

### Performance review relating to Statutory Corporation

#### Kerala State Electricity Board

### 3. Performance Review on the Generation activities of Kerala State Electricity Board

#### Executive Summary

##### **Introduction**

One of the core objectives of 11<sup>th</sup> Five Year Plan (2007-12) has been “Supply of power to all” by the end of the plan period. The National Electricity Policy (NEP) 2005 declared by Central Government, also envisaged development of power sector based on optimal utilisation of resources like coal, gas, nuclear material, hydro and renewable sources of energy. This performance audit covering the period 2005-06 to 2009-10 was conducted to examine as to what extent the State of Kerala has equipped itself to achieve the stated plan objective. Overall efficiency of the State Power undertaking namely, Kerala State Electricity Board (Board), in utilising the existing resources, and planning for the sustained development of power sector in the State was also evaluated as a part of this audit study.

##### **Salient features of power sector in Kerala**

Kerala is a power deficient State, where the requirement and available capacity were in the order of 2998 MW and 2563.25 MW (Board- 2126.48, Others- 436.77 MW) respectively, as at the end of the year 2009-10. The growth in demand in the State during the review period was 546 MW whereas capacity addition was only 124.30 MW. The energy sources in the State were predominantly hydel. During the review period, actual generation of power in the State was only 70 to 82 per cent of average demand and 62 to 77 per cent of peak demand.

##### **Status of capacity additions**

Capacity addition plans of Board were not realistic. Assessment in audit disclosed that the likely capacity addition during 11<sup>th</sup> plan will be about 21 per cent of targets (610.15 MW). As against five projects of Board included in National Electricity Plan for capacity addition during 11<sup>th</sup> plan viz., Kuttiady Additional Extension (100 MW), Athirappally (163 MW), Pallivasal Extension (60 MW), Thottiyar (40 MW) and Mankulam (40 MW) only the first one, which spilled over from 10<sup>th</sup> plan, is commissioned (May 2010) during the plan period.

##### **Project Implementation**

Though the State was having identified but untapped hydel generation potential, new project proposals of Board in hydel sector were either getting abandoned due to non-receipt of Forest / Environmental clearances or their implementation made difficult on account of problems connected with land acquisition. Delay in land acquisition has already affected the implementation schedules of all projects executed / under execution during plan period. The project implementation processes were also quite slow paced. The investigation and preparation of Draft Project Reports often took time in excess of five years, as against the normal period of two years reckoned in the National Electricity Plan. Inadequacies in investigation had led to design changes during course of construction and consequent time and cost overrun. Deficiencies in Project Management had resulted in time / cost overrun. Delay in decision making at different stages of

construction caused further slippages in time schedules.

#### **Renovation and Modernisation of existing stations**

As on 31.3.2010, Renovation and Modernisation works of power plants at Poringalkuthu, Sholayar and Kuttiady were overdue, but got postponed for different reasons. High incidence of machine outages was noticed in all these stations. Generation losses to the tune of ₹ 12.60 crore occurred due to outages of machines, when the dams were spilling. Post RMU performance of machines of Pallivasal and Sabarigiri Stations was not successful. The re-conditioned machines developed serious technical problems at both the stations. The runner buckets of three of the machines of Pallivasal were developing frequent pitting and cracks, resulting in generation losses, due to machine outages for runner-repairs. Machine no.4 of Sabarigiri station commissioned after RMU works in February 2007 exploded in May 2008, causing damages and losses. The explosion was attributed to manufacturing defects.

#### **Plant Availability**

As against CERC norm of 80 per cent plant availability during 2004-09, the average plant availability in KSEB was 76.36 per cent for major Hydel stations, 37.16 per cent for small HEPs and 46.47 per cent for Thermal stations. High rate of breakdowns as a result of inadequate maintenance operations lowered the plant availability.

#### **Poor performance of Small HEPs**

None of the 10 independent SHEPs have been giving satisfactory performance. The actual output for all the five years was lower than potential output. The overall short generation was 195.42 MU.

#### **Input efficiency**

Diesel power stations of the Board at Brahmapuram and Kozhikode were mainly operated as peak load stations due to high operational costs. Timely maintenance operations were also not undertaken due to delay in decision making on the basis of cost-benefit

considerations. Generation losses due to inadequate fuel stock and consumption of fuel in excess of norms were also noticed at these stations. Owing to curtailed operations on considerations of cost, the plant load factor of diesel stations was only in the range of 5.97 per cent to 38.98 per cent during the review period.

#### **Financial Management**

As observed in audit, decisions on project financing were being taken without active involvement of Finance Wing and the system lapse caused drawal of high interest bearing loans without genuine requirement and resultant cost overrun.

Project Accounts were being closed years after their completion and no effective system of post implementation evaluation of projects was in place.

Instances of drawal of excess payments by project contractors against LCs, resulted out of deficiencies in contract payment terms as well as bill passing systems were also noticed.

#### **Conclusions and recommendations**

Power potential from non-conventional energy sources was not adequately developed by the state despite liberal financial assistance from Central Government. Forest / environmental clearances were the major hurdles faced by the Board in implementing new projects.

Capacity constraints and financial problems too prevented the Board from undertaking R & M activities of the existing HEPs and those carried out were also not fully successful. PLF of thermal plants of the Board were very low due to curtailed operation.

The review contains nine recommendations:

The Board should evolve an action plan on priority basis to expedite the implementation of 11<sup>th</sup> Plan projects and avoid slippages. Policy guidelines from Government in matters of forest clearances, land acquisition and rehabilitation of people affected by projects would be helpful to the Board in its efforts to meet the targets for capacity addition. Project investigation-systems

*have to be strengthened by incorporating collective decision making in the initial stages itself to avoid inadequacies in designs at later stages. The Board should establish proper system for project monitoring enabling the flow of management information to the top management on time to take decisions on project management. The performance standards of contract agencies engaged by the Board were wanting in many respects. This highlighted the need for more stringent pre-qualification norms while*

*short listing the contract agencies. Preventive maintenance schedules of the power stations have to be adhered to with more regularity and consistency. Cost benefit aspects of operation of Thermal Stations have to be examined more closely with updated and accurate cost data and possibility to optimise the utilisation examined with a view to contain the operational cost. System of maintenance of project accounts should be strengthened to avoid undue delay in closure of accounts.*

## Introduction

**3.1** Power is an essential requirement for all facets of life and has been recognised as a basic human need. The availability of reliable and quality power at competitive rates is very crucial to sustain growth of all sectors of the economy. The Electricity Act 2003 provides a framework conducive to development of the Power Sector, promote transparency and competition and protect the interest of the consumers. In compliance with Section 3 of the *ibid* Act, the Government of India (GOI) prepared the National Electricity Policy (NEP) in February 2005 in consultation with the State Governments and Central Electricity Authority (CEA) for development of the Power Sector based on optimal utilisation of resources like coal, gas, nuclear material, hydro and renewable sources of energy. The Policy aims at, *inter alia*, laying guidelines for accelerated development of the Power Sector. It also requires CEA to frame National Electricity Plan (NE Plan) once in five years. The Plan would be short term framework of five years and give a 15 years' perspective.

**3.2** At the beginning of 2005-06, electricity requirement in the State of Kerala was assessed as 12698 Million Units (MU) of which only 6629.06 MU were available leaving a shortfall of 6068.94 MU, which works out to 47.79 *per cent* of the requirement. The total installed power generation capacity in the State of Kerala was 2618.74 Mega Watt (MW) (Kerala State Electricity Board (KSEB)-2047.23 MW, Others-571.51 MW) and effective available capacity was 2438.95 MW (KSEB-2047.23 MW, Others-391.72 MW) against the peak demand of 2452 MW leaving deficit of 13.05 MW. As on 31 March 2010 the comparative figures of requirement and available capacity were 2998 MW<sup>1</sup> and 2563.25 MW (KSEB-2126.48 MW, Others-436.77 MW) with deficit of 434.75 MW. Thus there was a growth in demand of 546 MW<sup>2</sup> during review period, whereas the capacity addition was only 124.30 MW (KSEB-79.25 MW, Others-45.05 MW).

**3.3** In Kerala, generation of power is carried out by Kerala State Electricity Board (Board), a statutory body constituted on 01-04-1957 under Section 5 of the Electricity Supply (Act), 1948 for the coordinated development of

<sup>1</sup> Requirement in terms of MU- 17200 MU.

<sup>2</sup> Growth in demand in terms of MU – 4502 MU.

Generation, Transmission and Distribution of electricity in the State of Kerala under the administrative control of the Power Department of the Government of Kerala. As per Section 172 (a) of the Electricity Act 2003 and as mutually decided by the Government of India and the State Government, Board has continued as Transmission utility and Distribution licensee till 24-09-2008. In exercise of powers conferred under Section 131 of the Electricity Act, 2003, State Government has vested (September 2008) all functions, properties, interests, rights, obligations and liabilities of Board with it till it is re-vested in a corporate entity. Accordingly, Board has been continuing all the functions as a Generation utility, State Transmission Utility and a Distribution Licensee in the State.

**3.4** The Management of the Board is vested with a Board of Directors comprising of Chairman, Technical Members for Generation, Transmission and Distribution, Member (Finance), two ex-officio members and one non-official member, all appointed by the State Government. The day-to-day operations are carried out by the Chairman, who is the Chief Executive with the assistance of Members, Chief Engineers and Financial Adviser. As on 31 March 2010 the Board had 24 hydro generation stations, two thermal generation stations and one renewable energy station with the installed capacities of 1889.85 MW, 234.60 MW and 2.03 MW respectively.

**3.5** The turnover of the Board was ` 5349.82 crore in 2008-2009 equal to 48.13 *per cent* and 2.97 *per cent* of the State PSUs' turn over and State Gross Domestic Product, respectively. Out of total turnover of ` 5349.82 crore, the Board's turnover from generation activities was to the tune of ` 722.43 crore. It employed 28043 employees as on 31 March 2010 of which 1038 employees were deployed in generating activities of the Board.

### **Scope and Methodology of Audit**

**3.6** The present review conducted during February 2010 to May 2010 covers the performance of the Board in respect of generation activities only during the period from 2005-06 to 2009-10. The review mainly deals with Planning, Project Management, Financial Management, Operational Performance, Environmental Issues and Monitoring by Top Management. The audit examination involved scrutiny of records at the Head Office and 17 out of 27 generating stations. All major hydel generating stations, except for Kakkad and both thermal stations, with gross installed capacity of 2035.85 MW (95.74 per cent of total installed capacity) were reviewed.

**3.7** The methodology adopted for attaining the audit objectives with reference to audit criteria consisted of explaining audit objectives to top management, scrutiny of records at Head Office and selected units, interaction with the auditee personnel, analysis of data with reference to audit criteria, raising of audit queries, discussion of audit findings with the Management and issue of draft review to the Management for comments.

## Audit Objectives

**3.8** The objectives of the performance audit were:

### Planning and Project Management

- To assess whether capacity addition programme taken up / to be taken up to meet the shortage of power in the State is in line with the National Policy of Power for All by 2012;
- To assess whether a plan of action is in place for optimisation of generation from the existing capacity;
- To ascertain whether the contracts were awarded with due regard to economy and in transparent manner;
- To ascertain whether the execution of projects were managed economically, effectively and efficiently;
- To ascertain whether hydro projects were planned and formulated after taking into consideration the optimum design to get the maximum power, dam design and safety aspects; and
- To ascertain whether the Board had taken up the projects under non-conventional sources such as wind, solar, biomass etc., and tap generation from captive power sources.

### Financial Management

- To ascertain whether the projections for funding the new projects and upgradation of existing generating units were realistic including the identification and optimal utilisation for intended purpose;
- To assess whether all claims including energy bills and subsidy claims were properly raised and recovered in an efficient manner; and
- To assess the soundness of financial health of the Board.

### Operational Performance

- To assess whether the power plants were operated efficiently and preventive maintenance as prescribed was carried out minimising the forced outages;
- To assess whether requirements of each category of fuel worked out realistically, procured economically and utilised efficiently;

- To assess whether the manpower requirement was realistic and its utilisation optimal;
- To assess whether the life extension (renovation and modernisation) programme were ascertained and carried out in an economic, effective and efficient manner; and
- To assess the impact of R&M / LE<sup>3</sup> activity on the operational performance of the Unit.

### **Environmental Issues**

- To assess whether the various types of pollutants (air, water, noise, hazardous waste) in power stations were within the prescribed norms and complied with the required statutory requirements; and
- To assess the adequacy of waste management system and its implementation.

### **Monitoring and Evaluation**

- To ascertain whether adequate MIS existed in the entity to monitor and assess the impact and utilise the feedback for preparation of future schemes; and
- To ascertain whether a documented and proper disaster management system was in place in all generating units.

## **Audit Criteria**

**3.9** The audit criteria adopted for assessing the achievement of the audit objectives were:

- National Electricity Plan, norms / guidelines of Central Electricity Authority (CEA) regarding planning and implementation of the projects;
- standard procedures for award of contract with reference to principles of economy, efficiency and effectiveness;
- targets fixed for generation of power ;
- parameters fixed for plant availability, Plant Load Factor (PLF) etc;
- comparison with best performers in the regions / all India averages;
- prescribed norms for planned outages; and

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<sup>3</sup> Repairs Maintenance/Life Extension.

- Acts relating to Environmental laws.

### Financial Position and Working Results

**3.10** The financial position of the Board for the four years ending 31 March 2009 was as given below.

(` in crore)

Particulars	2005-06	2006-07	2007-08	2008-09
<b>A. Liabilities</b>				
Paid up Capital	1553.00	1553.00	1553.00	1553.00
Reserves and Surplus (including capital grants but excluding depreciation reserve)	3091.41	3536.11	4055.27	4683.59
Borrowings (Loan Funds)				
Secured	3713.62	2498.52	1856.72	1100.36
Unsecured	...	...	...	...
Current Liabilities & Provisions	5018.79	3422.82	3812.35	4472.61
<b>Total</b>	<b>13376.82</b>	<b>11010.45</b>	<b>11277.34</b>	<b>11809.56</b>
<b>B. Assets</b>				
Gross Block	7711.62	8216.85	8684.56	9249.12
Less: Depreciation	2664.28	3070.27	3489.36	3924.10
Net Fixed Assets	5047.34	5146.58	5195.20	5325.02
Capital works in progress	1152.26	1184.48	1090.49	1171.12
Investments	16.52	16.48	16.48	25.80
Current Assets Loans and Advances*	7160.70	3060.61	3772.87	4085.32
Accumulated Losses				
Miscellaneous Expenditure	...	1602.30	1202.30	1202.30
<b>Total</b>	<b>13376.82</b>	<b>11010.45</b>	<b>11277.34</b>	<b>11809.56</b>

\*Includes regulatory asset during the four years 2005-09 and intangible asset (` 0.69 crore) in 2008-09.

The Board's financial position during 2005-2009 showed improving trend due to:

- Reduction in system losses, improvement in revenue assessment and collection consequent to replacement of faulty meters / static meters with electronic meters, effective anti theft activities and partial revision in tariff during 2007-08;
- Swapping of high cost loans; and
- Good storage of water in the hydel reservoirs except during 2008-09. Consequent increase in cash flow also enabled reduction in long term borrowings with higher interest burden.

The 'reserves and surplus' position shown in the balance sheet was, after adjusting subsidy / regulatory asset representing revenue gap (for the purpose of meeting Central Electricity Regulatory Commission's (CERC) stipulation of 14 per cent return on equity). The revenue gap so adjusted, however, got reduced from ` 144.56 crore in 2005-06 to ` 91.28 crore in 2007-08, but increased to

` 749.17 crore during 2008-09 due to increased power purchase necessitated by failure of monsoon.

The debt equity ratio of the Board varied from 2.39:1 during 2005-06 to 0.71:1 during 2008-09 as a result of repayment of high cost loans, equity remaining constant.

**3.11** The Board did not keep activity-wise accounts of income and expenditure and therefore, the statement below has been prepared adopting expenditure figures apportioned to 'Generation activity' (ie., whole expenses of Generation Wing plus allocated finance charges<sup>4</sup>) and, in the same way apportioning gross revenue in the ratio of expenditure allocated to each activity. The details of working results like cost of generation of electricity, revenue realisation, net surplus / loss and earnings and cost per unit of operation are given below:

**Cost of generation of electricity vis-à-vis revenue realisation of Generation Profit Centre**

*Y Information not available*

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<sup>4</sup> Basis of allocation not on record.



Sl No	Description	2005-06	2006-07	2007-08	2008-09
		( ` in crore)			
1	Income				
	Revenue	626.96	447.34	627.31	718.54
	Other income including interest/subsidy	0.92	1.18	0.66	3.89
	Total Income	627.88	448.52	627.97	722.43
2	Generation				
	Total Generation (in MUs)	7600.78	7745.78	8703.55	6494.50
	Less: Auxiliary Consumption (in MUs)	46.42	50.67	55.86	54.06
	Total generation available for Transmission and Distribution (in MUs)	7554.36	7695.11	8647.69	6440.44
3	Expenditure				
(a)	Fixed Cost				
(i)	Employees Cost (less expenditure capitalised)	35.41	32.22	31.49	48.89
(ii)	Administrative and General Expenses	3.77	4.98	5.29	5.28
(iii)	Depreciation	139.02	145.64	110.08	110.48
(iv)	Interest and Finance charges (net) <sup>5</sup>	196.09	0.02	0.01	0.03
	Total fixed cost	374.29	182.86	146.87	164.68
(b)	Variable cost				
(i)	Fuel consumption				
	(a) Coal				
	(b) Oil	51.09	111.53	195.73	414.59
	(c) Gas				
	(d) Naphtha				
	(e) Other fuel related cost including shortages / surplus				
(ii)	Cost of water (hydel/thermal/gas/others)				
(iii)	Lubricants and consumables	0.21	0.30	0.24	0.37
(iv)	Repairs and maintenance	9.31	5.12	7.02	14.92
	Total variable cost	60.61	116.95	202.99	429.88
(c)	Total cost 3(a)+3(b)	434.90	299.81	349.86	594.56
4	Realisation (per unit) `	0.831	0.583	0.726	1.122
5	Fixed Cost (per unit) `	0.495	0.238	0.170	0.256
6	Variable cost (per unit) `	0.080	0.152	0.235	0.667
7	Total cost per unit (5+6) `	0.575	0.390	0.405	0.923
8	Contribution (4-6) per unit `	0.751	0.431	0.491	0.455
9	Profit /Loss(-) per unit (4-7) `	0.256	0.193	0.321	0.199

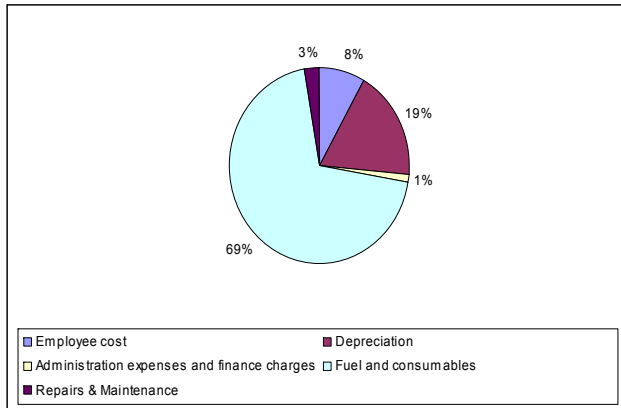
<sup>5</sup> Basis of allocation not on record.

The generation activity was marginally profitable during the review period since own generation at normal level could be maintained during most of these years. The reduction in interest and finance charges also significantly contributed to the positive working results.

**Elements of Cost**

**3.12** Fuel for thermal stations and depreciation constituted the major elements of cost for the Generation profit centre. The percentage break up of allocated costs of Generation Profit Centre for 2008-09 is given below in the pie chart.

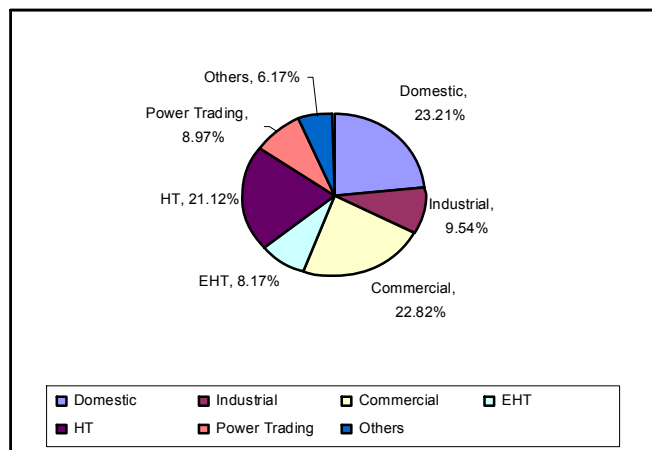
**Components of various elements of cost**



For the Board as a whole, purchase of power was the major element of cost accounting for 55.69 per cent followed by employee cost (20.46 per cent), depreciation (7.08 per cent), cost of own generation (6.76 per cent) interest and finance charges (5.54 per cent) and other operational expenses (4.47 per cent).

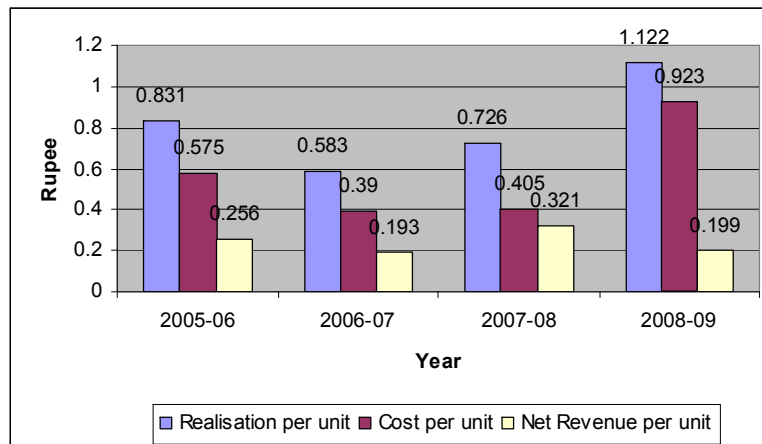
**Elements of revenue**

**3.13** Sale of Power constitutes almost 100 per cent of Board’s revenue. Segment-wise distribution of revenue was as indicated below:



### Recovery of cost of operations

**3.14** The revenue realisation covered up the cost during the four years 2005-09. The trends of recovery of cost of operations are shown in the graph given below:-



### Audit Findings

**3.15** We explained the audit objectives to the Board / Government during an ‘entry conference’ (March 2010). Subsequently, we reported the findings to the Board and the State Government in July 2010 and discussed in an ‘exit conference’ (August 2010) which was attended by Principal Secretary to Government of Kerala, Power Department and Special Officer, Kerala State Electricity Board. The Board / Government replied to audit findings in August 2010. The views expressed by them have been considered while finalising this review. The audit findings are discussed below.

### Operational Performance

**3.16** The operational performance of the Board for the five years ending 2009-10 is given in the *Annexure 14*. The performance was evaluated on various operational parameters as described below. It was also seen whether the Board was able to maintain pace in terms of capacity addition with the growing demand for power in the State. Audit findings in this regard are discussed in the subsequent paragraphs. These audit findings show that the generation losses were controllable and there was scope for improvement in performance.

### Planning

**3.17** NEP aims for availability of over 1,000 Units of electricity per capita by 2012, for which it was estimated that need based capacity addition of more than 1,00,000 MW would be required during 2002-2012 in the country. The Government has laid emphasis on the full development of hydro potential being cheaper source of energy as compared to thermal. The Central Government

would support the State Government for expeditious development of hydro power projects by offering the services of Central Public Sector Undertakings like NHPC<sup>6</sup> NTPC<sup>7</sup> and NEEPCO<sup>8</sup>. In order to fully meet both energy and peak demand by 2012, there is need to create adequate reserve capacity margin. In addition to enhancing the overall availability of installed capacity to 85 *per cent*, a spinning reserve of at least five *per cent* would need to be created. Besides, environmental concerns would have to be suitably addressed through appropriate advance actions. The power availability in the State indicating own generation, purchase of power, peak demand and net deficit was as under.

**3.18** During the period 2005-10, the actual generation in the State was substantially less than the peak as well as average demand as given below:

Year	Generation within the State (MW)	Peak demand (MW)	Average demand (MW)	Percentage of actual generation to average demand	Percentage of actual generation to peak demand
2005-06	1804	2624	2406	74.98	68.75
2006-07	2143	2880	2627	81.58	74.41
2007-08	1864	3020	2666	69.92	61.72
2008-09	1953	2931	2499	78.15	66.63
2009-10	2305	2998	2854	80.76	76.88

As may be seen from the above, the actual generation was only 69.92 to 81.58 *per cent* of the average demand and 61.72 to 76.88 *per cent* of the peak demand. However, the total supply even after import was not sufficient to meet the peak demand, as given below:

Year	Peak demand (MW)	Peak demand met (MW)	Sources of meeting peak demand		Peak deficit (Percentage of peak demand)
			Own (MW)	Import (MW)	
2005-06	2624	2578	1804	774	1.75
2006-07	2880	2742	2143	599	4.79
2007-08	3020	2745	1864	881	9.11
2008-09	2931	2765	1953	812	5.66
2009-10	2998	2998	2305	693	-

**Even after import of power, shortfall of power to peak hour demand ranged between 46 to 275 MW.**

**3.19** There remained a shortfall of 46 to 275 MW (about 1.75 *per cent* to 9.11 *per cent* of the peak demand) even after import except in 2009-10. Consequently rotational (cyclic) load shedding was forced on the populace for 14 days in 2007-08, 278 days in 2008-09 and 17 days in 2009-10. Station-wise shortfall in generation is discussed in paragraphs 3.55 and 3.56 *infra*.

Management stated (August 2010) that all efforts to meet consumer demand were taken and any restrictions imposed were on account of transmission constraints, low inflow, forced outages of machines and maintenance needs of major stations.

<sup>6</sup> National Hydro Power Corporation Limited.

<sup>7</sup> National Thermal Power Corporation Limited.

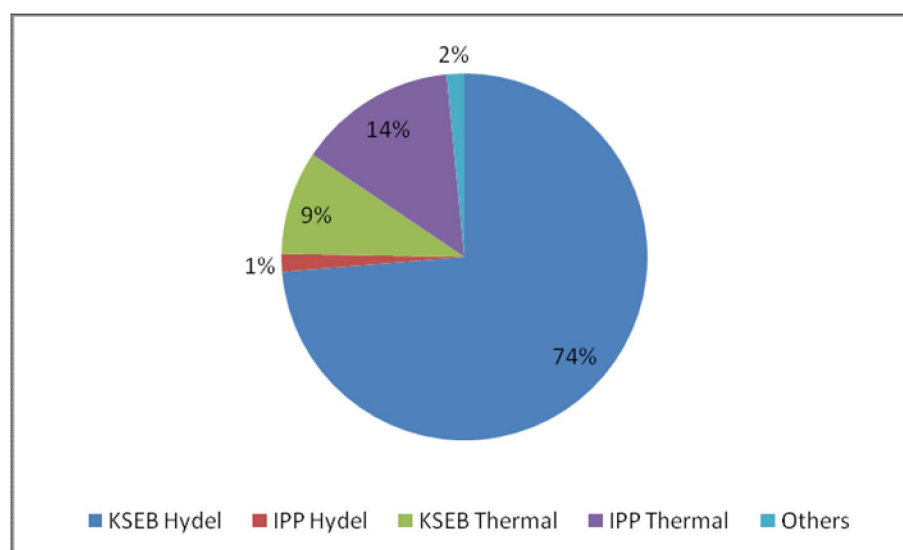
<sup>8</sup> North Eastern Electric Power Corporation Limited.

The fact, however, remains that the main reason for load shedding was the capacity constraints of the State to meet the growing electricity demand from own generation.

**3.20** This section deals with capacity additions and optimal utilisation of existing facilities.

### *Capacity Additions*

**3.21** The State had total effective capacity of 2438.95 MW at the beginning of 2005-06 and increased to 2563.25 MW at the end of 2009-10. The break up of generation capacity as on 31 March 2010, under thermal, hydro, Central, IPP and others is shown in the pie chart below.



**3.22** To meet the energy generation requirement of 17200 MUs in the State during 2009-10, a capacity addition of about 2627.37 MW was required during 2005-06 to 2009-10, at the existing plant load factor (PLF).

**3.23** The projects categorised as ‘Projects under Construction’ (PUC) and ‘Committed Projects’ (CP) earmarked for capacity addition during Plan period according to NE Plan are detailed below.

(In MW)

Sector	Thermal	Hydro	Non-conventional Energy	Total (for Plan period)	Additions planned for review period
PUC	...	263 <sup>10</sup>	...	263	100
CP	...	140 <sup>11</sup>	...	140	...
<b>Total</b>		<b>403</b>		<b>403</b>	<b>100</b>

<sup>9</sup> National Electricity Plan defines Committed Projects as projects for which the formal approval to take up the same has been granted by CEA.

<sup>10</sup> Athirappally (163 MW) and Kuttiady Additional Extension (100 MW).

<sup>11</sup> Pallivasal (60 MW), Mankulam (40 MW) and Thottiyar (40 MW).

**3.24** The NE Plan had incorporated only major Hydro Electric Projects (HEPs) as state specific projects and indicated overall national target of 14000 MW for Small Hydro Electric Projects (SHEPs<sup>12</sup>) without identifying them state wise. The Board, in its 11<sup>th</sup> Plan approach paper, targeted overall capacity addition of 610.15 MW during Plan period which included 20 SHEPs with a total generation potential of 149.15 MW. The Achencoil (30 MW) and Chinnar (28 MW) HEPs, did not form part of 11<sup>th</sup> Plan targets in the NEP; but were identified as projects earmarked for commissioning during 12<sup>th</sup> Plan. These projects were however included by Board in 11<sup>th</sup> Plan itself envisaging capacity addition during 2011-12. Thus, Board's capacity addition plans, to the extent of 403 MW (610.15 – (149.15+58)) only were specifically recognised in NE Plan. The particulars of capacity additions envisaged by KSEB, actual additions and peak demand vis-à-vis energy supplied during review period are given below.

Sl.No	Description	2005-06	2006-07	2007-08	2008-09	2009-10 (Provisional)
1.	Capacity at the beginning of the year (MW)	2047.23	2068.23	2085.73	2090.73	2123.23
2.	Additions Planned for the year as per NE Plan (MW) (11 <sup>th</sup> Plan)				100.00 <sup>13</sup>	
3.	Additions planned by the Board (MW)	185.00	200.00	132.50	10.80	41.00
4.	Actual Additions (MW)	21.00	17.50	5.00	32.50	3.25
5.	Capacity at the end of the year (MW) (1 + 4)	2068.23	2085.73	2090.73	2123.23	2126.48
6.	Shortfall in capacity addition (MW) (3-4)	164.00	182.50	127.50	Nil	37.75
7.	Energy requirement (MUs)	13760.00	14549.00	15384.00	16266.00	17200.00
8.	Energy supplied (MUs)	13618.96	14798.06	15375.55	15606.09	17335.58
	a) Energy produced (MUs)	7554.36	7695.11	8647.69	6440.44	7189.52
	b) Energy Purchased (MUs) (net of sale)	6064.60	7102.95	6727.86	9165.65	10146.06
<b>9.</b>	<b>Surplus(+)/ Shortfall(-) in meeting demand (MUs)</b>	<b>(-)141.04</b>	<b>(+)249.06</b>	<b>(-)8.45</b>	<b>(-)659.91</b>	<b>(+)135.58</b>

**3.25** The actual capacity addition by KSEB during 2005-10 was 79.25 MW (13.92 per cent) (*Annexure 15*) as against 569.30 MW planned, leaving shortfall of 490.05 MW. The State was not in a position to meet the demand as the power generated by Board as well as power purchased fell short to the extent of 8.45 MUs to 659.91 MUs during review period, except for 2006-07 and 2009-10.

We observed that:-

<sup>12</sup> Hydel projects with capacity of less than 25 MW.

<sup>13</sup> Kuttiyadi Additional Extension Scheme (100 MW) planned for 2008-09 and Athirappally (163 MW), Pallivasal (60 MW), Thottiyar (40 MW) and Mankulam (40 MW) planned for 2010-11.

- The capacity addition plans of the Board were unrealistic. These were made without adequate preparedness for implementation and before obtaining forest / environmental clearances wherever required, as discussed in paragraphs 3.38 to 3.43. The Ministry of Environment and Forests, GOI had not yet cleared (October 2010) Athirappally HE Project (163 MW) which was the single largest project planned for implementation during 11<sup>th</sup> Plan period.

The execution of other three projects included under NE Plan viz., Pallivasal, Mankulam and Thottiyar HEPs also were behind schedule as the Board failed in completing land acquisition process within the projected time frame. Pallivasal Project also encountered material changes in design parameters of water conductor system, due to discrepancies in project investigation. These three projects were bound to spill over to 12<sup>th</sup> Plan. Out of five projects identified by CEA for capacity addition during 11<sup>th</sup> Plan, only one Project viz., Kuttiadi Additional Extension – 100 MW (slipped over from 10<sup>th</sup> Plan) could be commissioned during the plan period, recording only 24.81 *per cent* achievement of specific target (403 MW) fixed for the State in the NE Plan.

- Generation potential of five projects included under the plan proposals was incorrect. The capacity projected was 87 MW as against actual of 67.75 MW.
- Out of 27 projects planned by KSEB for commissioning during 11<sup>th</sup> Plan, envisaging capacity addition of 610.15 MW, 18 projects with proposed capacity of 367.35 MW (60.21 *per cent*) have not yet been taken up (October 2010) for execution though the Plan period ends by 2012. Based on status of 11<sup>th</sup> Plan projects (October 2010), actual achievement of capacity addition was only 28.75 MW as against 184.30 MW targeted (only 15.60 *per cent*) for the first three years of the plan period (2007-10). Further, about 60 *per cent* of the projects planned for implementation were run of the river schemes. Generation potential of these schemes is confined to monsoon months, during which power availability position was comfortable and cheaper. Therefore, the effective capacity addition achieved on implementation of these schemes would be very marginal.
- The slow pace of project implementation was attributable to lack of importance given to investigation work. Test check of projects forming part of 11<sup>th</sup> Plan proposals indicated that their investigation and surveys were commenced during 1980s and 1990s and the time taken for finalisation of DPRs was more than five years on an average as against a normal period of two years envisaged in the NE Plan.

### **Development of energy from non-conventional (renewable) sources**

**3.26** The NE Plan emphasised the need for development of maximum energy from renewable sources. The State Planning Board had estimated (2006) the power generation potential from non-conventional / renewable sources in Kerala at 1715 MW. However, the State could tap power generation potential

of only 173.925 MW (Small Hydel-133.85 MW, Wind-30.075 MW and Co-generation-10 MW) up to 31 March 2010 of which Board's share was 95.88 MW (Small Hyde-93.85 MW, Wind-2.03 MW). The State Government had also established (January 1986) Agency for Non Conventional Energy and Rural Technology (ANERT) for development of non-conventional energy sources. ANERT approached the Board for setting up a 3.5 – 5 MW demonstration wind farm at Ramakkalmedu on cost sharing basis but Board failed to find out a suitable agency for establishing the project and in the absence of internal know-how also, the proposal was shelved (January 2009).

### Optimum utilisation of existing facilities

3.27 In order to cope with the rising demand for power, not only the additional capacity needs to be created, the plan needs to be in place for optimal utilisation of existing facilities and also undertaking life extension programme / replacement of the existing facilities which are near completion of their age besides timely repair / maintenance. The details of the power generating units, which have completed the age of 30-35 years and therefore, fell due for Renovation and Modernisation / Life extension programmes (as per CEA norms) during the five years ending 2009-2010 vis-à-vis actually taken up are indicated in the Table below.

Sl. No.	Name of Station	Unit No	Installed Capacity (MW)	Year of installation	Year of RMU as per CEA norms	Status of RMU works
1	Poringalkuthu	1	8	1957	1992	The RMU works planned in 1992 (cost of ` 9.54 crore) and again in 1996 (cost ` 40 crore) was postponed due to financial constraints. DPR has since been finalised (June 2010) involving investment of ` 68.20 crore for implementation during 11 <sup>th</sup> Plan period (2007-12) as against 2007-08 indicated in the NE Plan. An RMU Division was formed (July 2010) at Poringal to oversee the project works. However, the work is yet to be commenced (August 2010).
		2	8	1958	1993	
		3	8	1959	1994	
		4	8	1960	1995	
2	Sholayar	1	18	1966	2001	The RMU was scheduled for completion in 11 <sup>th</sup> Plan (2007-12) but DPR was under preparation (August 2010).
		2	18	1968	2003	
		3	18	1968	2003	
3	Kuttiady	1	25	1972	2007	A feasibility study was already made and RMU was programmed for 11 <sup>th</sup> plan, so that the work could be taken up after commissioning Kuttiady Additional Extension Scheme (KAES) nearing completion (September 2010).
		2	25	1972	2007	
		3	25	1972	2007	
4	Idukki	1	130	1976	2011	The Board assessed the machines to be giving satisfactory performance and hence RMU works were proposed for commencement during 12 <sup>th</sup> Plan after conducting Residual Life Assessment (RLA) studies.
		2	130	1976	2011	
		3	130	1976	2011	



Sl. No.	Name of Station	Unit No	Installed Capacity (MW)	Year of installation	Year of RMU as per CEA norms	Status of RMU works
5	Idamalayar	1	37.5	1987	2022	RMU works were advanced since both machines developed critical operational problems prematurely during 1990s. Orders were placed (November 2008) with BHEL, scheduling completion by November 2010, at a cost of ` 11.70 crore. Equipment supplies were in progress (August 2010).
		2	37.5	1987	2022	

From the above, it may be seen that none of the 10 units due for Renovation and Modernisation/ Life extension programmes (Sl. No. 1, 2 and 3), were actually taken up as planned.

Management attributed the delay in arranging RMU works to system constraints and delay in selecting the agency for conducting Residual Life Assessment (RLA) study. While system constraint should not be a valid reason for carrying the risk of postponement of RMU works, delay in selection of agency was avoidable through advance planning and action.

The detailed audit observations relating to repair, maintenance and life extension programmes are discussed in succeeding paragraphs.

**3.28** We observed that the postponement of RMU works had adverse effects on the performance of the machines. In respect of Poringalkuthu, except for a marginal increase in 2009-10, the hours of operation gradually decreased since 2006-07 and the extent of outages for repairs and maintenance went on increasing from 17.5 *per cent* of scheduled hours in 2005-06 to 28.45 *per cent* in 2008-09 and 23.12 *per cent* in 2009-10.

One or the other machine of the station was under prolonged shut down for periods exceeding three months during the monsoon months<sup>14</sup> of 2007-08 and 2008-09, when the Poringalkuthu reservoir was spilling. We calculate, the consequential generation loss at 14.98 MU with revenue potential worth ` 5.26 crore.

**3.29** The outages of Sholayar machines were 16.49 to 29.99 *per cent* during 2005-06 to 2008-09 and as a result the operated hours decreased from 16990.87 in 2005-06 to 13536.05 in 2008-09. Machine #3 of the HEP was under forced shut down for six months during 2005-06 due to thrust bearing pad damage. The spillage from the reservoir during this period was 47.2984 Million Cubic Meter (MCM) resulting in generation loss of 20.38 MU with potential revenue worth ` 6.30 crore. The same machine was again under forced shut down for another 62 days during 2006-07 due to the same problem. In November 2009, the machine again encountered stator core blow off and was out of service up to 2 June 2010.

**Due to postponement of RMU works, generating machines of Poringalkuthu, Sholayar and Kuttiyadi stations had to be shutdown for long duration. Consequent generation loss amounted to ` 12.60 crore.**

<sup>14</sup> June-December.

**3.30** Kuttiady machines were also out of service for 2247.08 hours to 6251.13 hours (11.35 to 31.34 *per cent* of scheduled hours) during the four years 2005-09. Machines no. 2 and 3 were under shut down for a period of 36 days (between June 2007 and July 2008) and 29 days (between June 2005 and March 2009) respectively, due to runner damages. Out of 36 days (864 hours) of shut down of machine no 2, for 119 hours during July- August 2007 (spill period) due to runner damages resulted in generation loss of 2.98 MU worth ` 1.04 crore. Machine # 3 was under maintenance shutdown from 11/01/2006 to 27/05/2006 and the repairs of this machine required total shut down of the Station from 11/4/2006 to 22/5/2006.

Repeated occurrence of major break downs indicated the need for urgent renovation and modernisation of these stations, to guard against generation loss of considerable extent.

**3.31** The five diesel generating machines of Brahmapuram Diesel Power Plant (BDPP) required repairs and maintenance operations on completion of every 12000 hours of running and the maintenance works needed on completion of every 24000 hours of running was equivalent to complete overhauling costing around ` 3 – 4 crore. In the absence of indigenous know-how, the maintenance/ repair works were being entrusted with the OEM.

While the engines were designed for continuous operation the Diesel Plant was operated only as a peak-load station. Any cold start<sup>15</sup> of the engine was as good as 30 hours of running and therefore, it enhanced the maintenance needs of the machine besides, causing abnormal break down. Hence, scheduled maintenance based on stipulated operational parameters was inevitable and unavoidable for the healthy operation of the plant.

The Table below contains particulars of 24000 hours maintenance works undertaken/ to be undertaken for the machines of BDPP.

Machine No.	Date of commissioning	Hours operated at the time of shut down for overhauling	Date of shutdown for overhauling	Date of starting of overhauling works	Date of re-commissioning after overhauling	Cost of overhauling (` crore)
1	6/5/1997	24722.82	18/10/2007	1/1/2008	21/4/2008	3.23
2	8/8/1997	24748.89	6/2/2004	2/8/2004	18/12/2004	2.28
3	07/10/1997	23937.72	29/5/2009	10/8/2010	Work in progress	4.57 (Estimated)
4	17/12/1997	24751.35	2/2/2009	2/5/2009	1/8/2009	3.21
5	24/11/1998	26113.67	26/8/2010	Not taken up		

In the case of overhauling of four machines ( 1 to 4), the work of overhauling was started after keeping the machine idle for long durations of three to 14 months due to delay in arranging the work.

<sup>15</sup> Starting the engine when the jacket water temperature and lube oil temperature are equal to atmospheric temperature is called 'cold start'.

Management stated (August 2010) that the delay was because of the longer lead time required for arranging supply of imported spares. We are of the opinion that the need for repairs was already known and hence sufficient advance action should have been taken to avoid unnecessary shutdown.

**Extra cost on purchase of power due to non-operation of one KDPP machine (April 2005-September 2008) amounted to ` 11.72 crore.**

**3.32** Maintenance needs of the machines of KDPP were also not attended as per requirement after 12000 hours of operation. Maintenance of machines # 1 to 3 was carried out after operating them for extra hours in the range of 3257 to 5192. Likewise, the 24000 hours maintenance of machine # 5 and 8 was undertaken after running them for extra hours of 7262 and 8787 respectively. The station had effectively operated only seven out of eight machines at a time, keeping one of the machines idle for want of spares. The spares of idling machine were being used in the machines under operation. We observed that the cost of generation at KDPP was always lesser than the price of power imported from NTPC's Kayamkulam Combined Cycle Plant during 2005-09. The extra cost incurred due to non-operation of one of the machines during the period April 2005 to September 2008 (when Kayamkulam power was costlier) amounted to ` 11.72 crore.

The Board maintained (August 2010) that its commitment for availing of bulk supply on round the clock basis from Kayamkulam prevented it from taking advantage of the partial availability from Kozhikode at lesser cost.

We observed that there was no contractual obligation that disabled the Board in limiting drawal of Kayamkulam power to the required level. Further, the Board as a policy scheduled the generation from own power plants based on merit order<sup>16</sup> and resorted to power purchases only when internal generation was costlier.

We are of the opinion that the Board could not achieve the optimum utilisation of available capacity of its hydro as well as thermal projects and lost out on making use of commercial opportunities by delaying decision of undertaking RMU works.

## PROJECT MANAGEMENT

### Project Formulation

**3.33** Preparation of accurate and realistic Draft Project Reports (DPR) is a critical activity in planning stage of the project. Feasibility studies of potential Hydro Electric Projects were made, projects having scope for further investigation were identified and Preliminary Investigation Reports (PIR) were prepared. On its approval by Deputy Chief Engineer, sanction for conducting detailed investigation was given by Chief Engineer, based on which the DPR was prepared.

<sup>16</sup> Merit Order: System of prioritising generation / purchase of power, based on cost of generation/ cost of import.

**Due to lack of foresight, the Board had to incur wasteful expenditure of ` 3.58 crore on 23 abandoned projects.**

**3.34** We observed that the Board had not standardised any policy guidelines and methodology for selection of projects. Because of this, projects cleared for detailed investigation were abandoned during the course of investigation due to the changes in the ideas of top management. During the period of review, 23 projects under investigation were dropped due to lack of foresight on the part of the Management as the projects involved contentious inter-state issues and acquisition of forest land and only 13 projects were taken up. The wasteful expenditure incurred on the survey and investigation of these abandoned projects amounted to ` 3.58 crore.

**3.35** Budgetary controls were not being exercised over investigation activity. Further, no time bound milestones were fixed for completion of each activity of project investigation except in the case of prioritised projects. Due to lack of effective control and monitoring by top management, project investigation was often inordinately delayed. For instance-

- Three projects (Achancoil, Vakkalar and Chilikkalar) in Achancoil river basin were proposed during 1999. It took seven years for completion of investigation of the Project and to finalise (August 2006) the DPR of Achancoil. The DPR of Vakkalar was finalised in December 2007 and of Chilikkalar was yet to be finalised (October 2010).
- Marmala SHEP (4.5 MW) was proposed (September 1997) for implementation with Chinese assistance. Due to conflicting views about the viability of different proposals decision was delayed. Fresh surveys were undertaken and Detailed Investigation Report was finalised only in April 2010 with delay of nearly 10 years.
- The Anakkampoil (7.5 MW), Kandappanchal (3.75 MW) and Pathamkayam (4 MW) projects were separately investigated in the Chaliar river basin (1994 onwards) and project reports prepared in December 2007, February 2008 and June 2008 respectively. All the three schemes were planned for implementation during 11<sup>th</sup> Plan Period. Later, it was decided (December 2008) that Projects in the same river basin could be developed together for optimum utilisation of head and resources. Investigation of the cluster project has not been completed (August 2010) even after the lapse of 19 months.
- Feasibility studies of Koodam HE Project were conducted during 1999. However, no further action was taken until February 2007 when it was included in the list of schemes to be commissioned before 2011. But the DPR was approved only in December 2009.
- The Vadakkepuzha Diversion Scheme implemented (July 2003) at a cost of ` 2.66 crore contributed additional revenue of ` 13.77 crore by pumping 46.86 MCM of water into Idukki reservoir from Vadakkepuzha reservoir. As second part of Vadakkepuzha Diversion Scheme, a diversion channel from Pothumattom stream was constructed (July 2006) through which additional inflow was obtained in Vadakkepuzha reservoir during monsoon season. The low storage capacity of

Vadakkepuzha reservoir and intermittent failure of pumping operations, however, caused heavy spillages through the overflow path of the temporary bund of the reservoir during every monsoon. Thus the benefit of the scheme was not fully derived. In order to prevent the spillage, a proposal to construct a pipeline from outlet of Pothumattom channel to Idukki reservoir was made (December 2007) based on which a feasibility report was finalised (June 2008) envisaging construction cost of ` 48 lakh with which additional power generation worth ` 51 lakh was achievable every year. Detailed investigation was ordered in June 2009.

We observed that the pipeline scheme was conceivable at the time of construction (July 2006) of diversion channel itself and the avoidable delay of three years (July 2006- June 2009) in finalising the proposal thereto had caused potential revenue loss of ` 1.53 crore (` 51 lakh x 3) already.

- The Pallivasal Extension Scheme (PES) and Sengulam Augmentation Scheme (SAS) targeted for commissioning during 11<sup>th</sup> Plan were investigated and taken up for implementation prior to 2000-01. With the commissioning of PES (December 2012) and SAS (January 2013) as targeted, the inflow of water would increase by 33.91 M<sup>3</sup>/sec<sup>17</sup> into downstream Sengulam Reservoir. As the maximum requirement of water for existing Sengulam Station is only 17.92 M<sup>3</sup>/sec and its reservoir was having storage capacity of only 0.7 MCM, the excess inflow into Sengulam Reservoir would result in spillage of water. However, the requirement of capacity enhancement for Sengulam station, along with the PES and SAS was realised by Board only in June 2008. Consequently action was initiated (September 2008) to complete the investigation and implement the Scheme. As per management's projections, time gap between the commissioning of the existing projects and the newly proposed project will be a minimum of two years resulting in generation loss of 348.984 MU of potential value ` 132.61 crore as reckoned on the basis of projected annual generation of the proposed projects.

We observed that the project investigation was not planned at the appropriate time with a view to exploit the maximum potential and optimum utilisation of resources. Further, merits and demerits of different alternatives of project proposals were not collectively examined at the formulation stage and the most feasible option and substantive value addition often emerged during the advanced stages of project.

Management contended (August 2010) that the Board's investigation systems evolved over the last five decades were foolproof and sufficient. We are of the opinion that there exists scope for review and refinement of the system as evidenced by the lapses in investigation detected and reported by Board's own expert committees, in the different cases.

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<sup>17</sup> PES-13.95 M<sup>3</sup>/sec and SAS 19.96 M<sup>3</sup>/sec.

### Project Implementation

**3.36** Project management includes timely acquisition of land, effective actions to resolve bottlenecks, obtain necessary clearances from authorities, proper scheduling of various activities etc. Time and cost overruns were noticed due to absence of co-ordinating mechanism throughout the implementation of the projects during review period as discussed in succeeding paragraphs.

**3.37** The following table indicates the scheduled and actual dates of completion of the power stations, date of commissioning of power stations and the time over run.

#### Time over run

	Malankara	Lower Meenmutty	Neriamangalam Extension Scheme	Kuttiady Tail Race	Kuttiady Additional Extension Scheme
Time of completion as per DPR	2 years	2 years	2 years	2 years & 9 months	3 years
Date of commencement	December 1999	February 2003	July 2003	February 1990	November 2003
Date of completion	October 2005	March 2006	May 2008	October 2009	Work in progress
Date of commissioning	October 2005	March 2006	May 2008	-do-	Work in progress
Time overrun	47 months	14 months	35 months	17 years	Work in progress

It would be seen from the above that none of the five projects implemented during 2005-10 was completed in time and slippages at various stages of implementation were due to delay in land acquisition, geological surprises, delay on the part of contract agencies in work execution.

The estimated cost of power projects completed during review period, actual expenditure, cost escalation and percentage increase in cost are tabulated below:

	Malankara	Lower Meenmutty	Neriamangalam Extension Scheme	Kuttiady Tail Race
Cost as per DPR ( ` crore)	41.13	11.26	47.76	17.71
Cost as per contract ( ` crore)	27.44	12.38	35.06	12.48
Actual cost (Booked till 31.3.09) (Provisional)	33.67	21.33	38.37	14.88
Cost overrun ( ` crore)	6.23	8.95	3.31	2.40
Percentage increase as compared to contract cost	22.70	72.29	9.44	19.23

There was cost overrun ranging from 9.44 per cent to 72.29 per cent in respect of completed projects and reasons as analysed in audit were as under:

- Delay in organising the project works.
- Lack of effective controls over work execution.
- Extra cost due to excess inputs.
- Execution of additional items of work.

### **Delays in land acquisition**

**3.38** Before tendering of any project construction works, it is imperative that land acquisition should be completed. The Board formulated policy guidelines in this regard only in June 2007. The new policy was also not followed for any of the projects executed thereafter. Consequently, schedule of implementation of projects that involved land acquisition was adversely affected due to delay in acquisition proceedings. The main reasons for the delay were lack of policy guidelines from Government for fixing compensation and the procedural delay on the part of State Revenue / Forest Departments in facilitating the acquisition. Because of this, compensation payable for revenue / forest land under encroachment by private parties could not be decided which delayed the works. Major deficiencies noticed in land acquisition for projects are discussed below.

**The State Government did not review procedure for land acquisition for hydro electric projects despite stipulation in NEP.**

**3.39** The Draft Investigation Report of Kuttiadi Additional Extension Scheme (KAES) had indicated the option of tunneling along the penstock route to avoid land acquisition for surface penstock. Yet, the DPR was prepared (1998) incorporating provision for surface penstock, on the ground that steel lined pressure shafts were expensive. The Environmental Management Cell (EMC) of the Board, however, refuted (April / May 1999) this view and supported tunnel option due to reduction in land requirement, minimum energy loss and overall reduction in project cost by ` 17.60 crore. The proposal in project report prevailed upon that in DIR and EMC report and land acquisition process was commenced with, in 1999 which was completed only by October 2006, following disputes over acquisition of 1.65 ha of forest land under encroachment. The dispute had to be resolved by the Board, paying land value of ` 31.16 lakh to Forest Department as well as compensation of ` 10.70 lakh to encroachers. The time overrun in the project work on this account was 34 months. The consequential cost escalation claim (` 12 crore) of project contractors, recommended by Project Manager for settlement at ` 8 crore was under scrutiny of Legal Cell of the Board (May 2010).

**Decision to acquire land disregarding the tunnel option resulted in loss of energy and cost saving of ` 17.60 crore.**

The Chairman, KSEB had also observed (January 2008) that the Scheme suffered from improper design of water conductor system, as the adoption of exposed penstock instead of tunnel resulted in considerable delay in land acquisition in most critical section of penstock route causing slippage of schedules.

We observed that the decision to act upon the proposal to construct surface penstock was taken without fully investigating into hurdles and obstacles involved in land acquisition.

**3.40** The project works of Pallivasal Extension Scheme were awarded (January 2007) and the work commenced (March 2007) but the land (9.19 ha) acquisition proceedings were commenced only in April 2007.

The land acquired included 2.4559 ha of Government land encroached by private parties. As the existing rules in Government did not permit payment of compensation for acquisition of non-patta land, the Board had to pay ex- gratia for the same. Thus, the land acquisition cost of the project actually incurred amounted to ` 7.10 crore against ` 75 lakh provided for in the project report. The inordinate delay in the land acquisition caused prolonged interruptions in civil works of the project also.

**3.41** When the issue of payment of compensation for non-patta land at Pallivasal became controversial the Board requested Government for approval of similar compensation payments for other ongoing projects in the same or nearby areas viz., Thottiyar, Mankulam, Sengulam Augmentation Scheme, Sengulam Tail Race SHEP and Perumthenaruvi SHEP. Government sanctioned (November 2009) payment of compensation in the form of ex gratia to unauthorised occupants of Government revenue land and forest land<sup>18</sup>.

**3.42** In respect of Thottiyar project, acquisition proceedings for 26.33 ha of land were commenced in July 2007 but land acquisition was not completed by January 2009 when the project work was commenced. As of March 2010, 4.67 ha of land only could be acquired. Though the forest clearance was received for 3.8 ha of forest land, the same is pending for 1 ha till May 2010. The progress of project (March 2010) was only 0.88 per cent during the first 14 months as against the target period of completion of 40 months.

In Mankulam Project, the Board had to face public agitation on the issue of settlement of compensation claims and due to this no progress could be achieved in the execution of the project. In respect of Perumthenaruvi Project, Board could not find out and acquire the required extent of private land for surrender to the Forest Department for compensatory afforestation even after two years' time (August 2008-August 2010) resulting in slippage of equal extent of time in implementation of the project.

For Chathankottunada HE project, the Board granted financial assistance (` 28.97 lakh) in lieu of rehabilitation package to 11 beneficiaries at rates envisaged in the draft Rehabilitation and Resettlement Bill.

Thus, the absence of policy guidelines from State Government or its own common policy framework, the Board had to resort to different terms of settlement for different projects in resolving land acquisition proceedings.

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Project	Government land	Forest land
Thottiyar HEP	7.753 ha	1.1726 ha
Mankulam HEP	23.96 ha	5.00 ha
Sengulam Augmentation Scheme	3.4876 ha	--
Sengulam Tail Race SHEP	1.4605 ha	--
Perumthenaruvi SHEP	0.417 ha	1.00 ha



### **Delay in obtaining Forest/ Environmental Clearance**

**3.43** The procedural delays and uncertainty involved in obtaining Forest/ Environmental Clearances have also upset the project implementation schedules of the Board. As submission of approved DPRs and Environmental Impact Assessment Reports, as the case may be, was a prerequisite for applying for these clearances, lot of manpower costs and other expenses were also borne by the Board without any assurance of getting clearance. The status of 11<sup>th</sup> Plan projects that required forest / environmental clearances is given in *Annexure 16*.

As could be seen in the Annexure, non-receipt of forest/ environmental clearance was the major reason for slippage of Athirappally Project from both 10<sup>th</sup> Plan and 11<sup>th</sup> Plan and the delay in receipt of forest / environmental clearances had substantially altered the implementation schedules of other projects as well. Apart from the delay in receiving clearances, further delay involved in removal of trees from the transferred areas also contributed to overall time overrun in completion of projects.

### **Cost/ Time over run due to inadequacies in investigation and designs**

**3.44** As envisaged in DPR, the tail race channel of Kuttiady Additional Extension Scheme (KAES) with a maximum flow of 21.38 m<sup>3</sup>/sec was to discharge into Kakkayam thodu, a stream that flowed from the upper reaches and it required deepening of the stream (discharge capacity 10 m<sup>3</sup>/sec) to accommodate the tail water flow. During execution, the diversion of the stream from the upstream level was found necessary due to inverse slope of the tail race pit, great velocity of the flow in the stream, and possibility of accumulation of debris at tail race which may also enter the machine pits of KAES during monsoon.

The Board agreed (August 2010) that decision to divert the stream was taken as a very essential item of work and it was also treated as an extra item of work as per the terms of the agreement necessitating payment (September 2008) of ` 80.54 lakh against the estimated value of work of ` 32.27 lakh, resulting in extra expenditure of ` 48.27 lakh due to omission to incorporate an easily foreseeable item.

**3.45** The Kuttiar Diversion Scheme taken up (1991) for implementation envisaged diversion of water from Kuttiar stream to Idukki reservoir for additional power generation. The work involving construction of a concrete weir and unlined diversion tunnel awarded (June 1991) with date of completion by March 1994 at an estimated cost of ` 2.52 crore (based on 1989 Schedule of rates) was terminated (March 2001) due to very slow progress in execution. The contractor sued (2002) the Board against the termination order and rearrangement of work got delayed upto April 2003. A new contractor was awarded the work at a revised estimated cost of ` 8.79 crore (based on 1999 schedule of rates). The works came to a standstill (March 2006) following allegations against sanctioning of several extra items / excess quantities and

agitation of local people demanding construction of a motorable bridge across Kuttiar stream. The enquiry conducted by Vigilance Wing of Board brought out lapses in project investigation which did not foresee all the components of project works. This necessitated execution of several extra items of work, costing ` 1.72 crore and excess quantities of work amounting to ` 1.50 crore. The Technical Committee of the Board, which looked into the facts of the case also observed (February 2008) that proper geological exploration was not conducted at detailed investigation stage and the lapses led to revision in designs.

The time overrun of four years and cost overrun of ` 3.22 crore was mainly attributable to deficiencies in project investigation.

### Discrepancies in DPR

**3.46** The Draft Project Reports are the essential plan documents to visualize and foresee all the fundamental features and requirements of project execution and should contain accurate design parameters of generators, water conveyance systems and power house, failing which the Project was bound to confront unforeseen obstacles during the course of execution. Deficiencies in DPR resulted in substantial time and cost overruns in the case of following projects under execution, as part of the 11<sup>th</sup> Plan projects.

**3.47** A DPR made in October 1994 for setting up a SHEP with installed capacity of 5 MW at Ranni- Perinad (cost ` 8.47 crore) was revised (cost ` 19.94 crore) in September 2004 due to lapse of time and setting up of a SHEP upstream of project location. The project works tendered (September 2005) could not be finalised as only one bidder was prequalified. The work was re-tendered (January 2008) and finally awarded (October 2008) at contract cost of ` 30.84 crore with a completion period of 24 months.

After execution (February 2009) of agreement, the contractor intimated (February 2009) the difference between the 'net head'<sup>19</sup> actually available and that indicated in DPR. Re-examination of data (March 2009) led to refixation (November 2009) of net head and the Board had to agree with the design changes proposed by the contractors. To attain the same, the depth of excavation and size of power house was materially altered. The additional cost on account of excess quantities of work necessitated due to the alteration was estimated (August 2010) at ` 4.99 crore.

The Board replied (August 2010) that no projects can be completed without modification during execution. Moreover, the Board recorded (March 2009) that while considering the rated head, the increase in tail water level during machine operation was not considered.

**3.48** The Adyanpara SHEP (3.75 MW) envisaged utilisation of yield of Kanjirampuzha river in Chaliyar basin for power generation. The work was

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<sup>19</sup> Difference in elevation between head water level and tail water level.

Lapses in the preparation of DPR and tendering led to additional civil works resulting in committed extra expenditure of ` 4.99 crore.

awarded (May 2007) for an estimated cost of ` 21.33 crore which included civil works of ` 11.17 crore stipulating completion date as September 2009.

During execution, several items of extra works were found necessary for successful completion which were left out in the DPR. Following disputes over admissibility of extra items, the contractor discontinued the work in January 2008. The DPR was re-examined by the Board and revised contract amount was estimated at ` 26.18 crore. Further an option for incorporating a tunnel was examined and it was decided (September 2008) to invite separate tenders for tunnel work and to allow existing contractors to complete the rest of the works. Moreover, due to dispute with the contractor over the rates, the Board terminated (August 2009) the work and retendered it at the risk and cost of the contractor. The contractors, approached (August 2009) the Hon'ble High Court of Kerala against the termination order and thereby the project works were held up. Legal proceedings were in progress (August 2010).

Thus, the project planned for completion by October 2009, was still pending due to apparent deficiencies in investigation and design for which responsibility was being fixed by the Board.

Management stated (August 2010) that an enquiry was held (July-December 2008) by Vigilance Wing of the Board to find out the deficiencies in investigation and design of Adyanpara SHEP. Based on the findings in the preliminary report detailed enquiry was ordered (August 2009) to be conducted.

## Contract Management

**3.49** Contract Management is the process of managing various stages of the contract in an effective, efficient and economic manner. Board had not laid down policy guidelines on benchmark project cost for inviting global tenders / turnkey contracts and on having separate or combined contracts for civil and electromechanical works of hydro electric projects. The projects tendered between 2005-10 were mainly for joint execution of civil and electromechanical parts by consortiums of contractors. The KAES and Athirappally HEP were, however, tendered on 'turnkey basis'.

The Board concluded (August 2009) that the consortium route was less competitive due to the fact that only few parties were interested in consortium formation and the Board may go for separate bidding for civil and electromechanical works. Four project works were tendered using the new route during subsequent period.

We observed (*Annexure 17*) that the tender evaluation and finalisation of work order had been a time consuming process in the Board. Test check of 10 projects<sup>20</sup> executed/ planned for execution during the 11<sup>th</sup> plan disclosed that the time gap between date of tender and date of award of work ranged upto 28

<sup>20</sup> Lower Meenmutty, Pallivasal Extension Scheme, Neriamangalam Extension Scheme, Ranni- Perinad, Thottiyar, Chathankottunada, Adyanpara, Poozhithode, Vilangad and Peechi.

months, the average being 13 months mainly due to procedural delay in evaluation of bids and their finalisation at the Board's level.

This delayed award of work is bound to affect the pricing structure of the bids and Board will be always at a disadvantage in getting the price clauses enforced as the cost of construction material is dynamic in present business environment.

**3.50** Some of the major observations in respect of contracts test checked in Audit are discussed below.

A compensation claim of ` 6.06 crore was preferred by the Board on Steel Industrials Kerala Limited (SILK) for the generation loss sustained due to delay in attending to the repairs of Malankara machines. Considering the fact that generation loss could not be recovered legally and in the absence of provisions in the agreement besides precarious financial position of SILK, the Government of Kerala directed (November 2009) the Board to drop the demand to which the Board acceded (December 2009).

We observed that SILK had only acted as an intermediary agency and almost all the items of work were arranged on sub contract basis. However, SILK was allowed to arrange repairs by providing unreasonably longer period of time. Despite the poor performance of contract by SILK in Malankara and Peppara HE Project, the Board had since awarded (April 2010) the work of Peechi SHEP to SILK as a consortium leader. The concessions given to SILK by virtue of being a PSU only indirectly aided the private agencies to whom the works were entrusted by SILK.

### **Non-achievement of Guaranteed Performance**

**3.51** The Neriamangalam Extension Scheme, envisaged utilisation of excess inflow into Kallarkutty reservoir, that used to spill out causing loss of potential generation. The DPR projected (January 2000) a completion time of two years but the project was awarded (April 2003) allowing completion time of 36 months. The contractors delayed the work execution and therefore, the Board formally extended the completion time initially upto May 2007 and again upto September 2007 subject to levy of penalty. The completion of work was delayed further and therefore, the machine could be synchronised only by July 2008 after a lapse of two years from original scheduled completion as per award of work. The machine developed frequent technical problems that resulted in prolonged outages (July 2008-December 2009) of 7747.40 hours against total available hours of 13176.67 (58.80 *per cent*). This also included 326.35 hours of outage during 2008 monsoon season when there was spillage of water from the dam reservoir. The outages caused generation loss of 164.66 MU (at 85 *per cent* PLF) during monsoon period resulting in irrecoverable loss of ` 3.10 crore.

We observed that the contractors could establish continuous test run of 72 hours and got (September 2008) a provisional acceptance certificate from the Board on condition that all the problems in the machine would be sorted out within 30 days. The contractors, however, did not turn up to rectify the defects and to furnish a performance guarantee. But for the bank guarantee against retention

money of ` 5.80 crore, no security was available with the Board to enforce the performance guarantee.

Thus, from above cases, it can be seen that the Board failed to enforce effective action to recover the consequential losses due to delay in completion of work or to obtain the performance guarantee to guard against generation losses which is a normal precondition.

### Input Efficiency

Efficiency of fuel procurement systems and fuel efficiency of machines of the two Diesel Generating stations were reviewed in audit and deficiencies noticed in fuel management at these stations are discussed below:

#### Loss of Generation due to inadequate fuel stock

**3.52** Fuel supplies for the thermal stations were obtained from Indian Oil Corporation (BDPP) and Bharat Petroleum Corporation Limited (KDPP) against long term contracts. No stock levels were fixed for fuel stock and procurement was made on the basis of monthly generation plans. Due to unsteady nature of generation plans on account of fluctuations in power prices in open market, the stock levels held, were disproportionately high and low, on different occasions. The depleted stock position of fuel had often adversely affected the power generation by both the stations. For instance, Machine # 2 of BDPP was under shut down for want of fuel from 31/03/07 to 17/05/07. The estimated short generation of power on account of the shut down was 2.75 MU. Similarly, the average generation at KDPP was only 0.2408 MU per day during the period 22/06/09 to 30/06/09 and the monthly average was 0.752 MU/day against the anticipated generation at the rate of 1.5 MU/day.

**Shortage of fuel when cost of generation was lower resulted in loss of generation of 20 MU valued at ` 10 crore/month.**

During the year 2009-10 when fuel prices had decreased considerably the cost of BDPP power was cheaper than the purchase price of power by the Board. The station, however, faced acute shortage of fuel due to insufficient supplies from Indian Oil Corporation ie, the average supply was only 3000 MT/month against 8000 MT/month required. As worked out by Board, loss of generation was to the tune of 20 MU /month due to short availability of fuel; equivalent to loss of ` 10 crore per month.

Board stated (August 2010) that the short supplies on above occasions were due to logistical problems of oil companies which had since been overcome.

#### Consumption of fuel in excess of norms

**3.53** The BDPP utilises HSD and LSHS as fuel. HSD was used as start-up fuel and switch over to LSHS was made when the machines attained 35 *per cent* of rated load. The specific fuel consumption norms for LSHS and HSD were 190.03 gm/KWH and 211.99 ml/KWH respectively. Fuel consumption during the five years 2005-10 was in excess of norms for both LSHS and HSD resulting in extra expenditure of ` 20.65 crore (*Annexure 18*).

**Consumption of fuel in excess of norms in two diesel power plants during 2005-10 resulted in extra expenditure of ₹ 60.36 crore.**

Consumption of LSHS at KDPP was also higher than the norms (194.40 gm/kwh). Moreover, it showed an increasing trend since 2007-08. As against the consumption rate of 204.27 gm/KWH and 204.01 gm/KWH recorded for the years 2005-06 and 2006-07 respectively, the consumption for the three years from 2007-08 to 2009-10 was in the order of 205.59 gm, 205.83 gm and 206.29 gm respectively per KWH of power generated. The cost of fuel consumed in excess of norms amounted to ₹ 39.71 crore (**Annexure 18**). The management noted (May 2009) the excess consumption and the Member (Generation) had directed (May 2009) Deputy Chief Engineer, KDPP to examine reasons for low output.

Management stated (August 2010) that fuel consumption standards guaranteed by machine manufacturers was based on theoretical/ laboratory conditions with fuel having specific calorific values. As the fuel available in India was not having the stipulated calorific values, the fuel efficiency tends to decrease. Frequent stops and starts, wear and tear of machines, variations in grid frequency and loss of fuel while filtering were stated as other contributory causes.

### Manpower management

**3.54** Deployment of staff in the generation wing was made by the Board as per sanctioned strength fixed on conventional basis without reference to actual field requirements on any scientific basis. When compared with sanctioned strength, there was shortage of 366 employees. A need based assessment of staff strength was also made during this period. We, however, noticed that, in certain cadres, there was excess staff strength available in some of the field offices, while shortages in very same cadres were reported from certain other offices indicating avoidable imbalances in staff strength.

The position of actual manpower and man power required as per CEA recommendation, for the four years upto 2009-10 is given below:

Sl. No	Particulars		2006-07	2007-08	2008-09	2009-10
<b>Manpower as per CEA norms (in numbers)</b>						
1	(a) Technical	(i) Thermal	84	84	84	84
		(ii) Hydro	2829	2837	2886	2891
		(iii) Total	2913	2921	2970	2975
	(b) Non-technical	(i) Thermal	40	40	40	40
		(ii) Hydro	481	482	491	491
		(iii) Total	521	522	531	531
<b>Actual manpower</b>						
2	(a) Technical	(i) Thermal	104	101	105	125
		(ii) Hydro	602	596	668	744
		(iii) Total	706	697	773	869
	(b) Non-technical	(i) Thermal	41	31	26	24
		(ii) Hydro	174	165	166	145
		(iii) Total	215	196	192	169

Excess(+)/deficit(-)						
3	(a)Technical	(i)Thermal	20	17	21	41
		(ii)Hydro	-2227	-2241	-2218	-2147
	(b)Non-technical	(i)Thermal	1	-9	-14	-16
		(ii)Hydro	-307	-317	-325	-346
4	Expenditure on salaries in Generation activity ( ` crore)		32.65	31.72	49.1	Not available
5	Excess expenditure on excess manpower in thermal stations ( ` crore)		0.69	0.59	1.05	Not applicable

Above table shows that men in position was more than the normal strength assessed as per CEA norms in thermal stations and the resultant excess expenditure for the three years up to 2008-09 worked out to ` 2.33 crore.

Rational assessment of man power in hydel stations with reference to norms, was not possible, in view of the fact that the hours of operation varied substantially from station to station in accordance with generation potential and system requirements. Management stated (August 2010) that reorganised staff pattern of Generation Wing was under implementation stage.

Manpower requirements of Civil Wing for project works were not assessed/ reassessed on the basis of works on hand. As number of projects suffered long delay during implementation, the services of officials posted at the project site were underutilised. One such instance noticed in Audit was that of Division III of the Pallivasal project which was assigned with the supervision of the civil work of power house and incurred establishment expense of ` 45.09 lakh (2008-09) accounting for 34.40 *per cent* of the value of works ( ` 1.31 crore) carried out. Similarly, a full fledged project office was in existence since 1999 for 10 years for the Athirappally Project which is yet to be started (August 2010) for want of final clearance from Ministry of Environment. The average establishment cost incurred at the Division was ` 89 lakh per annum.

Management stated (August 2010) that the staff strength was also deployed for managing the litigation related jobs and also for investigation of Anakkayam HEP. Our findings from cost benefit angle indicated that the need of a full fledged office at project site for all these years was not there for the above jobs which were of relatively recent origin.

## Output Efficiency

### *Shortfall in generation*

**3.55** The targets for generation of power for hydel stations for each year were fixed by the Board and approved by the CEA. The targets were fixed based on the estimated power potential from the average inflow for the previous ten-year period. As the actual generation potential solely depended upon the inflow received during the year, variations were expected to occur due to vagaries of monsoon. Thus, favourable variations were recorded during 2005-08 and shortfall from targets during 2008-10 when targets were fixed at a higher level as given below.

Year	Target (MU)	Actual (MU)	Variation (MU)
2005-06	5444	7413.30	(+ )1969.30
2006-07	6292	7496.60	(+)1204.60
2007-08	6749	8327.28	(+)1578.28
2008-09	7008	5839.26	(-)1168.74
2009-10	6769	6646.27	(-)122.73

**3.56** The year-wise details of energy to be generated as per design, actual generation, plant load factor (PLF) as per design and actual plant load factor in respect of 23 power projects commissioned up to March 2010 are as given in **Annexure 19**.

It could be seen from the Annexure that the actual generation and actual PLF achieved were higher than the targets as per design only in respect of Kuttiyadi and Neriamangalam stations during the entire period of 2005-10.

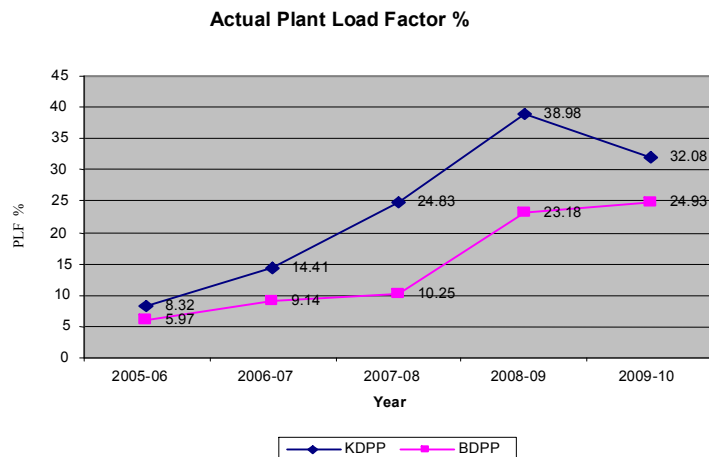
- The designed output of Kakkad was 50 MW and the actual maximum delivery was only 41 MW because of high pressure or head loss occurred in the pressure shaft and tunnel, due to design deficiencies of the water conducting system.
- The Malankara station also could not achieve the designed output on combined operation of its machines as there was capacity limitation for the water intake pipe to the turbine unit laid by Irrigation Department, due to design deficiency.

The Board is on record pointing to design deficiencies in above projects. Reasons for short generation at Pallivasal HEP are discussed in paragraph 3.67.

#### **Low Plant Load Factor (PLF)**

**3.57** Plant Load Factor (PLF) refers to the ratio between the actual generation and the maximum possible generation at installed capacity. According to norms fixed by Central Electricity Regulatory Commission (CERC), the PLF for thermal power generating stations (TS) should be 80 *per cent*, against which the national average ranged from 73.70 to 78.60 *per cent* during the review period. The PLF of the two thermal power stations of the Board was as depicted in the following line graph:





The PLF of these stations was relatively very low since they were being operated as peak load stations for reasons of economy.

**3.58** The details of maximum possible generation at installed capacity, actual generation and corresponding Plant Load Factor achieved in respect of each of the hydel generating units for the five years 2005-10 are given in *Annexure 19*. The reasons for the low PLF, as observed in audit were:

- Low plant availability.
- Low capacity utilisation.
- Major shut downs and delays in repairs and maintenance.

These are discussed in the following paragraphs

Management also attributed (August 2010) the low PLF to substantial variations in demand during peak and off peak hours due to peculiar nature of system load in Kerala Power Grid, which necessitated installation of high capacity machines without having round the clock requirement of full capacity utilisation.

#### ***Low plant availability***

**As against the CERC norm of 80 per cent, plant availability of 13 major HEPs, 11 SHEPs and two Thermal Stations during the years 2005-10 was 76.36, 37.16 and 46.47 per cent respectively.**

**3.59** Plant availability means the ratio of actual hours operated to maximum possible hours available during certain period. As against the CERC norm of 80 per cent plant availability during 2004 – 2009 and 85 per cent during 2010 – 2014, the average plant availability of power stations of the Board was 76.36 per cent for 13 major HEPs, 37.16 per cent for 11 SHEPs and 46.47 per cent for two TS during the five years 2005-10 as given below.

**Table I – Major HEPs**

Particulars	2005-06	2006-07	2007-08	2008-09	2009-10	Period Total
Total Hours Available	327014.25	333888.58	331314.83	309756.28	313049.81	1615023.75
Operated Hours	258682.53	263152.95	261010.30	205418.79	244932.73	1233197.30
Planned S/d (in hrs)	55858.47	60247.99	54677.60	61483.42	50604.74	282872.22
Forced S/d (in hrs)	12473.25	10487.64	15626.93	42854.07	17512.34	98954.23
Availability Factor	79.10	78.81	78.78	66.32	78.24	76.36

**Table II – SHEPs**

Particulars	2005-06	2006-07	2007-08	2008-09	2009-10	Period Total
Total Hours Available	139043.73	167595.00	169884.35	211738.72	217667.19	905928.99
Operated Hours	57452.60	73217.57	70505.97	70824.80	64635.11	336636.05
Planned S/d (in hrs)	1787.68	9146.57	39190.55	32445.92	47309.50	129880.22
Forced S/d (in hrs)	79803.45	85230.86	60187.83	108468.00	105722.58	439412.72
Availability Factor	41.32	43.69	41.50	33.45	29.69	37.16

**Table III – Thermal Stations**

Particulars	2005-06	2006-07	2007-08	2008-09	2009-10	Period Total
Total Hours Available	39245.57	40133.54	61695.95	81177.87	74938.23	297191.16
Operated Hours	9827.07	16371.57	25644.22	45397.08	40878.10	138118.04
Planned S/d (in hrs)	19934.07	17270.00	18633.25	20035.42	19706.73	95579.47
Forced S/d (in hrs)	9484.43	6491.97	17418.48	15745.37	14353.40	63493.65
Availability Factor	25.04	40.79	41.57	55.92	54.55	46.47

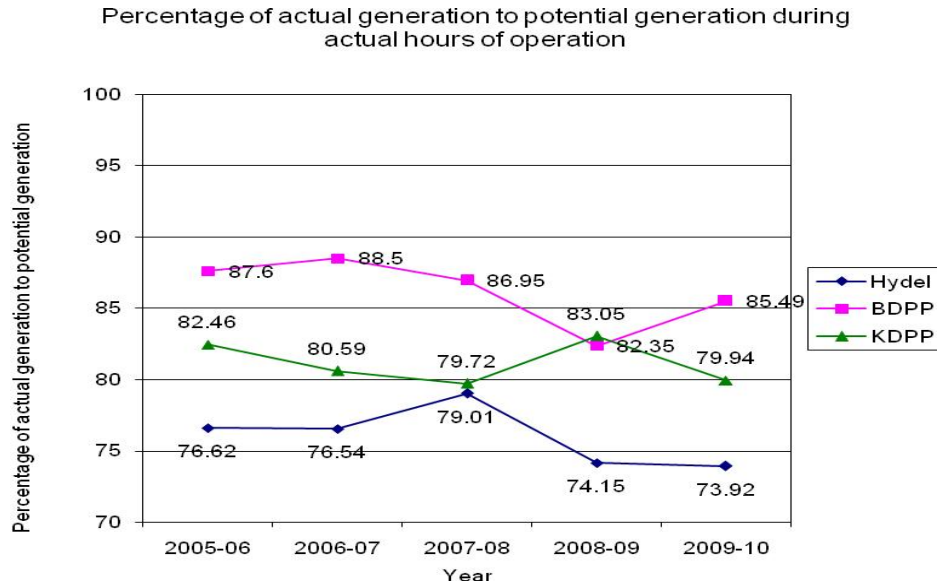
We observed that:

- Low plant availability at major HEPs was due to longer durations of outages caused by penstock accident at Panniar, explosion of machine #4 at Moozhiyar and prolonged spells of repairs and maintenance (including RMU at Neriamangalam and Moozhiyar) due to age factor.
- Lower machine availability at SHEPs was due to technical snags of machines as well as water conductor systems.
- Plant availability of thermal stations was very low due to postponement of repairs and maintenance due to cost considerations.

The Board stated (August 2010) that generation from thermal stations is decided based on requirements after considering all other sources.

### ***Low Capacity Utilisation***

**3.60** Capacity utilisation means the ratio of actual generation to possible generation during actual hours of operation. Based on national average PLF of 76.50 *per cent* and plant availability at 80 to 85 *per cent*, the standard capacity utilisation factor works out to 90.30 *per cent* for thermal and 85.97 *per cent* for hydel. We observed that 11.50 to 20.28 *per cent* of the installed capacity of Thermal Stations and 20.99 to 26.08 *per cent* of the installed capacity of Hydel Stations remained unutilised. The percentage of actual generation to potential generation during actual hours of operation is given in the following line graph.



We observed that the following were the main reasons for the low utilisation of available capacity during 2005-10:-

- Running of units with partial load.
- Reduction in output at Pallivasal, Kakkad and Malankara HEPs due to limitations in water conductor system.
- Capacity limitations of hydel reservoirs, and low storage position in years of poor monsoons.
- Operation of Idukki HEP machines at reduced loads to maintain flexibility in the system.
- Decline in efficiency of BDPP machines.

### Outages

**3.61** Outages refer to the period for which the plant remained closed for attending planned/ forced maintenance. We observed:

- In respect of major HEPs, the total number of hours lost due to planned outages varied between 50604.74 hours and 61483.42 hours per annum during the review period i.e., between 16.17 *per cent* and 19.85 *per cent* of total available hours. Planned outages of SHEPs widely varied between 1.29 *per cent* and 23.07 *per cent* of available hours. The relatively higher levels of outages were attributable to age factor necessitating increased maintenance requirements for major HEPs and teething troubles of newly commissioned SHEPs.
- The forced outages of major HEPs during 2005-10 were in the range of 12473.25 hours (2005-06) to 42854.07 hours (2008-09) and varied between 3.81 *per cent* and 13.83 *per cent* of available hours. In the case of SHEPs, forced outages were in the range of 35.43 *per cent* (2007-08)

to 57.39 per cent (2005-06) of available hours. These outages were mainly because of accidents at Panniar and Moozhiyar HEPs and deficiency of water for small HEPs most of which were run of the river projects.

**3.62** None of the ten independent SHEPs have given satisfactory performance, due to non-stabilisation of operation of the machines as well as water conductor systems. The output of these stations was substantially lower than the potential output envisaged in the Project Report, for all the five years (2005-10), resulting in overall shortfall of 195.42 MU.

**3.63** The planned and forced outages of the two Thermal Stations ranged from 24.68 per cent to 50.79 per cent and 16.18 per cent to 28.23 per cent respectively during 2005-10 as shown below. The reason for the outages was non-availability of spares, as and when needed.

Particulars	2005-06	2006-07	2007-08	2008-09	2009-10
Total machine hours available	39245.57	40133.54	61695.95	81177.87	74938.23
Planned Outages (in hours)	19934.07 (50.79)	17270.00 (43.03)	18633.25 (30.20)	20035.42 (24.68)	19706.73 (26.30)
Forced Outages (in hours)	9484.43 (24.17)	6491.97 (16.18)	17418.48 (28.23)	15745.37 (19.40)	14353.40 (19.15)

Management stated (August 2010) that spares for the machines were not being stocked in consideration of the high cost involved. Considering the generation loss consequent to non-availability of critical spares in time, the reply furnished was not adequately convincing. The Board may consider undertaking a periodical exercise to replenish stock of spares considering cost benefit effects.

#### Auxiliary consumption of power

**3.64** Energy consumed by power stations themselves for running their equipments and common services is called auxiliary consumption. CEA has fixed an auxiliary consumption norm of 0.50 per cent of generation for hydel stations and 3 per cent for thermal stations (combined cycle type) against which the auxiliary consumption of the Board for the five years 2005-10 was as given below:-

	2005-06	2006-07	2007-08	2008-09	2009-10
Hydel Stations	0.41	0.44	0.42	0.46	0.32
Thermal Stations	4.35	3.43	2.89	2.63	2.93

Auxiliary consumption at Madupetty, Panniar and Sholayar stations was not metered for the last few years and was, therefore, accounted on estimated basis. The auxiliary consumption at TS was higher than norms during 2005-07 since the levels of generation operation was very low during that period.

## Repairs & Maintenance

**3.65** To ensure long term sustainable levels of performance, it is important to adhere to periodic maintenance schedules. The efficiency and availability of equipment is dependent on the strict adherence to annual maintenance (A/M) and equipment overhauling schedules. Non-adherence to schedule carries a risk of the equipment consuming more fuel oil and a higher risk of forced outages which necessitate undertaking R&M works. These factors lead to increase in the cost of power generation due to reduced availability of equipments which affect the total power generated.

Schedules of A/M of power stations were fixed by the Board and each of the machines was shutdown for maintenance after obtaining prior permission. The schedules were drawn in line with the specific generation policy for each station. Accordingly, preventive maintenance of machines of Stations having storage reservoir was undertaken during monsoon months and the maintenance of run of the river projects planned for summer months. The normally permitted time for A/M was 15 days to one month for different machines. However, deviations from set schedules were noticed on account of unexpected outages of other machines at same or other stations, breakdowns during unscheduled periods and other system constraints. We noticed:

- The average time taken for annual maintenance of renovated machines (6 Nos) of Pallivasal Station ranged up to 36 days against the stipulated time of 15 days. Similarly, the duration of annual maintenance of Sengulam machines was 34 to 52 days against normal time of 30 days. The time taken was higher in view of the fact that all the machines had undergone RMU works during the year 2000- 02.
- The A/M of machines of Neriamangalam and Sabarigiri Stations, recommissioned during 2005-09, was not properly carried out after recommissioning. Time gap of 15 to 23 months was observed in arranging the A/M of these machines after completion of RMU works (*Annexure 20*). No reasons were on record for the long time gap in A/M efforts.
- A/M of Idamalayar machines was also carried out inconsistently. The time gap between two maintenances of machine# 1 ranged between five months to 14 months and for machine #2 between eight months to 17 months during 2005-10. The changes in schedules were mostly on account of forced shut down necessitated due to technical snags before the due dates of A/M.
- The A/M of Sholayar machines was also undertaken at irregular intervals. The A/M of machine # 1 was not carried out from August 2006 to January 2008. The actual duration of A/M of unit #3 was 45 days on an average for the three years upto 2009-10.

- The average duration of A/M of Poringalkuthu machines was also in the range of 33 to 43 days due to high rate of maintenance needs.

### Post Renovation & Modernisation Status

**3.66** Renovation, Modernisation and Uprating (RMU) works of hydel stations were to be planned when the life of the existing units crossed 30 to 35 years, as per CEA Guidelines. The RMU works involved identification of the problems of units, preparation of techno economic viability reports, preparation of detailed project reports (DPR) to lay down benefits to be achieved from these works.

**3.67** We observed :-

- The renovation and modernisation work of the Pallivasal station carried out (2000-02) envisaged replacement and upgradation of existing plant for increase in the station output. On renovation (June 2002) the machines, however, were giving an output of only 32.50 MW on combined operation as against the rated output of 37.50 MW, although the units were giving rated output when operated individually. The Board attributed the short performance to the fact that the water conductor systems (60 years old) that carry water from storage reservoir to power station were not renovated along with the machines. Loss of generation (2005-09) on account of this was 58.925 MU of potential revenue worth ` 18.21 crore at 85 *per cent* rated capacity. Further, the runner buckets of Units 4, 5 and 6 replaced by the RMU contractors had been frequently developing pits and cracks, ever since recommissioning (2002). Apart from getting the runners repaired at the cost of RMU contractors during guarantee period (2002 to 2005), no effective action to evolve a lasting solution to the problem, was insisted by Board before settling their accounts. The Board suffered a loss of ` 3.86 crore on account of generation loss due to machine outages for want of serviceable runner during the review period. Action for procurement of a spare runner costing ` 94 lakh was initiated (August 2010) by Management to overcome the problem.
- When machine availability is critical during the monsoon period, RMU works of Neriamangalam Machine 2 and 3 were undertaken in 2005-06 and 2006-07 respectively. The loss of generation was 82.18 MU of potential worth ` 25.83 crore. Though the time required for RMU works was 6 – 8 months, the works could not be carried out during non-monsoon period due to delay in commencement of work and consequent non-completion of works within the stipulated time.
- RMU works of all the 6 machines of Sabarigiri station were carried out by M/s VA Tech Austria between the period July 2003 to December 2009. There was time overrun ranging between 126 days and 616 days for six machines which adversely affected the generation plan of the Board. The quality of works carried out was also unsatisfactory.

Machine #5, recommissioned (May 2006) after RMU had to be shut down (July 2006) for 127 days following an accident. Machine No.4 recommissioned in February 2007 exploded in May 2008, resulting in total loss of the unit, major repairs to Unit #3 and partial damages to other Units. Investigation conducted by CEA attributed the cause to manufacturing defects. Board estimated and initiated legal action for recovery of loss of ` 51.10 crore from M/s VA Tech.

## Financial Management

**3.68** Efficient fund management is a tool for decision making for optimum utilisation of available resources and borrowings at favourable terms at appropriate time. The power sector companies should, therefore, streamline their systems and procedures to ensure that:

- Funds are not invested in idle inventory,
- Outstanding advances are adjusted / recovered promptly,
- Funds are not borrowed in advance of actual need, and
- Swapping high cost debt with low cost debt is availed expeditiously.

The main sources of funds were realisations from sale of power, subsidy from State / Central Governments, loans from State Government/Banks/Financial Institutions (FI) etc. These funds were mainly utilised to meet payment of power purchase bills, debt servicing, employee and administrative costs, and system improvement works of capital and revenue nature.

Details of sources and utilisation of resources on actual basis for the years 2005-06 to 2009-10 are given below:

S.No.	Particulars	2005-06	2006-07	2007-08	2008-09
<b>Sources</b>					
1.	Net Profit/(loss)	101.26	217.42	217.42	217.42
2.	Add: adjustments	498.29	879.89	914.27	108.14
3.	Funds from operations (1+2)	599.55	1097.31	1131.69	325.56
4.	Decrease in working capital	593.43	0.00	0.00	1096.29
5.	Cash deficit (10-(3+4))	0.00	0.00	0.00	0.00
<b>6.</b>	<b>Total (3+4+5)</b>	<b>1192.98</b>	<b>1097.31</b>	<b>1131.69</b>	<b>1421.85</b>
<b>Utilisation</b>					
7.	Capital expenditure	463.59	514.48	364.88	644.50
8.	Increase in working capital	0.00	56.60	240.29	0.00
9.	Cash surplus (3+4)-(7+8)	729.39	526.23	526.52	777.35
<b>10.</b>	<b>Total</b>	<b>1192.98</b>	<b>1097.31</b>	<b>1131.69</b>	<b>1421.85</b>

The surplus cash position was mainly on account of reduced levels of capital expenditure as a result of slow progress of targeted project works and absence of new project works.

The Board had been meeting the project fund requirements mainly from internal generations and short term borrowings except in case of term loan ( ` 158.40 crore) taken for KAES from REC.

### **Delay in decision making over financial tie-up**

**3.69** In case of KAES, the lowest offer of M/s. BHEL – L&T Consortium was found (June 2001) acceptable provided the party withdrew their demand for deviations from payment terms of the Board. Even though the withdrawal was communicated (June 2001) by the Consortium, the Board finally decided (August 2003) that the financial package offered carried very high interest rates when compared with the prevailing market rates and interest subsidy under Accelerated Generation and Supply Programme. The contract was finally awarded to BHEL L&T Consortium in August 2003 at the cost of ` 168.28 crore. As a result of the delay of over two years in decision making without valid reason the Board had to allow BHEL – L&T Consortium escalation of 7.5 *per cent* amounting to ` 11.94 crore with consequential delay of two years in completion of the project.

**Delay in decision making led to escalation of financing cost to the tune of ` 11.94 crore and delay of two years in completion of project.**

### **Drawal of high interest bearing loan funds without requirement**

**3.70** A term loan of ` 176 crore from Rural Electrification Corporation (REC) was got sanctioned (March 2005) by Board for KAES, which carried interest at the rate of 8 *per annum*. with reset option at the end of every three years. The loan was to be availed of on reimbursement basis. REC recovered upfront fee of ` 17.60 lakh from the initial instalment. In September 2008, when an amount of ` 31.07 crore (net of upfront fee) was already drawn, and the rate of interest stood enhanced to 12.75 *per cent* as per reset option, the Board availed of fresh instalment of ` 85.45 crore, when its fund position was quite comfortable to meet the project commitments and the Financial Adviser objected to the drawal on the ground that the rate of interest was quite high. The Board was also keeping its surplus funds in short term deposit bearing interest of only 9.02 to 9.29 *per cent*, all along the period of drawal and utilisation of loan funds. Further instalments of ` 4.30 crore and ` 6.92 crore were also drawn during September 2009 and March 2010 respectively when the internal fund position was still better, and the Financial Adviser did not endorse the proposal for additional drawal. REC turned down (December 2009) request of the Board (November 2009) to short close the loan without prepayment premium in the absence of enabling provisions in contract agreement. Drawal of high interest bearing loan funds without genuine requirement thus resulted in avoidable extra expenditure of ` 2.88 crore for the project implementation.

We also observed that the funding proposals for projects were originated by Planning Wing and the Finance Wing had exercised only limited control or no control at all in the matter of drawal of loan funds for project finance.



### **Drawal of payments by contractor in excess of due amounts**

**3.71** The agreements executed with the contract agency that executed RMU works of Sabarigiri Station and the Neriamangalam Extension Project, provided for payments for supplies and services through irrevocable letters of credit(LC). The terms of LC were such that payments were to be released by Bankers against certificates of receipts of materials at site, to be issued by the Board within 21 days and in case the certificates were not issued within the said period the Bankers were at liberty to pay the entire invoice amount as claimed by the contractors.

Majority of the invoices issued by the contractors did not reach the project offices of the Board within the stipulated time of 21 days as a result of which the contractors could obtain full payments against their claims, on expiry of stipulated time. These claims were made by the contractors without making all applicable deductions including statutory deductions and hence there was excess drawal of ` 1.48 crore against 22 passed invoices in the case of Sabarigiri Project and ` 63.84 lakh against 13 invoices for the Neriamangalam Project between the period October 2004 to December 2008.

Adoption of liberal payment terms without safeguarding the financial interests of the Board coupled with inadequacy of internal systems to ensure timely compliance with payment terms in contract agreement resulted in the over payments.

### **Non-closure of Project Accounts**

**3.72** Information on actual cost of completion was not forthcoming for any of the projects commissioned during 10<sup>th</sup> Plan/ 11<sup>th</sup> Plan. The Account Closing Units functioning at different sites in respect of five<sup>21</sup> projects which were commissioned between April 1987 and October 1999 were not able to finalise and close the project accounts so far (May 2010).

Management stated (August 2010) that closing of accounts was often delayed due to litigation and vigilance enquiries. The reasons attributed were not valid since it was possible to finalise the accounts making adequate provisions and disclosures for issues under litigation / vigilance enquiries.

### **Higher cost of construction of Small HE Projects**

**3.73** In accordance with the KSERC (Power Procurement from Renewable Sources) Regulations 2006, a uniform capital cost of ` 4.88 crore per MW could be treated as reasonable for SHEPs. Test check of DPRs of nine<sup>22</sup> SHEPs included in the 11<sup>th</sup> Plan showed that the cost per MW was more than the prescribed limit by ` 0.11 crore to ` 4.35 crore (*Annexure 21*).The causes of variations were not analysed and the Board has no inbuilt system for analysing such issues of the project management.

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<sup>21</sup> Idamalayar , Madupetty, Poringalkuthu Left Bank Extension Scheme, Kakkad and Lower Periyar.

<sup>22</sup> Adyanpara, Sengulam Tail Race, Anakkampoil, Kandappanchal, Chathankottunada II, Perunthenaruvi, Poozhithode, Ranni- Perinad and Barapole,

Thus Board could not effectively monitor the physical progress of the work through financial controls. Though the financial management of the Board improved during the review period, the internal control systems were not adequately effective.

### **Tariff Fixation**

**3.74** In accordance with KSERC (Tariff) Regulations, 2003, the Board was to file before the Commission its Annual Revenue Requirement (ARR) and the Expected Revenue from Charges (ERC) for each financial year not later than four months before commencement of financial year unless revenue gap could be met by any other means. KSERC was to allow tariff revision to bridge the gap in accordance with KSERC (Terms and Conditions of Tariff for Retail Sale of Electricity Regulations, 2004). The status of filing of ARR & ERCs by the Board and their disposal by KSERC for the period under review were as given below:

**3.75** KSERC allowed to recover revenue gap of ` 904.89 crore out of ` 3079.11 crore claimed by the SEB in five ARR applications filed during review period. The reasons for disallowing expenses to be claimed through tariff fixation from customers were as follows:

- (a) higher employee cost including terminal benefits should be justified on the basis of production norms;
- (b) consumers deposit should be utilised for meeting working capital requirement to control interest on borrowings, depreciation, etc.;
- (c) Electricity duty was to be borne by Licensee.

Revenue shortfall of ` 239 crore for the period from January 2006 to November 2007 in pursuance of direction of State Government and order of KSERC (January 2006) allowing a rebate of ` 0.20 per unit from tariff applicable to domestic and commercial consumers remained unrecovered as State Government declined to release subsidy in monthly instalments to compensate the shortfall as directed by KSERC.

### **Dam Safety Aspects**

**3.76** A separate wing named 'Research and Dam Safety Organisation' (RDSO) was in existence in the Board to look after the security and safety of Dams and Power Houses, and to protect the landed properties of Board in Project areas. Scrutiny in audit disclosed the following shortcomings in the functioning of the organisation.

- The Wing had not undertaken research oriented dam safety activities during the period of review for want of adequate manpower.
- Although Dam Break Analysis was a prerequisite to the formation of Emergency Action Plan which was a mandatory exercise for facing any

eventuality of a dam failure, it was not systematically carried out for any of the Dams of the Board. In its absence, documented disaster management systems have not also been put in place. As a result, duties and responsibilities were not properly assigned with field personnel so as to ensure that there was adequate preparedness to take necessary relief/ remedial measures in the event of any calamity/ disaster.

- Safety concerns expressed by Central/State Intelligence/Vigilance Organisations were also not being addressed properly. Adequate security was not provided for Dams and other vital installations and armed security was not provided except for few of the major stations.
- The average value of Dam Safety works executed by the RDSO during 2005-09 was only ` 1.05 crore per annum. Test check disclosed that its employee cost for 2008-09 was ` 3.38 crore which was 320 *per cent* of the annual average value of works executed.

### Monitoring by Top Management

3.77 Board had evolved regular monitoring systems through which the top management kept itself informed of the operational and financial performances in broad parameters. State's power position was reviewed in power position meetings held every month at Chief Engineer level, also attended by Board's technical members for generation and transmission. The generation strategy for each month was evolved in these meetings with reference to storage position in Hydel reservoirs. Similar monitoring systems were also existing for monitoring of other operational and financial issues which were also systematically reviewed at the level of Board members through quarterly meetings. Important issues related to project execution were also discussed upon at Board level and collective decisions were taken in consideration of recommendations of field officers.

### Conclusions

- **The generation capacity requirement for the State as on 31 March 2010 was assessed at 2998 MW against which the capacity available was only 2563.25 MW. The capacity additions made in the State over a period of five years 2005-10 was only 124.30 MW whereas the growth in demand during the same period was 546 MW.**
- **Capacity addition plans of the Board were unrealistic. As against the addition of 610.15 MW planned for 11<sup>th</sup> Five Year Plan, the likely addition, as estimated in audit would only be 135.05 MW (22.13 *per cent* of projection).**
- **Out of five projects viz., KAES (100 MW), Athirappally (163 MW), Pallivasal (60 MW), Thottiyar (40 MW) and Mankulam (40 MW) included in the NE Plan towards capacity addition during 11<sup>th</sup> Plan only the first scheme is being commissioned during the Plan period which actually spilled over from 10<sup>th</sup> Plan.**
- **Power potential from renewable (non-conventional) sources was not adequately developed by the State, even after obtaining liberal financial assistance from Central Government for different schemes of MNRE.**

The Board could not render any assistance to the designated State Agency (ANERT) formed for the purpose of implementation of its developmental schemes.

- Forest/ Environmental clearances and acquisition of necessary land were the major hurdles faced by the Board in implementing new power projects. Timely assistance from State Government was not forthcoming in the matter of resolving issues connected with forest clearances and land acquisition.
- Capacity constraints and financial problems prevented the Board from undertaking overdue R&M works of its older stations in time. Maintenance needs of Diesel Power Stations were also not properly attended to due to delay in decision making on cost benefit considerations.
- RMU works of Pallivasal and Sabarigiri Stations already undertaken were not fully successful.
- Deficiencies in contract management also contributed to time and cost overruns.
- PLF of thermal power plants of the Board was very low due to curtailed operation. Outages of all the power stations were also high. Performance standards of small hydel projects were low.
- The performance results of the small HE projects were discouraging. None of them achieved the generation capacity projected in their DPRs during any of the years of review period.
- Decisions on project finance were taken without giving due consideration to the opinion of Finance Wing.

### Recommendations

- The Board should evolve an action plan on priority basis to expedite the implementation of 11<sup>th</sup> Plan projects and avoid slippages. Policy guidelines from Government in matters of forest clearances, land acquisition and rehabilitation of people affected by projects would be helpful to the Board in its efforts to meet the targets for capacity addition.
- Project investigation systems have to be strengthened by incorporating collective decision making in the initial stages itself to avoid inadequacies in designs and geological surprises at later stages.
- The Board should establish proper system for project monitoring enabling the flow of management information to the top management on time to take decisions on project management.
- The post implementation technical problems developed in most of the power stations recently established/ renovated made it obvious that the performance standards of contract agencies engaged by the Board were wanting in many respects. This also highlighted the need for more stringent pre-qualification norms while short listing the contract agencies.
- Preventive maintenance schedules of the power stations have to be adhered to with more regularity and consistency. Scope for curtailment

of period of shut down for annual maintenance and possibility of standardisation have to be examined.

- **Cost benefit aspects of operation of Thermal Stations have to be examined more closely with updated and accurate cost data and possibility to optimise the utilisation examined with a view to contain the operational cost.**
- **System of maintenance of project accounts should be strengthened to avoid undue delay in closure of accounts. System of post implementation financial analysis of project expenses has to be introduced. Evaluation of time and cost overruns has also to be systematically carried out and the findings utilised for making more realistic projections in DPRs for future projects.**
- **The Finance Wing should be more actively involved in decision making on project finance.**
- **Deficiencies in Dam Safety – Security Systems have to be remedied on priority basis.**