

CHAPTER III

Performance Review relating to Statutory Corporation

Kerala State Electricity Board

3. Implementation and Performance of Small Hydro Electric Projects

Highlights

Due to laxity in preferring the subsidy allowed by MNES the Board was yet to obtain the benefit of Rs. 15.50 crore.

(Paragraph 3.10)

Since the capacity of the SHEPs was reduced to suit the Chinese design, the Board could not tap potential energy of 3.40 MU from available water.

(Paragraph 3.11)

Non-receipt of Chinese suppliers' export credit for projects resulted in excess financing cost of Rs. 38.29 lakh per annum.

(Paragraph 3.12)

Due to lack of proper synchronisation of work, design deficiencies, failure in co-ordination of civil works, delay in acquisition of land, providing sanction and issue of work orders and resultant delay in commissioning of projects, there was loss of generation of power.

(Paragraphs 3.16, 3.17, 3.20, 3.25, 3.26, 3.27)

On account of inferior design leading to frequent failure of equipments and delay in repair of generators during the post-commissioning period, there was generation loss valued at Rs. 4.44 crore.

(Paragraphs 3.30, 3.31)

Introduction

3.1 Hydro electric power constitutes 98 *per cent* of the total energy generated by the Kerala State Electricity Board (Board). As there was delay in getting clearances for major hydro electric projects from the Government of India and other statutory bodies, the Board took up (1998) implementation of small and mini schemes which had the advantage of low investment, low generation cost, minimum gestation period and least environmental problems. As per the guidelines of the Ministry of Non-conventional Energy Sources (MNES), hydel projects having capacity above one MW and upto 25 MW are to be classified as Small Hydro Electric Projects (SHEPs).

At the beginning of the ninth plan, the Board had two* SHEPs having an aggregate capacity of 18 MW. During the ninth plan period (1997-2002), the Board took up implementation of nine* SHEPs with total installed capacity of 39.50 MW and potential generation of 137.07 MU. As against the target of commissioning of nine SHEPs, the Board could commission only Madupetty SHEP during the ninth plan period.

During the tenth Plan period (2002-2007), the Board targeted commissioning of 10 SHEPs with an installed capacity of 40.85 MW to generate 150.62 million units (MU) of power annually. As against this, the Board commissioned seven SHEPs (total capacity of 29.10 MW) with annual generation capacity of 112.62 MUs of electricity at a cost of Rs. 104.39 crore. While the works of two projects (Sengulam Tail Race and Landrun) were not taken up, one project (Kuttiyadi Tail Race) was under implementation (August 2008).

Organisational Set-up

3.2 The Board is governed by a seven member Body headed by the Chairman. The Chief Engineer, Generation is in charge for implementation and operation of hydro electric projects in the State. The Chief Engineers (Civil Construction) North and South are in charge of construction activities.

Scope of Audit

3.3 The present performance review conducted during November 2007 to March 2008 covers the implementation and performance of eight SHEPs (seven commissioned and one ongoing) of the Board during 2002-03 to 2006-07.

Audit Objectives

3.4 The objectives of the performance review with reference to the envisaged advantage of low investment, low generation cost, minimum gestation period and least environmental problems were to ascertain whether:

- The SHEPs were implemented in an economic, efficient and effective manner;
- Detailed feasibility studies were conducted before undertaking the projects;
- The finance obtained for the project was cost effective and utilised efficiently for the intended purpose;
- The various subsidies receivable from the Central/ State Governments were actually received;
- The commissioned units were performing at the envisaged capacity and the cost of generation was optimum; and

* Kallada-15MW and Peppara-3MW.

• Madupetty (2.00 MW, 6.40 MU) Malampuzha (2.50 MW, 5.60 MU) Chembukadavu I (2.25 MW, 5.60 MU) Chembukadavu II (9 MW, 16.40 MU) Urumi I (2.00 MW, 5.00 MU) Urumi II (4.00 MW, 9.53 MU) Kuttiyadi Tail Race (3.75 MW, 15.00 MU) Malankara (10.50 MW, 65.00 MU) Lower Meenmutty (3.50 MW, 10.14 MU).

- Periodical maintenance was conducted and the defects noticed during guarantee period were promptly rectified by the contractor.

Audit Criteria

3.5 The following criteria were adopted:

- Policies formulated by the Board/ Government, guidelines and directions issued by the Central/ State Governments and the Board with regard to implementation of SHEPs;
- Detailed Project Reports (DPR)/ Feasibility Study Reports, Board minutes and agenda papers of meetings of the Board;
- Tender documents, MoU/ Agreements signed with contractors; and
- Standards fixed by the CEA as regard to cost of the project, capacity utilisation and cost of generation.

Audit Methodology

3.6 The audit adopted the following mix of methodologies:

- Review of policies, guidelines and directions issued by the Central/ State Government and the Board;
- Scrutiny of feasibility study Reports/ DPRs, Board minutes and agenda papers of meetings of the Board;
- Adherence to prescribed procedure for invitation of tender and award of contracts as well as review of execution of works and payments to contractors;
- Scrutiny of progress report, performance appraisal reports and generation details;
- Scrutiny of operation and maintenance cost of commissioned project; and
- Issue of audit enquiries and interaction with the Management of the Board.

Audit findings

3.7 Audit findings as a result of performance review were reported (June 2008) to the Board/ Government and discussed in the meeting (7 August 2008) of the Audit Review Committee for State Public Sector Enterprises (ARCPSE), which was attended by the Additional Secretary, Power Department, Government of Kerala and Chairman of the Board. The views expressed by the Board/ Government have been taken into consideration while finalising the review.

The audit findings are discussed in the succeeding paragraphs:

Status of projects

3.8 The Board fixed a target of commissioning of eight^{*} ongoing SHEPs at an estimated cost of Rs. 118.52 crore. Out of these eight projects, the Board decided to implement four projects under Chinese assistance and the balance on its own. As against this, the Board commissioned seven SHEPs (four with Chinese assistance and three by the Board) and one project is still in progress. The status of the projects was as given below:

Name of the project	Capacity		Due date of commissioning	Actual date of commissioning	Time overrun	Estimated cost	Actual cost
	MW	MU				Rs. in crore	
Chinese assisted projects							
Chembukadavu-I	2.70	6.24	September 2001	January 2004	28 months	11.38	12.74
Chembukadavu-II	3.75	9.66	October 2002	January 2004	15 months	12.72	13.86
Urumi I	3.75	9.53	October 2002	January 2004	15 months	13.20	12.38
Urumi II	2.40	6.10	May 2003	January 2004	8 months	10.95	12.45
K S E B Schemes							
Lower Meenmutty	3.50	10.14	February 2005	April 2006	14 months	11.26	16.01
Malankara	10.50	65.35	December 2003	October 2005	22 months	41.13	33.67
Malampuzha	2.50	5.60	February 1992	November 2002	10 years 9 months	2.94	3.28
Kuttiyadi Tail Race	3.75	15.00	April 2003	In progress	---	14.94	13.04*
Sengulam Tail Race	4.50	12.50	Not taken up for implementation			--	--
Landrun	3.50	10.50				--	--
Total	40.85	150.62				118.52	117.43

Project financing

3.9 The Board initially planned the financing of the four Chinese Projects by availing export credit from China and the implementation of the remaining four projects using institutional borrowings/ own funds. Since export credit assistance was not forthcoming as discussed in paragraph 3.12, the financing of five[∞] projects was made through loan (Rs. 74.48 crore) from Rural Electrification Corporation Limited (REC) at interest rates varying from 9.50 per cent to 11.75 per cent per annum. The remaining three[∅] projects were financed from own funds (Rs. 42.95 crore). As against the total estimated cost of Rs. 118.52 crore, the actual cost amounted to Rs. 117.43 crore. The subsidy available for SHEPs from MNES was not considered for project financing and was also not obtained subsequently as discussed below:

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- * Out of ten projects proposed, two projects (Sengulam Tail Race and Landrun) were not taken up for implementation.
 - ∞ Expenditure incurred upto August 2008.
 - ∞ Chembukadavu I, Chembukadavu II, Urumi I, Urumi II and Malankara.
 - ∅ Lower Meenmutty, Malampuzha and Kuttiyadi Tail Race.

Failure to obtain capital subsidy

3.10 As per the subsidy scheme announced (July 2003) by the GoI (MNES), the new SHEPs and the ongoing projects were eligible for subsidy at the rate of 40 per cent of the project cost limited to Rs. 1.5 crore plus Rs. 25 lakh per MW and at the rate of 75 per cent of the balance project cost limited to Rs. 75 lakh plus Rs. 12.50 lakh per MW respectively.

Due to laxity in preferring the subsidy allowed by MNES the Board lost the benefit of Rs. 15.50 crore.

Audit noticed that the Board obtained the benefit of subsidy of Rs. 2.13 crore in respect of Lower Meenmutty project only and was yet to obtain the benefit of Rs. 15.50 crore in respect of other projects due to laxity in pursuing the claim.

The Board stated (July 2008) that MNES was addressed to release subsidy amount in respect of all the projects. The fact remains that the Board failed to effectively follow up the matter with MNES for release of subsidy as no correspondence was made with MNES since July 2006.

SHEPs implemented with Chinese assistance

Project formulation and MoU implementation

3.11 A Memorandum of Understanding (MoU) was signed (4 May 1998) between Government of Kerala and HIC/IN-SHP* for implementing 18 small/mini schemes (**Annexure 16**) in Kerala with a capacity of 107 MW to generate 296.36 MU per annum. Another MoU was also signed on the same day with HIC/IN-SHP for implementing four projects[®] as pilot projects. To formulate the MoU for development of SHEPs in the State, the Energy Management Centre (EMC) Kerala, an autonomous body, acted as a liaison agency between the Board and HIC/ IN-SHP. Accordingly, agreements were executed (October 1998/ April 2002) between KSEB and HIC/IN-SHP for engineering, design and on-site consultation for implementation of the four pilot projects at a price of USD 3,96,800 and for supply and erection of equipments at a contract price of USD 42,63,000 (Rs. 19.18 crore) CIF Kochi.

Audit noticed the following discrepancies in the MoU/ agreement executed with HIC/IN-SHP which affected the financial interests of the Board:

Since the capacity of the SHEPs was reduced to suit the Chinese design the Board could not tap potential energy of 3.40 MU from available water.

- The capacity of the four pilot projects as ascertained by the Board in their preliminary studies was lowered from 17.25 MW to 12.60 MW (from 34.93 MU to 31.53 MU) at the instance of HIC/IN-SHP based on their engineering design and machinery available. Since the potential generation of power was compromised to suit the design of Chinese equipments, the Board could not tap additional energy from the available water to the extent of 3.40 MU per annum.

The Board stated (July 2008) that the capacity assessed at the time of preparing the report cannot be taken as the capacity of the project. The Board, however, lowered the capacity to suit the Chinese design and

* HIC/IN-SHP is an international non-profit making organisation under the joint ownership of UNDP, UNIDO, Chinese Government and several other international, regional and national energy organisations and institutions.

® Chembukadavu stage I & stage II and Urumi stage I and stage II.

proposed to undertake another down stream scheme, Chembukadavu-III (6 MW) for utilising the remaining head available which should have been included in the original Chembukadavu-II scheme itself.

- As per MoU, HIC/IN-SHP was to arrange export credit with financing agencies in China for equipment supplied for the four pilot projects. The Board, however, deviated from the MoU, and executed (3 October 1998) the agreement with HIC/IN-SHP linking export credit to the equipment supply for 18 SHP projects. Due to this deviation, the export credit eligible for the four pilot projects could not be availed as the remaining 14 projects were not taken up for implementation. Consequently, KSEB had to finance the four pilot SHEPs by obtaining loan from Rural Electrification Corporation at higher interest rates involving additional financing cost as discussed in paragraph 3.12.

The Board stated (July 2008) that they would have incurred exchange variation loss due to depreciation of Indian Rupee against US Dollar. However, the rupee on an annual average had appreciated against US Dollar during the period (2002 to 2008).

- To avail export credit facility from HIC/IN-SHP, the Board had foregone the benefit of international bidding for the supply of equipment and the tender was limited to Chinese equipment suppliers. With the subsequent amendment to MoU delinking the export credit from the four projects, the Board had to accept Chinese technology at the rates specified by them. This resulted in non-availability of competitive rates for the equipment of the project besides lack of transparency in the contracts executed.
- As per the General Conditions of agreement, one turbine for the first station (Chembukadavu I) of the four pilot projects was to be supplied free of cost by HIC/IN-SHP. But the Board had not ensured that the generator was delivered free of cost by HIC/IN-SHP resulting in loss of Rs. 1.45 crore (USD 3,15,557 X Rs. 46) towards cost of generator not supplied.

One turbine to be supplied free of cost was not received resulting in loss of Rs. 1.45 crore.

The Board stated (July 2008) that an amount of USD 65,969 was deducted towards cost of one free turbine from the amount payable to HIC/IN-SHP at the time of concluding the contract price. The reply is not acceptable as an ineligible amount of USD 63,354.45 was paid to HIC/IN-SHP as service charge for export credit and USD 43,834 was also added on the ground of mistake in calculation of total price before deducting the cost of the generator from the total price, offsetting the intended benefit of free supply.

- The Director of EMC and Ex-officio Secretary to Government, who played a key role in identification of small hydro projects in Kerala during the period of selection of HIC/IN-SHP as consultant cum supplier and held negotiations with HIC/IN-SHP on behalf of KSEB and Government, later on became the Managing Director of HIC/IN-SHP. The same Director as MD of HIC later (August and October 2004) conducted negotiations for settling the claim with the Board.

The Director of EMC who played a key role in the negotiation for selection of consultant later became the MD of the consultant firm.

There was conflict of interest in the Director of EMC subsequently becoming MD of the consultant supplier.

The Board stated (July 2008) that the appointment of former Director of EMC as Managing Director of HIC/IN-SHP did not have any financial impact on the contract with HIC/IN-SHP and he was not a member in the evaluation panel for finalisation of equipment price. The fact remains that the former Director of EMC had been a member of the Steering Committee for finalising of MoU and had subsequently participated as MD of HIC/IN-SHP in the steering committee meeting to settle disputed claims of HIC/IN-SHP.

Non-availing of supplier's export credit

3.12 As per agreement with HIC/IN-SHP, the Board was to get supplier's export credit facility for 18 projects as a single package covering 85 *per cent* of the value of equipment in China, cost of installation (15 *per cent* of total equipment ex-factory price) and 1.5 *per cent* incidental expenses. The period of credit was to be seven years including one year as grace period with interest rate of 7.5 *per cent* per annum plus 1.5 *per cent* for insurance warranty.

Non-receipt of Chinese supplier's export credit for projects resulted in excess financing cost of Rs. 38.29 lakh per annum.

Audit noticed (January 2008) that as per MoU with HIC/IN-SHP, export credit was available for equipment supplied for the four pilot projects valued at Rs. 17.01 crore. Contravening this provision in the MoU, agreement was executed with HIC/IN-SHP linking export credit to the equipment supply for all the 18 projects as a single package. As a result, the Board did not get the supplier's export credit facility. Due to non availability of Chinese supplier's export credit the Board had to avail loan from Rural Electrification Corporation (REC) Limited at interest rate of 11.25 *per cent* per annum resulting in excess financing cost to the tune of Rs. 38.29 lakh per annum.

At the time of entering into MoU the export credit facility was considered as attractive part of the contract and for this purpose the Board had foregone the benefit of invitation of global tenders. Due to non-availing of export credit, the Board's interests were not protected while concluding the supply contract.

The Board stated (July 2008) that they would have incurred a loss of around Rs. 1.95 crore due to depreciation of Indian Rupee against USD during the period 1995 to 2005 had Chinese export credit been availed. The reply is not acceptable as Indian Rupee had appreciated from Rs. 45 per USD in 1995 to Rs. 40 per USD in 2007-08 during the pay back period (2002 to 2008) and hence the export credit would have been more beneficial. Besides, the benefit of availability of export credit at reduced rates of interest as projected by the Board while signing of MoU with HIC/IN-SHP had also been foregone.

Execution of projects

3.13 The Board targeted commissioning of the four Chinese projects during the period September 2001 to May 2003. The details of capacity of each of the projects, target date of commissioning, time overrun, estimated cost and actual cost were as given below:

Name of the project	Capacity		Due date of commissioning	Actual date of commissioning	Time overrun	Estimated cost	Actual cost
	MW	MU				Rs. in crore	
Chinese assisted projects							
Chembukadavu I	2.70	6.24	September 2001	January 2004	28 months	11.38	12.74
Chembukadavu II	3.75	9.66	October 2002	January 2004	15 months	12.72	13.86
Urumi I	3.75	9.53	October 2002	January 2004	15 months	13.20	12.38
Urumi II	2.40	6.10	May 2003	January 2004	8 months	10.95	12.45
Total	12.60	31.53				48.25	51.43
Average cost per KW (in Rs.)						38,300	40,800
Average cost per KW of Board's projects (in Rs.)						37,421	35,050
Average cost per KW as per MoU (at the rate of 800 USD per KW)						36,000	

It would be seen from the above that:

- The Board estimated average cost of Rs. 38,300 per KW for the Chinese projects as against the cost per KW of Rs. 36,000 projected as per the MoU indicating that the projections given at the time of concluding the contract were not realistic. The actual average cost per KW on execution of the projects was Rs. 40,800 involving additional capital cost of Rs. 6.05* crore.
- While the actual average cost per KW of SHEPs implemented by the Board was Rs. 35,050, the cost of Chinese projects was Rs. 40,800 indicating that Chinese technology did not bring in cost effectiveness.
- There was delay in commissioning of the projects ranging between eight months and 28 months mainly due to delay in execution of associated civil works by the Board resulting from non-compliance with tendering formalities, failure to plan and design civil works in consonance with project requirement, avoidable rectification works arising from design defects and poor quality of construction, etc., as discussed in succeeding paragraphs.

Delay in execution of civil works

3.14 While the on-site consultation, equipment supply and erection of equipments of the four pilot projects were executed by HIC/IN-SHP, civil works of these projects were undertaken by the Board. The details of execution of the civil works are indicated below:

* (Rs. 40,800-Rs. 36,000)X 12,600 KW.

Sl. No.	Particulars	Chembukadavu I	Chembukadavu II	Urumi I	Urumi II
1	Name of the contractor	Dr.Sasi Elloor	Paulose, George & Co.	Aarti Engineering Company	Paulose, George & Co.
2	Tendered cost (Rs. in crore)	3.72	4.70	5.48	4.55
3	Actual cost (Rs in crore)	3.39	4.87	4.36	5.30
4	Scheduled date of completion	4-9-2001	24-10-2002	26-10-2002	6-5-2003
5	Actual date of completion	19-8-2003	04-09-2003	22-7-2004	31-12-2003 (extended date)
6	Delay in months	23	10	21	Nil
7	Date of commissioning	25-1-2004	25-1-2004	25-1-2004	25-1-2004

Details in the table indicate that there was delay ranging from 10 months to 23 months in completing the civil works of the three SHEPs due to non-provision of surplus channel, design deficiency and delay in acquisition of land. Since the completion of civil works and the equipment supply and erection works by HIC/IN-SHP required proper synchronisation, delay in completion of civil works in turn resulted in delayed commissioning of the four pilot projects with consequent generation loss as discussed in paragraphs 3.16, 3.17 and 3.20.

Failure to provide Diversion Canal

3.15 After commissioning (January 2004) of Chembukadavu stage II, a landslide occurred (July 2007) near the Chembukadavu Stage II canal due to which water to stage II power house was blocked by the earth and the overflow of water led to stoppage of generation of power from Stage II.

Since there was no alternate arrangement of concrete lined contour channel, when stage II was not working, the generation of power could resume only in July 2007, after fixing stop log gates at Chembukadavu stage-II canal at a cost of Rs. 6.30 lakh. The generation in Stage-II resumed on 11 August 2007.

In the absence of alternate channel for discharge of water the power generation from Chembukadavu I had to be stopped for 52 hours (19 July 2007 to 21 July 2007) and the generation loss worked out to Rs. 5.39 lakh.* Thus the failure of Board in providing diversion canal for the tail water from Chembukadavu-I to the mother stream, resulted in wasteful expenditure of Rs. 11.69 lakh[†].

The Board stated (July 2008) that the diversion of tail water of Chembukadavu-I to main stream was not envisaged earlier to exploit maximum energy with minimum structure. However, the Board had admitted

* 2,700 KW x 52 hrs. at the rate of Rs. 3.84/unit.

[†] Rs. 6.30 lakh plus Rs. 5.39 lakh.

Failure to provide diversion canal resulted in wasteful expenditure of Rs. 11.69 lakh.

the fact that power canal is situated in landslide prone area, and hence diversion canal should have been envisaged.

Failure in planning and construction of Surplus Channel

3.16 The Board decided in May 2003 to construct a surplus channel which was critical for the commissioning of both Chembukadavu Stage I & II. The final proposal at an estimated amount of Rs. 10.54 lakh with copies of the drawings was forwarded (July 2003) to the contractor and after completion of the work, the generation commenced (September 2003) at Chembukadavu stage II.

Due to lack of proper synchronisation of work, there was loss of generation valued at Rs. 3.18 crore.

Due to lack of proper synchronisation of the construction work of surplus channel with the other civil works there was no generation for 92 days from July to September 2003 involving a loss of Rs. 3.18 crore.*

The Board accepted (July 2008) the audit observation.

Deficiencies in planning and design

3.17 After completion of the civil and erection works of the Chembukadavu Stage II in September 2003, the Board, could not commission the project till January 2004 as there was delay in load testing on account of overflow of the canal berm and sliding (August 2003) of the left side of the berm during the load rejection test of Chembukadavu Stage I.

Due to design deficiencies in overflow structures, there was loss of generation valued at Rs. 1.97 crore.

Audit noticed (December 2007) that the overflow structures constructed according to the drawing provided by the HIC/IN-SHP were not sufficient for the maximum discharge of water from three machines in Chembukadavu-I at maximum load and opening of valve to the full extent. The consultants had not taken into account the probable outflow from Chembukadavu I, during operation at full capacity. Due to the delay in commencement (January 2004) of generation arising from above design deficiency, there was loss of generation for 57 days from 4 September 2003 to 31 October 2003, involving loss of Rs. 1.97 crore^u.

Avoidable rectification work

3.18 As per the Chinese design, the power canal of the Chembukadavu Stage-I project was constructed with pre-cast concrete slabs at the sides and 'cast insitu' concrete at the bottom of the canal to reduce cost. Since the side portion of the R.R. masonry parapet was not cement plastered as recommended in the Chinese design there was excessive seepage of water.

The contractor also refused to rectify the defect citing the reason that seepage of water was on account of design defect and not due to deficiency in construction. The proposal to strengthen the canal construction at a cost of Rs. 17.50 lakh (July 2008) was yet to be implemented.

* 92 days X 3,750 X 24 hours X Rs. 3.84/ unit.

^u 3,750 x 24 hrs x 57 days at the rate of Rs. 3.84/ unit.

The Board stated (July 2008) that it was not a design defect as pointed out in the audit paragraph. The reply is contrary to the fact that the Board had proposed (February 2004) to arrange canal lining as a separate work indicating that there was initial design defect in the power canal.

Non-recovery for unreturned rubble

3.19 As per terms of the agreement with the contractor for civil works of Chembukadavu Stage II, the balance of rubble issued to the contractor was to be returned to the Board on completion of the work and recovery at three times the standard rate of Rs. 170/ m³ was to be effected for unreturned rubble.

Undue favour extended to the contractor due to non-recovery of cost of rubble at penal rates amounted to Rs. 18.08 lakh.

Audit observed (November 2007) that the contractor had retained 4,062.715 m³ quantity of rubble out of 6,128.410 m³ recorded as receipt, and recovery was made only at the standard rate of Rs. 170/ m³ for 1,550 m³ instead of thrice the standard rate applicable and no recovery was made for 2,512 m³ of rubble resulting in undue favour to the contractor on account of non-recovery of cost at penal rates amounting to Rs. 18.08 lakh.

The Board stated (July 2008) that out of 4,174.53 M³ of rubble to be returned, 2,624.53 M³ of rubble was used by the contractor for different works of the project and recovery was proposed for balance 1,550 M³ of rubble and hence no favour was extended to the contractor. However, as per the agreement penal recovery at three times the market price of material issued had to be effected for non-return of unused balance of materials. As per records the contractor had not used the rubble for any other work. No recovery has been made even though the civil works were completed (September 2003) and the project commissioned (January 2004).

Non-imposition of Liquidated damages for delay

3.20 The civil work of Urumi-I SHEP was awarded (July 2001) to Aarti Engineering Company, Nagpur (AEC), at Rs. 5.48 crore for completion before October 2002. The contractor commenced the works in August 2001. However, the work could not be completed as scheduled due to the following reasons:

- The excavation of power channel could not be started in August 2001 as the land acquisition for the project was not completed. The land was handed over to the contractor only in October 2001, after two and a half months from the date of award (June 2001) of work. The contractor intimated (February 2002) the Board about the readiness of power house excavation for geological inspection. The geological mapping of the power house area, however, could be carried out only in April 2002, after a delay of 2¹/₂ months.
- As per the agreement, the Board was to supply the steel required (130 MT) for fabrication of penstock by October 2001. The Board, however, supplied the entire quantity by October 2002. The delay in

issue of steel plates for 5 months resulted in consequent delay in the fabrication and erection of penstock and connected accessories.

As per general conditions of contract, the contractor was liable to pay damages for delay after the scheduled date of completion at the rate of one percent on the estimated value of the contract per day, not exceeding five days. Despite consequential loss to the tune of Rs. 5.50 crore on loss of generation, the Board, had not imposed liquidated damages of Rs. 27.40 lakh (Rs. 5.48 crore x 5 per cent) on the contractor for no reasons on record.

The Board accepted (July 2008) the audit observation.

Failure to ensure quality of construction

3.21 The electro mechanical equipments in the power house of Urumi I project were damaged (July 2004) due to floods. These equipments had to be repaired by the Board at a cost of Rs. 58.45 lakh.

Audit noticed (November 2007) that the flood waters entered the power house due to weakness in the masonry of the protection wall of the powerhouse. The Board did not undertake replacement of the masonry wall with RCC structure even though the matter was pointed out by the Executive Engineer of the Board as early as in March 2002. The proposal for strengthening the original masonry wall with concrete lining was also not undertaken on the ground of savings in cost. Subsequently the electro-mechanical equipments of Urumi I project were damaged due to floods and these equipments were repaired at a cost of Rs. 58.45 lakh.

Failure in ensuring quality of construction resulted in avoidable expenditure of Rs. 58.45 lakh.

Thus, the failure of the Board in ensuring the quality of construction resulted in avoidable expenditure of Rs. 58.45 lakh on repairs to the power house.

The Board stated (July 2008) that the damage to the power house was due to flash flood and not due to inferior quality of construction. The reply is contrary to the fact that a proposal from the field engineer to strengthen the masonry wall with RCC structure was rejected by the Board on the ground of savings in cost.

Avoidable extra expenditure on Chinese consultation and erection

3.22 As per agreement with HIC/IN-SHP, on-site consultation for civil work of all the four Chinese projects was to be provided for a total 2,160 mandays at a consultation fee of USD 80 per manday. The civil works of Chembukadavu-I commenced on 4 July 2000 whereas works relating to the other three Chinese projects commenced after delays ranging from 12 months (Chembukadavu II) to 16 months (Urumi II) which resulted in additional expenditure as detailed below:

- Failure in commencing the civil works on all the projects concurrently and completing the same as scheduled resulted in payment of Rs. 10.51 lakh* as excess consultation fee for 292 mandays.

* 292 x USD 80/ manday x Rs. 45 per dollar.

- Non-deployment of Chinese team during October 2002 to April 2003 for erection work necessitated payment of Rs. 2.80 lakh towards idleness fee to the erection team.

The Board accepted (July 2008) the audit observation.

Payment to contractors in violation of agreement

3.23 Audit noticed that the following payments were made to the civil construction contractors in violation of the contractual provision:

The Board paid stacking charges of Rs. 27.35 lakh on unstacked rubbles.

- As per general conditions of agreement with civil contractors, materials retrieved from foundation excavation, blasting, etc., which were suitable for construction purposes should be segregated separately from other materials and suitably stack piled for use as and when required. The stacking charges payable for useful blasted rubble was stipulated at Rs. 219.75 per 10 m³. The Board, however, paid aggregate stacking charges of Rs. 27.35 lakh for Chembukadavu Stage I & II and Urumi Stage I & II for 1,24,450 m³ of non-stacked rubbles.
- Board had released the security deposit (except Urumi I) of Rs. 64.89 lakh even before passing the final bill.

The Board stated (July 2008) that final bills of the contractor have not been settled and the final decision in the matter would be taken in the interest of the Board. The fact remained that the Board had released the security deposits even when the recovery was pending and the final bill amount would not be sufficient for the recovery.

SHEPs implemented by the Board

3.24 The Board targeted implementation of four SHEPs during the period 2002-2007 using its own expertise and personnel, at a total estimated cost of Rs. 70.27 crore. The details of capacity of each of the projects, target date of commissioning, time overrun, estimated cost and actual cost were as given below:

Name of the project	Capacity		Due date of commissioning	Actual date of commissioning	Time overrun	Estimated cost	Actual cost
	MW	MU				Rs. in crore	
Lower Meenmutty	3.50	10.14	February 2005	April 2006	14 months	11.26	16.01
Malankara	10.50	65.35	December 2003	October 2005	22 months	41.13	33.67
Malampuzha	2.50	5.60	February 1992	November 2002	10 years 9 months	2.94	3.28
Kuttiyadi Tail Race	3.75	15.00	April 2003	In progress	---	14.94	13.04*
Total	20.25	96.09				70.27	66.00

* Expenditure incurred upto August 2008.

It would be seen from the above details that out of four projects targeted, the Board could commission three projects during the review period. Out of these, the work of Malampuzha project was completed as early as 1999 but the formal commissioning was done only in November 2002 due to disputes arising from technical defects in execution. After incurring an expenditure of Rs. 13.04 crore, the Kuttiyadi Tail Race Scheme remained to be completed (August 2008).

Details of work executed by the Board are given in **Annexure 17**. Deficiencies noticed in the implementation and post-commissioning performance of these projects are discussed in succeeding paragraphs.

Malankara SHEP

3.25 Malankara SHEP, having an installed capacity of 10.5 MW, envisaged diversion and utilisation of 2,745.94 mm³ of water from Malankara Dam for power generation. The project was commissioned in October 2005/ August 2006 after a delay of 16 years due to absence of proper co-ordination between various works relating to the project and slackness on the part of the contractor as discussed below:

- As per the contract, the contractor (WCP) was to complete the civil works of the project in 24 months. Even after allowing extension of time twice for completion of work, the work was completed only in June 2005 at a cost of Rs. 4.51 crore. The main reason for delay in completion of work was non-compliance of commitments on acquisition of land by the Board and slackness on the part of contractor in executing the works in time.
- As a result of the delay of 20 months from December 2003 to August 2005 in completing the allied works for evacuation of power, the Board had incurred revenue loss of Rs. 37.55 crore (7,000 Units X 24 X 582 days at the rate of Rs. 3.84/unit).
- Due to forced shutdowns of Unit-II from September 2005 to August 2006 and Unit-III from February 2007 to April 2008, on account of the damage of its high speed gear wheel and problem with Programmable Logical Control (PLC) respectively, there was loss of generation of 19.189 MU. The Board decided (September 2007) to recover Rs. 6.06 crore from the contractor, towards energy loss. The loss was yet to be recovered (July 2008).

The Board stated (July 2008) that the delay in completion of civil works was due to presence of large volumes of rock at the site and restriction in blasting of rock at the dam toe. The Board admitted that the site for 66 KV substation was handed over to the contractor in October 2003 when the substation was to be completed in September 2003. The matter was pending before the high power committee constituted by the Board.

Lower Meenmutty Project

3.26 The Lower Meenmutty Project, a run of the river scheme with an installed capacity of 3.5 MW, envisaged generation of 7.63 MU of energy per annum by utilising the water from Vamanapuram Irrigation project. The scheme was sanctioned (October 1994) by the Government of Kerala and Board (September 1995) respectively. Administrative Sanction was accorded (May 2000) by the Board specifying the period of completion as two years.

The contract for execution of the work was awarded (January 2003) to Asian Techs–VA Tech Joint Venture (Asian Tech) at an estimated cost of Rs. 8.51 crore and agreement executed (July 2003).

The work commenced in February 2003 could not be completed even after extension of time upto November 2005. The estimate was revised to Rs. 11.26 crore. The project was finally commissioned in March 2006 at a cost of Rs. 16.01 crore. The main reasons for delay of 10 years and six months in commissioning the scheme after its approval were:

Nature of delay	Duration
Acquisition of land	3 years 6 months
Administrative sanction	1 year 2 months
Issuance of work order	2 years 8 months
Construction	1 year

The reasons for delay as analysed in audit were delay in purchase of land, fixing incorrect compensation for lands purchased and related disputes, arranging funds, giving approvals for various stages of work, revision of estimates, inept decision on disputes and matters of Court cases and delay in making payment to contractors. Though these were time consuming projects, the Board could have properly planned and monitored effectively to reduce the delay. The Board, however, failed to arrest the delay caused due to the above reasons.

The irregularities noticed in the implementation of the project were as discussed below:

- Utilisation of plates of 12mm, 14mm and 16mm thickness instead of 10mm plates and resultant increase in the weight of the plates required for fabrication of Penstock from 61 tonne to 110.296 tonne (including normal wastage of 3.21 tonnes allowed at the rate of three *per cent* on the finished penstock weight of 107.086 tonnes) involving additional expenditure of Rs. 29.24 lakh.
- Due to delay in completion of the project from February 2005 to March 2006 there was generation loss of 16.80 MU valued at Rs. 3.87 crore*.

Due to delay in completion of project, there was generation loss of 16.80 MU valued at Rs. 3.87 crore.

Malampuzha Project

3.27 Mention was made in the Report of the Comptroller and Auditor General of India for the year ended 31 March 1999 about the non-commissioning of

* 3,500 units x 24 hours x 120 days at the rate of Rs. 3.84/unit.

Malampuzha project after incurring an expenditure of Rs. 4.73 crore upto March 1999. In August 1999 oil leakage problems developed and even after further repairs the anticipated generation could not be achieved.

Due to failure (November 2000) of the machine and delay on the part of the contractor to procure and install a new bearing, there was no generation of power during the remaining period of the irrigation season. The machine was put to continuous operation from October 2001 and generated 8,27,125 Kwh of energy up to December 2001 when the machine was stopped due to pressure oil leakage.

As per the report (July 2002) by a committee constituted (August 2000) to study the problems, failure of the machine was due to poor installation and inferior design. Eventually power could not be generated for 179 days out of 214 days for which water was available due to which there was energy loss of 10.74 MU valued at Rs. 4.12 crore (at the rate of Rs. 3.84/ unit for 10.74 MU). Subsequently, the project restarted in September 2005 failed in December 2006. Since then, there was no generation of power (August 2008).

Due to technical defects, inferior design coupled with other failures, the project had come to a halt. The Board may initiate measures to revamp/ refurbish the projects to make it viable for operation on a continuous basis.

On account of inferior design and resultant frequent failure of equipments there was generation loss valued at Rs. 4.12 crore during 1999-2000 & 2000-01.

Ongoing Schemes

Kuttiyadi Tail Race Project

3.28 The Kuttiyadi Tail Race Project (KTR), with an installed capacity of 2.5 MW envisaged the utilisation of tail race discharge water of Kuttiyadi Power Station for generating 14.05 MUs of power per annum. Administrative sanction for the project was received in June 1989.

The work of design, supply, erection and commissioning of generating equipments was entrusted (April 1993) to Boving Fouress Limited (BFL), Bangalore at a total cost of Rs. 3.01 crore with stipulation of completion by 1995. The Board subsequently enhanced (May 1993) the capacity of the scheme to 3.75 MW (17.10 MU) and decided (1995) to install Tubular Kaplan turbine instead of Francis turbine by incurring an additional expenditure of Rs. 2.19 crore. Due to this, the tenders invited (1994) for civil work had to be cancelled. The civil work was entrusted to SILK only in October 2000 at a PAC* of Rs. 4.61 crore. As per the agreement, SILK was to commence the work before 5 October 2000 and complete by 4 April 2003. The work was completed within the extended period of 30 June 2008.

BFL completed (26 June 2008) the erection work of Unit I & II. The unit III has not been supplied so far (July 2008) and the Board had incurred a total expenditure of Rs. 13.04 crore. The project was yet to be commissioned (August 2008).

Audit noticed the following:

* Probable Amount of Contract.

- Due to delay in erection of equipments consequent to delayed completion of civil work, the equipments supplied (December 2000) by BFL for Unit I & II at a cost of Rs. 3.07 crore remained idle for 90 months (up to June 2008). The interest loss on the blocked up capital worked out to Rs. 2.42 crore[∇].
- Due to delay in commissioning of the scheme the Board lost generation of 17.10 MU of electricity during May 2003 to July 2008.
- Rs. 1.48 crore paid (1999) as advance to BFL for supply of Unit III remained blocked up for 90 months (upto June 2008). The interest loss on the blocked up capital worked out to Rs. 1.18 crore.
- As a result of the delay in completion of the project the equipments supplied (December 2000) by BFL were rendered unusable and the Board had to incur (June 2007) avoidable expenditure of Rs. 1.75 crore in refurbishing of the equipments.

Post commissioning performance of projects

3.29 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 the seven SHEPs commissioned during the five years up to March 2007, cost per KW of installed capacity for six projects were as given in **Annexures 18** and **19**.

The details in the **Annexures** indicate that:

- The actual generation and actual PLF achieved was far below the energy to be generated and PLF as per design during the five years upto 2005-06.
- In the case of Malampuzha SHEP, the annual generation of energy ranged between 0.176 MU and 2.951 MU only when compared to the optimum level of 5.60 MU.
- During 2006-07, when all the projects were in operation, total actual energy generated was 66.98 MU (59.43 *per cent* of capacity) as against the total Design Energy Capacity of 112.71 MU, involving a shortfall in generation of 45.73 MU.
- As against the total designed generation of 408.03 MU of energy during the six years ended 2007-08 the actual generation was 197.25 MU involving an aggregate shortfall of 210.78 MU.
- As the PLF had been designed considering the availability of water the loss of generation (total 210.78 MU) during the period 2002-03 to 2007-08 indicated that water resources and capacity were not being utilised to the optimum level due to design deficiencies, frequent breakdown of units and delay in timely rectification of defects as discussed below:

[∇] At the average interest rate of 10.50 per cent applicable on REC loan.

Frequent breakdown of generator

Due to frequent failure of turbine there was generation loss valued at Rs. 2.41 crore.

3.30 During 2005-06, the generating machine of Malampuzha project started in September 2005 but the turbine failed due to crack in the runner shaft and after repair at a cost of Rs. 4.87 lakh the machine commenced operation (August 2006) but failed again in December 2006.

Due to frequent failure of equipments, there was no generation of power for 180 days resulting in loss of 6.288 MU valued at Rs. 2.41 crore.

Non-recovery of penalty from the contractor

Undue delay in repair of generator resulted in generation loss of Rs. 2.03 crore.

3.31 The generating Units No. III (1.5 MW) and No. I (0.5 MW) of Lower Meenmutty project were reported faulty from March 2007 and May 2007 respectively. As against the time of four months and 10 days respectively required for repairing Units No. III and I, Unit No. I was repaired and put into operation in November 2007 and Unit No III was not repaired (January 2008). The generation loss on account of undue delay of 110 days in repair of the above worked out to 5.28 MU valued at Rs. 2.03 crore. The penalty recoverable as per Guarantee Clause of the agreement amounting to Rs. 82 lakh has not yet been recovered from the contractor.

An amount of Rs. 82 lakh recoverable from the contractor as per contract was not recovered.

The Board replied (July 2008) that a letter was issued (February 2008) to the contractor for recovery of Rs. 99.40 lakh and for withholding pending claims of the contractor. The fact, however, remained that the amount was yet to be recovered.

Acknowledgement

Audit acknowledges the co-operation and assistance extended by the staff and the Management of the Board at various stages of conducting the performance audit.

Conclusion

The Board while having an estimated potential of 1,000 MW for development of small Hydro-electric Power Projects implemented only seven projects with a total capacity 29.10 MW during the Tenth plan period (2002-07) against 10 projects of 40.85 MW targeted. There was delay ranging from eight months to 129 months in implementation of the projects mainly due to delay in acquisition of land, granting sanction, invitation and award of tenders, non-synchronisation of various works arising from absence of proper planning and co-ordination. The project financing was not cost effective and the benefit of subsidy available from MNES was not availed of to a substantial extent. There was lack of transparency in the planning and formulation of Chinese assisted projects due to which the benefit of competitive rates could not be availed of on account of deviation from the normal procedures of global tendering. There was loss of generation arising from delay in execution of projects and various technical and design defects.

Recommendations

The Board needs to:

- **implement small hydro electric projects within the scheduled time through better planning and co-ordination of the work.**
- **follow best commercial practices in evaluation and award of contracts so that technically qualified and experienced contractors are selected in order to avoid technical and design defects and failure of the equipments during post commissioning period.**
- **ensure proper synchronization in implementation of the work to avoid idling of completed work, thereby, reducing the loss of envisaged benefit.**
- **ensure close monitoring in an effective manner so as to avoid time and cost overrun.**