

## **CHAPTER III**

### **SECTION 3**

#### **TAMIL NADU ELECTRICITY BOARD**

#### **REVIEW ON SATHANUR DAM HYDRO ELECTRIC PROJECT**

### **HIGHLIGHTS**

**Delay in firming up of capacity of the project deprived the state of potential availability of 105.21 million units of electricity. Delay in implementation of project resulted in potential revenue loss of Rs.13.62 crore.**

*(Paragraph 3.3)*

**Increase of more than 100 per cent in the cost of project resulted in increase in investment per KW with consequent increase in cost of generation.**

*(Paragraph 3.4.2.2)*

**Non-acceptance of lowest tender for fabrication and erection of steel liners and penstock resulted in extra expenditure of Rs.42.71 lakh.**

*(Paragraph 3.5.3.1)*

**There was an excess consumption of steel plates (Rs.19.77 lakh) and excess payment of fabrication charges to the contractor (Rs.13.12 lakh) in fabrication of steel liners.**

*(Paragraphs 3.5.3.2 and 3.5.3.3)*

**Undue benefit of Rs.0.54 crore was given to a supplier due to extra payment made on account of (i) payment for an item, cost of which was not quoted in original bid (Rs.35 lakh) (ii) non-inclusion of a suitable penal clause (Rs.10.50 lakh) and (iii) payment of price variation on bought out items (Rs.8.93 lakh).**

*(Paragraphs 3.5.4.1, 3.5.4.2 and 3.5.4.3)*

**Low Plant Load Factor led to increase in cost of generation resulting in increase in revenue deficit by Rs.1.56 crore.**

*(Paragraph 3.6.2)*

### **3.1 Introduction**

Sathanur Dam Hydro Electric Project (SDHEP) with an installed capacity of one unit of 7.5 MW (as against originally conceived 20 MW – 2 units of 10 MW each) was proposed (July 1991) to be established by the Board at the down stream of Sathanur Reservoir. A Supplementary Detailed Project Report (SDPR) for the execution of the above project at an estimated project cost of Rs.17.03 crore was finalised by the Board and submitted to the State Government for approval in October 1992. The Government gave its approval in December 1994. As per the construction schedule prescribed in the SDPR, the project was slated for commissioning in September 1995. The project was finally completed in March 1999 at a total cost of Rs.35.75 crore and generation commenced from April 1999.

### **3.2 Scope of Audit**

The present review, conducted from December 2001 to February 2002, covers the implementation of the project and its performance since inception to February 2002. The Audit findings are discussed in the succeeding paragraphs as under:

- (a) Conceptualisation and Firming up of the project
- (b) Project Funding and cost over run
- (c) Execution of the project, monitoring and time over run
- (d) Performance

### 3.3 Conceptualisation and firming up of the project

The project was conceived in 1984 by the Board to have a generation capacity of 20 MW (two units of 10 MW each) with an estimated cost of Rs.9.01 crore for providing additional facilities to the Tamil Nadu Grid during the North East Monsoon period (October to January). Subsequently in 1986, the capacity of the project was reduced to 15 MW (two units of 7.5 MW each) on the advice of Central Electricity Authority (CEA) to have substantial savings in the cost of project with marginal reduction in generation. The project cost was also revised to Rs.15.20 crore. The techno-economic clearance for this project was accorded by CEA in November 1987 and the Union Planning Commission approved the project in April 1988. The State Government also approved the project in September 1988.

Subsequently, pre-construction investigation conducted by the Board in 1989 indicated that there was lesser inflow in to the reservoir and consequent reduction in the potential to generate energy. It was, therefore, decided (July 1991) to install one unit of 7.5 MW at an estimated cost of Rs.14.49 crore. The Board, at the instance of CEA, prepared (October 1992) SDPR estimating the cost of the project at Rs.17.03 crore and forwarded it to the State Government for approval. The State Government approved the project in December 1994 and the Board accorded administrative approval for the project in January 1995. As per completion schedule of SDPR, the project was expected to be completed by September 1995. But the major work on the project commenced only in November 1995 and was completed in March 1999, after a delay of 42 months at a final cost of Rs.35.75 crore.

It may be seen from the above facts that

**Delay in firming up of capacity deprived the state of potential availability of 105.21 million units of electricity. Delay in implementation of project resulted in potential revenue loss of Rs.13.62 crore.**

- The Board took more than seven years (1984 to 1991) for firming up the capacity of the project, which in turn deprived the State of potential availability of 105.21 million units of electricity.
- Even after firming up the capacity, the Government took another two years and two months (October 1992 to December 1994) for according approval for the project.
- Out of the period of implementation of 42 months (from October 1995 to March 1999), a delay of 36 months was caused by the supplier of the generating machinery. As a result, 35,754 million cubic feet of utilisable discharge from the Sathanur reservoir had gone waste resulting in potential generation loss of 73.14 million units with a consequential revenue loss of Rs.13.62 crore.

### 3.4 Project funding and cost over run

#### 3.4.1 Project Funding

The project was initially proposed (July 1991) to be financed by securing loan from the World Bank. The loan did not materialise owing to the condition of private sector participation in executing mini-hydro projects imposed by the World Bank. The Board decided (November 1991) to delete this project from World Bank schemes and execute the project from its own funds. The entire cost of the project amounting to Rs.29.85 crore was met out of borrowed funds by incurring interest of Rs.5.90 crore during construction period.

#### 3.4.2 Cost over run

3.4.2.1 The project, which was estimated to cost Rs.17.03 crore as per SDPR in October 1992, was actually completed at a cost of Rs.35.75 crore in March 1999. The estimated cost of the various components of the project, the final cost of completion, the cost escalation and percentage increase in the cost are tabulated below:

(Rupees in crore)

Components	Estimated cost as per SDPR	Actual Expenditure	Increase in expenditure (4) = (3-2)	Percentage Increase as compared to SDPR (5)=(4)/(2)
(1)	(2)	(3)	(4)	(5)
Civil works including water conductor system	4.25	14.69	10.44	245.73
Electrical works – generator, turbine, etc.	12.25	14.75	2.50	20.37
Transmission works	0.53	0.41	(-)0.12	---
Interest during construction period	0.00	5.90	5.90	100
<b>TOTAL</b>	<b>17.03</b>	<b>35.75</b>	<b>18.72</b>	<b>109.93</b>

The increase in the project cost was attributed to

(Rupees in crore)

Sl.No.	Particulars	Amount
1.	Subsequent inclusion of interest during construction, which was omitted to be considered at the time of SDPR	5.90
2.	Increase in civil works due to addition of new items	1.68
3.	Increase in cost due to price/exchange rate variations in generating equipment	1.43
4.	Other additional works executed	1.07
5.	Excess cost due to change in specification for steel liners/penstock	3.05

Sl.No.	Particulars	Amount
6.	Increase in the cost of construction of power house and changes in the alignment of tail race channel	2.91
7.	Increase in establishment charges	2.68
	<b>TOTAL</b>	<b>18.72</b>

**3.4.2.2** An analysis of the increase in the cost revealed the following:

**Increase of more than 100 per cent in the cost of project resulted in increase in investment per KW with consequent increase in cost of generation.**

- While the major civil works commenced only by the end of 1995, the estimates were prepared based on the PWD schedule of rates for 1992-93, making the estimates unrealistic.
- The cost of generating machinery (Rs.12.25 crore) contemplated in SDPR was based on the budgetary price quoted by M/s BHEL for indigenous generator whereas costlier imported generator (Rs.14.75 crore) was procured.
- The thickness of steel liners to be inserted in to the dam sluices, which was proposed to be 12 mm, was increased to 38 mm on the recommendations of Central Water Commission (CWC) and this increased the cost by Rs.1.38 crore.
- Increase of more than 100 *per cent* in the project cost was mainly due to time over run, incorrect/inadmissible payments to the contractors during execution of the project and lack of effective control over the implementation schedule (discussed in detail in the succeeding paragraphs). This resulted in increase in per KW investment to Rs.47,667 against Rs.20,040 envisaged in SDPR and the maximum tolerant investment of Rs.15,908 prescribed by Indian Renewable Energy Development Agency (IREDA).
- As against the anticipated cost of generation of 159 paise per unit in October 1992, the actual cost was 367 paise per unit (as per Board's working) on completion of the project (March 1999). This was very high compared to the average realisation of 210 paise per unit during 1999-2000, with the consequential loss of 157 paise in each of the unit generated.

### **3.5 Execution of the project, monitoring and time over run**

#### **3.5.1 Absence of project monitoring**

As per SDPR prepared in November 1992, the project was slated for commissioning in September 1995. For monitoring the project and fixing milestones for various packages of the project, a PERT chart was prepared by the Board in November 1992. This was revised twice in May 1994 and March 1995 with commissioning schedule as September 1996 and February 1997

respectively in tune with the actual progress of works. However, even these revised schedules were not adhered to by the Board. Thus, the preparation of PERT chart did not serve as a tool of control technique in execution of the project. Absence of effective project management and monitoring was also evident from the delay of nearly 42 months in the supply of generating machinery, which was considered critical in PERT chart, leading to heavy slippages in the implementation of the project as discussed below:

### 3.5.2 Time over run

The following table indicates the scheduled/actual dates of completion and delay caused in each component of works, during execution:

Details of the work	Scheduled date of completion of works		Actual date of completion	Time over run (in months)	
	As per SDPR	As per purchase/work order		With reference to SDPR	With reference to purchase/work order
(1)	(2)	(3)	(4)	(5)	(6)
Power House – Civil works – sub-structure – Stage-I	November 1994	March 1996	October 1996	24	7
Power House – Civil works – sub-structure Stage-II	February 1995	December 1996	January 1999	48	25
Power House – Civil works – super structure	November 1994	July 1996	October 1997	36	15
Fabrication of penstock and erection of the water conductor system	August 1994	November 1996	October 1997	39	12
Design and supply of generating machinery with all accessories	June 1995	December 1995	November 1998	42	36
Erection, testing, commissioning and handing over of the generating machinery	September 1995	June 1996	March 1999	43	33

Analysis of delay revealed:

- Delay of over 25 months (*i.e.*, May 1992 to June 1994) in finalising tenders and placing purchase order for imported generating machinery on account of prolonged correspondence with the bidders.
- Delay in inviting tenders for civil works ranged from 30 to 37 months (October 1992 to April 1995/November 1995).

- Delay in supply of the generating machinery by the supplier by 36 months (*i.e.*, from December 1995 to November 1998), which led to overall delay in the commissioning of the project.

The Government replied (September 2002) that the time over run of 42 months was mainly due to getting concurrence of PWD for carrying out works such as erection of intake gates, tail race channel and other critical items at reservoir and due to carrying out additional quantities of work and due to delay by the supplier of generating equipments. This confirms the audit point that the Board neither prepared the estimates on realistic basis nor monitored the project effectively.

### 3.5.3 Award of contract for Mechanical works

#### 3.5.3.1 Extra expenditure due to non-acceptance of lowest tender

The Board invited (August 1994) tenders for fabrication, supply and erection of steel liners and penstock for the project with an estimated cost of Rs.1.46 crore. In response to the above tender, three firms quoted their prices as detailed below:

(Amount – Rupees in crore)

Sl.No.	Name of the firm	Price quoted	Rank
1.	Southern Structurals Limited (SSL), Chennai (a Government of Tamil Nadu Undertaking)	1.32	L-1
2.	Sri Saravana Engineering Works, Bhavani	2.19	L-2
3.	Rajagopalan and Company	2.30	L-3

**Non-acceptance of lowest tender resulted in extra expenditure of Rs.42.71 lakh.**

The tender committee of the Board rejected (December 1994) the lowest tender on the grounds that the rates quoted by SSL were unworkable and they were slow in execution of other works awarded to them by the Board. But the Members of the Board did not agree with the proposal of the tender committee and proposed (March 1995) to the Government to award the contract to SSL. However, based on the direction (April 1995) of the Government to reconsider the decision taken to award the contract to SSL, the Board again proposed (May 1995) to the Government recommending award of the contract to the L-2 *viz.*, Sri Saravana Engineering Works, Bhavani at a negotiated price of Rs.1.74 crore. The proposal was accepted by the Government and the contract was awarded to L-2 in September 1995.

It was noticed in audit that the decision of the Government to award the contract to L-2, a private company instead of to a Government Company, whose main line of activity being fabrication of structural materials, on the grounds that the rates quoted were unworkable and slow progress in other works, was not justified because (i) the rate quoted by L-1 was only 10 *per cent* less than the estimated cost and hence could not be treated as unworkable and (ii) the Board could have made provision for levy of penalty in case of delay by L-1.

Moreover, in the event of the Board/Government having reservations in awarding the contract to SSL, the Board should have either negotiated with the L-2 to match L-1 rates or finalised the contract after inviting fresh tenders. The Board did not do either.

Thus, award of work to L-2 by ignoring the offer of L-1 resulted in an avoidable extra expenditure of Rs.42.71 lakh.

The Government replied (September 2002) that the reasons for not awarding the work to L-1 were that its vendor rating was not satisfactory and it was a sick unit. The reply is untenable as these facts were known to the Board when it recommended L-1 to the Government for award of contract.

### ***3.5.3.2 Excess payment to the contractor for fabrication***

The contract entered in to with Sri Saravana Engineering Works, Bhavani for fabrication of steel liners and penstock provided for payment towards fabrication and erection charges at the rate of Rs.47,000 and Rs.28,000 per tonne for 38 mm steel plates, Rs.30,000 and Rs.27,000 per tonne for 12 mm steel plates respectively.

Accordingly, the contractor was paid fabrication charges of Rs.0.89 crore for 148.204 MT of 38 mm plates and 63.656 MT of 12 mm plates and erection charges of Rs.0.54 crore for erecting 133.668 MT of 38 mm plates and 61.545 MT of 12 mm plates. However, it was noticed in Audit that claims for the above were not restricted/regulated with reference to the actual use of steel from the stores of the Board, which resulted in excess payment of Rs.13.12 lakh.

**Excess payment of Rs.13.12 lakh to a contractor due to non-restriction of claims with reference to actual use of steel.**

### ***3.5.3.3 Excess consumption of steel plates***

For the above fabrication work, standard quantity of steel to be used (taking in to account the standard wastage norm of 0.5 per cent) worked out to 134.409 MT and 51.257 MT for 38 mm size and 12 mm size respectively. But it was noticed in Audit that as against the standard quantity, the quantity issued to the contractor was 171.234 MT and 64.481 MT for 38 mm and 12 mm steel respectively. The value of excess consumption of steel plates was Rs.19.77 lakh. The Board did not recover the excess amount from the contractor.

The Government replied (September 2002) that a special nature of steel (ASTM-A517 grade “F” plate) was used for the penstock work and hence the excessive scrap occurred and excess payment to the contractor was unavoidable. The reply is untenable because even at the time of placing work order, the Board was aware of the special nature of steel and hence, it was not a new development.

### ***3.5.4 Undue benefit to the supplier of generating equipments***

The contract for design, supply, erection and testing of 7.5 MW hydro generating set with all accessories for the project was awarded (June 1994) to



M/s Flovel Limited, New Delhi (supplier) at a cost of Rs.11.34 crore. A review of the contract revealed the followings:

**Avoidable payment of testing charges of Rs.35 lakh not quoted originally by the supplier.**

**3.5.4.1** The contract cost of Rs.11.34 crore *inter alia* included Rs.35 lakh for manufacture and testing of a prototype model. The manufacture of main turbine and generator was to be taken up only after approval of prototype model by the Board. During negotiations held in September 1992, the supplier indicated that the rates quoted were inclusive of model testing charges. However, based on revised supplementary offer, a separate rate of Rs.35 lakh was approved for manufacture and testing of a prototype turbine model. The Board did not object to the separate rate.

The supplier produced a model test report prepared by a company located in Finland and claimed (December 1994) payment of testing charges. The Board accepted the test report and paid the testing charges in January 1995.

Thus, by admitting payment of Rs.35 lakh for model testing, despite supplier's offer to carry out model test within quoted rates, the supplier was allowed to reap undue benefit. Moreover, the contractor did not supply the model also.

The Government replied (September 2002) that the original specification was for the design, manufacture, testing at works, supply, erection and handing over of the machine at dam site. During the time of technical discussion, model test was insisted by the Board and included in the revised price bid. However, the fact remains that the supplier himself had indicated that he could carry out model test within his quoted rates.

**3.5.4.2** There was no provision in the purchase order for levy of penal interest for belated settlement of principal and interest on account of delay in execution of the order. It is pertinent to point out that the purchase order placed (August 1995) on the same supplier for erection of generating machinery of the project contained a provision for levy of penal interest at the rate of 22 *per cent per annum* for belated recovery of advance due to delay in execution of work. The supplier was paid mobilisation advance of Rs.1.07 crore, being 10 *per cent* of the ex-works price of the generating machinery in October 1994. Failure of the Board to insert a similar clause in the supply order for generating machinery to safeguard its financial interest resulted in foregoing of interest amounting to Rs.10.50 lakh on the belated settlement of mobilisation advance due to delayed supply.

**Failure to safeguard the financial interest of the Board by including suitable penal clause resulted in foregoing Rs.10.50 lakh.**

The Government replied (September 2002) that provision for penal interest at borrowing rate was made for the erection order for the reason that if erection was not completed in time, the entire supply would be dead stock and could not be put to beneficial use. The reply is not tenable as without critical equipment, supply of which should be made within the specified time, the expenditure incurred on civil works, transmission line, *etc.*, would remain unutilised and in this project, it actually happened.

**Undue benefit of Rs.8.93 lakh due to payment of price variation on bought out items.**

**3.5.4.3** The Purchase order provided for payment of price variation (PV) for the turbine and generating equipment as per the formula of Indian Pump/Electrical Equipments Manufacturers Association. It was noticed in Audit that while allowing PV to the supplier, the Board allowed PV on certain items directly procured as finished products (value: Rs.0.89 crore) from the market (evidenced from the excise gate passes) by the supplier. As these bought out items were already billed at much higher rates than their purchase rates, payment of price variation in addition to the inflated price was not only irregular but also resulted in undue benefit of Rs.8.93 lakh to the supplier. The Government accepted the audit observations.

### ***3.5.5 Infertuous expenditure on fabrication of Permanent Trash Rack***

SDPR provided for erection of a Permanent Trash Rack (PTR) arrangement in front of the intake gates of the dam to prevent entry of logs of wood and other materials in to the penstocks and generator turbine. In order to erect the PTR on a good foundation at the upstream of dam wall, the water level of the reservoir had to be depleted one foot below the sill level for fixing and welding of the PTR over the dam body. The Board addressed (April 1996) the three departments of the State Government viz., Public Works Department (PWD), Forest Department and Fisheries Department, which were also utilising the water in the reservoir seeking their co-operation and concurrence for depletion below the sill level. Even without waiting for response from these Departments, the Board placed (October 1996) order for fabrication of PTR. Thereafter, the work order for Temporary Trash Rack (TTR), not requiring depletion in water level, was also placed (December 1996). TTR was erected (February 1997) at a cost of Rs.2.99 lakh, rendering PTR redundant. But the Board did not consider the cancellation of fabrication of PTR and the fabrication was completed in June 1997 at a total cost of Rs.12.46 lakh. PTR has not been used so far and is kept in open yard of project site.

The Government replied (September 2002) that initially PWD agreed to deplete water level in April 1997 but later on informed that the water level in the reservoir could not be depleted below sill level. It was further stated that the erection of PTR would be taken up at appropriate feasible time. The reply is not tenable in view of the fact that the work order for TTR was issued in December 1996 and the same was ready in February 1997 itself. This being the case, the Board could have waited for the fabrication of PTR till the clearance from the PWD.

Thus, the fabrication of PTR without obtaining clearance from other departments for depletion of water level in the reservoir rendered the expenditure of Rs.12.46 lakh on its fabrication infertuous.

### ***3.5.6 Idle investment in erection of transmission lines due to improper planning***

For evacuation of power generated from this project, SDPR provided for laying 33 KV double circuit lines from the project site to Thandarampattu sub-station (a distance of 15 KM) at an estimated cost of Rs.0.53 crore. But the PERT chart did not mention about laying of transmission lines.

This activity was not synchronised with implementation schedule as per PERT chart nor with actual execution. It was noticed in Audit that even though the supply and erection of generating equipment was delayed by the supplier by 42 months, the Board went ahead with completion of transmission line works. The work was completed as early as in August 1995 at a cost of Rs.0.81 crore. As the commissioning of generating equipment was completed in March 1999 only, these transmission lines were kept idle for 42 months from September 1995 to February 1999. This resulted in blocking of funds amounting to Rs.0.81 crore with consequent interest loss of Rs.42.30 lakh to the Board (at 15 per cent per annum on Rs.0.81 crore).

The Government replied (September 2002) that a project was made up of a lot of activities, which might be inter-connected or independent and that erection of transmission line was an independent activity. The reply is untenable in view of the fact that erection of transmission lines without synchronising with generation pointed to lack of planning.

### **3.6. Performance**

#### **3.6.1 Generation**

After commissioning of the project in March 1999, the generation achieved from April 1999 up to February 2002 and Plant Load Factor (PLF) were as follows:

<b>Sl. No.</b>	<b>Period</b>	<b>Generation (In Million Units)</b>	<b>PLF achieved</b>
1.	April 1999 to March 2000	9.5185	14.49
2.	April 2000 to March 2001	16.3049	24.82
3.	April 2001 to February 2002	13.6992	22.79

It was observed in Audit that as per the guidelines for hydro power developers issued by IREDA in October 1993, PLF for irrigation based hydro electric schemes was to be maintained at 30 per cent. In respect of this project, the PLF worked out to only 22.88 per cent at SDPR stage, when the annual generation was estimated at 15.03 million units. Even the estimations in SDPR could not be achieved in this project (except in the year 2000-01).

The lower PLF achieved during the last three years after commissioning directly affected the viability of the project due to high cost of generation.

The Government replied (September 2002) that in 2000-01, PLF was higher than that worked out at SDPR stage and with good rains and heavy inflows, the performance of the project was expected to improve. However, the fact remains that PLF in 1999-2000 and 2001-02 was poor.

**Low PLF led to increase in cost of generation resulting in increase in revenue deficit by Rs.1.56 crore.**

**3.6.2** The lower PLF achieved after the commissioning resulted in actual cost of generation going up to 407 paise per unit against estimated cost of generation of 367 paise per unit. This resulted in increase in revenue deficit by Rs.1.56 crore on the generation of 39.5226 million units from April 1999 to February 2002.

### **Conclusion**

**There were inordinate delays in conceptualisation and firming up of the capacity of the project, which deprived the State of potential availability of 105.21 million units. At the time of project formulation, the Board justified the project in view of lower capital cost and cost of generation compared to the cost of purchase from the thermal stations of neighbouring States. These justifications were belied on completion of the project as the project cost increased by more than 109 *per cent*. The Board failed to analyse the viability of the project by using scientific methods such as (i) Discounted Cash Flow and Net Cash generation over its anticipated life span (ii) Earliest Pay back period (iii) Internal rate of return and (iv) Probable cost of purchase of energy from nearest available source in the State. The cost of generation also increased steeply from the projected 159 paise per unit to 367 paise per unit. Incorrect assessment of project requirement, absence of control over time schedule for implementation, failure to safeguard the financial interest of the Board at the time of award of contracts and lack of effective project management, all resulted not only in steep increase in the project cost but also resulted in potential generation loss of 73.14 million units leading to revenue loss of Rs.13.62 crore. Even during the three years after completion, the total generation was 39.52 million units only against projected generation of 45.18 million units.**

**The Board should take effective steps to analyse the viability of future projects based on scientific and financial data. The cost and time over run should be eliminated/minimised. While awarding contracts, the financial interest of the Board should be fully safeguarded. The Board should also increase the Plant Load Factor and generation in this project, which will not only result in increased availability of power but also reduce cost of generation.**