) project in the Eastern Region, etc.

The loan negotiation with Asian Development Bank (ADB), has successfully been completed with the signing of the agreement on July, 1996 for an amount of US \$ 275 million. This is the first sectoral loan sanctioned by ADB to POWERGRID as also in the Indian Power Sector. The highlights of the loan is that the basket of the projects to be funded by ADB, occupy high priority by POWERGRID and Government of India towards transmission development plan of the country. The major components include augmentation of transmission system in North-Eastern Region (NER), transmission system associated with Agartala, Kopili Stage-I extension, NER Load Despatch & Communication Scheme, Jeypore-Gazuwaka, Vindhayachal Stage-II and Unchahar Stage-II. Presently, all the necessary actions have been initiated by Government of India towards loan effectiveness to facilitate draws from this loan towards the various packages already awarded (amounting to US \$ 74 million).



The Overseas Economic Co-operation Fund (OECF), Japan has already provided a loan amounting to Y 32.754 billion towards the implementation of transmission system associated with the Gas Power Projects of Gandhar (Y 7.115 billion), Kathalguri (Y 22.101 billion) and Faridabad (Y 3.538 billion). The Gandhar transmission system has since been completed.

European Investment Bank (EIB) has also extended the first ever sectoral loan to POWERGRID as well as in Aisa. It is co-financing the Southern Region Load Despatch & Communication (SRLDC) Project to the extent of 55 billion European Currency Unit (ECU) amounting to Rs. 198 crore.

Other Financial Institutions and Banks, such as, the Overseas Development Administration, UK, the West Merchant Bank (WMB), UK, the Banque Indosuez, Paris and Credit Nationale, Paris have extended loans and grant commitments of the order of £112.5 million and Fr 396 million.

Industrial Bank of Japan (IBJ) & Export-Import Bank of Japan (J-Exim) both have already financed POWERGRID projects and have shown keen interest in financing new projects worth about US \$ 400-500 million.

#### **10.6.5.2 DOMESTIC BORROWINGS**

During the current financial year, Rs. 207 crores of Power Grid Bonds were raised by POWERGRID.

### **10.6.6 RESEARCH AND DEVELOPMENT**

POWERGRID in association with Central Power Research Institute (CPRI), has concluded the first phase of the study for measurement of AC/DC field in EHV transmission lines and sub-stations. The second phase, involving biological effects of EHV transmission system is commencing this year.

POWERGRID has also taken up in association with CPRI, field testing on 400 KV transmission system to evaluate the need or otherwise for pre-insertion resistors, which is likely to be completed before March, 1997.

Further, POWERGRID has also entered into MoU with IIT, Kharagpur and has taken up the work pertaining to development of Real Time Digital

Simulator for Northern Region. It is for the first time that such indigenous development of this nature has been taken up by any Utility in the power sector in the country. Software for load flow, state estimation have been developed. Software for graphic user interface and dynamic stability are under development. Similarly, MoU with IIT, Delhi for taking R&D projects has also been signed. It has shown keen interest in developing artificial neural-networks for load flow study to be used as part of the system operation.

## **10.6.7 FUTURE PERSPECTIVE**

### **10.6.7.1 POWER POOLING**

POWERGRID plans to promote creation of Regional Pools of public and private utilities in all the power regions of the country, on a voluntary co-operation basis. The concept of power pooling, as applicable in the country, would imply that each SEB and distribution company would be responsible for supplying the power in its own area. This could be achieved either by using its own generation, or power purchased from other generating utilities, in accordance with the agreements made among the parties. The principles and procedures governing relationships between users of transmission system and the system operator to facilitate trading by providing common rules in states and regions as also to facilitate planning, development and maintenance of an integrated regional network, will be enforced as a condition of framework contract for transmission services by way of a well documented Grid Code. In a power system where the generation facilities are owned and operated by a mix of Central agencies, SEBs and private agencies, POWERGRID intends to operate loose regional power pools as a facilitator/clearing house for the power trading between various entities.

As an operator of power pools, POWERGRID will provide information on available capacity and energy to members for their needs and price range; a forum for coordinating generation maintenance schedules; monitor tie-line flows for ensuring system reliability and informing the parties accordingly; deviations from agreed transactions; information for raising bills and settlement, etc. This system will ensure most economic generation of power based on commercial principles.



POWERGRID will play a vital role in settlement system viz., accounting for trading. It will provide information on metered power and energy flows, prices, transmission pricing aspects of contractual agreements and the trading rules. It will compute applicable charges in accordance with the contractual and trading arrangements for each generator to their customers. POWERGRID will help in reducing the overall cost of supply by helping SEBs trade power in accordance with merit order despatch, without actually participating in the transactions for its own account.

#### **10.6.7.2 JOINT VENTURE (JV)**

After the policy decision taken by the Government of India to permit private sector participation in power sector, a large number of private entrepreneurs have evinced interest in investing in the Indian Power Sector. A large number of proposals have been received by the Government of India for setting up of generating stations with an aggregate capacity of about 93,000 MW involving an investment of more than Rs. 300000 crores. Looking into such large addition and investment in generation side, huge amounts would be needed to be invested in transmission & distribution sector too. To pave the way for private sector participation in transmission, POWERGRID has signed an MoU with NGC, UK. Its proposals for formation of joint venture and amendment in the existing provisions for Electricity Supply Act are under active consideration of Government of India and a policy framework towards this end is expected to be in place soon.

#### **10.6.7.3 CEPA POWER PROJECT**

The Memorandum of Understanding (MoU) between Consolidated Electric Power Asia (CEPA) and POWERGRID which was valid up to September 22, 1996 is being extended for a further period of one year. CEPA plans to implement their 1st phase comprising of 6 x 660 MW units at Hirma Village in the state of Orissa, for which "in-principle" clearance of CEA has been obtained. The power from the phase-I Project of CEPA is proposed to be shared by the States in Northern & Western Regions, namely Rajasthan (1200 MW), Punjab (960 MW) and Haryana (500 MW) in Northern Region and

Gujarat (700 MW) & Madhya Pradesh (600 MW) in Western Region. For evacuation of power generated from CEPA project, POWERGRID will be augmenting/implementing the associated transmission system.

The associated transmission system of CEPA power project will be to the tune of 5,000 CKms of mostly 400 KV transmission system and 1,200 KMs of HVDC bipole of 3,000 MW capacity with 3 dedicated sub-stations. The estimated cost of transmission system is more than Rs. 5,000 crores.

For funding of the above the detailed proposal has been submitted to World Bank in July, 1996. However, keeping in view the Bank's conditionality regarding restructuring/reforms of beneficiary SEBs, a route through formation of joint venture is also being explored for which discussions are in progress with M/s National Grid Company, U.K.

To help the beneficiary SEBs for negotiation of CEPA's Generation Tariff M/s ICICI, Mumbai has been commissioned as Consultant. Further, for negotiation and finalisation of PPAs, transmission and other related agreements including evolution of implementation strategy of associated transmission system, the International Consultants are being engaged.

#### **10.6.7.4 MEGA POWER PROJECTS**

For development of mega power projects having capacity 1000 MW or more and envisaging more than one State as beneficiary, in private sector, Government of India has framed guidelines to such power projects. According to the guidelines, CEA is to identify the potential project location and M/s NTPC is to prepare the Feasibility Report and obtain initial clearance required for the project. POWERGRID has been entrusted with the task to undertake the pre-qualification and selection of IPPs on Competitive Bidding basis and to provide escort and facilitator services to IPPs.

The first mega power project (2,000 MW) has been identified at Nabinagar, Bihar alongwith development of associated Coal Mines at North Karanpura. The Request for Qualification (RFQ) document for pre-qualification of the IPPs has been finalised. The press notification for the same has

been issued in August, 1996. Keeping in view the multiplicity and intricacy involved in bidding process for such mega project, the services of International Technical, Financial & Legal Consultants are considered necessary for which POWERGRID has already initiated action.

#### **10.6.8 EXTENDING THE NATIONAL POWER GRID TO NEIGHBOURING NATIONS**

POWERGRID's long-term perspective plan looks forward to dovetailing its grid into the power grids of neighbouring nations. Some of India's neighbouring countries has vast hydro-potential, but do not have adequate demand or finance to harness them. POWERGRID plans to tap these sources and import power to India. In this endeavour, POWERGRID is already exchanging power with Bhutan from its Chukha hydro-electric project and

has also started a dialogue for interconnection and power sharing arrangements with other neighbouring countries, to take advantages of diversity of resources and load pattern for mutual benefit of each other.

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#### **Lines completed/commissioned during April to November, 1996.**

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1. Hissar-Jaipur	400 KV D/C	278 CKM
2. Bawana-Bhiwani	400 KV D/C	198 CKM
3. Gandhar-Gandhar	400 KV S/C	18 CKM
4. Dimarpur-Imphal	132 KV S/C	177 CKM
5. Agartala-Agartala	132 KV D/C	16 CKM
Total		687 CKM

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*Typical view of a transmission tower-POWERGRID*

## 10.7 TEHRI HYDRO DEVELOPMENT CORPORATION (THDC)

The Tehri Hydro Development Corporation (THDC) was incorporated on 12th July, 1988, as a joint venture of the Government of India and Government of Uttar Pradesh, to execute the Tehri Hydro Power Complex in Garhwal District of U.P. and also to plan, promote and organise the development and harnessing of such other hydro-electric sites/projects in Bhagirathi, Bhilangna valley as may be entrusted to the Corporation by the Government. The Corporation has an authorised share capital of Rs. 1200 crores.

The Corporation is responsible for the Tehri Project since June, 1989 after the works were transferred to it by the Government of Uttar Pradesh. The Tehri Complex is located on river Bhagirathi, envisaging construction of two dams, one downstream of Tehri Town and other at Koteshwar, 22 Kms. downstream of main dam.

### 10.7.1 PROJECT CLEARANCE

Government of India has on 15.03.1994 approved implementation of Stage-I of the project at present, i.e., Tehri Dam & HPP (1000 MW), alongwith minimum essential works of P.S.P. & ongoing commitments of Koteshwar Dam & HPP and the Associated Transmission System for evacuation of power at the following costs :

Components	(Rs. in Crores)
	Cost (March '93 price level)
1. Tehri Dam & HPP (Stage-I) (1000 MW)	2815.00
2. Committed works of Koteshwar Dam & HPP (400 MW)	34.36
3. Essential works of Tehri PSP (1000 MW)	114.30
Total	2963.66
4. *Associated Transmission system	371.00
Grand Total	3334.66

\*To be executed by the Power Grid Corporation through its own resources.

### 10.7.2 TEHRI DAM & HPP STAGE-I

Tehri Dam & HPP, Stage-I, comprises of the following major components:

- \* 260.5 M high earth and rockfill dam at Tehri.
- \* 4 nos. diversion tunnels 11M dia each.

Total length : 6.3 Km.

- \* 1000 MW underground Power House having four conventional turbine generator sets of 250 MW each.
- \* Water conductor system for power house comprising 2 nos. of 8.5 M dia each head race tunnels, 4 nos. pressure shafts, 2 nos. tail race tunnels etc.
- \* A concrete chute spillway, with 3 bays of 10 M span each, 4 nos. shafts spillway-two ungated on the right bank and two gated on the left bank.
- \* An intermediate outlet for controlled filling of the reservoir and for irrigation releases when the power house is shut down.

### 10.7.3 BENEFITS

Tehri Dam & HPP Stage-I is a Multipurpose project catering to the needs of power generation, irrigation and drinking water. The main benefits from the Stage-I when completed would be :

- Addition to the installed capacity in Northern Region by 1000 MW (2400 MW on completion of entire complex).
- Annual energy availability (peaking): 3568 Million Units (6500 MUs on completion of entire complex).
- Additional irrigation in 2.7 lakh hectares area besides stabilisation in existing 6.04 lakh hectares area.
- 162.0 Million gallons of water per day (300 Cusecs) for drinking water supply to Delhi.
- 108.0 Million gallons of water per day (200 Cusecs) for drinking water supply by the towns and villages of Uttar Pradesh.
- Integrated development of Garhwal Region, including construction of a new hill station with provision of all possible facilities, improved communication, education, health, tourist traffic, setting-up of non-polluting industries, development of horticulture, fisheries, afforestation of the region, etc. much to the advantage of the people of that region.

### 10.7.4 STATUS OF PROJECT WORKS

The present status of the project is :

- Various infrastructural works have been completed at the project site;



- All the four diversion tunnels have been completed and the river diverted through the two Right Bank Tunnels;
- The foundation of the main dam over the entire length of 1.1 Km has been laid and main dam has been raised upto EL 615 M. Coffor Dam has been raised upto EL 661 M;
- Excavation of four numbers (two each for HPP Stage-I & PSP) Head Race Tunnels of 8.5 mt. diameter each, with a total length of 5190 mt have been completed and lining work is complete in Stage-I tunnels while it is partly done in tunnels for PSP;
- Approach adits to underground power station cavern also completed;
- The work related to Power House is in progress in all three packages consisting of Intake structure and HRT's, Main Power House and Tail Race Tunnels. The excavation work at main caverns of Transformer Hall and Power House is also in progress;
- Tenders for the major civil works of Main Dam & Spillways are under finalisation. Meanwhile, major excavation works in spillway area is in progress to utilise the working season till the major contractors mobilise at site;
- For procurement of Electro-Mechanical equipment, the detailed terms and conditions of contract and financing proposals have since been finalised with the consortium of manufacturers from Russia/Ukraine, and ABB-Germany and are awaiting Government approval;
- ICB for balance equipment, viz., Transformers, Busducts, Switchgear has been issued and pre-qualification bids received;
- First Stage rural rehabilitation of the rural area coming under submergence due to construction of coffer dam has been completed. Works for establishment of New Tehri Town (NTT) which is already partly inhabited, are in advance stage of construction;
- All the studies required by MOEF relating to environment protection have

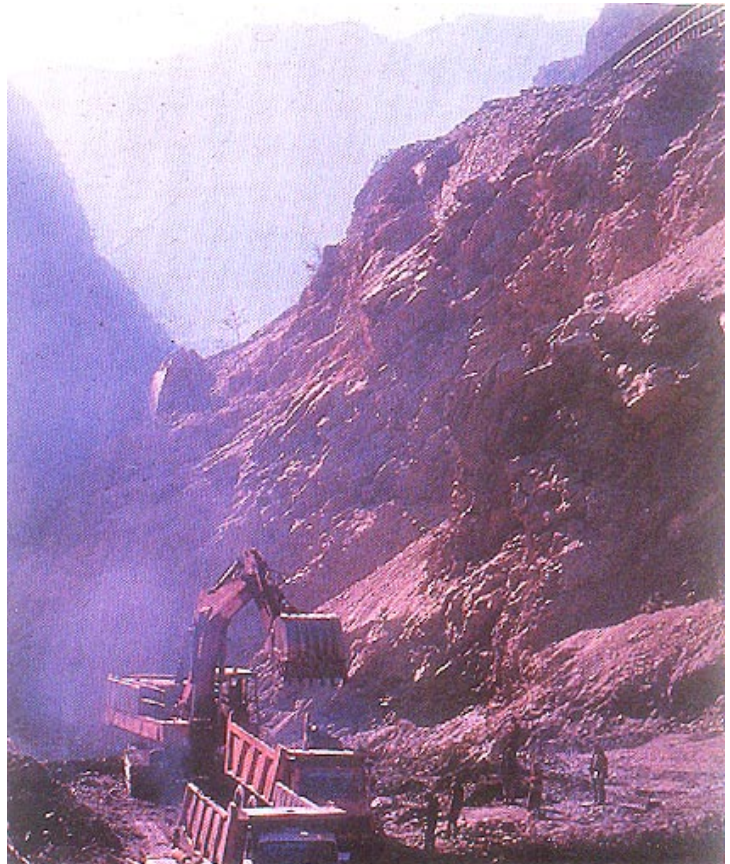
been completed and submitted to MOEF. These indicate that no environmental damage would be caused by the construction of the project;

- A revised package of rehabilitation measures, evolved in association with the State Administration and after consulting a cross-section of the local population, keeping in view the genuine problems of the oustees has been implemented and has been welcomed by project affected population;

- The Catchment Area Treatment in about 29,351 Ha. and compensatory afforestation in about 4335 Ha. have been completed against the planned total of 36,000 Ha. and 45050 Ha. respectively.

#### **10.7.5 COMMISSIONING SCHEDULE**

The Stage-I of the project (1000 MW) is envisaged to be commissioned by 2001-2002 AD.



*Work in progress at Tehri Dam site*



## **10.8 NATHPA JHAKRI POWER CORPORATION LIMITED**

### **10.8.1 INTRODUCTION**

The Nathpa Jhakri Power Corporation Limited (NJPC) was incorporated in May, 1988 as a joint venture of the Government of India and the Government of Himachal Pradesh to plan, promote, organise and execute Hydro-electric Power Projects in the Satluj river basin in the Himachal Pradesh. The authorised share capital of NJPC is Rs. 1000 crores with debt equity ratio as 1:1. The authorised share capital of NJPC is being processed to be enhanced to Rs. 2000 crores.

NJPC is presently executing its first mega project namely Nathpa Jhakri Hydro-electric Project (NJHEP) with an installed capacity of 1500 MW in the Shimla and Kinnaur district, Himachal Pradesh. The World Bank has sanctioned a loan of US \$ 437 million for which the Government of India and the Government of Himachal Pradesh are to share cost of the Project in the ratio of 3:1 respectively. NJPC also planned to take up investigations of new Hydro-electric projects in the Satluj river basin in the Himachal Pradesh.

In the implementation of its first project, NJPC is supported by CWC and CEA as Principal Consultants, along with the consortium of Nippon Koei, Japan, Electrowatt, Switzerland and WAPCOS, India, as the Retainer Consultants. Besides these, NJPC is also backed by the services of a Panel of Experts, comprising both nationally/internationally renowned professionals and an Advisor (ENV/R&R).

### **10.8.2 NATHPA JHAKRI HYDRO-ELECTRIC PROJECT(6x250 MW)**

The Nathpa Jhakri Hydro-electric Project envisages the construction of:

- A 60.50 m high concrete Dam on Sutluj river at Nathpa to divert 405 cusecs water through four Intakes;
- An underground Desilting Complex, comprising four chambers, each 525 m long, 16.31 m wide and 27.5 m deep, which is one of the largest underground complexes in the world;

- A 10.15 diameter and 27.3 km long Head Race Tunnel (one of the longest hydro power tunnels in the world), terminating in a 21 m diameter and 301 m deep Surge Shaft;

- Three circular steel-lined Pressure Shafts, each of 4.9 m diameter and 633 m long, bifurcating near the Power House to feed six generating units;

- An underground Power House with a cavern size of 222m x 20m x 49m, having six Francis Units of 250 MW each to utilise a design discharge of 405 cusecs; and design head of 425m;

- A 10.15m dia and 982m long Tail Race Tunnel to discharge the water back into the river Satluj.

### **10.8.3 PROJECT BENEFITS**

Besides the social and economic upliftment of the persons in its vicinity, on commissioning, the 1500 MW NJHEP will generate 6700 million units of electrical energy in a 90% dependable year and 7447 MUs in an average year, besides providing 1500 MW of valuable peaking power to the Northern Grid.

### **10.8.4 PROJECT COMMISSIONING SCHEDULE**

The Commissioning schedule of all the units was envisaged to be an ambitious five year period i.e. end October, 1999.

Preliminary estimate now indicates the successful commissioning of the first unit of NJHEP by June, 2001.

### **10.8.5 PROJECT COST**

The approved cost of the NJHEP is Rs. 4337.95 crores at March, 1993 price level. This includes Rs. 648.69 crores as Interest During Construction.

The project is now estimated to cost Rs. 7151.86 crores at the time of commissioning, at March, 1996 price level.

### **10.8.6 PROJECT PROGRESS**

#### **10.8.6.1 INFRASTRUCTURE WORKS**

The excavation of all the HRT audits have been completed. Construction of the Residential Buildings as well as Non-Residential Buildings such as Commercial Complex, Administrative Office, Transit Camps, Auditorium, etc are also in progress.

### 10.8.6.2 MAIN CIVIL WORKS

The implementation of the civil works for the four major civil contracts are in progress with the three joint venture of the Indian and foreign construction companies.

#### 10.8.6.3 DAM COMPLEX

Presently, the excavation in the river channel is underway. On the left bank of river Satluj, 14 nos. 200 T, test rock anchors have been installed and their stressing shall be completed shortly. Drilling and consolidation grouting for additional 12 rock anchors has been completed. Upon initial completion of the upstream and downstream Cofferdams, the excavation in Dam foundation below EL 1462 M has commenced, and so far about, 48,600 cum. of the excavation has been completed.

The excavation of the Central Gullet of the Desilting Chambers no. 2 has been completed and the balance excavation in the Desilting Chambers is progressing.

#### 10.8.6.2.2 HEAD RACE TUNNEL

Excavation of a length of 18.30 kms has been completed out of a total of 27.30 kms of head Race Tunnel. The progress of excavation has suffered due to shortage of the construction power and emergence of shear zones at various places on the excavation fronts of HRT. The preparatory works for erection of the steel liner in the HRT is also progressing. On the 301 m Surge Shaft, excavation up to the depth of 207 m has been completed.

#### 10.8.6.2.3 POWER HOUSE COMPLEX

The excavation for benching, rock bolting and shotcreting in the Transformer Hall is in progress. The widening work of the Pressure Shafts 1 and 3 is in progress. The erection of steel liners of the Pressure Shaft no. 2 and 3 has started from the Surge Shaft side. Consequent upon completion of the heading excavation of 982 m long Tail Race Tunnel and 558 m benching excavation has been completed. Fabrication of 66 no. Ferrules for the

Pressure Shafts have been completed and erection of 31 nos. Ferrules in the Pressure Shafts have been completed. Open excavation in TRT outfit area is also progressing.

### 10.8.6.3 OTHER PACKAGES

#### 10.8.6.3.1 PACKAGE I - ELECTRO-MECHANICAL

The erection works for the EOT Cranes no. 1 and 2 are in progress. The erection of blockouts for embedded piping for drainage of draft tube, penstock, shaft seal, spiral casing, etc. for unit - I has been completed.

#### 10.8.6.3.2 PACKAGE-II - BUTTERFLY VALVES

The Buyers Credit agreement for the 85 percent financing was signed on September 14, 1996 with Barclays Bank plc, U.K. The commercial loan agreement for the balance 15 percent is proposed to be signed during February, 1997. The buyers credit agreement shall also cover 85 percent interest during construction.

#### PACKAGE III - GENERATOR TRANSFORMERS

The financing for the equipments under this Contract is being tied up.

#### PACKAGE IV - 400 KV SF6 GIS AND BUSDUCTS

The Buyers credit agreement for the 85% financing was signed on 30.8.1996 with BNP, Paris. The commercial loan agreement for the balance 15% is proposed to be signed in 2/97.

#### 10.8.6.3.3 EXPENDITURE

The status of expenditure as on end December, 1996 is as given below :

(Rs. in Crores)			
Description	During Dec, 1996	During FY 1996-97	Cumulative since beginning
Total Expenditure	52.00	291.42	1708.82
Utilisation of World Bank Assistance	38.12	90.14	642.40

#### 10.8.6.4 FUTURE PROJECTS

NJPC is awaiting clearance for taking up the investigation and construction and consequent commissioning, operation and maintenance of the Rampur Hydro-electric project (439 MW), Kol Dam Hydro-electric Project (840 MW) and the Parbati Hydro-electric Project Stage-II (800 MW) in the Himachal Pradesh.

##### 10.8.6.4.1 RAMPUR HYDRO-ELECTRIC PROJECT

The RHEP envisages construction of a balancing reservoir of 0.125 Million Cubic Metre capacity, besides construction of a 15.70 Km., 10.15m. dia. Head Race Tunnel, 110 metre deep Surge Shaft, 200 metre deep steel line Pressure Shaft and an underground Power House. The RHEP will utilise a gross head of 147.5 metre for an installed capacity of about 439 MW each (3 x 146.33 MW) at an estimated cost of Rs. 2000 crores (excluding escalation and IDC).

##### 10.8.6.4.2 PARBATI HYDRO-ELECTRIC PROJECT

Parbati river is one of the major tributaries of Beas river and is estimated to have potential of nearly 2050 MW.

The proposed Parbati Hydro Electric Project (PHEP) is planned to consist of three stages with a capacity of 750 MW, 800 MW and 501 MW respectively. The NJPC is planning to take up the investigation, construction, commissioning, operation and maintenance of the Parbati Stage-II.

##### 10.8.6.4.2.1 PARBATI HEP STAGE-II

This is envisaged to be a run of the river scheme by diverting the waters of river Parbati at Pulga by constructing a 90m high dam, the water after desilting will be carried through a 31 km long HRT to generate a gross head of 870m generating 800 MW in a surface power house at Sainj.

The project will generate 2921 GWH in a 90% dependable year & 3476 GWH in a 50% mean year. The cost of the project at 1991 indices works out to be Rs. 1115.08 crores. The cost per unit works out to be 46.26 paise per KWH in a 90% dependable year and 38.88 paise per KWH in a 50% mean year.



*1500 MW Nathpa - Jhakri Power Project - the office top of the 301 metre deep SURGE SHAFT under excavation at Jhakri*

## 10.9 DAMODAR VALLEY CORPORATION

### 10.9.1 ORGANISATION AND OBJECTIVES

The Damodar Valley Corporation (DVC) was established on July 7, 1948 under the Damodar Valley Corporation Act. The Corporation has a full-time Chairman and two part-time Members. The part-time Members represent the States of Bihar and West Bengal.

### THE FUNCTIONS OF THE CORPORATION INCLUDE

- \* the promotion and operation of the schemes for irrigation, water supply and drainage;
- \* the promotion and operation of schemes for the generation, transmission and distribution of energy, both hydro-electric and thermal;
- \* the promotion and operation of schemes for flood control in the Damodar river and its tributaries and the channels excavated by the Corporation for the improvement of flow conditions in the Hooghly river and promotion and control of Navigation;
- \* the promotion of afforestation and control of soil erosion in the Damodar Valley; and
- \* the promotion of public health and the agricultural, industrial, economic and general well-being in the Damodar Valley and its areas of operation.

The Corporation has so far constructed four multi-purpose dams at Tilaiya, Konar, Maithon and Panchet. The irrigation system comprises a barrage over river Damodar at Durgapur and the canal system of 2495 kms which includes 137 kms long irrigation-cum-navigation canal on the left bank of the river Damodar. The management of Barrage and irrigation system excluding the navigation canal was transferred to the Government of West Bengal in 1964.

### 10.9.2 EXISTING POWER PLANTS

#### THERMAL

Bokaro 'A'	152 MW (3 x 45 MW) & (1 x 40 MW)
Bokaro 'B'	630 MW (3 x 210 MW)
Chandrapura	750 MW (3x130 MW & 3x120 MW)
Durgapur	350 MW (1x140 MW & 1x210 MW)
Mejia TPS (Unit-I)	210 MW (1 x 210 MW)

#### GAS TURBINE

GTP, Maithon	82.5 MW ( 3 x 27.5 MW)
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#### HYDEL

Tilaiya	4 MW ( 2 x 2 MW)
Maithon	60 MW (3 x 20 MW)
Panchet	80 MW (2 x 40 MW)

DVC's Transmission System runs to a total length

of 5328 Ckt long comprising of 1091 CKt kms 220 lines, 3342 Ckt Kms 132 KV line, 895 Ckt 33 KV lines.

DVC's soil conservation activities have already covered an area of three lac hectares of affected areas. More than 8000 check-dams have already been constructed for controlling run off soil and providing small irrigational facilities.

(Details of DVC Network and DVC Dams may be seen at Annexure I & II)

### 10.9.3. OVERALL PERFORMANCE AND ACHIEVEMENTS

During the period under review (April - November, '96) DVC's system generation was 4401 MU of which thermal contribution was 4047 MU, Hydel 343 MU and Gas Turbine 11 MU. During the period DVC's turnover was Rs. 875 crores which enabled DVC to earn a profit of Rs. 27.5 crores.

#### Performance Highlights (April-November, '96)

System Generation (MU)	4401.00
PLF (Thermal) on installed capacity• (excluding Mejia TPS)	34.85
Sp. Oil Consumption (MI./Kwh)	20.34
Sale of Power (MU)	5068.00
Turnover (Rs. Crores)	875.00
Profit (Rs. Crores)	27.50
Target generation for 1996-97 (MU)	8080.00

On 26th June '96 DVC dams combatted one of the major floods when 2.10 lakh cusec of inflow was moderated to 1.04 lakh cusec outflow moderating 1.06 lakh cusec.

Bermo Mines: DVC's Bermo Mines produced 136, 478 MT of coal upto November, '96.

### 10.9.4 PROJECTS UNDER CONSTRUCTION

#### 10.9.4.1 MEJIA THERMAL POWER STATION (3 X 210 MW)

Government of India sanction for the project was accorded on 20.3.1986 at an estimated cost of Rs. 641.42 crores (3rd Qtr. 1983 price level). Revised Project Cost estimate of Rs. 1989.14 crores (3rd Qtr. 1995 price level) has been approved by PIB on 20.6.96. CEA clearance awaited, expenditure till 3/96 is 1557.54 crores & cumulative expenditure till 11/96 is Rs. 1639.76 crores (Provisional). Unit-I was Synchronised with oil firing on 22.12.95 and Synchronisation with coal firing has been achieved on 25.3.1996. Revised commissioning target dates as anticipated by DVC are 3/97 & 12/97 for Unit-2 & Unit-3 respectively.





Civil work in Power House for Unit-I has almost been completed and that of Unit-2 and Unit-3 are 97.0% and 94.0% completed respectively.

Structural steel erection in Power House Unit-I has been completed. The same for Unit-2 and Unit-3 are 99.9% and 98.9% respectively.

Ash Handling Plant with 1 no. each of Bottom ash & Fly ash slurry pumps and Temporary Ash Bundh commissioned. Ash water pumps commissioned. One out of four compartments of Ash Bundh is ready.

In Coal Handling Plant 99.77% civil work completed & structure erection 87% completed. Ist stream of Phase-A Ckt. required for coal firing of U-1 has been erected and put into operation while the work in 2nd stream is nearing completion. The work on Phase-B & C is also progressing.

Multiflue Stack with 3 steel can flues have been completed.

Work on 220 KV L-I-L-O line for CTPS-Mejia TPS Loop has been completed and DVC power supply was made available from 25.10.1994 and the DTPS - Mejia loop work is about 50% completed. Erection of 220 KV Maithon-Mejia line is also progressing.

Possession of land for about 2505 acres has been received out of 2574 acres. 387 families of homestead land evictees out of 399 families shifted to rehabilitation site. 15 more families have been shifted on 12.7.96 as per the additional list submitted by district authority. Employment offered to 84 land losers out of which 79 candidates already joined.

#### **10.9.4.2 BOKARO 'B' TPS STAGE II (2 X 210 MW)**

The revised cost of the project Rs. 351.34 crores excluding IDC of Rs. 92.36 crores & WCM of Rs. 9.00 crores has already been approved by Government of India on 17.10.95. The expenditure till 3/96 is Rs. 331.78 crores & expenditure till 11/96 is Rs. 337.63 crores (Provisional). Unit-2 and Unit-3 were put under commercial operation w.e.f. 15.12.1991 and 01.04.94 respectively.

#### **R.C.T.S :**

Rapid Coal Transportation System (RCTS) has already been commissioned and is in operation. Some tit-bit leftover work of dust suppression, dust extraction, etc. is in progress and likely to be completed shortly. Railway siding work at Dhori mines (under CCL's scope) : Rail laying work

completed upto silo except in the area (about 100 meters stretch) covering temple & some hutments. Pending completion of siding at Dhori, Coal - Transportation is being presently effected by Rail from temporary siding arrangements.

#### **ASH DISPOSAL SYSTEM**

Out of 607 acres of forest land earmarked in Govindpur Mouza of Bokaro District, 50 acres of land has been handed over to DVC by Government of Bihar on 04.07.1994. M/s Continental Consultant have completed soil testing of 50 acres of land. Proposal for handing over of 303.94 acres of forest land to DVC has been recommended by Regional Chief Conservator of Forest, Hazaribagh in 12/95. DVC has already given the equivalent land for afforestation to Forest Department, Government of Bihar and also paid Rs. 2.08 crores to Forest Department, Government of Bihar on 30.3.96. Presently the case is lying with Dy. Conservator of Forest (Planning), Ranchi. DVC is vigorously pursuing the matter at various levels of Forest Department, Government of Bihar.

#### **ASH BOOSTING STATION**

Civil work completed. Erection of equipment - 100% completed. Piping erection : construction of pedestals completed. Trenches completed. Pipe erection completed for 4.98 KM route length out of total 5 KM.

#### **10.9.4.3 PANCHET HILL HYDEL UNIT-II (1 X 40 MW)**

The Panchet Hydel Unit-II was commissioned in Turbine mode on 11.4.1991 and taken over by DVC on same date.

#### **TAIL POOL DAM**

Till date about 58% of cut-off wall and 7.23% of concrete work in Spillway & Under sluices have been completed. However, the work is totally stopped since 8.1.96 due to reasons beyond DVC's control.

#### **10.9.5 FUTURE PROJECT**

##### **10.9.5.1 REHABILITATION : 2 NOS. 75 MW UNIT AT DTPS:**

Techno-economic approval for the project was received on 24.1.95 for an estimated cost of Rs. 2.61 crores for MW (Sept '94 price level). The revised cost estimate of the project is Rs. 510 crores

(Rs. 3.40 crores per MW) based on November '96 price level due to increase in scope of work. Funding clearance and revised PIB are awaited clearance.

### 10.9.5.2 MAITHON RIGHT BANK TPS

The project has been approved by CEA in November, 1988 for an estimated cost of Rs. 1205.00 crores which has since been updated to Rs. 3820 crores (approx.), on the price level of 7/96. The project has been delayed due to constraints in funding pattern.

### RENOVATION AND MODERNISATION

Massive R & M activities have been taken up to make optimal utilisation of the existing three Thermal Power Stations of DVC at Bokaro "A", Chandrapura and Durgapur which have old units in operation between 14 and 43 years.

R & M activities at Bokaro "A" TPS (Units 1, 2 & 3) have been completed.

The CTPS is now better organised with new Coal Handling Plant and it is expected that the PLF and availability of the plant will improve after completion of the activities under Phase-II R & M scheme, part of which has already been completed. After completion of various R & M activities of DTPS Unit-3, PLF and availability of the station have already improved which are likely to further improve after completion of Phase-II R & M activities.

Details of the draft report by the RLA team for CTPS Unit-2 has been submitted by TVA. The estimated cost for implementation of TVA's recommendation for Live Extension of one Unit as indicated in their final report is Rs. 82 crores. On implementation of the recommendations the Units are expected to be operated at their rated capacity for a further period of 15 years. This was a part of the R & M activities. RLA study for Bokaro "A"

Unit- 1 has also been completed and BHEL has submitted their final report in May '95 with detailed recommendation. Implementation shall be taken up shortly.

Since Transmission and Distribution System of DVC also needs refurbishment due to ageing, steps have been initiated for augmentation of transformer capacity, reconductoring of transmission lines and changing of equipments involving an expenditure of Rs. 51.07 crores upto 1996-97.

### ENERGY CONSERVATION

Efforts are being made for optimisation of consumption of fuel oil and coal. A study has already been made for optimal consumption of fuel oil. Monitoring of the rate of consumption of coal, oil and heat rate are also conducted besides review of auxiliary consumption of power.

### 10.9.5.3 15 - POINT PROGRAMME

For meeting the need of peripheral development a special department of Social Integration Programme has been set up. Works related to extending facilities for education, health, civic amenities, vocational training, micro lift irrigation and other allied activities are conducted in 90 selected villages around major DVC Projects.



*A view of DVC's Durgapur Thermal Power Station*

## HIGHLIGHTS

### PERFORMANCE FOR THE PERIOD FROM APRIL '96 TO NOVEMBER 1996

#### a) (i) Generation of energy (MU) and Plant Load Factor (%)

Station	Energy Generation (MU)	PLF (%)	Auxiliary Consumption (%)
Bokaro 'A' TPS	164.250	16.03	12.91
Bokaro 'B' TPS	1207.810	32.74	11.85
Chandrapura TPS	1500.701	34.17	12.37
Durgapur TPS	1015.203	49.53	10.07
Mejia TPS	159.076	12.94	
<b>Total Thermal</b>	<b>4047.040</b>	<b>34.85</b>	<b>11.63</b>
		(Excluding Mejia TPS)	(Excluding Mejia TPS)
Maithon HS	140.741		
Panchet HS	196.074		
Tilaiya HS	6.534		
<b>Total Hydel</b>	<b>343.349</b>		
Gas Turbine	10.713		
<b>Grand Total</b>	<b>4401.102</b>		

#### a) (ii) Consumption rate of fuel

Station	Coal Kg./Kwh	Oil (MI/Kwh)
Bokaro 'A' TPS	1.003	4.85
Bokaro 'B' TPS	0.794	18.01
Chandrapura TPS	0.808	27.97
Durgapur TPS	0.618	14.34
Thermal (excluding Mejia TPS)	0.762	20.34

## DVC NETWORK

### Power

Total installed capacity	: 2341.5 MW
Thermal Power Stations	: Five
	Capacity : 2115 MW (including Mejia Unit-I)
Hydel Power Stations	: Three
	Capacity : 144 MW
Gas Turbine Station	: One
	Capacity : 82.5 MW (3x27.5MW)
<b>Power Expansion Programme</b>	: Mejia Thermal 630 MW (3x210 MW) Mejia Stage II (500 MW) Maithon Thermal (proposed) 840MW (4x210 MW)/1000 MW (4x250 MW)

<b>Sub-Stns. &amp; Receiving stns.</b>	: At 220 KV : 7
	: At 132 KV : 27
	: At 33 KV : 14

<b>Transmission Line</b>	: At 220 KV : 1091 Circuit KM
	: At 132 KV : 3406 Circuit KM
	: At 33 KV : 1052 Circuit KM

### Water Management

Major Dams and Barrages	: Tilaiya, Konar, Maithon, Panchet Dams and Durgapur Barrage.
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<b>Irrigation Command Area (gross)</b>	: 5.69 lakh hectares
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<b>Irrigation Potential Created</b>	: 3.64 lakh hectares
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<b>Flood Reserve Capacity</b>	: 1270 million cu.m.
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<b>Canals</b>	: 2.495 KMs.
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### Soil Conservation

Forest and Farms (covered area)	: 3 lakh hectares
Check Dams	: 8400



*Flood fighting at Panchet Dam, DVC*

## 10.10 BHAKRA BEAS MANAGEMENT BOARD (BBMB)

Bhakra Management Board (BMB) was constituted under section 79 of the Punjab Re-organisation Act, 1966 for the administration, maintenance and operation of Bhakra Nangal project w.e.f. 1st October, 1967. The Beas Project Works, on completion, were transferred by Government of India from Beas Construction Board (BCB) to BMB as per Section 80 of the Punjab Re-Organisation Act, 1966 and the Bhakra Management Board was renamed as Bhakra Beas Management Boards (BBMB) w.e.f. 15.5.1976.

### FUNCTIONS

The Bhakra Beas Management Board manages the facilities created for harnessing the waters impounded at Bhakra & Pong in addition to those diverted at Pandoh through the BSL Water conductor system. It has also been assigned the responsibility of delivering water and power to the beneficiary States in accordance with their due/entitled shares. The Board is responsible for the administration, maintenance and operation works at Bhakra Nangal Project, Beas Project Unit I & II including Power houses and a network of transmission lines and grid substations. The function of Bhakra Beas Management Board are:-

To regulate the supply of Satluj and Ravi-Beas waters to the States of Punjab, Haryana, Rajasthan and Delhi, through a wide network of canals. To distribute power from Bhakra Nangal and Beas Projects to the States of Punjab, Haryana, Rajasthan, Himachal Pradesh, Jammu & Kashmir and U.T. of Chandigarh.

The works being managed by the BBMB are broadly grouped as three large multipurpose projects viz., Bhakra Nangal Project, Beas Project Unit-I (BSL Project), & Beas Project Unit-II (Pong Dam).

The Bhakra Nangal Project comprises the Bhakra Dam, Bhakra Left Bank & Bhakra Right Bank Power Houses, Nangal Dam, Nangal Hydel Channel and Ganguwal & Kotla Power Houses. Bhakra Dam is a majestic movement across the river Satluj. It is a large straight gravity concrete dam rising 255.55m

(740 ft.) above the lowest foundation and spanning the gorge with 518.16m (1700 ft.) length at the top. The Govind Sagar Lake created by the Dam has 168.35 Sq.Km. area and a gross storage capacity of 9621 million cubic metre (7.80 MAF). The two power houses—one on the Left Bank (5 x 108 = 540 MW) and the other on the Right Bank (4 X 132 + 1 X 157 = 685 MW) have a combined installed capacity of 1225 MW. The Ganguwal & Kotla Power Houses fed from Nangal Hydel Channel have an installed capacity of 155.3 MW.

The Beas Project Unit-I (BSL Project) envisages the diversion of Beas Water into the Satluj Basin, falling from a height of 320 metre (1050 ft.) and generating power at Dehar Power House having an installed capacity of 6 x 165 = 990 MW. This project comprises a diversion dam at Pandoh, 13.1 km Pandoh Baggi Tunnel having a discharge capacity of 9000 cusecs, 11.8 km long Sunder Nagar Hydel Channel, Balancing Reservoir at Sunder Nagar, 12.35 km long Sunder Nagar Satluj Tunnel, Surge Shaft and Dehar power plant.

The Beas Dam at Pong is the highest earth filled (earth core, gravel shell) dam in India, having 132.6 metre (435 ft.) height with a live storage capacity of 7290 million cubic metre (5.91 MAF). The Pong Power Plant (6 x 60 = 360 MW) is located on the right side of the stilling basin of the dam.

The total installed generating capacity of the BBMB Power Houses is 2730.30 MW which is more than 1/8th (about 13%) of the total installed Hydro-electric generating capacity in the country as per following details:-

Power Houses	Installed Capacity (MW)	
1. Bhakra (Right Bank)	4 x 132 + 1 x 157	= 685
2. Bhakra (Left Bank)	5 x 108	= 540
3. Ganguwal	2 x 24.2 + 1 x 29.25	= 77.65
4. Kotla	2 x 24.2 + 1 x 29.25	= 77.65
5. Dehar	6 x 165	= 990
6. Pong	6 x 60	= 360
<b>Total</b>		<b>2730.30</b>



### 10.10.1 GENERATION & TRANSMISSION SYSTEM

The BBMB Power Houses generate about 12000 M.U.s of energy/annum, thus contributing about 17.5% of the all India Hydro Generation. These Power Plants have highest plant availability factor (90 to 95%). The generation during 1995-96 was 12016 M.U.s against the target of 10020 M.U.s. Thus additional generation of 1996 M.U.s valueing Rs. 199.60 crore was achieved during the year 1995-96. In fact for the 6th year, the annual generation has exceeded the previous best generation of past 25 years. The BBMB power Houses have generated 9048 M.U.s against the target of 8522 M.U.s (i.e., 6.17% more) for the period from April, 96 to November, 96. The total target fixed for BBMB for 1996-97 is 11600 M.U.s and the likely generation during 1996-97 shall be about 12000 M.U.s.

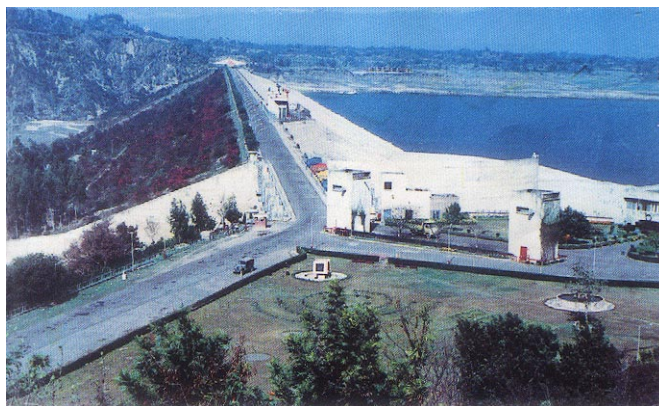
The power generation at BBMB power stations is being evacuated through BBMB power evacuation system running into 3735 Circuit Km length of 400 KV, 220 KV, 132 KV and 66 KV transmission lines and 24 EHV substations. BBMB power evacuation

system runs in an integrated manner in the Northern grid with its transmission network spreading over the States of Himachal Pradesh, Punjab, Haryana and Delhi. The system is interconnected with transmission system of Power Grid and the State of Uttar Pradesh, Rajasthan and Delhi.

### 10.10.2 RENOVATION AND MODERNISATION

All the 5 units of Bhakra Right Bank Power House are being renovated from the original capacity of 120 MW to 157 MW each. This will result in gain of the installed capacity by 185 MW with additional annual energy generation of 310 M.U.s. Renovation and Modernisation of Unit No. 9 has been completed in February 1996. The 2nd Unit for R&M (Unit No. 6) has been taken on shut down from October, 1996.

The R&M of Ganguwal and Kotla Power Houses has been planned in two phases. In Phase I, the R&M of one Unit each at Ganguwal and Kotla Power Houses has been approved and orders for turbine/generator placed on M/s. BHEL. The work of both the Units likely to be completed during 1997-98.



*A panoramic view of Beas Dam at Pong (BBMP)*

The enhancement in the installed capacity of these two units will be 7.75 MW and additional annual generation of 63 M.U.s. In phase-II, the R & M of one unit each at Ganguwal and Kotla Power Houses is under approval. This will result in capacity enhancement of 5.94 MW and increased annual generation of 49 M.U.s.

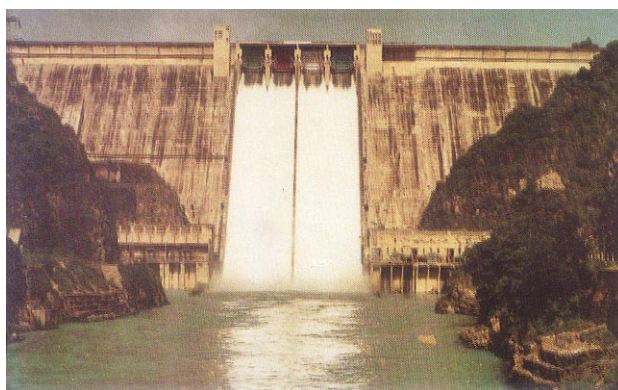
Upgrading and modernisation of one unit of Pong Power Plant from 60 MW to 66 MW has been approved. After observing its performance upgrading and modernisation of remaining 5 units will be taken. The benefits include additional peaking capacity of 36 MW, additional annual generation of 173 M.U.s. apart from the additional 90 MVAR reactive power besides life extension of the units.

Two sets guide vanes are being purchased from BHEL to improve maintenance programme and also decrease the down - time of machines at Dehar Power Plant. This will result in increased efficiency by 1.4% (i.e., increase of about 15 M.U.s/year).

The performance parameters of the BBMB are

comparable to the best utilities anywhere in the world. Some performance indicators of BBMB are as under :-

- Highest recorded annual generation of the past has been achieved in years 1990-93, 1994-96 despite the machines being operational for over 35 years.
- Highest plant availability : 90 - 95%
- Highest transmission line serviceability: 99.5% - 100%
- Lowest cost generation: 5.18 p/Kwh (due to increased generation and economy at various cost centres)
- Increase in life of generating plants from 35 - 60 years (i.e., 25 years by introducing Scientific Preventive Maintenance)
- Down time of machine reduced from 311 hours to 22 hrs. (per year)
- Number of outages of machines reduced in a year from 14 to 5.



*Down stream view of Bhakra Dam (BBMB)*

## 10.11 CENTRAL POWER RESEARCH INSTITUTE

The Central Power Research Institute (CPRI) was established in Bangalore by the Government of India in 1960. It was organised into an autonomous society in the year 1978 under the aegis of the Ministry of Power, Government of India. The main objective of setting up the Institute was to serve as a National Laboratory for undertaking applied research in electric power engineering besides functioning as an independent National Testing and Certification Authority for electrical equipment and components to ensure reliability and improve, innovate and develop new products. More specifically the objectives cover the following :

### OBJECTIVES

- \* To serve as a national centre for applied research in electrical power engineering;
- \* To function as an independent and impartial authority for certification and testing of electrical equipments manufactured in the country for quality assurance;
- \* Performing tests for product development;
- \* To offer consultancy on problems referred by utilities and industries;
- \* Undertake sponsored research programmes on subjects of interest in the power systems field.

The Institute is headed by a Director General and has several research laboratories and testing facilities, and employ over 300 qualified scientists and engineers besides other supporting staff guiding and maintaining various operations. The Head Office of the Institute is at Bangalore and its other units are located at Bhopal, Hyderabad, Nagpur, Ghaziabad, Thiruvananthapuram and Raichur.

### PERFORMANCE AND ACHIEVEMENTS - YEAR AT A GLANCE

The CPRI continued to play a vital role in quality assurance to ensure reliability of power supply by discharging the onerous responsibility of testing and certification of electrical equipment in accordance with national and international standards. During the year, the testing activity registered an all time

high growth in terms of number of tests conducted, number of samples tested, number of customers serviced and revenue earned. More than ever, the focus was to bring about improvement in the services to the customers by way of improvement in handling facilities, lowering waiting period and test duration, expeditious issue of test reports and their impressive presentation.

The Institute continued its strides in the area of research by successfully completing six projects upto November end out of a total of 73 ongoing and new projects. The R & D efforts resulted in development of new equipment and processes and application softwares.

### NEW TEST FACILITIES

Some of the new test facilities added during the year are:

- i. Impulse current generator for testing Zinc oxide lighting arresters upto 10 KV, 150 KJ.
- ii. New Pollution Laboratory.
- iii. Impulse dielectric tests on all electrical equipments upto 3 MV, 150 KJ.
- iv. Ion migration test facility.
- v. Multi product calibration system for all electrical measuring instruments.
- vi. Refrigerator & temperature bath test facility.
- vii. All tests on Energy meters.

### MOBILE ENVIRONMENTAL MONITORING LABORATORY

With the increased awareness on maintaining a clean environment and stringent stipulations laid down by the regulatory bodies on air and water quality, it becomes essential for every industry to monitor the ambient atmospheric quality around their industry. It is mandatory to have environmental impact assessment carried out to obtain clearance from Ministry of Environment and Forests. Keeping these requirements in view, CPRI has established a Mobile Environmental Monitoring Laboratory facility at Thermal Research Centre, Koradi, Nagpur.



**UNIQUE TESTS CARRIED OUT IN CPRI**

CPRI's UHV Research Laboratory, Hyderabad, carried out Bias testing of 400 KV SF 6 circuit breaker, with lightning impulse combined with power frequency and switching impulse both under dry and wet conditions as per International Standard IEC-56 for the first time in our country. With this, circuit breaker & isolator manufacturers need not go abroad for these tests any more. This will save a significant amount of foreign exchange for the country.

CPRI successfully tested the NHVDC Phase II Thyristor valve for Barsur station. The testing of this double valve design of BHEL rated for 200 KV DC was a challenging task in view of its high inherent capacitance and called for very high skills and expertise for successful conducting and completion of tests. The tests included dielectric tests like steep front impulse test, non-periodic firing test and other tests like Corona, etc. Special tests like lightning/Switching impulse test super imposed on AC voltages were also conducted. Had such tests been carried out abroad, it would have resulted in drainage of a huge amount of foreign exchange. With successful completion of the testing of the Thyristor valve, CPRI has acquired invaluable skills and experience in undertaking special tests which will be helpful for saving valuable foreign exchange.

The research activities were given a new thrust by redefining the objectives for deriving tangible end results for the benefit of the power utilities and the manufacturing industry. This resulted in stepping up of liaison with the utilities, manufacturing industries and academic institutions for promoting joint research projects. As an off shoot of R & D efforts, CPRI continued its course of collaboration with other organisations by signing Memoranda of Understanding with them for commercialisation of the technologies already developed.

CPRI organised several Workshops/Seminars/Training programmes, Technology upgradation and clients meets, etc., during the year. In order to publicise and propagate the promotional efforts of Research & Development, Consultancy and testing activities, a large number of technical papers were presented in both National & International Seminar/Workshops and CPRI also participated in EXPO' 96 exhibition at Dubai.

Computerisation played a key role in all activities and the year witnessed a manifold increase in the hardware and software capability and usage of computer in the day-to-day activities.

Under the VIII plan augmentations scheme, modernisation of laboratories, viz., High Voltage, Short Circuit at Bangalore has been completed. Modernisation of Materials Technology laboratory at Bangalore and Switchgear Testing & Development Station at Bhopal is continuing and will be completed in 1997-98. These modernisation programmes involve a capital investment of Rs. 6051 lakhs.

The major capital project was of 1500 MVA. Additional Short Circuit Alternator at STDS, Bhopal at a cost of Rs. 67.34 crores has been completed and made operational.

The Institute has been meeting its non-plan expenditure through revenue generated by testing and consultancy for the last nine years and the revenue has been increasing over the years. The trend is expected to continue also during the current year.



*3 MV 150 KJ Impulse Voltage Generator*



## 10.12 NATIONAL POWER TRAINING INSTITUTE

National Power Training Institute (NPTI) has been set up by Government of India to function as the national apex body for the Human Resource Development in Power Sector by upgradation of erstwhile Power Engineers Training Society (PETS) w.e.f. 1st April, 1993. The Institute operates on all India basis through its four Regional Power Training Institutes at Neyveli (Tamil Nadu), Durgapur (West Bengal), Badarpur (New Delhi) and Nagpur (Maharashtra). The NPTI including its four Regional Power Training Institute is fully equipped with latest state-of-the-art training infrastructure and also expert faculty with long years of professional teaching background as well as adequate R&D exposure. The training Institute at Badarpur is equipped with a computerised full scope simulator of 210 MW fossil fuel Thermal Power Plant to provide off-job/hands-on operation training. Two more Simulators of 500 MW and 210 MW, based on latest technology i.e. DDC based instrumentation, are in the process of getting commissioned at NPTI Headquarters and the training Institute at Nagpur respectively. A training Resources Unit is also functioning at NPTI Headquarters to develop training materials to meet the training needs of power sector.

An Institute for Advanced Learning and Management Studies for higher echelons of Power Sector is being established at Faridabad. The envisaged role of this Institute would be - Training of higher echelons of power sector; training in management area; training of faculties for Plant Level Training Cells, State Power Training Institutes; Regional Power Training Institutes. Preparation of standardised training material and training packages for training Institutes of Power Sector; and providing consultancy to the Utilities on training and technical problems including setting up of Plant Level/State Level Training Institutes.

The four training Institutes of NPTI are presently offering 29 long-term courses on 8 topics and 319 short-term courses on 74 different topics for Engineers, Operators and Technicians in the areas of Thermal Generation, Hydro Generation and

Power System. More than 42,000 personnel have been trained upto October, 1996. The number of persons trained in the various courses conducted by the Institute under NPTI during the year 1996-97 (upto October, 1996) is as under:

Sl. No.	Courses	No. of persons trained
1.	Long-term courses for Engineers	141
	Long-term courses for Operators	23
	Long-term courses for Technicians	390
2.	Short-term courses for Engineers	140
	Short-term courses for Operator/Technicians	296
3.	On-Job/On-site courses	202
4.	Simulator Courses	54
	Total	1246

In addition, All India Council for Technical Education (AICTE), New Delhi has accorded approval for recognition of 52 weeks Graduate Engineer Course (Thermal) as Post Graduate Diploma in Thermal Power Plant Engineering to be conducted at the four Regional Power Training Institutes of NPTI. The first batch has started in August, 1996 and currently 174 persons are undergoing the course.

The achievements in terms of Trainee Weeks have been 11259 during 1996-97 (upto October, 1996). Already, 3750 Engineers have been imparted training on the 210 MW Simulator at Badarpur Institute since its installation in 1982 under UNDP Assistance. Anticipated Trainee Weeks for the whole year (1996-97) is around 21,000.

NPTI has diversified into different areas of consultancy such as Setting up of Training Institute, Assessment of Training Needs, etc. In this respect, the following assignment have been carried out/being carried out:

- i) Setting up to Training Institute in Bhutan for which NPTI has been appointed as consultant by the Ministry of External Affairs.
- ii) Consultancy for DVC on formulating training needs and other associated aspects of career development for various categories of employees.
- iii) Training Need Assessment of PSEB Transmission and Distribution Personnel.
- iv) Training Need Assessment of BSEB Patratu Thermal Power Plant Personnel.

Under the ODA aided Computer Based Training (CBT) Plan Scheme, NPTI is developing computer aided self learning packages on the various topics of thermal power stations, operation and maintenance. The total cost of this scheme is Rs. 373.91 lakhs which comprises an ODA component of Rs. 179 lakhs and Indian cost component of Rs. 194.91 lakhs. A team of 6 officers has visited U.K. on a study tour regarding the CBT development/packages.

CBT packages being developed by NPTI are multimedia based. So far NPTI has developed three packages on (i) Drum and Drum Internals, (ii) Turbine vacuum system and (iii) Generator cooling system. Seven more packages are under development. All these packages shall be made available to SEBs/Utilities.

### FUNDS

During the year 1996-97, Ministry has released grants-in-aid of Rs. 500 lakhs under Plan and Rs. 160 lakhs under Non-Plan upto 30th November, 1996. The balance amount of Plan and non-plan funds amounting to Rs. 1656.06 lakhs and Rs. 105 lakhs respectively shall be utilised during the current financial year 1996-97.

In regard to the trainee fees and other miscellaneous receipts, NPTI realised a sum of Rs. 142.20 lakhs during the year 1996-97 (Upto October, 1996) against a BE 1996-97 of Rs. 135 lakhs as a whole and hence the 1996-97 target has been revised to Rs. 182.39 lakhs under RE 1996-97.



*Simulator Training at RPTI, Badarpur*

## 10.13 ENERGY MANAGEMENT CENTRE (EMC)

The Energy Management Centre (EMC) was established by the Government in April, 1989 (registered as an autonomous body under the Societies Registration Act) to act as a focal point for exchange of experience and function as a Centre for information, research, training and international cooperation in the field of energy management. EMC advises/assists the Ministry of Power in formulation of policy and programmes on energy conservation and functions as a nodal point at the Central level for monitoring and coordination of energy conservation activities in the country. It also takes up implementation of specific programmes on its own as well as on behalf of the Ministry of Power and other organisations. At present, EMC is sustained by budgetary support from the Government in the form of grants-in-aid. Its current annual budget is of the order of Rs. 55 lakhs.

### 10.13.1 ACTIVITIES OF THE ENERGY MANAGEMENT CENTRE

Two projects involving (a) energy audits in selected small and medium industrial units, (b) building up of energy audit capabilities in the country through instrumentation support, etc., have already been implemented with technical and financial support from UNDP and EEC. As a result, Leading Agencies/Advisory Centres in some parts of the country have been developed to assist the consumers in identifying the scope for energy conservation and implementing energy saving measures.

#### EMC HAS UNDERTAKEN THE FOLLOWING ACTIVITIES DURING 1996-97:

- Macro-level policy study on Energy-Efficiency in Indian economy vis-a-vis other developing economies in Asia-Pacific region.
- Preparation of Energy Efficiency booklets on:  
Industrial energy efficient technologies, Paper Industry and Secondary Steel Industry.
- Preparation of Status Report on Action Plan on Time of Use Tariff in India.

- Status reports for selected domestic appliances.
- Development of informative booklet on strategic management of energy efficiency at the corporate level.
- Showcase demonstration project on energy savings through fan efficiency improvement in Cement Industry.
- DSM plan for Gujarat Electricity Board.
- Energy consumption norms in foundry and mini steel industry.
- Energy saving in Aluminium Electrolysis by bringing down the operating temperature of Electrolyte.
- Replacement of foot valves in 20, 000 agricultural pumpsets in Andhra Pradesh.
- Preparation of industrial energy efficiency agenda for Secondary Steel, Pulp & Paper and Chlor-Alkali industrial sub-sectors.
- Preparation of detailed project report for rapid displacement heating pulping process.
- Study on prospects and strategies for energy efficient buildings.
- Demonstration projects on energy efficient lighting.
- Four training programmes and four workshops under collaboration with European Commission under SYNERGY programme.
- Training programmes for training of personnel on energy conservation in the various sectors of industry.
- Indo-EC Energy Management Cooperation Programme (Phase-II).
- Indo-German Technical Cooperation Programme on Energy Conservation in Indian Industries.
- Studies sponsored by a Swedish agency (SAREC) on Green House Gases (GHG) emission for assessment of energy efficiency options for mitigation of the emissions.
- Energy Efficiency Support Project of the Asian Development Bank (ADB).
- Indo-US Energy Efficiency Cooperation Programme.

## 11. OTHER IMPORTANT ACTIVITIES

### 11.1 CONSULTATIVE COMMITTEE OF MEMBERS OF PARLIAMENT

Consequent on the formation of Eleventh Lok Sabha, a Combined Consultative Committee of Members of Parliament for the Ministry of Power and Ministry of Non-Conventional Energy Sources was constituted on 21.8.1996. The Combined Consultative Committee discussed issues relating to Ministry of Power and Ministry of Non-Conventional Energy Sources in its alternative sittings. As far as Ministry of Power is concerned meetings of the Consultative Committee were held which discussed issues relating to "National Thermal Power Corporation" and "Rural Electrification Corporation".

### 11.2 IMPLEMENTATION OF OFFICIAL LANGUAGE POLICY

The Ministry of Power, its attached and subordinate offices and Public Sector Undertakings/Autonomous bodies/Boards/Societies/Institutions under the administrative control of the Ministry of Power have continued their efforts in ensuring effective implementation of the Official Language Policy of the Government and encouraging progressively the use of Hindi in official work.

In compliance with the Constitutional and statutory requirements of Section 3(3) of Official Language Act as amended from time to time, all documents required to be issued bilingually are being issued bilingually by the Ministry. The agenda notes and the papers for the Chief Minister's Conference on Power held on 16.10.96 and 3.12.96 were issued both in Hindi and English. Similarly, all communications received in Hindi are replied to in Hindi compulsorily. The Sub-Committee of Parliament on Official Language has visited four offices under the ministry of power namely THDC, CPRI, NTPC and PGC and appreciated the efforts and achievement made in the progressive use of official language in these offices.

In compliance with the Official Language Policy, a 'Hindi Pakhwara' was celebrated in the Ministry of Power from 2.9.1996 to 16.9.1996 to step up the

use of Hindi in official work. Competitions in Hindi Essay Writing/Shorthand/typing were organised. Officers/employees of the Ministry took part in the competitions with zeal and the successful participants were awarded prizes.

### 11.3 CHIEF MINISTERS' CONFERENCE AND EVOLUTION OF COMMON MINIMUM NATIONAL ACTION PLAN ON POWER

The Ministry of Power convened Chief Ministers' Conference on 16th October and 3rd December, 1996 to discuss and deliberate the issues pertaining to the power sector. As a result of these discussions, a Common Minimum National Action Plan on Power has been formulated and circulated to the States and other Utilities on 31.12.1996. Some of the noteworthy features of the Action Plan are as below:

**State Electricity Regulatory Commission (SERC) :-** Each State/Union Territory shall set up an independent SERC. To start with these commissions will undertake only tariff fixation, Licensing, planning and other related functions could also be delegated to SERCs. Appeals against orders of SERCs will be to respective high courts unless any State Government prefers such appeals being made to the Central Electricity Regulatory Commission.

**Central Electricity Regulatory Commission (CERC):-** Union Government will set up a CERC. The agency will set the bulk tariffs for all central generating and transmission utilities. Licensing, planning and other related functions could also be delegated to CERC. All issues concerning inter-state flow and exchange of power shall also be decided by the CERC.

**Rationalization of Retail Tariffs:-** SERCs will ensure that the tariffs allow a minimum overall 3 per cent rate of return to each utility. Cross-subsidisation between categories of consumers per cent rate of return to each utility. Cross-subsidisation between categories of consumers may be allowed by SERCs. No sector shall, however, pay less than 50 per cent of the average cost of supply (cost of generation plus transmission



and distribution). Tariffs for agricultural sector will not be less than 50 paise per Kwh to be brought to 50 per cent of the average cost in not more than three years. Recommendations of SERCs are mandatory. If any deviations from tariffs recommended by it are made by a State/UT Government, it will have to provide for the financial implications of such deviations explicitly in the State budget.

### **PRIVATE SECTOR PARTICIPATION IN DISTRIBUTION:-**

State governments agree to a gradual programme of private sector participation in distribution of electricity. The process of private participation shall be initially in one or two viable geographical areas covering both urban and rural areas in a State.

**ROLE OF CENTRAL ELECTRICITY AUTHORITY:-** The Central Government would make a comprehensive review of the role of Central Electricity Authority (CEA).

Techno-economic approval of competitively bid power projects will be simplified and CEA shall not be concerned with capital cost, tariff and other commercial aspects of the project. Powers regarding approval of projects shall stand delegated to the States in respect of thermal power station upto 250 MW. However, in respect of thermal projects beyond 250 MW capacity and other schemes, CEA's appraisal will continue in respect of planning and other related matters. Subject to such technical clearances which shall be accorded within two months, state governments will have powers to accord approval for power projects.

**ENVIRONMENTAL CLEARANCES:-** Government of India will issue guidelines and delegate more powers to States. Ministry of Environment and Forests has proposed the following delegation to the States:

- All cogeneration plants and captive power plants upto 250 MW.
- Coal-based plants upto 500 MW using fluidised bed technology, subject to sensitive area restrictions.

- Power stations upto 250 MW on conventional technology.
- Gas/naphtha-based station upto 500 MW.

### **IMPROVEMENT OF PHYSICAL PARAMETERS**

- Government of India will carry out necessary amendments in the relevant Acts/Rules to allow private participation in transmission.
- State Government will provide higher allocation for early completion of public sector projects.
- Compulsory metering at sub-stations and on all major feeders would be introduced. Compulsory metering of all new electricity connections as also of connections to agriculture sector exceeding 10 HP will be undertaken and completed in two years. All electric supplies would be metered by A.D. 2002.
- Demonstration projects on energy efficient lighting. Compulsory annual energy audit of large consumers i.e., 100 KVA and above would be undertaken. Time of the day metering would be introduced for big power consumers for better load management.

### **COGENERATION/CAPTIVE POWER PLANTS**

To facilitate evacuation of power from these plants to the grids, states shall formulate clear and transparent policies for purchase of power and wheeling charges. The cogeneration/captive power plants could also sell power to a group of industries as well as other categories of consumers in the same industrial area.

### **SETTING UP OF WASHERIES**

Coal India Limited and its subsidiaries shall put up washeries at pitheads wherever necessary. In case CIL cannot set up the washery, private sector would be permitted to set up such washeries at pitheads. In either case, supply washing and transportation of coal shall be on the basis of legally enforceable commercial contracts.

## **11.4 VIGILANCE ACTIVITIES/ DISCIPLINARY CASES**

Steps are being taken to boost the vigilance activities in the Ministry. Stress is being laid on the

need for greater role of preventive vigilance. Presently, there are 11 vigilance/disciplinary cases, which are at the various stages of processing.

## 11.5 WELFARE OF MINORITIES

The Prime Minister's 15 Point programme on Welfare of Minorities is being implemented in the Ministry of Power. It has been ensured that in case of direct recruitment to Group "C" and "D" posts, a member of a minority community is included in the Selection Committee. Quarterly returns in respect of Scheduled Castes and Scheduled Tribes and minorities from Public Sector Undertakings are being regularly monitored in accordance with the guidelines on the subject.

	GROUP 'A'			GROUP 'B'			GROUP 'C'			GROUP 'D'		
Name of Office	Total	SC	ST	Total	SC	ST	Total	SC	ST	Total	SC	ST
Ministry of Power	34	4	-	97	11	-	103	20	-	69	32	3

## 11.6 RECREATION ACTIVITIES

The Ministry is promoting sports and cultural activities. Power Sports Control Board (PSCB), constituted as a nodal agency with the participation of Central Power Organisation i.e., Central Electricity Authority and all the public sector undertakings/autonomous bodies under the administrative control of the Ministry of Power, is arranging various tournaments in various disciplines every year, all over the country with the help of member organisations. The Board got formally registered as a society under the Societies Regulation Act, 1860 on May 13, 1994. The Ministry is encouraging the participation of its officers and staff in several other sports and cultural meets organised by the Central Civil Services Cultural and Sports Board.

## 11.7 GRIEVANCE CELL

The Grievance Cell of Ministry of Power dealt with 46 cases. Most of these cases relate to Pension, Pensionary Benefits, Transfer, Payfixation, Seniority, Employment on Compassionate Grounds etc. Out of these, 17 cases have been finally disposed off.

## 11.8 CONTROLLER OF ACCOUNTS

The office of the Controller of Accounts has four Pay & Accounts Offices, working under his payment

control viz., PAO, CEA, New Delhi; PAO (CEA), Bangalore; PAO (Sect.), New Delhi and PAO (BMCC), New Delhi. The monthly accounts of these offices are submitted regularly to Principal Accounts Offices, thereafter these are consolidated and sent to the Office of the Comptroller General of Accounts, Ministry of Finance. The monthly accounts are prepared after incorporating the financial transactions of the Ministry of Power in a detailed classified form. The payment on account of DCRG, Pension, Commuted value of pension, G.P.F. to the officials of the Ministry/Central Electricity Authority on retirement during the year by all the PAOs were made in time. The Principal Accounts office is also responsible for the preparation of Appropriation Accounts, Statement of Central Transaction (SCT) and Finance Account on annual basis for submission to the Comptroller General of Accounts (CGA). The principal Accounts Office also brought out the document "Accounts at a Glance" for 1994-95.

## COMPUTERISATION OF ACCOUNTS

The office of the Controller of Accounts utilises the software packages INTERGRATED MODULE FOR PROCESSING VOUCHER (IMPROVE) AND CONTROLLER'S ACCOUNTING (CONTACT) provided by CGA. The voucher level computerisation has been carried out in all the four PAOs. The consolidation of monthly accounts of all the PAOs in Ministry of Power is done by using the CONTACT software packages. Various other packages like SCT, MIS are also used for report Generations. Reports are also generated from the options provided in Report Generation menu in Contact. The accounts consolidated through the CONTACT programme are then sent by the Controller of Accounts to the Comptroller General of Accounts.

## 11.9 INTERNAL AUDIT WING

The Internal Audit Wing ensures adoption of sound procedure, regularities and financial propriety of transactions and accounts. This wing advises the DDOs and their staff for correct implementation of rules and maintenance of proper records. Internal Audit Wing also pursues the settlement of objections raised by the Statutory Audit.



Performance of the Internal Audit Wing during the year 1995-96 is as under:

Year (Accounts due for Audit during 1995-96)	No. of units due/inspected	No. of paras raised	No. of paras settled	No. of paras outstanding upto 31.3.96
1994-95	25/25	409	267	142

## 11.10 AUDIT OBSERVATIONS

The organisation-wise break-up of Audit observations and Inspection Report as on 31.3.1996 are as under :

Audit objections as on 31.3.1996

Sl. No.	Organisation	No. of Inspection Reports	Number of Paras
1.	Central Electricity Authority	4	19
2.	BTPP/BTPS	16	190
3.	Ministry of Power	6	57
4.	NPTI (including Institutes)	5	61
5.	C.P.R.I.	3	10
6.	E.M.C.	3	39
<b>PAY AND ACCOUNTS OFFICE/CONTROLLER OF ACCOUNTS</b>			
7.	PAO (CEA), New Delhi	6	18
8.	PAO (BMCC), New Delhi	1	4
9.	PAO (Sectt.), New Delhi	4	12
10.	PAO (CEA), Bangalore	1	5
<b>TOTAL</b>		<b>49</b>	<b>415</b>

## POWER SUPPLY INDUSTRY IN INDIA - HIGHLIGHTS

### STATEWISE GENERATING CAPACITY, ELECTRICITY GENERATION, SALES AND PER CAPITA CONSUMPTION

State/U.T.	**	**	#	@ @
	Capacity (MW)	Generation (MU)	Sales (GWH)	Percapita Consumption (KWH)
	1994-95	1994-95	1994-95	1994-95
Haryana	1780	7418	7624	467
Himachal Pradesh	274	1132	1380	254
J & K	362	879	1640	196
Punjab	3509	17175	15951	759
Rajasthan	1949	8773	11891	270
Uttar Pradesh	6075	21675	25524	204
Chandigarh	2	—	626	676
Delhi	585	2304	7826	747
Central Sector	9287	44652	—	—
<b>Total (N. Region)</b>	<b>23823</b>	<b>104008</b>	<b>72342</b>	<b>302</b>
Gujarat	4939	24934	23393	608
Madhya Pradesh	3864	16597	20452	335
Maharashtra	9987	46561	40888	500
Goa	—	—	702	602
Daman & Diu	—	—	170	1548
D & N Haveli	—	—	236	1574
Central Sector	5512	27019	—	—
<b>Total (W. Region)</b>	<b>24302</b>	<b>115111</b>	<b>85841</b>	<b>468</b>
Andhra Pradesh	5209	21141	23634	214
Karnataka	3378	16830	15989	364
Kerala	1492	6571	6975	237
Tamil Nadu	4737	19917	23615	430
Pondicherry	—	—	829	969
Lakshadweep	5	14	11	185
Central Sector	4640	27818	—	—
<b>Total (S. Region)</b>	<b>19461</b>	<b>92291</b>	<b>71053</b>	<b>369</b>





## APPENDIX - I

### POWER SUPPLY INDUSTRY IN INDIA - HIGHLIGHTS

#### STATEWISE GENERATING CAPACITY, ELECTRICITY GENERATION, SALES AND PER CAPITA CONSUMPTION

State/U.T.	** Capacity (MW)	** Generation (MU)	# Sales (GWH)	@ @ Per capita Consumption (KWH)
	1994-95	1994-95	1994-95	1994-95
Bihar	1765	2700	\$9718	134
Orissa	1952	5765	6326	333
West Bengal	3550	14296	\$11643	175
DVC	2242	6913	—	—
A&N Islands	29	74	56	178
Sikkim	34	59	66	143
Central Sector	2730	5994	—	—
<b>Total (E. Region)</b>	<b>12302</b>	<b>35801</b>	<b>27809</b>	<b>182</b>
Assam	597	1255	1676	98
Manipur	12	3	214	107
Meghalaya	194	378	268	140
Nagaland	7	3	77	59
Tripura	53	174	198	66
Arunachal Pradesh	39	69	62	66
Mizoram	25	20	86	112
Central Sector	356	1378	—	—
<b>Total (N.E. Region)</b>	<b>1283</b>	<b>3280</b>	<b>2581</b>	<b>96</b>
<b>TOTAL (ALL INDIA)</b>	<b>81171</b>	<b>350491</b>	<b>259630</b>	<b>320</b>

\*\* Utilities only

@ @ Utilities and Non Utilities

# To ultimate consumers by Utilities.

\$ Includes D.V.C.'s sale to ultimate Consumers in Bihar & West Bengal Area.

\* Provisional.

	Dec. 1950	1970-71	1980-81	1990-91	1994-95*
<b>II. SYSTEM PEAK DEMAND (AGGREGATE)</b>					
Utilities (MW)	—	9743	19121	40672	—
<b>III. FUEL CONSUMPTION</b>					
<b>Utilities Steam Stations</b>					
Coal (MTx 1006) <sup>6</sup>	2.22	14.59	35.82	112.90	161.27
Lignite (MT x 1006) <sup>6</sup>	—	2.54	3.98	9.62	14.08
Furnace Oil (Kilo Lts x 10) <sup>6</sup>	—	1.28	1.87	0.78	0.64
Diesel Oil (Kilo Lts x 10) <sup>6</sup>	—	0.04	0.22	0.27	0.38
<b>IV. AVERAGE GENERATION PER KW OF INSTALLED CAPACITY (KWH/KW) @ @</b>					
<b>(Utilities)</b>					
Hydro	4505	3956	4075	3820	3970
Steam	2377	3702	3672	4147	4663
Diesel & Gas	1342	917	1219	2976	3184
Nuclear	0	5757	3512	3924	2539
Overall	2982	3795	3772	4000	4318
<b>V. ELECTRICITY SALE (GWH)</b>					
<b>Utilities</b>					
Domestic	525	3840	9247	31982	47915
Commercial	309	2573	4682	11181	15973
Industrial	2604	29579	48069	84209	100126
Agriculture	162	4470	11489	50321	19301
Public Lighting	60	500	748	1648	2011
Railway Traction	308	1364	2266	4112	5886
Public Water Works & Sewage Pumping	189	1016	1534	3643	5037
Miscellaneous	—	382	1332	3261	3321
<b>Total</b>	<b>4157</b>	<b>43724</b>	<b>79367</b>	<b>190357</b>	<b>199570</b>

	Dec. 1950	1970-71	1980-81	1990-91	1994-95*
Average Annual Growth Rate (%) during the decade	6.34	12.19	6.55	8.74	8.57

## VI. PATTERN OF ELECTRICITY SALE (%)

### Utilities

Domestic	12.6	8.8	11.2	16.8	18.5
Commerical	7.5	5.9	5.7	5.9	6.1
Industrial	62.6	67.6	58.4	44.2	38.6
Agriculture	3.9	10.2	17.6	26.4	30.5
Others	13.4	7.5	7.1	6.7	6.3

## VII. ELECTRICITY CONSUMPTION

### Utilities/Non Utilities

Per 1000 of Population (KWH)	15550	89760	13240	252770	320100
Per 1000 Sq. Kms. of area in (GWH)	1.69	15.35	25.05	64.35	88.02
Per MW of connected Load (GWH)	1.86	1.85	1.34	1.57	1.57
Per 1000 consumers (GWH)	3.52	3.31	2.53	2.73	2.01

## VIII. PER CAPITA(KWH)

### (Utilities+Non-Utilities)

Generation	18.17	113.29	175.95	345.87	426.52
Consumption	15.55	89.76	132.34	252.77	320.10

## NO. OF CONSUMERS (Thousand)

Domestic	1157	10165	22338	50389	63409
Commercial	259	2306	4582	8002	9558
Industrial	**63	553	1150	2077	2423
Agriculture	19	1571	4233	8631	10372
Others	3	70	268	534	637

<b>Total</b>	<b>1501</b>	<b>14665</b>	<b>32571</b>	<b>69633</b>	<b>86399</b>
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@ @ The Figures given under this table indicate the generation in KWH during the year per KW of installed capacity at the end of year.

\* Provisional

— Data not available

	Dec. 1950	1970-71	1980-81	1990-91	1994-95*
<b>IX. CONNECTED LOAD (MW)</b>					
Domestic	734	5986	13079	32051	51590
Commercial	401	1911	4494	8341	12123
Industrial	**1562	11631	24844	42947	54235
Agriculture	118	6225	16489	32511	40108
Others	20	477	2492	5051	7445
<b>Total</b>	<b>2835</b>	<b>26230</b>	<b>61398</b>	<b>120901</b>	<b>165501</b>

**X. LENGTH OF T & D LINES  
(Circuit Kms)**

H V D C	—	—	—	—	1667
400 KV	—	—	2340	21634	28025
230/220 KV	—	11211	31834	62345	75572
132/110 KV	2708	46160	59738	87965	96551
78/66/44 KV	7431	25679	26752	34947	37675
33/22 KV	5022	95073	163882	212267	231348
15/11/66/33/22 KV	14110	362628	784513	1329774	1509070
Distribution Lines	—	576323	1453402	2784482	3038500
<b>Total</b>	<b>—</b>	<b>1117074</b>	<b>2522461</b>	<b>4533414</b>	<b>5018408</b>

**XI. TRANSFORMATION CAPACITY (MVA)**

Step up	972.81	16256.24	37094	75823	97153
Step down	1366.76	34726.70	97882	207595	256645
Distribution	834.37	17048.84	43829	87501	139976

**XII. SYSTEM LOSSES(%)**

<b>All India</b>	<b>15.83</b>	<b>17.50</b>	<b>20.56</b>	<b>22.89</b>	<b>21.13</b>
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**XIII. ELECTRICITY SOLD DURING, 1994-95\* (GWH) (UTILITIES)**

	Domestic	Commercial	Industrial	Agricultural	Others	Total
<b>Region</b>						
Northern	16166	5528	22110	23883	4655	72342
Western	12934	4188	36077	27153	5489	85841
Southern	12182	3672	26823	25330	3050	71057
Eastern	5914	2317	14163	2846	2569	27809
North Eastern	719	268	953	89	552	2581
<b>Total</b>	<b>47915</b>	<b>15973</b>	<b>100126</b>	<b>79301</b>	<b>16315</b>	<b>259630</b>

@ Estimated

(\$) Figures ending March 1951

\*\* Including water works & traction

— Data not available

\* Provisional



# ELECTRICITY STATISTICS AT A GLANCE

## ELECTRICITY-INSTALLED CAPACITY, GENERATION & CONSUMPTION

	Unit	1990-91	1991-92	1992-93	1993-94	1994-95
<b>1. Installed Capacity</b>						
Utilities + Non-Utilities	MW	74699	78367	82375	87475	92332
Utilities	MW	66086	69065	72330	76753	81171
Hydro	MW	18753	19194	19576	20379	20833
Nuclear	MW	1565	1785	2005	2005	2225
Thermal (Coal)	MW	43004	44792	46597	49147	52139
Oil & Gas	MW	2764	3294	4152	5222	5974
Non-Utilities	MW	8613	9302	10045	10722	11161
<b>2. Generation</b>						
Utilities + Non-Utilities	BU	289.44	315.63	332.71	356.33	385.56
Utilities	BU	264.33	287.03	301.36	324.05	350.49
Hydro	BU	71.64	72.76	69.87	70.46	82.71
Nuclear	BU	6.14	5.53	6.73	5.40	5.65
Thermal (Coal)	BU	178.32	1973.16	211.12	233.15	243.11
Oil & Gas	BU	8.23	11.58	13.64	15.04	19.02
Non-Utilities	BU	25.11	28.60	31.35	32.28	35.07
<b>3. Consumption</b>						
Utilities + Non-Utilities	BU	210.15	229.52	245.47	265.45	289.42
Industrial	BU	105.35	110.60	116.15	121.36	129.83
Transport	BU	4.14	4.54	5.09	5.64	5.91
Agriculture	BU	50.32	58.56	63.33	70.70	79.30
Domestic Commercial and Services (\$)	BU	50.34	55.82	60.90	67.75	74.38
<b>3. A Auxiliary Consumption</b>						
Utilities + Non-Utilities	BU	22.77	24.67	25.68	27.32	28.05
T&D Losses	BU	56.52	61.44	61.56	65.01	69.57

(\$)



