P. A. C. No. 693

PUBLIC ACCOUNTS COMMITTEE (1978-79)

(SIXTH LOK SABHA)

HUNDRED AND TWENTY-SEVENTH REPORT

LOKTAK HYDRO-ELECTRIC PROJECT

MINISTRY OF ENERGY

(DEPARTMENT OF POWER)

[Paragraph 11 of the Advance Report of the Comptroller and Auditor General of India for the year 1976-77, Union Government (Civil)].

Presented in Lok Sabha on
Laid in Rajya Sabha on

LOK SABHA SECRETARIAT
NEW DELHI

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INTRODUCTION

I, the Chairman of the Public Accounts Committee, as authorised by the Committee, do present on their behalf this Hundred and Twenty-Seventh Report of the Public Accounts Committee (Sixth Lok Sabha) on paragraph 11 of the Advance Report of the Comptroller and Auditor General of India for the year 1976-77, Union Government (Civil) on Loktak Hydro-Electric Project relating to the Ministry of Energy (Department of Power).

2. The Advance Report of the Comptroller and Auditor General of India for the year 1976-77, Union Government (Civil) was laid on the Table of the House on 4 April, 1978. At their sittings held on 11 and 12 September, and 19 October 1978, the Public Accounts Committee (1978-79) examined selected aspects of the paragraph 11 of the Audit Report on the Loktak Hydro-Electric Project namely Commissioning of the Project, Project Estimates, Tunnel and Surge Shaft, Ithai Barrage & Power Channel, Penstocks and Power House. The Public Accounts Committee (1978-79) considered and finalised this Report at their sitting held on 19 April, 1979. The Minutes of the sittings form part II* of the Report.

3. A statement containing conclusions/recommendations of the Committee is appended to this Report (Appendix IV). For facility of reference these have been printed in thick type in the body of the Report.

4. The Committee place on record their appreciation of the assistance rendered to them in the examination of this paragraph by the Comptroller & Auditor General of India.

5. The Committee would also like to express their thanks to the officers of the Ministry of Energy (Department of Power), Department of Irrigation and Director General, Geological Survey of India for the cooperation extended by them in giving information to the Committee.

P. V. NARASIMHA RAO,

Chairman,
Public Accounts Committee.

NEW DELHI;
April 19, 1979
Chaitra 29, 1901 (*S*).

*Not printed. One cyclostyled copy laid on the Table of the House and five copies placed in Parliament Library.

REPORT

CHAPTER I

INTRODUCTORY

1.1. The Loktak Hydro-Electric Project in Manipur forms part of the Loktak Multipurpose Scheme for which investigations were started by the Central Water and Power Commission in 1957 and continued by the Public Works Department of Manipur from 1962. The Scheme envisages generation of electricity (installed capacity of 105 megawatts of power) by using the waters of the Loktak lake on the Imphal river, provision of irrigation facilities (about 60,000 acres) and reclamation of land (about 57,000 acres) around the Loktak lake. The hydro-electric project, which is to be implemented in two stages, is being executed by the Government of India while the other two parts of the scheme are being executed by the Government of Manipur.

1.2. According to a note furnished by the Ministry of Energy, the Loktak project aimed at achieving three objectives viz:—

(i) Generation of 70,000 KW of firm power at 60 per cent load factor in the Leimatak Valley;

(ii) Irrigation by lift of 23,000 hectares of land in Manipur Valley; and

(iii) Reduction of flood levels of the Loktak Lake and reclamation of land around periphery by providing additional drainage capacity to the Imphal river by remodelling and regrading the river course.

The salient features of the Project are as under:—

1. Location		39 Km south of Imphal, capital of Manipur State.	
2. Loktak Lake	Max. retention level	770·23 m
	Min. drawdown level	766·82 m
	Live storage	39,655 Hec. meters with 518 sq. km. area.
3. Ithai Barrage	Height	10·7 m
	Length	58·8 m between abutment
	Water way	5 Spans of 10 m each
	Discharge	566 m 3/sec.

4. Intake	. . .	Open channel	2·267 Km.
		Cut & Cover Section	1·223 Km.
		Total length	3·490 Km.
		Bed Width	18 meters
		Depth of excavation	2 m at lake
		end going upto tunnel end	35 m at
		Max. discharge	58·8 cusecs
		For power	42 cusecs
		For irrigation	16·8 cusecs
5. Head Race Tunnel	.	Diameter	3·81 m. horse shoe type
		Length	6·505 Km.
		Velocity of flow	4·5 m/Sec.
		Grade	1 in 200
		Length of pipe tunnel	0·278 Km.
		Total length with pipe	0·778 Km.
6. Total length of Water Conductor System.		Channel with Cut & Cover	10·268 Km.
		Tunnel with Pipe	3·490 Km.
			6·778 Km.
7. Surge Shaft	. . .	Diameter	9·15 m
		Height	60 m
8. Valve House	.	No. of butterfly valves	3
		Dia. of valve	2·20 m
		Rated Head	14 m.
9. Penstocks	.	3 Nos. 2·286 m dia; average length 1346 m; supported on 12 anchor blocks and 68 saddles.	
10. Power House	. .	Installed capacity 3 Units of 35 MW each	
11. Power Generation	.	70,000 KW of firm power at 60 Load factor.	
12. Generating Units		(i) Turbine	Type Francis Head Max. 312 m. Rated 298 m. Speed 500 rpm.
		(ii) Generators	3 Nos. Rating 11 KV 39000 KVA 0·9 p.f. 50 c/s.
		ii) E.O.T. Crane: Capacity:	Main hook 150 T Aux hook 30 T Span 13 m.
		(iv) Generator transformer: Type Single phase OEF/ON Rating A bank of 3 Nos. 13·33/10·66 MWA-11/132 KV Tap changer: Off load tap changer on HV side.	
13. Transmission Line	.	132 KV Single circuit, 35 Km long from Leimatak Power House to Imphal.	

(To carry power to jiribam and Dimapur two more transmission lines, outside this project estimate, one 132 KV/S/C , 120 km. long from Leimatak Power House to Jiribam and the other 132 KV S/C, 232 km. long from the same Power House to Dimapur are to be constructed by the Nationanonl Hydro Electric Power Corporation and the State Government respectively)

14. Estimate Cost
(Revised 1977)

(i) Excluding Receipts and Recoveries .	Rs. 80·63 crores
(ii) Including Receipts & Recoveries	Rs. 77·45 crores

The live storage of 39655 hectare meter in the Loktak Lake is utilized for power generation at the Loktak Hydro Electric Power Station. The water conductor system for the power project consists of 3490 m long power channel and 6505 m pressure Tunnel terminating in a surge shaft. From the surge, Shaft, a Pipe Tunnel 273 m long feeds three Penstocks 1346 m long terminating in the power station in the bank of the Leimatak river. The power Station will operate under a gross head of 312 m and has an ultimate installed capacity of 3 units of 35 mw each. Initialy, 2 units of 35 mw each will be installed. A barrage at thai across the Imphal river maintains the water level at 770.23 in the Loktak lake.

Audit Paragraph

1.3. The first stage of the hydro-electric project provides for an installed capacity of 70 megawatts of power at 60 per cent load factor and consists of the following major components:

(a) construction of a barrage, 10.7 metres high and 68.6 metres long, across the Imphal river at Ithai to provide adequate storage of water in the Loktak lake;

(b) construction of a water conductor system comprising a power channel 3.55 kilometres long and designed to carry a discharge of water between 2,100 and 1,500 cusecs, a pressure tunnel 6.77 kilometres long and of diameter 3.81 metres and two penstock pipes each 1,346 metres long and of diameter 2.3 metres;

(c) installation of two generating units, each of capacity 35 megawatts with provision for installation of a third unit of 35 megawatts in the second stage; and

(d) erection of a 132 kv transmission line, 40 kilometres long, from generating station to Imphal.

1.4. Based on topographical and hydrological surveys of the Loktak and other neighbouring lakes as also the related river systems by the Central Water and Power Commission (CWPC) and geological investigations by the Geological Survey of India (GSI), a project report was prepared by tho Public Works Department of the Government of Manipur in 1967.

1.5. The first stage of the project, estimated to cost Rs. 10.90 crores on the basis of the schedule of rates of 1966 applicable in Manipur, was approved by the Ministry of Irrigation and Power in February 1970. A construction organisation for the project headed by a Chief Engineer was set up in June, 1970 and the construction of the project started in October, 1970. The overall control of the project along with that of other Central hydro-electric projects was entrusted to the Central Hydro-Electric Projects Control Board headed by the Secretary, Department of Power, which was set up in 1970 by the Government of India for taking quick decisions on important matters relating to these projects. The control of the project along with its assets and liabilities was transferred to the newly established National Hydro-Electric Power Corporation from 1st January, 1977.

Commissioning of the Project.

1.6. According to the project report of 1967, it was anticipated that the first unit of the project would be commissioned by March, 1974. In the first revised estimate of 1974, the target date for commissioning the first unit was shifted to March, 1976. According to the schedule of programme drawn up for the second revised estimate of 1976, the target date of commissioning was December, 1980. Government stated (February, 1978) that the latest scheduled date of commissioning was March, 1982.

[Paragraph 11 (1.1—1.3 and 3.1) of the Advance Report of the Comptroller and Auditor General of India for the year 1976-77, Union Government (Civil)]

1.7. The Committee desired to know which organisation in the Government of India examined the project report prepared by the Public Works Department of the Government of Manipur before according approval to the estimate of Rs. 10.90 crores and whether the geological investigations done at that time were considered to be adequate. In reply, the Ministry of Energy (Department of Power) have explained the position as follows:—

"The project report prepared by the Public Works Department of the Government of Manipur was examined by the Central Water and Power Commission, Government of India and thereafter by the *Ad hoc* Committee on Irrigation, Flood Control and Power Projects under the Planning Commission. Thereafter the project Report and estimate was considered by the Planning Commission. Clearance to the project estimate was accorded by the Planning Commission in February, 1970 and communicated to the Ministry of Irrigation and Power and the Ministry of Irrigation and Power issued the expenditure sanction to the

estimate of Rs. 10.90 crores in February, 1970. It may be pointed out that while clearing the project, the Planning Commission had accepted the feasibility of the project. The project report was based on the geological report prepared by Geological Survey of India (December, 1966) and inspection of Shri M. S. Jain, Geological Survey of India. The investigations for the above project report were done by Manipur Public Works Department. A copy of the Geological report is appended to the original project report and estimate which were subsequently examined by Central Water and Power Commission/*Ad hoc* Committee on Irrigation, Flood Control and Power Projects and the Planning Commission, who, after satisfying themselves on all the relevant material placed before them, accorded sanction to the project. It is, therefore, concluded that the geological investigations done then were considered to be adequate to take up the execution of the project."

1.8. According to the audit paragraph, the project report was prepared by the Public Works Department of the Government of Manipur in 1967 and the approval thereto was accorded by the Ministry of Irrigation and Power in 1970. The Committee enquired the reasons for the delay in according the approval. In reply, the Ministry in a note furnished to the Committee have stated:—

"There are various stages and process to which a project report is subjected before its final acceptance and the issue of approval to the project. In order to assess whether there was any avoidable delay in the issue of the final approval to the Loktak Project Report, it would be useful to recapitulate the process and stages of examination that preceded such approval.

Project Reports of hydro-electric power schemes, during the period under reference, were, on receipt in the Ministry of Irrigation & Power, Government of India, referred to the Central Water & Power Commission for techno-economic security. In the Central Water Power Commission, there are a number of Directorates which examine the Project Report from different specialised aspects. In the course of such examination, should any points of clarification, etc. arise, they may require back reference to the authorities who have prepared the project report. After this process was completed and the project report cleared from techno-economic angle by Central Water and

Power Commission, a detailed appraisal note on the proposal was prepared and the Ministry of Irrigation and Power then suggested consideration thereof in a meeting of the *Ad hoc* Advisory Committee on Irrigation, Flood Control and Power Projects in the Planning Commission. Besides consideration of the proposed project on techno-economic aspects, there were certain other aspects which may be involve, such as the question of sharing of benefits of power generation among the beneficiary States, which has to be resolved through reference to the States concerned, the question whether the project should be in Central or the State Sector and so on. Only after all these aspects are cleared, was the stage reached for issue of necessary administrative approval and expenditure sanction by the administrative Ministry with the prior concurrence of Ministry of Finance.

In the case of the Loktak Hydro-Electric Project Report, the project report, prepared in December, 1967, was received in the Ministry of Irrigation and Power in January, 1968. The process of examination in the Central Water & Power Commission from the techno-economic angle was completed by August, 1978 when an appraisal note was forwarded for consideration of the *Ad hoc* Advisory Committee on Irrigation, Flood Control and Power Projects. This Committee cleared the proposal in its meeting held in September, 1968. Thereafter, certain important questions such as relating to the sharing of the benefits of the power generated from the project among the beneficiary States and the question of taking up the project in the Central Sector were taken up for consideration involving interchange of correspondence at the ministerial level in the course of 1968-69. In August, 1969, the Ministry of Irrigation and Power indicated to the Planning Commission that having resolved all the major issues involved, the project may be cleared and its feasibility accepted. The Planning Commission's clearance was obtained in February, 1970 and simultaneously the clearance from the Ministry of Finance was also received, leading to the issue of the final sanction by the Ministry of Irrigation and Power on 18-2-1970.

It would be seen from this narration that there was no undue or avoidable delay in the issue of the approval to the project."

1.9. Referring to the note furnished by the Ministry of Energy wherein it was stated that the project report prepared in December, 1967 was received in the Ministry of Irrigation and Power in January, 1968 and the techno-economic examination of the project by the Central Water and Power Commission was completed in August, 1968, the Committee enquired whether the escalation in cost was taken into account. The Chairman, Central Water Commission and *ex-officio* Secretary stated:—

> "The escalation part is taken into account. It is true that eight months is a long enough period. The Central Water and Power Commission prepares comments on each aspect of the project report and sends it to the State Governments, who will have to react or answer the comments that are made by the Commission. Sometimes the answers are not to the point and we will have to make further reference to the State. Many a time we call the engineers from the project and have discussions and try to thrash out the differences. Sometimes it takes one or two years to clear a project. But it is not that we only take long time but the response from the State Government also takes a considerable time."

1.10. The Committee note that as per project report prepared in 1967, the first unit of the project was anticipated to be commissioned by March, 1974. The target date for commissioning the first unit was shifted to March, 1976 in the first revised estimate of 1974. According to the schedule of programme drawn up for the second revised estimate of 1976, the target date of commissioning was December, 1980. The Government have now stated that the project would be commissioned in March 1982. The Committee are unhappy to note that the shifting of date of commissioning of the project from time to time has not only delayed its commissioning but has also resulted in the increase in the cost of the project. Initially, it was expected that the estimated cost of the project would be to the tune of Rs. 10.90 crores but as per revised estimate of 1977 the project would cost Rs. 80.63 crores. The Committee have gone into the details of various factors responsible for delaying the commissioning of the project in subsequent paragraphs of the report. At this stage they would like to point out that Government took about 2 years time in according approval to the project. The project report prepared in December, 1967 was received in the Ministry of Irrigation and Power in January, 1968 and accorded sanction in February, 1970. To their surprise the Committee find that the Central Water and Power Commission took 8 months to

complete the techno-economic appraisal of the project and the question of sharing of the benefits of the power generated from the project among the beneficiary States and the question of taking up the project in the Central sector remained under consideration of the Ministry for as long as one year. Thereafter, the Planning Commission took another six months to give their clearance for the Project. The Committee regret that the urgency of the commissioning of the project according to schedule was not realised from the very beginning. The delay in according sanction is to a great extent responsible for the escalation in the cost of the project. The Committee would like the Ministry of Energy to streamline the existing procedure for processing and appraisal of the Project Reports various stages so that minimum time is taken in according sanction to the projects thereby avoiding cost escalation as also delays in the completion of the projects.

CHAPTER II

PROJECT ESTIMATES

Audit Paragraph

2.1. The original project estimate of Rs. 10.90 crores was prepared on the basis of the quantities of works as per tentative designs and schedule of rates of 1966 of the Manipur Public Works Department. It was revised to Rs. 29.01 crores in November, 1972 on the basis of higher tendered rates received for the major civil works and approved by the Ministry of Irrigation and Power in June, 1974. The estimate was further revised to Rs. 60.11 crores in November, 1976 on the basis of the quantities of works as per detailed designs and after taking into account escalation in cost of labour and material. Approval of Government to this estimate was awaited (December 1977).

2.2. The following table shows the revised estimates for different times of work as compared to the original estimates and actual expenditure incurred upto December 1976/August 1977:—

Items of works	Original estimate 1967	Revised estimates		Expenditure upto	
		1974	1976	December 1976	August 1977
		(Rupees in lakhs)			
1	2	3	4	5	6
Barrage	21·98	56·54	131·76	94·30	101·99
Power channel including cut and cover conduit	124·00	622·58	1150·25	1553·01	1758·04
Tunnel including suge shaft	263·40	677·55	1475·60		
Penstocks	127·00	251·94	584·00		
Power house	31·50	86·45	208·71	184·94	224·08
Tail race	7·75	8·06	17·43	—	—
Generating plant and machinery	241·97	546·00	737·29	192·49	348·54
Transmission line	17·50	44·98	44·98	34·23	34·68
Buildings and communications	67·25	167·98	333·80	225·64	241·44
Ancillary works	29·60	88·70	331·85	96·23	102·01

1	2	3	4	5	6
Other works	28·43	74·85	140·99	40·92	63·57
Special and ordinary tools and plant	50·24	53·05	358·17	366·95	374·93
Establishment	71·57	196·84	441·19	14·39	36·78*†
Indirect charges . . .	8·40	25·40	55·15	—	—
Stock suspense . . .	—	—	—	352·85	333·34
	1090·49	2900·92	6011·17	3155·95	3619·40

*Actual expenditure incurred on establishment upto March, 1976 was included in t on various items of works.

2.3. Reasons for increase in cost:—The increase in cost as compared to the first revised estimate was attributed by the project authorities mainly to the following:—

		Rs. in lakhs
(i) Increase in cost due to increase in quantities:		
	Ithai barrage	29·89
	Tunnel .	404·86
	Penstocks .	220·04
	Power house	67·85
	Buildings and communications .	74·56
		797·20
(ii) Increase in cost due to extra items of work and revision of designs during execution:		
	Ithai barrage	31·19
	Power channel . .	375·55
	Tunnel	64·33
	Penstocks . . .	1·50
	Power house .	1·57
	Buildings and communications .	70·28
		544·42

(iii) Increase in cost due to escalation in labour and material cost :			
	Ithai barrage	.	12·08
	Power channel		148·38
	Tunnel	.	311·70
	Penstocks	.	98·87
	Power house	.	48·45
	Building and communications	.	14·60
			634·08
(iv) Increase in provision of contigencies due to increase in works cost:			
	Ithai barrage	.	2·74
	Power channel		21·36
	Tunnel . .		27·10
	Penstocks . . .		11·65
	Power house .		4·38
	Buildings and communications . . .		6·38
			73·61
(v) Increase in cost of generating plant and machinery. . .			191·89
(vi) Increase in cost of ancillary items, viz. running of field dispensaries, provision of medicines, water supply, lighting, security arrangements, etc. due to longer period of construction			243·15
(vii) Increase in other items, viz. land compensation, maintenan ce during the (longer) period of construction, tail race, etc.			77·15
(viii) Increase in provision of establishment cost at 8 percent of works cost .			244·35
(ix) Increase in cost of special and ordinary tools and plant because of grassy strata and difficult geological conditions encountered			305·00
	TOTAL	.	3,110·25

Government stated (January 1978) that the estimate of Rs. 60.11 crores was proposed to be revised further to Rs. 76.31 crores.

[Paragraph 11 (2.0—2.2) of the Advance Report of the Comptroller and Auditor General of India for the year 1976-77, Union Government (Civil)].

2.4. Referring to the audit paragraph that the increase in cost due to extra items of work and revision of designs during execution was to the tune of Rs. 544.42 lakhs, the Committee enquired whether the reasons for the extra items and revision in designs were analysed by Government. The Ministry of Energy have stated:—

"Details of the extra items of work arising from change in design were given by the project authorities in support of their draft revised estimate submitted in 1976. These reasons were analysed at the time of techno-economic scrutiny in the Central Electricity Authority/Central Water Commission. As a result of the scrutiny, it was felt that in the light of subsequent developments in the course of execution, the estimate would need updating and further revision. It is as a result of this advice that the estimate was brought uptodate and submitted in February 1978 to Central Electricity Authority|Central Water Commission. have since cleared the second revised estimate (May 1978).

The reasons for extra items of works and revision in designs, which took place subsequent to the 1974 revised estimate and reflected in the latest revised estimate of February, 1978 (awaiting approval), have been analysed, and are as follows:—

I. *Ithai Barrage*

(i) The number of barrage bays was increased from four to five. The addition of one more bay was based on the hydraulic model studies conducted by Central Water Power Research Station, Poona for reducing the maximum flood level of Loktak lake by removal of Shugnu hump. Provision of flaring out walls upstream and downstream of the abutment was also made to streamline the flow to reduce scouring of the weak rock noticed at the abutments after excavation.

(ii) *Excavation in rocks*:

For reasons explained above, additional rock excavation had to be done.

(iii) *Back filling*:

Wide hill cutting was involved due to 1:5 slope, which had to be backfilled after construction of the structure. This was necessitated by the conditions of the geological strata at site.

(iv) *Reinforced cement concrete*:

The addition of one more bay and change in the designs of abutments for the same reasons explained above.

(v) *Steel reinforcements*:

The addition of one more bay and provision of protective walls with flaring steps, provided for reasons already explained above.

(vi) *Anchor rods*:

Extra provision of anchor rods in the abutment to suit the rock conditions met with during excavation.

II. POWER CHANNEL

(i) *Drybоulder pitching*:

Earlier designs provided for pitching for a vertical depth of 4 metres representing the depth subject to fluctuating water levels in the lake during operations of the project. Because of the poor strength of the soil, subsequently the slope has been flattened and provision of pitching has been made for the entire increased side slope length. The bed of the approach channel has also been pitched.

(ii) Providing and laying 1:3:6 cement concrete in wall and in the bed of the channel.

Because of the unusually sloughing nature of the soil, the lining of the bed with cement concrete in certain reaches of the canal was considered necessary to check the upheaval action observed in the bay. This arrangement also could not check the upheaval action completely and hence lining the bed with 1750 mm. thick raft on grid of beams and struts were considered necessary.

(iii) Beyond R.D. 2270 of the channel, it was considered more economical and also safer to substitute the open channel by R.C.C. Cut & Cover Section. Excavation of the cut and cover section had been planned to be carried out with sheet piles and very heavy cross struts to take care of extra heavy side earth pressures. The excavation of open channel would have involved huge quantities of excavation due to the highly flattened slopes of 1:5 which may

have become necessary in this range. Also it would have necessitated acquiring of additional land. Even with this, the stability of the slopes would have been doubtful.

III. *Head Race Tunnel*:

(i) *Overbreaks*:

Due to weak strata, overbreaks in tunnel section were much more than anticipated.

(ii) *Steel supports*:

Again due to poor strata, the quantity of steel supports increased substantially. Previously, steel supports were expected to be required only for sheer zones and for a few bad patches. But subsequently, supports were necessary almost throughout and at closer spacing.

(iii) *Change from plain C.C. to R.C.C. Lining*:

In the original proposal, most of the tunnel lining was to be plain cement concrete, whereas in the final designs evolved for strata actually encountered the lining was designed to be of R.C.C. for most of the reaches.

(iv) The lining thickness had to be increased due to the poor geological conditions met at site.

(v) Pressure Grouting was required much more extensively than envisaged earlier.

IV. *Penstock*:

There has been change in the alignment in the reach between anchor blocks 8 and 10, to avail of better foundation conditions expected along the new alignment. This resulted in increased excavation since the alignment has been shifted towards a hill face. Some movement of the hill slopes in the penstock area between anchor blocks 4 and 5 also necessitated strengthening measures. There has been an increase in the quantity of reinforced cement concrete due to the change in the final foundation grade met with in the field after excavation and examination by the geologists.

V. *Power House*:

Extra excavation had to be done to obtain stable slope on the sides of the power house. There has been an increase in the provision of anchor rods in the power house foundation including

service bay, considering the nature of rock actually met with in the area. There has also been an increase in R.C.C. work in the service bay due to backfilling required, since the rock slopes were found to be not stable for the slopes indicated in the drawings. The steeper slopes indicated in the drawings were to achieve maximum economy and reduced back-fill quantity. Some smaller quantities of concrete were required for extra work as a result of minor changes in the design layout of the structure."

2.5. According to the audit paragraph, the project estimate was further revised to Rs. 60.11 crores in November, 1976 on the basis of the quantities of work as per detailed designs and after taking into account escalation in cost of labour and material. The Committee enquired whether the latest revised estimate had been approved by Government. The Ministry of Energy have stated as follows:—

"Proposal for the revision of the Project estimate was initiated in 1976 and the figure of Rs. 6011.17 lakhs indicating the revised estimate in 1976 was actually a draft stage revision attempted by the Project authorities in respect of Stage I of the project.

The Central Electricity Authority, after scrutiny of the draft revised estimate referred to the contemplated changes in the agencies for construction of certain reaches of the tunnel and the possibility of variations on this account and suggested that it would be worth-while to wait and finalise the estimate after the mode of construction of the tunnel and the agencies therefor were finalised. In the meantime, decisions regarding continuation of the work for certain reaches of the tunnel by the contractors at re-negotiated rates, departmental construction of the remaining reaches of the tunnel by mechanised methods were taken. Taking all these subsequent developments into consideration, it was decided to recast the estimate not only for Stage I (for which the Chief Engineer had revised the estimate to Rs. 60.11 crores in February, 1976) but also including Stage II. This further re-casting and revision of the estimate was undertaken in 1977 and completed in February 1978, which thus actually represents the second revision of the estimate, the first revision being in 1974.

The second revised project estimate was sent to Central Electricity Authority|Central Water Commission in February, 1978 and their clearance was received in May, 1978. The estimate is now under examination and consideration for according approval."

2.6. The Ministry of Energy have furnished the following statement showing the estimate for different items as revised in 1974 and 1977:—

(Rupees in lakhs)

S.No.	Head	Original estimate 1967	Revised Estimate 1974		Revised Estimate 1977	
			Stage I	Stage II	Total	(awaiting sanction)
1.	Direction and Administration	71·57	196·84	28·68	225·52	586·20
	Machinery and Equipment	50·24	53·05	3·58	56·63	516·17
	Suspense	Nil	Nil	Nil	Nil	Nil
	Barrage	21·88	56·54	Nil	56·54	149.11
	Water Conductor System	514·40	1552·07	80.57	1632·64	4077·94
	Power House	31·50	86·45	10·00	96·45	370·14
	Tail Race Channel	7·75	8·06	Nil	8·06	24·52
	Building & Communication	67·25	167.98	Nil	167·98	538·28
	Ancillary Work (including soil conserve)	29·60	89·70	Nil	89·70	404·73
	Transmission	17·50	44·98	Nil	44·98	58·96
	Generating Plant & Machinery	241·97	546·00	267·99	813·99	1111·27
	Other Expenditures	36·83	99·26	1·97	101·23	225.28
	TOTAL	1090·49	2900·93	392·79	3293·72	8062·60
	Cost chargeable to Irrigation		194·04	Nil	194·04	369·22
	Receipt & Recoveries(—)	23·99	(—)31·72	(—)1·36	(-)33·08	(—)317·86
	Net Estimate:	1066.50	2869.21	391·43	3260·64	7444·74

2.7. At the instance of the Committee, the Ministry have furnished the following note stating the reasons for revision of estimate from Rs. 60.11 crores to Rs. 77.45 crores:—

"The estimate of Rs. 60.11 crores was a draft stage revision attempted in 1976 and covered only Stage I of the project

comprising 2 units of 35 MW each. The latest estimate that has been approved by the Central Electricity Authority/Central Water Commission and is with the Government for approval is for a figure of Rs. 77.45 crores which includes provision for Stage II also, comprising the addition of a third unit of 35 MW and associated civil works. The provision for the second stage in this estimate is Rs. 6.61 crores. Hence for purpose of comparison, an analysis of reasons for increase in the comparable figure after deducting the component for Stage II would be Rs. 70.84 crores. The increase is, therefore, of the order of Rs. 10.73 crores. The major reasons for the increase are as follows:—

1. *Power Channel including Cut & Cover section*:

(a) Due to the unusually sloughing nature of the strata, sheet piles had to be used in the construction of cut and cover section much more extensively than was envisaged in 1976.

(b) It was also discovered that sheet piles were bending due to excessive side pressures and hence more number of struts at closer spacing had to be provided.

2. *Tunnel*:

(a) After the explosion of 1975, a High Power Organisational Committee was appointed by the Government of India to recommend the methods of construction as also the agencies for the balance work of tunnelling. The report of this Committee was not available at the time of preparation of draft estimate of 1976.

Based on the recommendations of this Committee on the methods for tunnelling in difficult and unusual strata, the tunnelling in two major reaches was to be done using sophisticated equipment much of which required to be imported. Greater provision had to be made for supporting lining and grouting in all reaches. The reach of about 3 Kms. between faces 4 and 5 was decided to be done departmentally and decision on faces O & 1 is yet to be taken. The remaining reaches were retained with the contractor with enhanced rates, recommended by the Committee.

(b) Due to presence of methane gas, all equipments to be used in tunnel have to be flameproof. The 1978 estimate was based on more realistic cost data as had become

available by that time for that equipment. Similarly, special ventilation system required for gassy mines had also been finalised in more detail by the time 1978 estimate was framed. The new mechanised methods of construction recommended to be adopted also included new techniques for supporting the tunnel.

(c) In renegotiating the contract earlier awarded to the contractor, they were left with only two reaches in the tunnel for which their original rates were also revised upwards. Besides the additional effect of the increased rates, quantitatively also their contract value had increased, the effect of which was taken into account in 1978 estimate.

(d) In the reaches to be completed by the contractor it was agreed that the cost of certain specific additional safety measures was to be borne by the project.

3. *Switchyard*:

Provision in the 1976 estimate was actually inadequate and this provision had to be increased in 1978 estimate on a realistic basis.

4. *Geneal Points*:

(a) Provision for additional buildings and structures had to be made consequent on extra staff required for departmental construction of the longest reach of the tunnel, along with necessary infra-structural facilities.

(b) Escalations on the increased cost of new items or increased quantities now provided for has also been a contributory reason as well as on account of the percentage provision for establishment."

2.8. The Committee asked during evidence, the reasons for revising the estimates in 1974 and 1977. The Chairman, Central Electricity Authority and ex-officio Additional Secretary stated:

"I am making a comparison between the estimate of 1967 and the estimate of 1972 which was sanctioned in 1974. The estimate of 1967 was meant for two generating units. This estimate which was approved in 1974 was meant for three units. So, there is a difference in the installed capacity. The cost has been practically doubled. We have collected statistical from the Manipur P.W.D. They have allowed double the rates for all the civil works. From Rs. 11 crores, there is a justification of the cost going up to about Rs 24 crores."

2.9. In reply to a question, the witness stated:

"When we invited quotations, we found that the rates were practically 2 to 2½ times of the project provision."

2.10. The Committee enquired the annual increase prior to 1967 and whether Government had visualised the increased rates in 1970. The Chairman, Central Electricity Authority stated:

"Between 1962 and 1972 the increase is of the order of 12.5 per cent, between 1962-67 the increase is hardly two or three percent, between 1966-70 the increase is of the order of 20 per cent."

2.11. The Committee enquired whether the price increases were reflected in the estimates prepared by Government. The Chairman, Central Water Commission, replied:

"Estimates are prepared on the basis of the prevailing prices at that time. Variation in the cost of material, if any, will be included whenever revision takes place."

2.12. The Committee desired to have a detailed note indicating the reasons for the escalation in the cost of the project from time to time. The Ministry of Energy have furnished the requisite note, which is reproduced at Appendix I.

2.13. At the instance of the Committee the Ministry have furnished the following statement showing the expenditure incurred upto 30 June, 1978 amounting to Rs. 4704.22 lakhs:

	(Rupees in lakhs)
1. Direction & Administration	117.15
2. Machinery & Equipment	440.48
3. Ithai Barrage	69.87*
4. Water Conductor System	2391.23
5. Power House	209.24
6. Tail Race Channel	..
7. Building & Communication	277.43
8. Ancillary Works	81.73
9. Generating Plant & Machinery	685.49
10. Transmission and other works	82.36
11. Stores.	355.06
TOTAL :	4704.22

*The figures of expenditure upto 8|77 against two heads as accepted by the Ministry to Audit *vide* D.O. No. FA|LP|Review|AGCW&M|77 dt. 4-1-78 were Rs. 101.99 lakhs and Rs. 224.08 lakhs respectively.

2.14. The Committee desired to know how much the supply of electricity would cost to the consumer. The Chairman, Central Electricity Authority, stated during evidence:—

> "The entire net cost....would be Rs. 73 crores. This will produce 450 million kw of energy. The cost of electricity is going to be about 16 paise per unit."

2.15. The Committee note that the original project estimate in 1967 was of the order of Rs. 10.90 crores. It was revised to Rs. 32.94 crores in 1974 and to Rs. 80.63 crores in 1977. Since the cost escalation in the second revised estimates of 1977 was about 150 per cent of the estimate of 1974, the Committee have a feeling that the first revised estimate was deliberately kept within limits to secure its approval. In any case, they would like to stress that the estimates of the projects involving huge outgo from the Exchequer should be prepared realistically so that Government may have a clear picture of the financial commitments involved therein.

2.16. The Committee have been informed that the second revised estimate prepared in 1977 and cleared by the Central Electricity Authority Central Water Commission in May 1978 is still under examination and consideration of Government for according approval. As about two years have elapsed since the estimate was revised and also in view of the fact that expenditure had already exceeded Rs. 47 crores by 30 June, 1978, it is imperative that the revised administrative approval and expenditure sanction should be accorded without any further delay.

CHAPTER III

TUNNEL AND SURGE SHAFT

Audit Paragraph

3.1. Progress of work upto October, 1977—Tunnel—Of the total length of 6,777 metres as per designs, tunnel yhad been driven in 2,496 metres. The slow progress was attributed by the project authorities mainly to poor geological conditions and emergence of methane gas. There were two explosions due to ignition of methane gas in face 5 of the tunnel on 25th January, 1975 which caused a major set-back to the progress of the work. Of the tunnelling yet to be done, the most difficult remaining gaps were stated to be between faces 4 and 5 (2,955 metres) and faces O and 1 (692 metres).

3.2. Award of contract—Tender notices were sent (September 1970) by the Chief Engineer to six leading contractors in the country. Against a provision of Rs. 145.55 lakhs in the sanctioned project estimate of 1967, the notice inviting tenders indicated an estimated cost of Rs. 380.00 lakhs. Out of 6 firms to which tender enquiries were sent, two firms responded. The tenders were evaluated (December 1970) by the Chief Engineer after taking into account the special conditions stipulated by the tenderers, as indicated below:

	As tendered	*As evaluated*
*Firm 'P'	Rs. 537.06 lakhs	Rs. 671.98 lakhs
**Firm 'H'	Rs. 642.95 lakhs	Rs. 739.46 lakhs

The tender sub-committee arranged (February 1971) to have some of the special conditions stipulated by the tenderers scrutinised by the concerned Directorates of the Central Water and Power Commission. The sub-committee also obtained from the tenderers details of the assumptions made regarding the use of departmental machinery in order to arrive at an equitable assessment of the terms offered. Based on the information obtained, the sub-committee arrived (February 1971) at a revised evaluation of the offers as indicated below:

*Firm 'P'	Rs. 571.05 lakhs
**Firm 'H'	Rs. 697.11 lakhs

*M/S Patel Eng.Co. Std. Bombay

**M/S Hindustan Construction Co. Bombay.

On the basis of this reassessment, the tender committee recommended award of the work to 'P'.

3.3. In his first evaluation report, the Chief Engineer had observed (December 1970) that an attempt should be made to negotiate with firm 'H' to bring down its tendered cost as near as possible to that of firm 'P' in view of the reputation of the former in tunnel work. He had also mentioned that in a difficult and remote area like Manipur the work would not be completed to schedule except by a highly experienced and specialised firm like 'H'. No negotiations appear to have been attempted and the work was awarded to firm 'P' in August 1971 after its tender valued at Rs. 571.05 lakhs had been accepted by the Ministry of Irrigation and Power in March, 1971. No formal agreement could, however, be signed (until August 1977) due to non-finalisation of the special terms and conditions that had been proposed by the tenderer.

3.4. In the technical specifications attached to the notice inviting tenders, it had been stated: "the nature and character of materials to be met with in the underground excavations is indicated in the drawings. The Government does not, however, take any responsibility for any variations that may be detected in actual excavation..... Reports of the geologists and core samples can be seen in the office of the Engineer-in-charge."

Geological investigations of the tunnel area were conducted by the GSI in 1957—60 and again in 1966-67. During these investigations, six holes were drilled near the inlet portal of the tunnel and the surge shaft site near the outlet end of the tunnel leaving the rest of the alignment unexplored. Nevertheless, the geological reports stated that rock conditions for tunnelling were not likely to be ideal and that, in fact, these would be quite poor both at the inlet and outlet ends. It was specially stated that "tunnelling will be hazardous involving heavy overbreaks in weak zones". It was also suggested that a few more holes should be drilled in this area before tunnelling was undertaken, which, however, was not done. The report of investigation (conducted in 1966-67) stated: "None of the drill holes have been pressure tested. It is considered that this vital information has already been lost which could have been of immense value to the designer and also to the geologist in interpreting the geo-technical problems involved in tunnelling through soft, weathered and structurally disturbed sedimentaries. It is felt that very little efforts and attention have been given by the project authorities in spite of repeated written and verbal advice." No more holes were drilled and the holes already drilled were also not pressure tested. In a

note (prepared by the GSI) appended to the additional special conditions of the contract with 'P', it was stated that "The construction of the project was taken up in 1970 without any further investigations."

3.5. Methane gas was noticed for the first time in face 5 of the tunnel in December 1972. The contractor was then advised to take necessary precautionary measures to avoid any accident. In July 1974, two workers received burn injuries as a result of inflammable gas. After this accident, the project authorities consulted the Director General of Mines Safety with a view to taking appropriate precautionary measures. The Director of Mines Safety, Eastern Zone, who visited the project site on 24th August 1974 to investigate into the occurrence of inflamable gas, recommended certain precautionary measures, namely, adequate and proper ventilation, check of methane gas with a methanometer, etc. The measures were stated (June 1977) to have been adopted.

3.6. Nevertheless, two major explosions took place on the 25th January 1975 inside the tunnel due to ignition of methane gas, causing the death of sixteen persons. The matter was reported on the 27th January 1975 to Government who set up a Committee headed by a Member of the Central Water Commission on 25th February 1975 to investigate into and ascertain the causes of the explosions. The Committee, in its report of 21st April, 1975, reported that the officers of the firm employed for the construction work did not seem to possess adequate experience in dealing with situations such as methane gas emissions and for taking timely preventive and safety meaures. Due to their lack of awareness of safety considerations, these officers laid themselves and the workers employed by the firm open to serious danger. These lapses on the part of firm 'P' were conveyed to it by the Central Hydro-Electric Projects Control Board on 3rd September 1975.

3.7. As mentioned in sub-paragraph 7.1 above, no formal agreement could be signed with the contractor and negotiations for finalising special terms and conditions continued. As the firm was not agreeable to sign the agreement, further payments to it were stopped by the Chief Engineer on 23rd July 1975. In its letter dated 4th August 1975, the firm stated: "We do not have any experience in tunnelling having such explosive gaseous conditions..... nor do we have trained and qualified personnel or suitable and necessary equipments to do such work....it will not be possible for us to execute the tunnel under such dangerous and highly hazardous conditions, never envisaged by any one". At a meeting held on the 28th August 1975 in the office of the Central Hydro-Electric Projects Control Board, the contractor firm expressed the view that due to existence of gas and soft rock, it was necessary to modify the contract after

technical details of the execution of the tunnel were worked out. It was pointed out to the firm by the Chief Engineer that the only new problem was the presence of gas and that the other problems of tunnelling in soft and squeezing rock were normally met with in boring a tunnel. The firm was, therefore, requested to indicate whether it required any assistance from the department for completing the tunnel on schedule. In its letter dated 3rd September 1975, the firm suggested appointment of a technical committee to advise it on tunnelling methods and equipments. This suggestion was recommended by the Chief Engineer to the Central Hydro-Electric Projects Control Board.

3.8. Appointment of committee of experts—A Committee of technical experts headed by the Chairman, CWC was appointed by Government in November 1975. It visitted the project in December 1975 and in its report submitted on 24th December 1975 observed: "Tunnel is the critical item for completion and commissioning of the project. About 70 per cent of the tunnel yet remains to be excavated ....The response of the strata to tunnelling has been poorer than anticipated originally....."

The Committee recommended both technical and administrative measures to overcome the difficult situation in tunnel boring. The former included basic changes in excavation methods for the various faces, etc.; the latter included immediate procurement of flame-proof equipments for all faces of the tunnel. To meet the existing situation and to ensure speedy progress of work, the Committee suggested that the staff on the civil side should be substantially reinforced.

The project authorities stated (May 1977) that the various recommendations/suggestions made by the committee "to overcome the difficulties in boring the tunnel under adverse geological and baseous conditions" were being implemented.

3.9. Appointment of Austrian expert—In early 1976, Government appointed an Austrian expert to advise on the tunnelling problems faced by the project. In his report (26th November 1976), the expert expressed the view that important rules and basic principles of tunnelling had not been followed by the contractor carefully enough in all faces except some singular fault zones. He suggested additional measures such as chemical grouting, long sheetpile forepoling, etc. to be adopted for tunnelling in face I where soil was highly plastic. He also suggested that the tunnel shape should be changed to a modified horse-shoe circular shape from the existing horse-shoe shape with vartical walls. Further, according to him, the steel support as executed did not provide an effective support. He

stressed the need for well trained crew at each work face of the tunnel. He also recommended the purchase of two cutters (AM 50) of Alpine and shotcreting equipment.

The project authorities stated (May 1977) that the measures recommended by the expert were being experimented with and that a final decision as to their implementation would be taken after seeing the results of the experiments.

3.10. Modified contract—Following the reports of the committee of technical experts (December 1975) and the Austrian expert (November 1976), the contractual problems remained under discussion/negotiation with firm 'P'. Finally a modified contract was signed by the contractor on 11th August, 1977. According to this contract, firm 'P' would not execute the balance work (about 3.60 kilometres) between faces 4 and 5 and faces O and I. The tunnel work to be done by the firm would now be about 3.15 kilometres (45 per cent of the total work). Rates for work done after 31st January 1975 were also revised and the value of the modified contract was worked out at Rs. 639.78 lakhs (for 45 per cent of the total work) as against the tendered value of Rs. 571.05 lakhs for the entire work. The balance work in faces 4-5 and 0-1 which is stated to be more difficult is proposed to be done departmentally.

3.11. Rupees 445.42 lakhs, being the value of the work done, were paid to the contractor upto October 1977. Besides, in terms of the special conditions of the contract, an *ad hoc* advance of Rs. 35 lakhs bearing interest at 6 per cent per annum and a further interest free advance of Rs. 91.01 lakhs, representing cent per cent cost of imported and indigenous equipment and spares brought to site by the contractor and value of tools, plant and machinery purchased from Government at issue price, had also been paid.

As per the terms of the contract, recovery of these advances was not to be made till the value of the work done reached twenty per cent of the total value of the contract. Thereafter, recovery was to be made from monthly account bills in the same proportion as the value of the bills bore to eighty per cent of the value of the contract.

Of the *ad hoc* advance of Rs. 35 lakhs (paid on 27th August 1971), Rs. 17.09 lakhs became due for recovery till April, 1976, against which Rs. 15 lakhs had been recovered till December, 1976. As in October, 1977, Rs. 13.53 lakhs (excluding interest) were outstanding. Out of the advance of Rs. 91.01 lakhs paid during 1971-72

to 1976-77 against machinery etc., Rs. 48.94 lakhs were outstanding (October 1977).

3.12. Timber supports in tunnel lining—The contractor's quoted rate of Rs. 130 per cubic metre for excavation of tunnel was inclusive of temporary steel/timber supports, wherever necessary, as per schedule of items of work attached to the notice inviting tenders draft agreement. A special clause had been added to the contract to the effect that the cost of temporary timber supports upto 300 cubic metres would be borne by the contractor firm and in case it was required to place temporary timber supports of more than 300 cubic metres, the additional quantity would be paid for at the rate of Rs. 750 per cubic metre.

Timber was not used by the contractor for temporary supports. Permanent timber supports and laggings were provided and for 851 cubic metres so provided payment was made at the rate of Rs. 750 per cubic metre *i.e.* Rs. 6.38 lakhs in all upto December 1976. Similarly, Rs. 0.22 lakh were paid for 30 cubic metres of permanent timber supports and laggings in rectification work. This was despite the fact that there was no provision for permanent timber supports and laggings in the technical specifications; these now lie embedded in the concrete tunnel lining.

In terms of the special conditions of the contract relating to permanent supports, the contractor could use reinforced precast concrete laggings. However, the contractor was allowed to use timber laggings to support the rocks between the steel ribs instead of reinforced pre-cast concrete laggings. The rate for reinforced pre-cast concrete laggings was Rs. 400 per cubic metre (as against Rs. 750 for timber support). Had reinforced precast concrete laggings been used, the cost (for 881 cubic metres) would have been Rs. 3.52 lakhs as against Rs. 6.60 lakhs paid for timber laggings. The project authorities stated in this connection (December 1976):

> ".....it has not been possible to remove the timber laggings as much of the loosened rocks has fallen over the laggings from the unsupported rock above. The permanent concrete lining has been placed against the timber and there may be hollow spaces behind the timber laggings. These spaces may have to be filled with concrete or cement grout. The timber will thus remain embedded. This matter needs thorough investigation and technical examination. It has been referred to the Central Water Commission. The use of timber laggings has been stopped (August 1975) and re-inforced pre-cast concrete laggings are being used."

Government stated (January 1978) that timber laggings had been reportedly used to span the ribs behind the steel supports. It was also stated that the use of timber laggings in this case was not prohibited and had to be adopted in certain cases depending on the type of rock strata.

3.13. Increase in cost of tunnel and surge shoft—The increase in the estimated cost of the tunnel from Rs. 677.55 lakhs in the first revised estimate to Rs. 1,475.60 lakhs in the second revised estimate was attributed mainly to, besides escalation in cost of labour and material (Rs. 311.70 lakhs), the following:—

(i) Boring in tunnel—The quantity increased from 1.29 lakhs cubic metres to 1.52 lakhs cubic metres due mainly to extension of the tunnel by 562 metres beyond the intake shaft and excessive over breaks due to soft rock encountered. Further, due to presence of mathane gas, the method of work in the tunnel had to be changed and flame proof equipment and additional ventilation etc. had to be provided. As a result, the cost of boring increased by Rs. 34.02 lakhs.

(ii) Permanent steel supports—Originally, provision had been made for permanent steel support only at shear zones where crushed rock was anticipated. In the second revised estimate, provision was made for steel support throughout the length of the tunnel in view of unstable soil strata encountered. The quantity, therefore, increased vided. As a result, the cost of boring increased by Rs. 34.02 lakhs.

(iii) Plain and reinforced cement concrete (RRC)—Because of unstable soil conditions, reinforced cement concrete had to be provided throughout the length of the tunnel. Thickness of plain and RCC lining had also to be increased from 450 mm to 625 mm. As a result, the total quantity of plain and RCC lining increased from 44,710 to 81,935 cubic metres and the cost by Rs. 175.40 lakhs.

(iv) Steel reinforcement—The quantity of steel increased from 180 tonnes to 3,542 tonnes because RCC lining had to be provided throughout the length of the tunnel. The increase in cost on this account was Rs. 67.70 lakhs.

(v) Grouting—Increased grouting became necessary because of flowing ground strata and weak rock met in tunnelling.

The quantity of cement increased from 17,000 bags to 1,40,000 bags and the cost by Rs. 79.68 lakhs.

(vi) Saving—There was a saving of Rs. 122.84 lakhs due to considerable reduction in the quantities of excavation as it was decided that the tunnel face at the upstream end would be started from the gate shaft instead of through open excavation.

[Paragraph 11 (3.0 and 7.0—7.11) of the Advance Report of the Comptroller and Auditor General of India for the year 1976-77, Union Government (Civil).]

3.14. At the instance of the Committee the Ministry of Energy have furnished the following note stating the latest revised estimate for the tunnel and surge shaft:—

"In the latest Revised Project Estimate 1977 (submitted to Government and awaiting approval), a provision of Rs. 1959.05 lacs has been made for the Tunnel and Surge Shaft. ..

The factors responsible for increase in the cost of works were (i) increase in quantities of tunnel boring due to extension of tunnel by 692 m beyond the Intake (ii) increase in quantities of excavation, concreting, steel supports, steel reinforcement due to poor geological conditions (iii) enhanced rates agreed to by Govt. for works of M|s. Patel Engg. Co. for unusual conditions of poor geology and methane gas which were not stipulated in their tender (iv) switch over to mechanised operation and (v) escalation in cost of materials, labour, etc. The increase can be broadly classified as under:—

		Amount in lakhs.
(i)	Increase in cost of construction due to change in the method of construction, changes of agencies, higher rates paid for works in gassey tunnel, estimates based on present day costs, new items of work, revised quantities etc.	812·11
(ii)	Increase due to extra items,involved in M/s. Patel Engg. Co.'s works. .	103·61
(iii)	Increase due to rise in price index in M/s. Patel Engg. Co.'s works. .	318·34
(iv)	Increase due to W/C Estt. and contigency as per cent of works . .	47·40
		1 281·53

Progress of Work

3.15. The Ministry of Energy have furnished the following note stating the progress made upto 30 June, 1978 in regard to the tunnelling work:—

'TUNNEL: Of the total length of 6778 metres the tunnel has been driven for a length 3055 m upto 30th June, 1978. Reach wise progress is given below:—

(a) Reach between Face O & I

Item	Total	Completed upto 30-6-78	Balance
Boring	692m	119.8m	572·2 m

The reach is scheduled to be completed by 31-12-1981.

(b) Reach between Face 2 & 3

Item	Total	Completed upto 30-6-78	Balance
Boring	720.93 m	(681.10 m)	39.83 m

Note: The work has been completed on 13-7-1978.

The reach is expected to be completed in every respect by 31-3-1980.

(c) Reach between Face 4 & 5

Item	Total	Completed upto 30-6-78	Balance
Boring	3848.54 m	1094 m	2754.54 m

This reach is expected to be completed by 31-3-1982.

(d) Reach between Face 6 & 7

Item	Total	Completed upto 30-6-78	Balance
Boring	1244.17 m	1160.36 m.	83.81 m

In this reach, boring is expected to be completed by August, 1978 whereas lining and grouting is expected to be completed by 31-3-1980. Hence the reach will be ready by March, 1980."

Geological Investigation

3.16. The Committee enquired during evidence, whether proper geological investigations of the region before the start of the project were conducted by Government. The Chairman, Central Electricity Authority, stated:—

> 'We had the geological investigations available with us, but those investigations were not considered to be sufficient. At that time, our experience in the Himalayan geo-technology was very much limited."

3.17. Asked whether the poor geological conditions in the tunnel were indicated during geological investigations. The Ministry of Energy have stated:—

> "During the geological investigations on which the original estimate was based, the incompetent shales and slaty shales found at the inlet of the tunnel was expected to induce caving, overbreak and roof collapse. Better tunnelling conditions were expected to be found in the central part because of the presence of harder sandstone bands with low dips. At the outlet and, the limited cover of overburden and preponderance of shaly rocks was expected to produce conditions similar to that at the inlet portal. Fault zones, shears and open joints along the tunnel line would present zones of overbeak and of crushed rock resulting in some seepage of water. Water seepage was expected only along the contact of the shales and sandstones.
>
> However, the extent of squeezing of rock towards the tunnel and heavy pressures exerted by the rock could not be foreseen during the initial geological investigations. The major set black to the project was due to presence of methane gas which was not indicated during earlier investigations. It may be mentioned that at that time the experience of tunnelling problems in the Himalayan region (which is now seen to compare with some of the worst tunnelling conditions anywhere) was very limited, so that the magnitude of the problems in this region could not be foreseen before execution was undertaken."

3.18. In reply to a question, the Chairman, Central Water Commission stated that it would take 4-5 years for conducting detailed

investigations. The Committee asked whether such an investigation was made in respect of Loktak Project. The witness stated:—

> "It was not taken up continuously. There was no decision whether to go ahead with the investigation, to prepare the project report."

3.19. Enquired, whether the project report was approved without making proper investigations, the Chairman, Central Water Commission stated:—

> "The geological investigations were undertaken by the Geological Survey of India with particular reference to the tunnel and the location of the power station, penstocks, etc. and they gave data for the design. Their investigations mainly confine to drilling a few holes—about three holes at the intake and three holes at the exit end of the tunnel and a few holes on the penstock slopes. With that data only, the Project was designed. Manipur Government prepared the project Report. Then this project was sent to the Central Water and Power Commission and the Planning Commission to get this cleared technically. This technical examination was undertaken in the Central Water and Power Commission. After going through the various aspects of the project this was cleared ultimately in February 1970. During the course of the examination some modifications were suggested and these modifications were done."

3.20. In reply to a query, the witness stated:—

> "The investigations that were conducted in this particular project were limited in nature. This is not, I should say, adequate for making a firm design. Always it is so, not only in our country but in many countries. It is a question of compromise between the extent of investigation and the formulation of a firm design for the project."

3.21. In reply to another question, the Chairman, Central Water Commission, stated:

> "Serious repercussions are there on the cost and there are heavy cost over-runs. Time over-runs are also there. We are completely at a loss to realise that these projects are dragging on, particularly, some of the projects are dragging on for a number of years. This has been agitating the Government and, therefore, the Government set up a Committee in 1970 to look into this particular aspect. Later

on the Ministry of Emergy set up another Committee. The first Committee looked it from the point of view of the time over-run and cost over-run and the various reasons why this is happening all over the country. Then one of the main points was inadequancy of the investigations which was high-lighted by the First Committee. Recently, the Ministry of Energy set up a Committee to look into the present methods of investigations of the projects."

3.22. The Committee desired that a note might be furnished stating the genesis of these committees, the recommendations made by them and the action taken by Government thereon. The Ministry of Energy have furnished the following note*:—

"The genesis of the two committees, the first, in 1970 and the other recently in 1978, the recommendations made by these committees and action taken by the Government thereon are at Appendix II."

3.23. Indicating the action taken by Government on the recommendations made by Naegamwala Committee set up in 1970, the Ministry have stated* as follows:—

"The most important recommendation of the Committee was that guidelines laid down by CW&PC for investigations to be carried out before preparations of the project reports and estimates for approval of the planning Commission should be strictly followed for preparing the reports and estimates of all major irrigation and multipurpose projects in the country. 'As a result of the above, recommendations, to enable investigations work to be carried out along the right lines and for preparation of realistic cost estimate, the Central Water Commission had circulated in August, 1975 and July, 1976 respectively two booklets' "Guidelines for investigation of Major Irrigation and Hydro Electric Projects" and "Broad guidelines for preparation of project estimates for major irrigation and multipurpose projects" to the various state Governments/State Electricity Boards. The former booklet contains the guidelines laying down the minimum investigations necessary for major irrigation and hydro-electric projects keeping in view the instructions issued from time to time by the Planning Commission on the formulation of new projects. The booklet on "Guidelines for preparation of estimates" furnishes items of the estimates together with suggestions on the method of

*Not vetted in Audit.

preparation of detailed and realistic project estimates. Adherence to these guidelines would go a long way in carrying out systematic investigations of projects and preparation of a detailed project report with realistic estimates of cost. The Indian Standards Institution has also finalised a number of standards and guidelines for carrying out investigation of projects and preparation of detailed project report. These deal with a number of subjects such as—

(a) The details of investigations to be carried out.

(b) The details of topographical survey.

(c) Geological survey.

(d) Material survey.

(e) Organisational set up for carrying out investigation.

(f) Methodology for preparation of the project report etc.

In July, 1976 the Conference of the Chairman, State Electricity Boards while considering the report noted that there was no uniformity of approach in the investigation of projects and preparation of project reports and recommended that a Committee bet set up to make a detailed examination of the procedures for investigating and implementing multipurpose and hydro-electric projects and, *inter alia*, make recommendations to reduce the cost and time overruns. Accordingly, the Ministry of Energy (Deptt. of Power) set up the Y. K. Murthy Committee in September 1976 to further study and to make recommendations in this regard. The Committee's recommendations, which were submitted in June, 1978 are being examined."

3.24. Asked how far the suggestions made by these committees have helped the Loktak Hydro-Electric Project authorities to forestall the problems now being faced by them, the Ministry of Energy have stated*:—

"The suggestions made by the First Committee of 1970 are constantly before all project authorities in charge of execution of projects and are being implemented to the extent that they are relevant and applicable. However, it would be difficult to make a quantitative assessment as to the extent to which the suggestions of the Committee have helped Loktak project to get over the difficulties faced by them. They certainly helped in a qualitative way in improving the pace of execution of the project."

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*Not vetted in Audit.

3.25. The Committee enquired whether Government was satisfied with the type of geological investigations done in the country. The Chairman, Central Water Commission, said:—

"The investigations that are being done not only in Loktak but in other parts of the country also are definitely sub-standard in our country. That is why we are getting into problems of cost over-runs and time over-runs in our projects. The other point is that the persons who are put on the investigations are those who are not wanted in the department."

3.26. In reply to a question, the witness elaborated the position thus:—

"As I said, these projects are prepared by the respective State Governments and they utilise the expertise available in those States. In respect of Central Projects the expertise available in the CWC is utilised. But whenever we come across certain lacuna in the preparation of projects by the States we try to advise them. Cost over-run and time over-run factors have been responsible for the delayed execution of the projects. In the light of the lesson which we learn in the Central Government, we issue definite instructions to the States, we issue guidelines to them so that projects are prepared with fairly adequate investigation and proper project estimate of costs is made. In the light of new developments we do change the guidelines from time to time. Much depends upon the 'perfectness of a project' if I may say so, which in turn depends upon the expertise and competence of the people or personnel employed on the job. These river valley projects are located in remote areas in the country. Various difficulties are faced by the people concerned while conducting investigations properly and in time. There are also limitations of funds. Invariably much difficulty is faced in getting funds at the stage of investigations of a project. Because of these difficulties, the projects by and large are not very satisfactory; but they go on improving as they come into contact with the Central Government and the organisations like the Central Water Commission. From time to time the Ministers who are in charge of Irrigation and Power have also addressed letters to the State Governments to see that at the initial stages of the investigation or formulation of the project, the available experts of the Central Water Commission could be associated, so that these difficulties do not crop up at the time of the

scrutiny of the projects. All efforts are being made by the Central Government to reduce these difficulties and to limit the increase in the cost of the project."

3.27. The Committee asked whether the officials who conducted faulty investigations were held responsible for it. The Chairman, Central Electricity Authority stated:—

"All these projects are located in very difficult areas. So, the people are very much reluctant to go and work on these sites. I frankly admit that the people who are posted in investigation organisations are the people who are to be punished. It is not a rewarding post. It is a punishment post. The V. K. Murthy Committee has recommended very specifically that first of all those people who are responsible for carrying out investigation must have proper guidance from an expert body, which is missing at present. There is no expert body available today to say how and to what extent the investigation should be carried out. As regards attracting good and willing persons, the Committee has also recommended that officers should be posted at district Headquarters where facilities for education and medical treatment are available. The officers are to stay at the project site during the field working season. It is not being done, at present. For the period when the officers stay at the project site, adequate compensation for payment of the normal DA and incentives in form of special pay should be granted to all the officers. The officers should have the preference for allotment of Government quarters at the headquarters. Once these facilities and tools are given and we are able to attract competent persons, they will certainly become accountable to the type of investigations they have carried out."

3.28. In reply to a query, the witness said:—

"We are not suffering so much for faulty investigation as due to inadequacy of the investigation. That is why our suggestion is that there should be an expert body to tell them that these are the further investigations to be carried out; this is the area where they have got to concentrate more."

3.29. The Committee enquired whether Government had considered the question of deputing officers from Centre for conducting investigations in order to find out that the investigations done by the States were satisfactory. The Chairman, Central Water Commission replied:—

"This is a very important aspect and we have been in touch with the State Governments in this respect. After all, the

State Governments are to do the work of investigation. They do prepare project reports. As I submitted a few minutes back, we had written letters at the Union Minister level to the Ministers of the States asking them to associate CWC even at the initial stage of the investigation so that CWC's expertise also comes into the picture. Whatever expertise is available in the centre is also made available to the States at the initial stage itself. But there is a little reluctance on the part of the States. They also have got a certain amount of expertise; they feel that they would be able to do it. In this respect there is a good understanding between the States and the Centre. Even after the project report is prepared we have a discussion with them and see that things are done properly. The only difficulty is that we cannot thrust ourselves on the States. We are doing our best to see that investigations are done properly."

3.30. Referring to the report of the Geological Survey of India, the Committee enquired why more holes were not drilled. The Director General, Geological Survey of India, stated:—

"In a set-up like the one prevailing in that part of the terrain with heavily broken rocks and shales, the drilling that they did earlier had given rise to hardly 10 to 20 per cent core recovery. With that condition, generally one would rely upon the assistance that one could get indirectly from the study of the out-crops on the surface. The question is whether the additional three holes which have been completed subsequently in 1971 but not at the time the report was submitted could have given information that could have materially changed the picture in regard to the feasibility of the project. My own assessment is, in the area where the three holes were recommended, they had certain difficulties in fixing the boundary of certain formations. To get a clear picture of that, they had asked for these holes. Normally when we are dealing with dam foundations, they are very strict that this should be done because it is fundamental for evaluation of competence of the foundation and what you have to do to strengthen them. But in the case of tunnels the information you get from the tests is relevant to the stage when you have to render the rocks round the tunnel lining strongly grouting and not for the stage where you decide in what direction I have to drive in or what supporting measures I have to provide. The information given by the test relates to a

later stage of project development and not to the immediate stage."

3.31. In reply to a question, the witness stated:—

"If you see the recommendation it says, "it will be quite poor both at the inlet and outlet ends, but in the middle of the hill ranges, it is expected to improve. From 'very poor' it may improve to 'poor'. If somebody has taken the statement to mean that in the middle it will be very good that was not a correct reading of the geological report."

3.32 In a note furnished to the Committee, the Ministry of Energy have explained the position thus:

"The practice for investigation of tunnels with high overburden of the order of 300 metres as in this tunnel is to drill holes near the portals at the inlet and outlet and depend largely on surface geological studies for the middle reaches. This is also the recommendation of the Geological Survey of India for the Loktak Tunnel as given by Shri B. Ramachandran in his report of December, 1966. The Loktak tunnel was, therefore, taken up for construction after drilling holes near the inlet and outlet as recommended by the geologist and as per the usual practice.

Regarding pressure testing, this could not be carried out by the investigating authorities. This information concerns the permeability of the rock, which has a direct impact only on the requirements of drainage of the tunnel. The available data was considered adequate to call for tenders.

Before taking up the project, the investigations conducted were reviewed during an inspection of the project by the then Union Minister of Irrigation and Power along with the officials of the Central Water & Power Commission, Geological Survey of India and Manipur Public Works Department in February, 1970 and it was considered that the data was adequate for the purpose of calling of tenders for the tunnel."

Award of Contract

3.33. Provision in the project estimate for tunnel and surge draft was Rs. 145.55 lakhs, the amount indicated in the tender was Rs. 380.00 lakhs and the work was awarded to M/s. Patel Engg. Co. Ltd., Bombay for Rs. 571.05 lakhs. The Committee desired to know

the reasons for these wide variations. In a note, the Ministry of Energy, have stated:

> "Provision in the project estimate for tunnel and surge shaft was based upon the details of works as envisaged in 1967 when the project estimate was approved and based upon the preliminary designs. Notices inviting tenders were issued in November, 1970 by which time tender drawings were prepared by Central Water Commission. Based on such tender drawings and detailed specifications prepared by Central Water Commission, both the quantities, items and the rates as were prevalent at that time, the estimates had undergone a change. The other major reason for the variations was the increase in cost of construction materials like cement, steel and in labour costs.
>
> A study of the cost of living index and the market prices in Manipur area revealed that the rise in the cost of living index and prices in the period between 1966—1970 were nearly double. As for example, the approved wages per day for unskilled labourers rose from Rs. 2.50 in 1966 to Rs. 4.50 by the time the project was set up. Furthermore, the local Public Works Department Manipur had authorised an increase in rates by 50 per cent to 70 per cent over the approved schedules of 1966 on which the project estimates were based. Thus, the variations between the provision in the original estimate of 1967 and the tendered estimates of 1970 was accounted for both by increase in the quantities as well as escalation in cost.
>
> As regards the variation between the tendered estimate of Rs. 380 lakhs and the lowest tender accepted Rs. 571.05 lakhs, it may be relevant to mention that tenders were received from two firms 'P' and 'H'. The tendered cost of 'P' was Rs. 537.06 lakhs while that of 'H' was Rs. 642.9 lakhs. Their loaded tender cost after evaluation of special conditions stipulated by them worked out to Rs. 571.05 lakhs and Rs. 697.11 lakhs respectively. It would thus be seen that both the tenders were about 50 per cent to 80 per cent higher than the tender estimate. The tender estimate given in the N.I.T. is a reference line. However, the tenderers quote rates according to their own assessment based on their own costs, over-heads, methods of tunnelling operations, the considerations of remoteness of the project from the nearest rail head and distance from market and workshop facilities etc. The variations in

assessment can be expected to be quite large in view of the remoteness of the project site where works of such magnitude had not been undertaken before.

The tender for the above work was awarded based on the assessment of tenders made by the Tender Committee headed by the Chairman, Central Water & Power Commission. Member (Hydro-electric), Member (Designs & Research) of Central Water & Power Commission, representative of Ministry of Finance, Chief Engineer, Loktak Project, F.A. & C.A.O. (Designate) and Secretary, Central Hydro-Electric Project Control Board were other members of the Tender Committee. Member (P&P) Directors incharge of Rates & Costs, Dams Designs of Central Water & Power Commission were also associated with the deliberations of the Tender Committee."

3.34. According to the audit paragraph, the Chief Engineer had observed in December, 1970 that an attempt should be made to negotiate with M/s. Hindustan Construction Company, Bombay to bring down its tendered cost as near as possible to that of MIs. Patel Engineering Co. Ltd., Bombay in view of the reputation of the former in tunnel work. The Committee enquired why negotiations were not attempted with M/s. Hindustan Construction Co., Bombay when it was more experienced and specialised. The Chairman, Central Electricity Authority stated during evidence:

"Patel Engineering Company are leading tunnel contractors and they are in this field since 1950; Hindustan Construction Co. came only in 1963-64 and had done work for about Rs. 7 crores, whereas Patel Engineering had completed works costing over roughly 15 crores. Hindustan Construction Co. are contractors for concrete dams and not tunnels. After taking all these factors into consideration, the tender Committee awarded the contract in favour of Patel Engineering."

3.35. The Committee wanted to know the reasons for the delay in finalising the special terms and conditions and concluding an agreement with M|s. Patel Engineering Company, Ltd., Bombay till August, 1977 when the work was awarded to them in August, 1971 after its tender valued at Rs. 571.05 lakhs had been accepted by the erstwhile Ministry of Irrigation and Power in March, 1971. The Ministry of Energy have sent a detailed note, which is at Appendix III. Briefly according to the note, the firm was directed on 20 August, 1971 to commence the work. The correspondence between the firm

and the project authorities regarding Clauses pertaining to 'Payment of Advances', 'Use of materials from excavation', 'Assistance in moving sites', 'Requirement of Power', etc. continued upto 5 February, 1972. The special conditions of the contract were finalised in various discussions held with the contractor. The correspondence on special conditions continued till 8 January, 1975. In the meantime, as a result of two explosions on 25 January, 1975 which occurred at face 5 of the Head Race Tunnel, 14 persons lost their lives. The firm referred the above accident in their letter dated 14 February 1975 and stated that their rates did not allow for tunnelling in such dangerous conditions and requested the Chief Engineer to do everything necessary to make the tunnelling conditions normal and safe from such dangerous gas, free of cost to them. A number of communications were exchanged with the firm and disccussions held in various meetings. In view of the advice of the Ministry of Law that the precipitate action should not be taken against the firm, the Ministry of Energy (Deptt. of Power) directed the Control Board Office on 29 December 1976 to bring the Law Ministry's advice regarding legal status of the contract to the notice of the Loktak Committee. Accordingly, the relevant papers were sent to the Members on 6 January, 1977.

The revised rates and conditions proposed by M|s. Patel Engineering Co. were considered by the High Power Organisational Committee and examined in detail by a Negotiating Committee set up by the above Committee in February 1977. The Negotiating Committee after careful examination of the proposals of M|s. Patel Engineering Co. for additional rates and extra conditions, arrived at agreed rates and conditions which, in their considered judgement and opinion, were reasonable. A formal agreement was accordingly signed with M|s. Patel Engineering Co. on 11 August, 1977.

Delay in completion due to appearance of Methane gas

3.36. As regards the delay in completing the tunnelling work, the Chairman of the Central Electricity Authority stated:

> "After the methane accident in January 1975, the work was suspended for a period of 2 years. Methane gas was a problem for us. The project is now expected to be completed by end of 1981."

3.37. The Committee enquired why necessary precautionary measures were not taken to avoid the accident when methane gas was noticed in 1972. The Ministry of Energy have stated:

> "Inflamable gas first made its appearance in No. 5 face in December, 1972. At that time, beyond the fact that it

was inflamable, the exact nature of the gas was not identified. Hence, practice obtaining then was to regularly burn the gas by lighting a piece of waste soakedly oil. It also transpired that the quantity of gas was maximum immediately after blasting and with the progress of time after blasting it used to come down. It is understood that on the detection of gas and its inflamability, the then Engineer-in-charge had issued instructions to the contractor who was operating on this face to take necessary precautions in the interest of safety without specifying what were the precautions to be taken. As stated above, the exact nature of the gas was then not clearly defined. It was only subsequently when during the middle of July, 1974 in the course of burning the gas, that the gas ignited inflicting burn injuries on two of the workers (one of whom subsequently died in the Hospital), that serious threat to safety that this gas posed was seriously taken note of. The investigation report also mentioned that of the two workers, the one who died probably died more due to shock and less due to burn injuries. However, following the accident the project authorities immediately decided to consult experts for a full investigation of the nature of occurrence and characteristics of the gas and take appropriate precautions. Officers from ONGC visited the project on 15-8-1974 and on analysis of the air in the tunnel found the presence of methane gas to the extent of 91.11 per cent by volume.

The Chief Engineer along with the Contractors' representatives met the DGMS on 17-8-1974 and wanted to know the precautions to be taken against risks attendant on inflamability of gas. The DGMS deputed one of his officers to make a thorough investigation in the matter and on the basis of his investigations that officer submitted a report which *inter-alia* recommended the following precautions to be taken to prevent danger from inflamable gas by diluting the same to harmless proportion and sending it out of the tunnel by providing adequate ventilation and secondly to ensure that even if there is dangerous accumulation of gas, there are no sources to ignite the same:—

1. Ventilation to certain specifications.
2. Leakage of air in the ducting to be prevented.
3. Capacity of the fans in the ventilation system to be of the adequate capacity such as to reduce the presence of the gas in any part of the tunnel to less than 1.25 per cent.

4. To minimise seepage of gas from the strata, to unite the surfaces.

5. Only permitted explosives to be used in the tunnel face.

6. The provisions of Rule 126 of the Indian Electricity Rules, 1956, to be strictly complied with.

7. Concentration of methane gas to be checked every four hours with a methanometer.

8. A number of flame safety lamps should be kept constantly burning on the roof near the face of the tunnel and frequently check the gas.

9. No smoking should be done in the tunnel."

3.38. The Committee desired to know that in case precautionary measures suggested by the Director General of Mines Safety were adopted, how it was that the accident on 25 January, 1975 could not be avoided. In reply, the Ministry have furnished the following note*:

"The precautionary measures suggested by the Director General of Mines Safety were conveyed to the project authorities in October 1974.

It is on record that the project authorities had conveyed all the suggested precautions to the contractor engaged in the tunnelling work. Some of the precautions that were prescribed involved action to import methanometers (at that time not available in the country), ducting arrangements and ventilation systems had to be altered to revised specifications, and procurement of exhaust fans and circulation fans of different capacities. Flame-proof equipment had to be acquired and partially imported. Pending the import of methanometers, the project immediately borrowed the instrument from the D.G. of Mines Safety for recording methane gas level readings in the tunnels. It would be appreciated that while action to take these measures were promptly initiated, the actual procurement and installation, particularly of imported items, would take time.

It was unfortunate that a major explosion on 25-1-1975 occurred before these precautions could be fully implemented. It may not be out of context to mention that as a result of the enquiry that was instituted consequent on the acci-

*Not vetted in Audit.

dent that took place on 25-1-1975, the following conclusions were reached:—

(a) the disaster of 25-1-1975 could be termed as a natural disaster which could not be envisaged earlier;

(b) the possibility that it was purely an act of God, which might have occurred in spite of observance of the usual routine cares and safety precautions, cannot be ruled out, and rather, the same appears to be more probable; and

(c) the work was proceeding under serious disadvantages and heavy odds, most of which was not the creation of the project officials."

3.39. The Committee asked whether the precautions suggested by the Director General of Mines Safety were taken by the project authorities. The Chairman, Central Water Commission replied:—

"This particular aspect has been gone into by the two Committees headed by very senior engineers of the country. They have brought out all the pros and cons of the entire case. The engineers who were involved were suspended and charge-sheeted. An enquiry was held and ultimately a decision has been taken."

3.40. The Committee were informed that M|s. Patel Engg. Co. Ltd., Bombay in its letter dated 4 August, 1975 had intimated the project authorities that they had no experience in tunnelling having such explosive gaseous conditions, nor had they trained and qualified personnel or suitable and necessary equipments to do such work and it would not be possible for them to execute the tunnel under such dangerous and highly hazardous conditions. The Committee enquired that when M|s. Patel Engg. Co. Ltd., as per their own admission were not capable of coping with the problem of tunnelling, why the work was allotted to the firm without being satisfied about its experience and capacity to do it. The Ministry of Energy have stated:—

"It may be mentioned that the firm 'P' is one of the leading tunnelling contractors in the country. What the firm in their letter dated 4-8-1975 stated was as follows:—

'We do not have experience in tunnelling having such extensive gaseous conditions....nor do we have trained and qualified personnel and suitable and necessary equipment to do such work....it will not be possible for us to

execute the tunnel under such dangerous and highly hazardous conditions never envisaged by any one.'

What the firm admitted was that 'they do not have any experience having such extensive gaseous conditions' and not that they were not capable of coping with problems of tunnelling that could be envisaged from the geological report attached to the N.I.T. leading to their contract. The statement of the firm has to be read in the context of the explosion that took place due to the presence of methane gas in the tunnel faces at which they were working. In this connection, the presence of methane gas was not contemplated or known in accordance with the results of geological investigations preceding the project estimates or even preceding the placing of the contract with the firm. In fact, in the geologist's report attached to the N.I.T. no mention was made about the presence or likely presence of gas in the tunnels, though such report did specifically describe the condition of rock in the tunnel which may result in squeezing and swelling of shales and the possibility of caving, overbreaking and roof collapse. Thus while the contractor was aware of difficult tunnelling conditions of the type normally met within the Himalayan strata for which he was prepared, what they mentioned in their letter dated 4-8-75 is that the experience they lacked was in gassy tunnels for which they had neither the equipment nor the men."

3.41. The Committee asked the extent to which the recommendations made by the Committee of technical experts headed by the Chairman, Central Water Commission to advise on tunnelling methods and equipments had been implemented. The note furnished by the Ministry of Energy in this regard has been reproduced below:—

"The recommendations made by the Committee of technical experts headed by the Chairman, C.W.C. fall into the following categories:—

(a) Technical measures

(b) Administrative measures

(c) Procurement and installation of equipment

(d) Communication system

(e) Organisation.

The progress of implementation of these recommendations is given below:—

(1) Technical measures—The Technical measures recommended by this Committee have undergone modifications in the light of recommendations of the Austrian Expert Mr. Golser whose recommendations find a place in the Report of the Organisation Committee constituted by the Government of India in July, 1976. What is being followed now is the progressive implementation of the recommendations made by Mr. Golser and accepted by the Corporation.

(2) Administrative measures—In the light of recommendations of the subsequent Committee referred to as the Organisational Committee, the recommendations regarding the administrative arrangements also underwent modifications in view of the development that the contractor was relieved of some portions of the tunnel (faces O; 1 and 4; 5). The administrative measures pertaining to safety are being progressively implemented in that, a Safety Officer has already been appointed at the Project and that his subordinate staff being picked up from various sources subject to availability. All the equipment now in use in the tunnel are flameproof, and continuous monitoring of Methane Gas is being done. The ventilation system has also been modified according to the revised specifications.

(3) Procurement and installation of equipment—All the equipment required are being progressively installed or brought into use, as they are procured....The two FLP locomotives have already arrived and the remaining are in the pipeline. All other FLP equipment is already in position.

(4) Communication System—Talex communication system between Loktak, Calcutta and Delhi has been established. Telephone link between Loktak and Leimatak has been established. Wireless communications between power house, face 5; Loktak and Ithai Barrage have been established.

(5) Organisation—Organisation and contractual recommendations of this Committee, to the extent modified by the subsequent Organisation Committee appointed in July, 1976 are being implemented."

3.42. The Committee wanted to know whether the findings/ recommendations of the Committee of Experts (Murthy Committee) which submitted its report in December, 1975 were considered to be adequate; and if so; why an Austrian expert was appointed to advise on the tunnelling problems faced by the project. The Ministry of Energy have stated*:—

"The findings/recommendations of the Committee of experts which submitted its Report in December, 1975 were discussed in meetings held in December, 1975 and April, 1976 in the Ministry of Energy (Department of Power). It was noted that the technical measures to be adopted in constructing the tunnel as recommended by the Committee which, though, adequate so far tunnelling by Conventional method was concerned, might not attain sufficient speed in the completion of the balance portion of the tunnel. It had been assessed that a total of about 82 months would be required to complete the excavation of the tunnel in Reaches between 4 and 5 by conventional methods. The technical experts who were present in the meeting referred to above were of the opinion that for effective and speedy method of tunnel construction foreign experts may be consulted. In other countries such as Austria, advanced techniques for construction of tunnel having difficult geo-technical features and proved successful and, therefore, it was decided that advantage should be taken of exploring the improved technique using sophisticated machinery that was in vogue in advanced countries. For this purpose, it was decided to consult M/s. Geo Consult of Austria, who made available the services of an Expert to visit the Project. The Expert after inspection of the site and examination of the data available submitted his final report in November, 1976. *Inter alia* the Austrian Expert recommended the excavation by use of point excavators for tunnel boring and supporting the roof by shotcreting. The report of the Austrian Expert was considered by the Organisation Committee constituted by the Govt. of India in July, 1976 to examine further and make comprehensive recommendations on the arrangements for construction and supervision of the different reaches of the tunnel so as to expedite the completion of the project. The Committee after considering the report of the Austrian Expert decided that in view of very adverse geological conditions and the show of methane gas in the

*Not vetted in Audit.

portion of the tunnel between reaches 4 and 5, it should be excavated by using imported point excavators. They further recommended the use of two such excavators, one opreating at Face 4 and the other at Face 5.

At this stage it was known that M/s. Coal India had received tenders for the supply of the same type of equipment for coal mining work and that they were going to place orders for the purchase. The Committee, therefore, felt that it would be better and expedient if the order for the purchase of two Alpine Miners with necessary modification in the equipment to suit the requirement of the Loktak tunnel, be placed on the same manufacturers on the basis of tenders received by Coal India. On this recommendation, the National Hydro Electric Power Corporation Ltd. (Incharge of construction of the Loktak Project) approached M/s. Coal India to include the requirement of two Alpine Miners for the Loktak Project while placing orders for such machines on the basis of the tenders received by them. Subsequently the Coal India authorities advised that the orders for purchase of these miners be placed directly by the purchasers. The NHPC negotiated with the manufacturers of the Alpine Miners, the supply of one miner which, after installation would be on trial for a period of 3 months and should the equipment be not found satisfactory that they would take it back free of cost, and the supply of the second miner was to be confirmed only after the satisfactory performance of the first miner in the trial period. However, the import of the equipment was only one aspect of the total arrangements which had to be made following from the report of the Austrian expert. The major decisions that had to be taken were in regard to the agency for the construction of the tunnel between faces 4 and 5, the organisational and infrastructural requirements if the construction was to be taken departmentally with the use of imported equipment, the procurement of other supporting equipment such as flame proof locomotives, blowers, lighting arrangement, ventilation arrangement, remote gas monitoring arrangement and shotcreting etc. etc. Though the position of availability of the miners was quite comfortable whereas their immediate import would not have served the purpose unless all the equipment mentioned above and infrastructural arrangements were also tied up properly so that the miners on arrival would

not remain idle, particularly since the condition of supply proposed to be imposed by the supplier was a trial within a period of 3 months and final acceptance of the supply on such successful trial."

"The organisation Committee devoted considerable thought to the totality of arrangements and advised that on the basis of time and motion studies and to ensure perfect matching of various tunnelling methods the project authorities should finalise the list of other equipment to be purchased, take action for procurement of these equipments. It was only after total plan for departmental construction of the tunnel with the use of the above referred equipment was drawn up and a proper schedule was prepared taking into account the expected lead time in procurement and installation of the different types of equipment and the time required for setting up the organisation, that the orders for the miners were placed after getting necessary foreign exchange released and other formalities completed.

The first of the miners has already reached Calcutta Port and is in the process of being transported to the Project site."

3.43. The Committee have been informed that an amount of Rs. 1,42,333 was paid to the Austrian expert who had advised on the tunnelling problems faced by the project. The Committee enquired the extent to which the various measures suggested by the Austrian expert had been implemented. The Ministry of Energy have replied*:—

"The following are the recommendations made by the Austrian expert and the progress made in implementing these recommendations:—

(i) the excavation in Face 1 to be done with the help of a knife cutter shield. The excavation at Faces 3, 4 and 5 to be done with the help of 2 cutters:—

The order for 2 nos. cutters (Alpine Miner AM-50) has been placed on M/s. VOEST Alpine Miner, Austria. The first Alpine Miner has been shipped by them on 19th August, 1978 and the second will be shipped in September, 1978. The cost of each Alpine Miner is approximately Rs. 28 lakhs (CIF). It is expected that excavation from face 5 and 4 would be started with these Miners in January-February, 1979. The exca-

*Not vetted in Audit.

vation on face 3 was continued by conventional methods as the reach left was only small and has since been completed. The excavation from Face 4 and 5 will be continued by conventional methods till the Miners are received. About 2700 m length still remains to be done here.

The global tenders were invited in October, 1977, for supply of a simple blade shield proposed to be used at Face 1. All the tenderers except one had offered the solid shield. One firm had offered both solid and the blade shield but recommended the use of solid shield. As mentioned above the Austrian expert had suggested the use of simple blade shield. Due to different types of equipments offered by various firms against our requirement of simple blade shield. Due to different types of equipments offered by various firms against our requirement of simple blade shield, it has been decided to invite fresh tenders for this equipment for having fair comparison of costs. However, for reach upstream of face 1, another face called face 0 has been opened and excavation work is being done by conventionel methods by departmental labour. About 500 m. out of total 690 m. length of tunnel is remaining to be excavated between Face 0 and 1. Flowing ground condition can be met in this reach any time. The tenders have also been floated for awarding the work of Face 0 to 1 to a contractor.

(ii) New Austrian tunnelling method 'NATM' (*i.e.* shotcreting and rockbolting) to be used for supporting the excavated tunnel:—

Four nos. shotcrete machines have been imported. Some shotcrete trials have also been made. Arrangements are made for manufacturing the rockbolts. By the time the Miners arrive at site, all the arrangements for doing shortcreting and rockbolting shall be made.

(iii) Effective ventilation system to be provided to cope with the Methane problem and the gas concentration to be controlled:—

The ventilation system for Face 4 and 5 has been finalised in consultation with the Central Mine Planning and Design Institute, Ranchi and M/s. VOEST Alipine, Austria (the suppliers of Alpine Miner AM-50). The

fabrication of ducks is in progress. The required ventilation fans have been ordered. The above ventilation system will be installed in the tunnel before the Alpine Miners are commissioned at site.

(iv) In the syncline zone between Face 4 and 5 the drainage holes of 50 to 80 mm. dia. should be drilled 10 to 20 m. ahead of the face:—

Two nos. Pneumatic core drilling machines with accessories have been arranged and received at site.

(v) Training of Miners and foreman for shotcreting and Rockbolting and other operations in tunnelling:

An offer has been received from M|s. Leonhard Moll of West Germany for giving such training. The offer is under process."

3.44. According to modified contract, the balance work in faces 4-5 and 0-1, which was stated to be more difficult was proposed to be done departmentally. The Committee enquired if the project was able to handle the job of tunnelling in difficult zones, why M|s. Patel Engg. Co. Ltd., Bombay could not do it. In a note furnished to the Committee, the Ministry of Energy have explained the position thus:—

"The Organisation Committee which was set up by Govt. to consider the situation arising out of the extraordinary conditions following the gas explosions, dealt at length with the situation arising from M|s. Patel Engineering Co. not being in a position to continue with the tunnelling between faces 4 and 5.

They came to the conclusion that the execution of tunnel between faces 2 and 3 and 6 and 7 may be continued by the contractors. Even as regards the reach between faces 4 & 5 M|s. Patel Engineering Co., in informal discussions with the Committee, expressed their willingness to continue with the work provided they were allowed collaboration with a foreign executing agency as a joint venture. This could not be allowed in consonance with the public policy in this regard keeping in view the strategic nature of the Manipur area in which the project is located. The alternatives were either to get the work done through some other private contractor or execute it departmentally.

As regards engaging another private contractor, the disadvantages were that calling of fresh tenders and going through

the whole process of tendering would have consumed unnecessary time. Particularly in the background of the explosions in the tunnel and the lack of knowhow in the country, the question of whether any other agency will come up at economical rates was also doubtful. By then, the Austrian expert's recommendations about the use of sophisticated equipment were also in hand and it was evident that speedy completion of the tunnel in the gassy reaches would require the use of sophisticated machinery. Therefore, the agency selected for completion of the reaches between faces 4 and 5 would have to be necessarily given the use of the sophisticated equipment. It was felt that the knowhow relating to use of this equipment being imported for the first time in the country should for tactical reasons not be passed on to private agencies who might exploit such knowhow in future and that such knowhow should remain with Government or its agencies. It was for these reasons that the Organisation Committee recommended and the Government accepted the recommendation that the construction of the tunnel with sophisticated equipment should be undertaken departmentally."

3.45. The Committee enquired whether any progress had been made in faces 4 and 5 and faces 0 and 1 of the tunnel which were proposed to be taken up departmentally. The Ministry of Energy have stated:—

"There has been progress of work in faces 4 and 5 and faces 0 & 1. Of the 692 metres in the reach between faces 0 & 1, 119.8 metres have been completed leaving a balance of 572.2 metres. The reach is scheduled to be completed by 31-12-1981 by using sophisticated machines for excavation etc. As regards faces 4 and 5, boring of the tunnel has been completed to the extent of 1094 metres out of 3848.54 metres, leaving a balance of 2754.54 metres expected to be completed by 31-3-1982, by employing mechanised tunnelling equipment under supply."

3.46. The Committee asked whether the project authorities were still encountering any trouble on account of methane gas. The Chairman, Central Electricity Authority, stated during evidence:—

"We have taken a lot of precaution. We have improved ventilation. The work, at present is being done manually. We

are preparing flame proof locomotives. After those locomotives have been received, we will take them right to the face. We are importing alpine machine. We are hopeful, after the machine starts working, that the tunnel boring will improve considerably. The cost of this machine is about Rs. 27 lakhs."

3.47. The Committee enquired whether the project authorities had sent any experts to Europe and Switzerland to gain some expertise and experience. The Chairman, Central Electricity Authority stated:—

"Only in respect of operation of the machine. Our idea is to support rock by shotcreting and rock bolting."

3.48. Asked whether there was any earlier experience of shotcreting and bolting, the witness said:--

"This shortcreting has been experienced at Yamuna project where it was found to be successful. Now we are going to introduce it here. We have already experimented it. It is proving successful. We have started rockbolting recently."

3.49. The Committee enquired how far the training abroad would help the experts to utilise the technique in India. The Chairman, Central Electricity Authority, stated:—

"On the return of our engineers from Austria, they are confident that it will be possible to adopt technique on this project. This was known to us earlier. In Austria, this has been experimented in a big way. They do not support rocks by means of steel ribs; they support them only by shotcreting. We know about this system. On this project, it was not experimented earlier, but we had some experience in other projects."

3.50. Since Government was aware of the technique, the Committee asked the reason why it was not experimented earlier on the Loktak project. The witness said.—

"The expertise for shotcreting was not available. Now we are training people. Last year, we had trained people. We hope that it will be possible to carry on this work. We imported machine and this took about a year. Shotcreting is also a means of supporting rock which is quicker than steel supporting. If the rock falls and it is not immediately supported, then there is a chance of rock fall-

ing. In this way, shotcreting is done quickly and the rock fall is avoided and the tunnel boring rate is improved."

3.51. In reply to question, the Chairman, Central Water Commission stated that Austria had developed the technique of shotcreting ten years ago and that the contractor had successfully used the technique of shotcreting in Yamuna in the year 1974. He further stated:—

* * * *

"We thought that one of the methods was shotcreting. But we thought that this may not be effective and may not be appropriate to the type of rock conditions that we had."

3.52. The Committee desired to know the reasons for revising the value of contract on 11 August, 1977 to Rs. 639.78 lakhs for 45 per cent of the total work as against the tendered value of Rs. 571.05 lakhs for the entire work. The Ministry of Energy have *inter alia* stated*:—

* * * *

"Patel Engineering Co., expressed their inability to undertake the work on faces 0 & 1 as well as faces 4 & 5 on the grounds, in the case of the former, that it was not within the scope of the contract, and in the case of the latter, that they lacked the experience and expertise of tunnelling in such adverse geological conditions with the existence of highly explosive methane gas.....

Patel Engineering Co., having agreed to continue with the tunnelling on faces 2 & 3 and 6 & 7, put forth their demands for enhanced rates coupled with various new conditions. The High Power Committee, referred to earlier, considered these fresh proposals of PEC and same to the conclusion that in view of the changed geological conditions and the presence of methane gas in the tunnel which required additional precautions by way of better ventilation, provision of steel supports, etc., the whole concept of tunnelling had undergone a change and thereby justifying an increase in the rates. The main reasons adduced

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*Not verified in Audit.

by PEC in support of increased rates were the total alteration in the scope and extent of work; that the site organisation including deployment of labour, staff, workshop, transport and other facilities, depreciation, repair charges, overheads etc., would now have to be absorbed on the relatively lower output of work; operations such as welding and gas cutting would not be possible and permissible inside the tunnel, thereby further increasing the cost; and that finally due to the poor alluvial and squeezing ground conditions tunnel progress would be very slow with conventional tunnelling methods The revised rates and conditions proposed by PEC were examined in detail by a Negotiating Committee set up in February, 1977, which, after careful examination of the proposals of PEC for additional rates and extra conditions, a study of comparable rates to the extent available on other jobs and comparison of rates indicated by another public sector undertaking, undertook negotiations with PEC and arrived at agreed rates and conditions which, in their considered judgement an opinion, were reasonable. On the basis of the negotiated rates, which were approved by the Board of Directors of NHPC (which took over the liabilities of the Government consequent on its coming into existence in 1976) the value of the residual portion of the contract settled with PEC worked out to Rs. 639.78 lakhs. A formal agreement was accordingly signed with PEC on 11th August, 1977.

It may, however, be mentioned that enhanced rates allowed to PEC were not the only reason for upward revision in the value of the contract. Actually, as worked out in the report of the High Power Committee, the additional amount due to higher rate worked out to be Rs. 77.51 lakhs. There were many factors responsible for increase in the value of the contract. The important ones can be summarised as below:—

(i) **Overbreaks:** Due to weak strata overbreaks in tunnel section were much more than anticipated. This increased the quantity of excavation as well as concrete.

(ii) **Steel supports:** Again due to poor strata the quantity of steel supports increased tremendously. Previously steel supports were expected to be required only for shear zones and for a few bad patches. But subsequently supports were necessary almost throughout and at closer spacing.

(iii) **Change from plain C.C. to R.C.C. Lining: In the original** proposal most of the tunnel lining was to be plain cement concrete, whereas in the final designs evolved for actual trata the lining was to be RC.C. for most of the reaches. Thus the quantity of steel reinforcement increased to a large extent.

(iv) **Increase in quantity of concrete:** In final designs the final lining thickness was also increased, thus increasing the quantity of concrete.

(v) **Pressure Grouting**: The quantity of this item was also increased due to poor rock conditions.

(vi) **Escalation in prices**: This was another important factor leading to increase in the value of the contract."

Recovery of Advances from the contractor

3.53. As regards the recovery of advances from the contractor, the Ministry of Energy have intimated that out of the advance of Rs. 91.01 lakhs paid during 1971-72 to 1976-77, Rs. 33.20 lakhs were outstanding at the end of August, 1978. It has also been stated that the recoveries were being made regularly in accordance with the terms of the contract and the entire amount of advance would be recovered by the time the contract was executed and completed.

Use of Timber laggings for support

3.54. According to the audit paragraph, the contractor was allowed to use timber laggings to support the rocks between the steel ribs instead of reinforced precast concrete laggings which would have resulted in saving of Rs. 3.08 lakhs to Government. The Committee desired that a note might be furnished stating the reasons why reinforced precast concrete laggings were not used as permanent supports when this would have cost less. The Ministry of Energy have furnished the requisite note which is reproduced below:—

"In a tunnel construction, various methods of supports have to be adopted depending on the rock behaviour at site. Concrete slabs were provided in the initial stages and these slabs, being rigid, were found to crack due to squeezing rock conditions met within the tunnel. Thereafter timber laggings were tried and these were found to be more suitable for the job. No doubt, the use of timber laggings is costlier than precast reinforced concrete lag-

gings, but as stated above the main considerations which weighed with the project in using timber laggings were:—

(a) the squeezing nature of the rock which resulted in cracking of the cement concrete laggings; and

(b) safety considerations of the personnel working in the tunnel to whom the cracked concrete slabs represented a source of danger."

3.55. From the facts brought to their notice, the Committee are sorry to note that the work on such a big project was started admittedly without proper geological investigations. The investigations done were sub-standard and not adequate for making a firm design. Although caution was sounded in the geological report that rock conditions for tunnelling were not likely to be ideal and tunnelling would be hazardous, no serious attention was paid to it. In the Committee's view information obtained by drilling more holes as suggested and pressure testing the drill holes, might have helped the geologist and the designer to understand better the geo-technical problems involved in the tunnelling. The net result of the lapse on the part of the project planning authorities was that not only the completion of the tunnel was delayed but also the estimated cost of the tunnel has skyrocketed to an astounding level.

3.56. It has been pointed out to the Committee by no less a person than the Chairman of the Central Water Commission himself that "the (geological) investigations that are being done not only in Loktak but in other parts of the country also are definitely sub-standard in our country", and that is why "we are getting into problems of cost over-runs and time over-runs on our projects." The other point that he made was that "the persons who were put on the (geological) investigations are those who are not wanted in the department." Agreeing with this view even the Chairman of the Central Electricity Authority informed the Committee that "the people who are posted in investigation organisations are the people who are to be punished; it is not a rewarding post." He further stated that "we are not suffering so much for faulty investigation as due to inadequacy of the investigation."

3.57. The Committee are greatly perturbed at the state of affairs disclosed as above which are confirmed by the results shown in the case of the Loktak Project. At this stage they can only deplore the inadequate geological studies made before designing the project and also due attention not being paid to the cautions struck in the geological investigation report, howsoever inadequate it was. The Committee strongly feel that due to inadequote investigations, there has been not only inordinate delay in the completion of the project but

also an eight fold increase in its cost which could have been avoided to some extent, if investigations had been properly done. They recommend that Government should ensure that proper and adequate geological investigations are made of project sites so as to give clear directions to the designers of the projects. They would also like the Ministries concerned to pay full attention to the geological investigation reports before clearing the projects. In this context they would also like to emphasise that since many of the State Governments do not have adequate expertise in project design and planning, the planning and designing of projects involving substantial expenditure from the exchequer should not be entirely left to them. For this purpose, the Centre should make available, on a more liberal basis, services of their own experts in the field.

3.58. The Committee note that the other reason responsible for the delay in completing the tunnelling work was the emergence of methane gas. Mathane gas made its first appearance in face 5 of the tunnel in December 1972. At that time no efforts were made to identify the exact nature of the gas. The seriousness of the gas was realised when two workers received burn injuries in July 1974. The precautionary measures as suggested by the Director General of Mines Safety were conveyed to the project authorities in October, 1974 and the project authorities had in the most casual and routine manner conveyed the same to the contractor. The Committee are sorry to note that before these precautions could be fully implemented, a major explosion occurred on 25 January, 1975 resulting in the death of sixteen persons. It was only after this explosion that Government set up a Committee to investigate into and ascertain the causes of the explosions. This Committee found that the officers of the firm employed for the construction work did not seem to possess adequate experience in dealing with situations such as methane gas emissions and for taking timely preventive and safety measures. The Committee regret that precautionary measures were not taken by the contractor and the project authorities when emergence of methane gas was first noticed in 1972 which resulted in the death of workers due to explosions and brought the work on the project to a grinding halt for well over two years.

3.59. The tender for tunnel and surge shaft was awarded to M/s. Patel Engineering Company Ltd., Bombay for Rs. 571.05 lakhs in preference to M/s. Hindustan Construction Company, Bombay who had quoted a higher rate. Although the Chief Engineering had pleaded that an attempt should be made to negotiate with M/s. Hindustan Construction Company, Bombay to bring down its tender cost as near as possible to that M/s. Patel Engineering Company Ltd., Bombay in view of the reputation of the former in tunnel

work, the project authorities did not negotiate with M/s. Hindustan Construction Company as in their view M/s. Patel Engineering Company Ltd. were leading tunnel contractors and were in this field for a longer period than M/s. Hindustan Construction Company. It was stated before the Committee that M/s. Patel Engineering Company Ltd. were known to be a firm of standing and considerable experience in the work of tunnelling. The Committee are constrained to note that the assessment made by the project authorities about the capability of M/s. Patel Engineering Company Ltd. in the tunnelling work did not come true. The firm declined to complete the tunnelling after explosion inside the tunnel due to emergence of methane gas in January 1975 on the plea that they had no experience in tunnelling having such extensive gaseous conditions and had no trained and qualified personnel and suitable and necessary equipment to do such work. Various reasons have been advanced to justify the stand taken by the firm but the fact remains that work between faces 4 and 5 and faces 0 and 1 is now being done departmentally and the original contract for the whole work has been modified in favour of the Contractor. According to the modified contract, the value of the contract for the completion of 45 per cent of the total work is Rs. 639.78 lakhs against the tendered value of Rs. 571.05 lakhs for the entire work. In these circumstances, the Committee have a feeling that M/s. Patel Engineering Co. Ltd. are being unduly protected by the authorities at various levels. The Committee would like the Ministry to ensure that contractual obligations cast on the firm are being strictly enforced.

3.60. The Committee are constrained to note that although the contract for the project estimate for the tunnel and surge shaft was awarded to M/s. Patel Engineering Co. Ltd. in February 1971, the formal agreement was signed with the contracting firm only in August 1977, i.e., after a lapse of 6 years. As for the full 6 years the firm was not bound down to any contractual obligation, it is not unlikely that they would have utilised this advantage in negotiating fresh terms and conditions even in the course of the execution of the project. The suspicion arises from the fact that the contractors were unwilling to render work on faces 4-5 and 0-1 and demanded higher costs for a considerably reduced size of work and that both the demands of the contractors had to be accepted by the authorities. That this situation was allowed to drift for so long is a sad commentary on the wisdom and efficiency of the authorities responsible for the execution of the project. The Committee would like the Ministry to put a stop to such practice and devise procedures making for the signing of the contract immediately on the award of work or soon thereafter.

CHAPTER—IV

ITHAI BARRAGE AND POWER CHANNEL

A. Ithai Barrage

Audit Paragraph

4.1. **Progress of work upto October, 1977:**— Civil work was almost complete. Erection of crest gates, hoist bridge, five 20-ton rope drum hoists and gantry crane is programmed for 1978-79 as 5 per cent balance material for crest gates, besides other items, was expected to be received by the end of 1977 from the suppliers.

4.2. **Construction of Ithai Barrage:**—Against a provision of Rs. 13.13 lakhs for this work in the project estimate of 1967, the notice inviting tenders indicated an amount of Rs. 20.00 lakhs.

Tender notices were sent by the Chief Engineer in August 1970 to eight leading contractors in the country. Only two tenders were received and opened on 16th November 1970, as indicated below:

*Firm 'N'	Rs. 30.62 lakhs
**Firm 'G'	Rs. 48.59 lakhs

The work was awarded in March 1971 to the lowest tendered, firm 'N' after approval by Government.

4.3. **Increase in quantity of work:**—As against the contract amount of Rs. 3.62 lakhs, the value of works executed upto August 1977 was Rs. 72.38 lakhs. This was due mainly to increase in the length of the barrage from 4 to 5 bays (each bay about 13 metres long) and alteration in the design of abutments, the bottom width having been increased from 2 metres to 14 metres. These changes resulted in the quantities of the following main items of work going up, as under:

	Tendered quantity	Executed quantity
	(In cubic metres)	
Excavation in ordinary soil	5,433	24,330
Excavation in rock	5,617	20,534
Earthwork in filling	1,453	13,660
Rainforced cement concrete	4,790	7,500
Cement concrete	1,173	3,250

Government stated (January 1978) that these quantities might

*M/s. National Projects Construction Corpn., New Delhi.
M/s. Gamman India Ltd., Bombay.

undergo upward as a result of the outlay on the project being proposed to be revised to Rs. 76.31 crores.

4.4. **Non- recovery of the cost of demolition of coffer dam:**— A coffer dam was constructed by the contractor during 1973 to facilitate construction of the barrage. This was to be demolished before the monsoon of 1974 (when the civil work was almost complete) to allow free and unobstructed flow of water in the river. However, the contractor did not demolish the coffer dam though required in terms of the contract and despite requests. The Engineer-in-charge got the coffer dam demolished at a cost of Rs. 1.79 lakhs through other contractors in May-June 1974 and May 1975. The cost of demolition (Rs. 1.79 lakhs) was to be recovered from the contractor's running account bills. The project authorities stated (December 1976) that the recovery would be effected but no recovery had been made (December 1977).

[Paragraph 11 (3.0 and 5.0-5.2) of the Adavance Report of the Comptroller and Auditor General of India for the year 1976-77, Union Government (Civil)]

4.5 The Ministry of Energy have furnished the following note stating the progress made upto 30 June, 1978 in regard to completion of Ithai Barrage:

"99 per cent of the civil works are completed. All the components for crest gates and guatry crane have been received. 90 per cent materials for 20 tonne Rope Drum Hoist have been received. 75 per cent of design and fabrication of hoist bridge has been completed and the delivery of material at site is awaited.

Erection work for all the above mentioned Hydro Mechanical Equipments will be taken up in next working season starting from September/October, 1978. The work is scheduled for completion by June, 1980."

4.6. According to the audit paragraph, provision in the project estimate for Ithai barrage was Rs. 13.13 lakhs, the amount indicated in tender notice was Rs. 20 lakhs, the lowest tender accepted was for Rs. 30.62 lakhs, and expenditure incurred upto August, 1977 was Rs. 72.38 lakhs. The Committee desired to know the reason for these wide variations. In reply, the Ministry of Energy have stated:—

"The provision in the project estimate for Ithai barrage was based upon the details of works as envisaged in 1967 when the project estimate was approved, and based upon pre-

liminary designs. Notices inviting tenders were issued in August, 1970 by which time tender drawings were prepared by Central Water and Power Commission. Based on such tender drawings and the detailed specifications contained therein, both the quantities, items and the rates as were estimated at that time had undergone a change. The reasons for the variations were thus due to:—

(i) change in the design of the structures whereby quantities and items were increased; and

(ii) increase in cost of construction materials like cement, Steel, P.O.L. as well as labour costs.

A study of the cost of living index and the market prices in Manipur area revealed that the rise in the cost of living index and prices of commodities in the period between 1966 and 1970 was nearly double, as for example, the approved wages per day for unskilled labour rose from Rs. 2.50 in 1966 to Rs. 4.50 by the time the project was set up. Further more, the local Public Works Department in Manipur had authorised an increase in rates from anything between 50 per cent to 70 per cent over the 1966 approved schedules on which the project estimate was based. Thus, the variation between the provision in the original estimate of 1967 and the tender estimate of 1970 was accounted for both by increase in quantities as well as escalation in cost.

As regards the variation between the tender estimate of Rs. 20.00 lakhs and the lowest tender accepted at Rs. 30.62 lakhs, it may be mentioned that while the tender estimate given in the NIT is a reference datum line, nothing prevents the tenderers from quoting according to their own assessment of their own costs, overheads, methods employed for construction, etc. The variations in assessment can be expected to be large in the case of remote areas where works of such magnitude have not been taken up before. The very fact that while firm 'N' quoted Rs. 30.00 lakhs, firm 'G' quoted Rs. 48.59 lakhs would indicate the large variations that are possible while different contractors of almost equal experience could quote against the same base line of Rs. 20.00 lakhs.

Expenditure incurred upto August, 1977 was Rs. 72.38 lakhs. The reasons for the expenditure having exceeded the ac-

cepted contract amount again were due to increase in quantities when detailed designs were prepared, the major items being increase in the length of the barrage from 4 to 5 bays each bay measuring about 30 metres in length; alteration in the design of abutments, the bottom width having been increased from 2 to 4 metres, increase in cost of construction materials and labour which are available as escalation in terms of the contract."

4.7. The Ministry of Energy have informed the Committee that the latest estimate of the cost of barrage as per the 2nd revised project estimate was Rs. 149.11 lakhs. The approval of Government for it was awaited. The Committee enquired the reason for further increase in the cost of barrage. The Chairman, Central Electricity Authority, stated during evidence:—

"Coming to Ithai Barrage, at the time of preparation of the original project, we have visualised four bays to give a discharge of 20,000 cu. secs. Later on the Manipur Government wanted to reclaim more land because during the monsoon period the lake level goes up. They wanted to increase the capacity of discharge and reclaim land. Unfortunately we have a very big hump down stream the river and unless the level of the lake goes up very high, the discharge capacity of the river is very much limited. In fact, it is the main reason why we have a big lake there. We had to remove that hump. The Manipur Government have made out a plan for reclamation of land and they wanted the discharge capacity of the river to be increased so that they can reclaim 30 to 40 thousand acres of land, during the monsoon period. Instead of 4 bays, the area of the regulator was increased to 5 bays. It resulted in an increase in the earth-work from 5,436 cu. metres to 24,000 cu. metres because the cides had also to be cut, on escavation in the rock, from 6,000 to 20,000 cu. metres, reinforced concrete from 4,700 to 7,500 cu. metres."

4.8. In reply to a question, the witness stated:

"We did not visualise that the labour had to be imported, practically hundred per cent."

4.9. The Committee desired to know why the need leading to changes in designs during execution could not be foreseen. The

Ministry of Energy have stated:—

"The need for changes in designs actually arose only as problems were confronted during execution. The original project estimate was based on preliminary drawings and the than expected soil and site conditions. It was only as a result of detailed investigations during pre-construction and construction period that changes in the designs to suit such soil and site conditions arose. Furthermore, the proposal for removal of sugnu hump and widening of Manipur river downstream of the barrage emerged during the construction period. Keeping in view these changes, the barrage had to be designed appropriately and accordingly the width of the barrage was increased from 4 to 5 bays."

4.10. As regards the recovery of Rs. 1.79 lakhs from the contractor on account if demolition of the coffer dam done through other contractors, the Ministry of Energy have stated:—

"The recovery of Rs. 1.79 lakhs representing cost of demolition which was to be recovered from the contractor has in fact been recovered from his 26th running account bill in March 1978 together with departmental charges amounting to Rs. 21,043.00"

B. Power Channel

Audit Paragraph

4.11. *Progress of work upto October, 1977.*—Of the total length of 2,300 metres of open channel, work in 1,790 metres was complete. However, rectification work was yet to be done in a length of 260 metres (out of 1,790 metres) where there were distortions due to heaving up of bed and sloughing of banks. Of the balance (out of 2,300 metres), excavation in 450 metres was partly done. In the remaining portion of 60 metres, the work was complete to the extent of 50 per cent. Of the total length of 1,253 metres of cut and cover conduit, 67 metres were complete. Remaining work was in progress.

4.12. *Award of contract.*—Tender notices were sent by the Chief Engineer to eight leading contractors in the country in September 1970. The provision for this work in the project estimate of 1967 was Rs. 124 lakhs but the estimated cost indicated in the notice inviting tenders was Rs. 240 lakhs. Three tenders were received (November 1970) one of which was very high and was not consi-

dered for comparative evaluation. The other two offers were as indicated below:—

*Firm 'H'	Rs. 529.60 lakhs.
**Firm 'N'	Rs. 632.19 lakhs.

After evaluting the special conditions stipulated by the two firms, the comparative position as assessed by the tender sub-committee appointed by the tender committee was as under:

*Firm 'H'	Rs. 610.76 lakhs.
**Firm 'N'	Rs. 632.19 lakhs.

4.13. The tender sub-committee recommended (February, 1971) the award of the work to 'H', the lower tendered. However, the firm had indicated in its tender that it would accept work on the power channel only if it was also awarded the work on the tunnel and surge shaft. Since it was not awarded the latter work and since it had declined (March 1971) to take up the work on power channel only, the tender committee recommended the allotment of the work of power channel to firm 'N' which had agreed to take it up for Rs. 600.57 lakhs. The work was accordingly allotted to 'N' with the approval of Government.

4.14. The original estimate of Rs. 124 lakhs, based on the local schedule of rates of 1966, was revised keeping in view the tender value of the work awarded to the contractor, to Rs. 622.58 lakhs in November 1972 and approved by Government in June, 1974. Further revision of the estimate to Rs. 1,150.25 lakhs in November 1976 was due mainly to, basides escalation in cost of labour and material, the following:—

(a) Changes in design and provision of extra items (Rs. 375.55 lakhs)—The bed level of the power channel as designed originally was at R.L. 763.524 metres with width of 6 metres and side slopes of 1:1.5. However, because of extremely sloughing nature of the soil, the bed level had to be kept at R.L. 765.048 metres and to get the necessary discharge of water the bed width had to be increased to 18 metres and the side slopes flattened to 1:3. Lining of the bed with cement concrete blocks of size 2516 mmx2515mmx750 mm, against 75 mm thick precast slabs provided originally, was considered

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* M/s. Hindustan Construction Co., Bombay.

** M/s. National Projects Construction corporation, New Delhi.

necessary to check the upheaval action observed in the bed. Where even this could not check the upheaval action completely, blocks of thickness 1,750 mm had to be laid. This increased the cement concrete quantity from 680 to 8,800 cubic metres (increase in cost Rs. 24.36 lakhs). Further, in view of the soil conditions met in actual execution, the provision of open channel beyond the first 2,300 metres had (1973) to be substituted by a reinforced cement concrete cut and cover conduit (1,253 metres long). A bridge (cost Rs. 22.97 lakhs) also had to be provided on the Imphal—Tiddim road. These changes and the extra items increased the cost by about Rs. 375.55 lakhs. All the extra items of work including the bridge and cut and cover conduit were got done by the same contractor, namely, firm 'N'.

(b) *Pitching of dry boulders on the side slopes of the channel.*—The estimated quantity of pitching boulders in the approved first revised estimate was 2,190 cubic metres. The quantity provided in the second revised estimate was 29,036 cubic metres. This increase was due to the sloughing nature of the soil on account of which the slopes had to be flattened. This in turn increased the length of the slope from 7 to 32 metres and more pitching had to be provided, the area being more. As a result, there was increase in the cost by Rs. 29.53 lakhs.

Government stated (January 1978) that the revised cost of the power channel as per the latest proposed revision of project estimate was Rs. 1,479.92 lakhs.

4.15. Rupees 679.37 lakhs were paid upto October, 1977 to the contractor against the contract value of Rs. 600.57 lakhs. Out of Rs. 679.37 lakhs, Rs 185.83 lakhs were paid provisionally for extra items of work at rates claimed by the contractor pending final decision.

4.16. Price escalation.—The work is expected (December 1977) to be completed by March 1980 as against the stipulated date of 30th June 1973. As per price escalation clause of the agreement, the contractor was paid till October 1977 Rs. 59.88 lakhs to meet the increase in the cost of labour. A further sum of Rs. 12.72 lakhs was paid on account of increase in the cost of petrol, lubricants, etc. (These two sums are included in the total payment made referred to in the above paragraphs).

4.17. *Extra expenditure*:—It had been stipulated in the original project estimate of 1967 that the side slope of the power channel as provided in the design should be checked for stability after obtaining clear test data of soil samples. However, soil testing was done by the Central Soil and Material Research Station, New Delhi in April-May 1973 long after the first sliding of soil, which occurred in April 1972. On the basis of this soil testing report, the side slope was flattened to 1:3. Thus, the designs had to be changed during execution and extra expenditure had to be incurred, as detailed below:

(i) Excavation of the power channel was started as per original design and the excavated earth was deposited on the banks in the form of roads. After sloughing of earth from the side slopes was noticed, as stated earlier, the bed level, the bed width and the side slopes had to be modified. As a result, 2.31 lakh cubic metres of sloughing earth had to be removed at a cost of Rs. 39.51 lakhs, the rate adopted for the purpose being Rs. 17.10 per cubic metre.

(ii) In addition to above, extra earthwork (0.57 lakh cubic metres approximately) for the removal of spoil banks constructed on both sides of the channel at the time of excavation of the channel as per original design had to be done, due to modifications in the bed width and the side slopes. This way likely to involve extra explenditure of Rs. 9.74 lakhs. Government stated (January 1978) that no payment had been made to the contractor and that the matter was under consideration.

[Paragraph 11 (3.0 and 6.0—6.5) of the Advance Report of the Comptroller and Auditor General of India for the year 1976-77, Union Government (Civil)].

4.18. At the instance of the Committee, the Ministry of Energy have furnished the following note stating the progress made in regard to completion of the power channel upto 30 June, 1978:

"The open channel section has been completed except the intake at the lake. However, the distortions due to heaving up of bed and slunghing of banks to the extent of 610 m (260+350 m) is still to be rectified.

Of the total 1223 m of cut and cover section, 567 m. has been completed in every respect. Remaining work is in progress. A serious bottleneck in the progress of this work was the non-availability of Sheet Piles. The Corporation was earlier advised to import the material, but recently an

indigenous plant has offered to role the same to meet requirement. Subject to the availability of sheet piles, the work is expected to be completed before March, 1980.

(a) For the purpose of construction, the entire tunnel length has been divided into four reaches, namely:—

(1) Reach between face 'Q' and 1 (*i.e.* between open channel and gate shaft)—692 metres long.

(2) Reach between face 2 and 3 (*i.e.* between gate shaft and construction shaft)—720 metres long.

(3) Reach between face 4 and 5 (*i.e.* between construction shaft and construction Adit)—3848.75 metres long, and

(4) Reach between face 6 and 7 (*i.e.* between construction Adit and Surge shaft)—1244.23 metres long."

4.19. The Committee enquired why the work of construction of the power channel was awarded for Rs. 600.57 lakhs when the amount indicated in the tender notice was Rs. 240 lakhs. In reply, the Ministry of Energy have furnished the following Note:—

"As against the amount indicated in the tender notice of Rs. 240.00 lakhs, the tenders received from two firms who were considered for comparative evaluation after evaluating the special conditions stipulated by them were found to be respectively Rs. 610.76 and Rs. 632.19 lakhs. Both these offers were within a comparable range and were indicative of the fact that the broader assumptions on which both the firms had tendered were not very divergent. The wide variation between the tender estimate of Rs. 240.00 lakhs and the tendered rate in the neighbourhood of Rs. 600.00 lakhs by the contractors can be attributed to the reason that the estimate was based upon locally prevalent schedule of rates generally for small works using local labour whereas for works of this magnitude labour in a large number had to be recruited and transported from elsewhere. Secondly, the work involved the use of heavy machinery involving substantial investment on earthmoving equipment which it would appear was not taken into account while framing the departmental estimates. Thus, the scope of the work as envisaged by the departmental estimates was widely divergent from that on which the tenderers estimated their costs. It may be mentioned that the Tender Committee was at the level of Chairman, Central Water & Power Commission assisted by Members of the Central Water & Power Commission, representatives of

the Ministry of Finance and assisted by Directors incharge of designs, cost of rates and other disciplines and it was after full consideration by this high powered body that the tenders were finalised."

4.20. The Committee were informed that the latest revised cost of the power channel as per second revised estimate was Rs. 1482.13 lakhs. Explaining the reason for the increase in the estimate from 600.57 lakhs to Rs. 1482.13 lakhs, the Chairman, Central Electricity Authority, stated during evidence:—

"The length of the channel remains same. It was about 4 Km. but because of the sloughing conditions in the channel it was considered necessary to revise the design of the structure and we have gone in for cut and cover portion in 1.2 km length of the channel which is roughly 2½ times costlier than that of the open channel. This has to be done because of the very bad conditions which are very sloughing in nature."

4.21. The Committee enquired why the sloughing nature of soil was not anticipated in the beginning when the first estimate was prepared. The witness stated:—

"We cannot change the geological features of the project. If there are adequate investigations, it will give sufficient advance notice to us. But as far as the design is concerned, we have to design the structure according to the local conditions."

4.22. In reply to a question, the Chairman, Central Water Commission, stated:—

"I would like to submit that on the earth slopes in the excavations there is a lot of uncertainties. Yesterday I submitted that we did conduct institute tests and also sample tests on the earth that was existing in the approach tunnel area. The difficulties are that the parametres go on changing depending on the moisture content and various other factors."

* * * * *

"In spite of our tests, it is very difficult in the tunnels or in the earth slopes to determine the actual factor of safety. So we go by trial and error processes."

4.23. In a written note furnished to the Committee the Ministry of Energy have stated:—

"While the geological report on which the project was based did mention chances of sliding at some places, it did not envisage the sloughing nature of the soil to the extent that subsequently was encountered. Even the side slopes which were previously envisaged as 1 : 1.5 had to be flattened to 1 : 3 or even more at some places."

4.24. According to the original project estimate of 1967, the side slopes of the power channel as provided in the design were to be checked for stability after obtaining clear test data of soil samples. However, the soil testing was done by the Central Soil and Material Research Station, New Delhi in April-May, 1973 long after the first sliding of soil which occurred in April, 1972. The Committee enquired the reasons for the delay in soil testing. The Ministry of Energy have stated:

"Pursuant to the stipulation in the original estimate of 1967 that the side slopes of the power channel as provided in the design should be checked for stability after obtaining test data of soil samples, such test data was actually obtained as far back as in April, 1968. On the basis of test results of laboratory samples and the cores taken from drill holes near intake, the power channel was designed with bed width of 6 metres and side slopes of 1 : 1.5. Subsequently, soil samples were taken in August 1970 also. After the major slide in April 1972, samples were collected and soil testing done. Samples were again tested in 1973 and again in 1976. However, the type of soil met with at Loktak is highly heterogenous and varies all along the depth. The type of soil is generally silty sand, silty clay, humus clay, stiff brown clay etc. found within a depth of 10 metres. In some reaches even artesian conditions are observed. Under such conditions the stable slopes are usually established by observational and testing procedure and hence in some reaches the side slopes had to be flattened to 1 : 5. It would be noted from the above that the soil testing was a continuous process undertaken at frequent intervals right from 1968 onwards and the report of the Central Soil and Materials Research Station, New Delhi obtained in April 1973 was only one of such reports as a result of soil testing undertaken in the series. It is, therefore, submitted that there were no delays in soil

testing which, as stated above, was being continuously done throughout the execution of this item of work."

4.25. The Committee desired to know the amount paid to the contractor for doing the extra earthwork (0.57 lakhs cubic meters approximately) for the removal of spoil banks constructed on both sides of the power channel at the time of excavation of the channel.

The Ministry of Energy have stated:

"The claim preferred by the contractor for doing the extra earth work for removal of the spoil banks constructed on both sides of the channel which was under construction for sometime past, on final examination has been found to be untenable. As such, the contractor has been finally informed on the 19th August, 1978 that their claim stands rejected. No payment has been made to the contractor for this item of work nor is proposed to be made."

4.26. The Committee regret to note that the project estimates for Ithai barrage and power channel were not prepared realistically. For Ithai barrage, the project estimate was Rs. 13.13 lakhs, the amount indicated in tender notice was Rs. 20 lakhs and the lowest tender of M/s. National Projects Construction Corporation accepted was Rs. 30.62 lakhs. The expenditure incurred upto August, 1977 was Rs. 72.38 lakhs and as per second revised project estimate it would be Rs. 149.11 lakhs. Similarly, for the power channel the provision in the original project estimate was Rs. 124 lakhs, the amount mentioned in the tender notice was Rs. 240 lakhs and the work was awarded to M/s. National Projects Construction Corporation for Rs. 600.57 lakhs. The latest revised cost of the power channel as per second revised estimate was Rs. 1482.13 lakhs. The reasons for the variations between the estimates and the actual expenditure incurred for the construction of Ithai barrage were stated to be inter alia the change in the design of the structures necessitated by the desire of the Manipur Government to reclaim more land and consequent increase in quantities and items of work, increase in the cost of construction materials like cement, steel, P.O.L. and increase in labour costs. The change in the design was affected when the construction work was in progress. The main reason for the increase in the cost of power channel was attributed to the sloughing conditions of the soil which resulted in the revision of the channel design. Besides the change in designs, other factors namely increase in the cost of construction materials like steel, cement etc. were stated to be responsible for the increase in cost of construction.

4.27. The Committee find it difficult to appreciate the cost escalation from Rs. 13.13 lakhs to Rs. 149.11 lakhs in the case of Ithai barrage project and from Rs. 124 lakhs to Rs. 1482.13 lakhs for the power channel. Despite the various reasons and explanations offered for this phenominal increase, the Committee consider that much of the escalation was due to project planning being seriously faulty and without perspective.

CHAPTER V

PENSTOCKS

Audit Paragraph

5.1. *Fabrication and erection of penstocks.*—Tender notices for this work were sent by the Chief Engineer in August 1970 to six leading contractors in the country. Against a provision of Rs. 118.13 lakhs (inclusive of cost of steel) for two penstocks in the sanctioned project estimate of 1967, the tender enquiry indicated an amount of Rs. 103.00 lakhs for fabrication of three penstocks excluding cost of steel (estimated at Rs. 129.60 lakhs).

Out of 6 firms to whom tender notices were sent, two quoted as below:

*Firm 'I'	..	Rs. 99.23 lakhs
**Firm 'B'	..	Rs. 115.49 lakhs

A late quotation from a public sector undertaking was returned to the firm unopened.

Both the firms had stipulated a number of conditions having financial implications and the two tenders were evaluated as indicated below:

Firm 'I'	..	Rs. 110.86 lakhs (Rs. 2,346 per tonne)
Firm 'B'	..	Rs. 119.07 lakhs (Rs. 2,483 per tonne)

It was seen that the tender notice did not contain information on the following two important matters as a result of which the tenderers made their own different stipulations:—

(i) Although an item rate tender, the notice did not indicate the estimated quantities against each of the six items mentioned in the tender as a result of which the tenderers calculated the quantities from the drawings supplied.

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*M/s. Indian Humo Pipe Co., Bombay.

**M/s. Giavanda Bimmey & Co., Cochin.

(ii) The width of the plates to be supplied by the project authorities had not been indicated as a result of which the tenderers made their own estimates of the number of circumferential joints in the penstocks.

After getting necessary clarifications, the tender Committee recommended award of the work to firm 'I' for Rs. 109.85 lakhs. This recommendation was accepted by Government and the work was awarded to 'I' in March 1971.

5.2. The work was due to be completed in 27 months to be reckoned from the date of first receipt of steel or approval of drawings by Government or the date of handing over site, whichever was later. The work was commenced in June 1973 and had not been completed (October 1977).

5.3. As stated earlier, out of 4,800 tonnes, 4,592 tonnes had been fabricated and brought to site and 2,335 tonnes had been erected (October 1977). The work was behind schedule because the civil works had not been completed due to unstable nature of the strata encountered. Against the contract value of Rs. 109.85 lakhs, Rs. 114.59 lakhs had been paid upto October 1977.

5.4. *Anchor blocks.*—Against a provision of Rs. 25.88 lakhs in the sanctioned project estimate of 1967 for the anchor blocks required for the erection of penstocks, the notice inviting tenders issued by Chief Engineer in July 1972 indicated an estimated cost of Rs. 41.40 lakhs. The work was awarded to 'N' (a public sector undertaking) at its tendered amount of Rs. 40.46 lakhs for completion by April 1975. The payment made to the contractor upto September 1977 amounted to Rs. 159.32 lakhs, the increase being due mainly to increase in the quantity of earthwork from 1,72,800 to 6,23,730 cubic metres. The increase was due to (i) change of alignment at the suggestion of the resident geologist to get rock profile for the foundations of anchor blocks; and (ii) sliding of hill because of unstable strata. There was also increase in the quantity of reinforced cement concrete from 9,500 to 20,245 cubic metres as the foundations of the anchor blocks had to be lowered by 1 to 2 metres to get to the rock foundations. As a result, the estimated cost went up by Rs. 145.89 lakhs. Extension of time upto June 1978 was given (May 1977) to the contractor to complete the work.

[Paragraph 11 (8.0—8.4) of the Advance Report of the Comptroller and Auditor General of India for the year 1976-77, Union Government (Civil)].

5.5. The Committee referred to the omission of information in the tender notice on two important matters namely estimated quantities and width of the plates to be supplied by the project authorities and enquired why the requisite information was not given in the tender notice. The Ministry of Energy have sent the following note* explaining the position:—

"The tenders were floated based on the tender drawings which gave details of the structure and its detailed specifications to enable the tenderers to make proper assessment and offer their tenders. The tender drawings and the detailed specifications contained in the NIT were considered to be adequate enough to facilitate the contracting firms to offer their tenders. The notice inviting tenders gave details of items of work involved and also total estimated value. The tenderers who offered their tenders made assessment based on drawings and specifications included in the N.I.T. and quoted their rates for various items."

* * * *

"As regards the width of plates the normal range of plates ordered for Penstocks is between 2 m. to 2.5 m. It was not considered necessary to specify the width of plates in tender specifications. Though the width of plates affects the number of circumferential joints, it can be seen that even with the reduced number of joints adopted by tenderer 'G' this did not affect the evaluation of tenders and the tender of 'G' being higher was rejected."

5.6. Explaining the variation between the project estimate and estimated cost in the tender notice, the Ministry of Energy have stated:—

"The variation between the Project estimate and estimated cost in the tender notice was due to their tender designs made before calling for tenders based on their surveys done during pre-construction stage. The work was tendered on the basis of approved tender designs. The tender for the civil works and the tender for fabrication and erection of penstocks was awarded in 1971. The Resident Geologist works. The change in alignment of the penstocks between anchor 8 and 11 was done in consultation with the Geologist. The change in alignment in this reach did not was continuously consulted during the construction of the

*Not vetted in Audit.

result in abandoning any work. The hill slide between anchor 11 and 12 occurred in 1975 and 4 & 5 and 5 & 6 in 1974 respectively.

It is expected to be completed by March, 1981 and the latest estimated cost for the complete work of penstocks, i.e., civil works and fabrication and erection of penstocks is Rs. 636.76 lakhs."

5.7. The reasons for the increase in the estimated cost have been indicated by the Ministry of Energy as follows*:—

"The reasons for increase in cost are due to escalation and increase in quantities of work. Reasons of increase due to quantities of work are given below:—

(a) Due to unstable strata met within certain reaches of the penstock, the civil works of that penstock required special measures to control the movements. Further, between anchor blocks 9 and 10, the alignment had to be shifted in order to obtain better foundation for that anchor blocks requiring additional excavation; and

(b) Due to the delay in the completion of Face 7 of the tunnel near its outlet, the Y pieces cannot be completed until this face is completed."

5.8. Asked to state why the unstable strata could not be known in investigations before taking up the work of ereqtion of penstocks. The Ministry of Energy have replied:—

"The report of geological investigation on which the project was formulated did not give any indication of unstable strata in the region of the penstock alignment. It was only subsequently when the work was in progress that unstable strata was noticed in certain reaches of the penstock."

5.9. The Committee are unhappy to note that the work of fabrication and erection of penstocks scheduled to be completed by 1974 is still in progress. According to the present position of the work, it is expected to be completed by 31 March, 1981. The delay in completion of work is attributed firstly to unstable strata met within certain reaches of the penstock and secondly to the delay in the completion of Face 7 of the tunnel near its outlet. These two factors not only delayed the completion of work but also led to increase in the quantities of work and consequent cost escalation.

*Not vetted in Audit.

The Ministry of Energy have admitted that the report of geological investigation on which the project was formulated did not give any indication of unstable strata in the region of the penstock alignment. It was only subsequently when the work was in progress that unstable strata was noticed in certain reaches of the penstock. The Committee regret to observe yet another case of faulty geological investigation resulting in delay in the execution of work and increase in the cost of work from Rs. 109.85 lakhs to Rs. 636.76 lakhs i.e. about 600 per cent more than the initial estimated cost. The Committee consider the delay of more than 6 years in completion of this work as unjustifiably long and hope every effort will be made to complete the work well before the target date now fixed i.e. 31st March, 1981.

CHAPTER VI

POWER HOUSE

Audit Paragraph

6.1. *Construction of power house*: Tender notices for this work were sent by the Chief Engineer in August 1970 to eight leading contractors in the country. The provision for this work in the sanctioned project estimate of 1967 was Rs. 31.50 lakhs but the notice inviting tenders indicated an estimated cost of Rs. 40 lakhs. There was only one tenderer 'G' whose tendered cost was Rs. 77.07 lakhs, which after evaluation of the special conditions of the tender worked out to Rs. 79.89 lakhs. The work was, however, not awarded to the tenderer as the tendered cost was considered high by the tender committee. Fresh tenders were, therefore, invited in March 1972. A public undertaking 'N', being the lone tenderer, was awarded the work at the tendered amount of Rs. 84.75 lakhs as against Rs. 79.89 lakhs, being the value of the tender of 'G'.

6.2. The estimate was revised to Rs. 86.45 lakhs in the first revised estimate (1974) and to Rs. 208.71 lakhs in the second revised estimate (November 1976). The increase in the cost was attributed to the following:—

(i) increase in the quantities of major items (Rs. 67.85 lakhs); these were as under:

	First revised estimate	Second revised estimate
Earth-work (in cubic metres)	5,280	28,519
Excavation in rock (in cubic metres)	47,520	80,000
Steel reinforcement (in tonnes)	315	960
Drilling holes upto 50 .mm dia in rock and concrete for grouting of machine foundations (in metres)	240	24,000
Reinforced cement contracts (in cubic metres) . .	1,530	6,820

(ii) Provision for extra items (Rs. 1.57 lakhs); and

(iii) escalation in cost of material and labour (Rs. 48.45 lakhs).

The contractor had been paid Rs. 202.86 lakhs upto August, 1977 including Rs. 28.07 lakhs referred to below. The work was to be

completed in April 1975 but had not been completed (August 1977). The contractor has been given extension of time upto June 1978. The delay in completion of work was stated (March 1977) by the project authorities to be due mainly to:

(a) substantial increase in the quantities of work;

(b) delay in supplying drawings by the project authorities; and

(c) delay in handling over site.

6.3. Test check conducted in February 1977 revealed the following:

(i) The first revised estimate provided for 180 cubic metres of reinforced cement concrete at Rs. 575 per cubic metre for the service bay of the power house. The quantity provided for in the second revised estimate was 3,220 cubic metres. The reason for the increase in the quantity was stated to be that the rock at R.L. 463.45 metres in the service bay collapsed suddenly when excavation was going on in the machine bay at R.L. 450 metres because of unstable strata. The whole area covered by the service bay had consequently to be filled with concrete, involving extra cost of Rs. 15.87 lakhs.

(ii) A sum of Rs. 28.07 lakhs being the cost of extra items not provided in the agreement and also not sanctioned (October 1977) by the competent authority had been paid to the contractor upto the end of December 1976.

[Paragraph 11 (9.0—9.3) of the Advance Report of the Comptroller and Auditor General of India for the year 1976-77, Union Government (Civil)]

6.4. According to the audit paragraph, the work of construction of power house was not awarded to M/s. Gammon India Ltd., Bombay as the tendered cost quoted by this firm was considered high. The same work was later on awarded to M/s. National Projects Construction Corporation, New Delhi which had quoted higher cost than the former firm. The Committee enquired how the tendered cost of M/s. National Projects Construction Corporation was considered reasonable. The Ministry of Energy have stated:—

"The Tender Committee recommended for rejection of the tender of 'G' (M/s. Gammon India Ltd.) in their meeting held on 9-3-1971 as its tender cost was Rs. 79.88 lakhs against tender estimated cost of Rs. 40.0 lakhs *i.e.*, about 100 per cent higher and the firm did not agree to reduce

the tender price. The recommendation of the Tender Committee for rejection of tender of 'G' and inviting of fresh tenders was accepted by the Control Board at its first meeting held on 17-3-1971.

Fresh tenders were invited in December, 1971. The delay in inviting fresh tenders was due to re-estimation of the quantities and the tender cost, based on revised tender specifications and drawings supplied by the C.W.&P.C. Accordingly, the original estimated tender cost of Rs. 40.00 lakhs had to be modified to Rs. 66.00 lakhs.

The tender intimations were sent to six firms. Of them, only two firms purchased the tender papers. However, only firm 'N' (M/s. N.P.C.C.) offered the tender at Rs. 91.42 lakhs. Although costwise the tender of 'N' was higher than that of 'G' but as compared to the tender estimate, the tender of 'N' was about 40 per cent higher than the revised estimated cost against 100 per cent higher tender price quoted by 'G' about a year ago. Moreover, due to revision of tender specifications, there was a change in the scope of work, as for example, against the reinforced concrete super structure contemplated in the earlier tender, the fresh tender envisaged steel super structures. Notwithstanding this, the Tender Committee would have rejected the tender of 'N' and would have recommended for inviting fresh quotation. However, in view of the record of poor response to tenders in this area and the fact that the 'N' is a public sector undertaking, the Tender Committee held negotiations with 'N' in a series of meetings. As a result of these negotiations, 'N' reduced rates of some of the items thereby reducing their tender price from Rs. 91.42 lakhs to Rs. 84.75 lakhs which was recommended by the Tender Committee and accepted by the Control Board."

6.5. The increase in cost was attributed *inter-alia* on account of increase in the quantities of major items and provision of extra items. The Committee desired to have a note on the extra items which were taken up during the construction of the power house. The note furnished by the Ministry of Energy is as follows:—

"Quantities mentioned in the contract were based on tender drawings prepared before calling for tenders.———Extra items were necessitated by unforeseen site conditions and developments subsequent to award of contract. The major extra item refers to type of strata met with in

excavation. The contract provides for escalation clause. The extra amount paid on this account upto 7/78 is Rs. 28,10,593. Extra quantities were mainly due to extra quantities placed under the service bay to take into account the backfill for the slided rock mass and also the differences between their tender drawings and detailed construction design prepared after receipt of drawings from manufacturers of equipment. Latest estimate for the Power House is Rs. 370.14 lakhs."

6.6. Referring to the statement of the Ministry that extra items were necessitated by unforeseen site conditions, the Committee asked why the site conditions were not known in investigation before taking up the work. The Ministry of Energy have stated:—

"The original geological report, on which the project report was based, did not contain any prediction of the type of strata that was actually met with at the site during the course of the excavation. As explained above, the actual conditions encountered at the site came to surface only as a result of excavation on the site."

6.7. As regards the completion of the work, the Ministry of Energy have stated*:—

"Various components of the Power House, namely Transformer Deck, Cable Gallery and Switchyard Structure, are expected to be completed by December, 1978. Small miscellaneous finishing works, may, however, continue for a year thereafter."

6.8. One of the reasons for the delay in completion of work was stated to be the delay by the project authorities in supplying drawings. The Committee enquired the reasons for the delay. The Ministry of Energy have stated*:—

"The drawings were supplied by the Project authorities to the contractor from time to time as received from the consultants. The delays were due to changes in the designs necessitated by site conditions as revealed from time to time. The detailed civil construction drawings and loadings etc. are made available by the various equipment suppliers."

6.9. The Committee asked why Rs. 28.07 lakhs, being the cost of extra items, not provided for in the agreement, was paid to the

*Not vetted in Audit.

contractor without being sanctioned by the competent authority. The Ministry of Energy have replied:—

> "The payments made on a provisional basis have since been regularised by issue of sanction by competent authority. The extra items could not be foreseen for inclusion in the agreement as they arose out of the design and other changes subsequent to the award of the contract."

6.10. The Committee find it interesting that the tender of M/s. Gammon India Ltd. was rejected by the tender committee on the plea that its tendered cost was Rs. 79.88 lakhs against the estimated cost of Rs. 40 lakhs whereas the same work was later on awarded to M/s. National Projects Construction Corporation—a public sector undertaking—at the tendered amount of Rs. 84.75 lakhs.

The Committee note that the cost of construction of the power house was originally estimated at Rs. 40 lakhs, the work was awarded at the tendered amount of Rs. 84.75 lakhs, while the latest estimated cost of the work is Rs. 370.14 lakhs. The variation between the cost as originally estimated and the latest estimated cost works out to more than 900 per cent. Whatever be the explanation, the Committee regard it as amazingly ridiculous and hardly doing any credit to the officers and personnel engaged in the estimating work for the project.

6.11. The Committee have in this report pointed out various lopses, irregularities, omissions and inactions which are, in the opinion of the Committee, directly responsible for the delayed execution of the Loktak Project and an eight-fold increase in its cost. Apart from the various suggestions for action made elsewhere in the report, the Committee recommend that a high level enquiry Committee may be appointed to go into various lapses etc. pointed out in this report as also in the Audit Paragraph with a view to fix responsibility therefor and, in the light of its finding, lay down guidelines for the execution of Projects in future.

NEW DELHI;
April 19, 1979.
Chaitra 29, 1901 (*S*).

P. V. NARASIMHA RAO,
Chairman,
Public Accounts Committee.

APPENDIX I

(*Vide* Para 2.12 of the Report)

Detailed Note on reasons for increase in the Estimated Cost of the Project at Different Stages of Revision

1.	Original Estimate Stage I (1970)	Rs. 10·90 crores
2.	Ist Revised Estimate Stages I & II (sanctioned 1974). .	Rs. 32·94 crores
	Increase over Original Estimate . .	Rs. 22·04 crores
3.	2nd Revised Estimate Stages I & II 1977 (Techno-economic clearance given by C.E.A. in May , 1978)	Rs. 80·63 crores
	Increase over Ist Revised Estimate . . .	Rs. 47·59 crores

Reasons for increase in the estimated costs under different heads of accounts are explained below:—

A. *Preliminary*

Original estimate (1970) . . .	Rs. 10·00 lakhs
1974 S.E.. .	Rs. 20·50 lakhs
Increase	Rs. 10·50 lakhs
1977 R.E.	Rs. 36·00 lakhs
Increase over 1974 S.E. . . .	Rs. 15·50 lakhs

2. The increase in 1975 S.E. was primarily due to adoption of figures of actual payment made by Manipur Government for surveys as also for further work envisaged as against the lump sum provision made in the original estimate.

3. The increase in 1977 R.E. over 1974 S.E. is due to detailed survey of Loktak lake and hydrological observations (Rs. 5.0 lakhs), Consultant's fees (Rs. 5.00 lakhs), establishment of soil testing laboratory (Rs. 1.00 lakh) not provided in the sanctioned estimate and Misc. additional requirements (Rs. 4.50 lakhs).

B. Land

Original estimate (1970)	3·00 lakhs
1974 S.E.	26·32 lakhs
Increase	23·32 lakhs
1977 R.E.	42·87 lakhs
Increase over 1974 S.E. . . .	16·55 lakhs

2. The increase in 1974 S.E. was mainly due to payments made for land on the basis of actual assessment made by Revenue authorities (Rs. 14.60 lakhs) and enhanced provision made for compensation of fruit trees (Rs. 5.40 lakhs).

3. The increase in 1977 R.E. over 1974 S.E. is mainly due to enhanced provision made for compensation for crop and fruit trees as per claims under process (Rs. 10.36 lakhs) and provision for land for construction Shaft designed later as per revised requirement and extension of colony (Rs. 3.00 lakhs) not provided earlier.

C. *Works*

(a) *Ithai Barrage*

		Rs. lakh
1.	Original estimate (1970) (Rs. 16.10 + Rs. 6.5 lakhs allocated to Irrigation)	22·6
2.	1974 S.E.	56·54
	Increase	33·94
	1977 R.E.	149·11
	Increase over 1974 S.E.	92·57

2. The increase in 1974 S.E. was due to increase in quantities of various items due to detailed designs, increase in rates on account of high tendered rates and due to higher provision made for crest gates an hoisting arrangements as the provision made in the original estimate for this was considered inadequate. There are various reasons for high tendered rates which may be enumerated as (i) adoption of local P.W.D. scheduled rates by Manipur Government which were actually meant for small works; (ii) Award of works to major contractors (iii) remoteness of the place and (iv) sharp rise in the cost of labour and material between the time when the original estimate was prepared in 1966-67 and the tenders received in 1971. The quantification of various reasons for the main increase is broadly given as under:

		Rs. lakhs
(*a*)	Due to increase in quantity Earthwork and rock excavation from 5510 Cu. M. to 11052 Cu. M. and R.C.C. from 2912 Cu. M. to 4790 Cu. M.	4·11
(*b*)	Due to high tendered rates for earthwork and R.C.C.	11·37
(*c*)	Enhanced provision made for crest gates, hoisting, arrangements etc.	17·60
	Total	33·08

3. The reasons for increase in 1977 R.E. over 1974 S.E. are explained below:

(a) *Earthwork in excavation.*—The quantity of excavation has increased from 5436 cum. covered in the sanctioned estimate to 24,530 cum. in the present revised estimate. The increase in quantity is due to extension of the Barrage by adding one more bay to reduce the maximum flood level. This addition of one bay required for widening of the river bed by 10 metres, involved a huge quantity of earthwork in hilly banks on both sides of the river. The provision for flaring out walls U/S and D/S of the abutment is also added.

(b) *Excavation in rocks.*—For reasons explained above the quantity of rock excavation has increased from 5617 cum. in sanctioned estimate to 20,730 cum. in the present revised estimate.

(c) *Back filling.*—The quantity has increased from 1435 cum. in sanctioned estimate to 7300 cum. in the R.P.E. The wide hill cutting involving widening of the river bed at 1:5 slope had to be backfilled after the construction of the structure and was not provided in the sanctioned estimate.

(d) *Reinforced Cement Concrete.*—The quantity has increased from 4790 cum. in sanctioned estimate to 7500 cum. in the present R.P.E. The increase is due to addition of one more bay of the Barrage and change in design of abutment increasing the bottom width from 2 m. to 4 m.

(e) *Steel reinforcement.*—The quantity has increased from 30 MT in sanctioned estimate to 245 MT in the present R.P.E. The increase is due to addition of one bay to the Barrage and provision of protection walls with flaring steps constructed U/S and D/S of the abutments.

(f) *Anchor Rods.*—The quantity in the sanctioned estimate was 1575 RM of 36 mm. dia. anchor bars. Although the dia. of bars were reduced to 25 mm. and 32 mm., the quantity increased in length of the bars from 1575 RM. to 10764 RM. The increase in quantity is due to extra provision of anchor bars in the abutments and protection walls to save extra excavation in rocks as well as the consequent concreting.

(g) *Extra items.*—There are 35 extra items in the present R.P.E. as a result of alteration and additions made in the

structures during execution in the work. The estimate increased by about Rs. 36.19 lakhs on this account alone.

The reasons for increase have been broadly identified and qualified as under:—

		Rs. lakhs
(*i*)	Increase in quantity due to change in design	37·77
(*ii*)	Increase in cost due to extra items of works from change in design	36·19
(*iii*)	Increase due to rise in price index	15·67
(*iv*)	Increase due to W/C Estt. and contingency based on % of I-Works	2·94
		92·57

(b) *Power Channel*

		Rs. lakhs
1.	Original estimate (1970) (Rs. 89 lakhs + Rs. 35 lakhs allocated to Irrigation)	124·00
	1974 S.E.	622·58
	Increase	498·58
	1977 R.E.	1482·13
	Increase over 1974 S.E.	859·55

2. The increase in 1974 S.E. was due to (i) high tendered rates and (ii) increase in quantities and provision of additional items due to detailed designs. The reasons for high tendered rates have been explained under Ithai barrage. The quantification under different reasons for major increases is given below:

		Rs. lakhs
(*a*)	Due to increase in quantities, Excavation in Rock from 0·36 lakh cum. to 1.05 lakhs cum.	7·3
(*b*)	Dut to high tendered rates	469·0
(*c*)	Due to additional items such as trash rack, stop logs, filters etc.	14·8
(*d*)	Due to percentage provision for establishment & contingency	7·4
	Total	498·5

3. The reasons for increase in 1977 R.E. over 1974 S.E. are explained below:—

(a) *Dry Boulder Pitching.*—The quantity has been increased from 2140 cum. to 29036 cum. In the original design the pitching was provided in a limited zone of 4 metres

vertical depth from supply level *i.e.* about 7 metres along the slopes on both sides. Because of the poor strength of the soil the slope has been flattened from 1:1.5 to 1:3 or more at places and the provision for pitching have been made covering the entire increased side slope length *i.e.* from 7 metres to 32 metres. The bed has also been pitched for 200 m. length U/S of bridge in the Tiddim Road crossing. All this has resulted in manifold increase in the quantity of pitching.

(b) *Providing and laying* 1:3:6 *cement concrets in wall and in the bed of the channel.*—The quantity has increased from 680 cum. in S.E. to 8800 cum. in the present R.P.E. This exhorbitant increase in the quantity has occurred because of two reasons *viz* (1) Increase in thickness of concrete lining in bed and (2) increase in the width of the bed. The bed was widened from 6 metres to 18 metres to get equivalent discharge at R.L. 765.048 m. Originally the designed bed level was + 763.524 with 6 metres bed width. Because of extremely sloughing nature of the soil, bed level had to be raised and this has resulted in increasing the bed width. Again the lining of the bed with cement concrete block was considered to check the upheavel action observed in the bed. The size of the block provided is 2515mm x 2515 x 750 mm. This arrangement also could not check the upheavel action completely and hence lining the bed with 1750 mm. thick raft on grid of beams and struts was considered necessary and accordingly the same has been provided in the estimate. In original estimate, this provision of the lining was with 75 mm. thick precast slabs only. This accounts for enormous increase in quantity in this item.

(c) *Provision of extra items.*—As mentioned above because of sloughing nature of the soil excavation of open channel was not considered economical where depth of cutting is more. The provision of open channel beyond RD 2270 was therefore substituted by an R.C.C. Cut & Cover Section. The excavation for the Cut & Cover Section has been planned to be carried out with imported sheet piles and very heavy cross struts to take care of extra heavy side earth pressures. The provision of Cut & Cover Section was considered to be more feasible on engineering and economical grounds as the excavation of the open channel would have involved huge quantity of excavation due to highly flattened side slopes, 5:1.

Also it would have necessitated acquiring of additional land and payment of compensation. Even with this the stability of the slopes would have been doubtful due to sliding nature of soil.

(d) *Price escalation in material, P.O.L. & Labour Component.*—Because of the price escalation in materials and labour component the increase in cost is estimated to be Rs. 259.60 lakhs.

(e) Due to change of design, the original items of the estimate had to be deleted and hence the rebate allowed by contractors could be availed of only on items 1, 3 & 5 of the estimate.

The reasons for increase have been broadly identified and quantified as under:

		Rs. lakhs
(*i*)	Increase in cost due to extra items of works from change in designs.	537·54
(*ii*)	Increase in cost due to rise in price index	261·60
(*iii*)	Increase due to W/C Estt. & contingency based on 5% of works	57·80
(*iv*)	Difference in 5% rebate allowed by contractor . . .	2·08
		859·05

(*c*) *Head Race Tunnel and Shafts.*—

	Rs. lakhs	Rs. lakhs
1. Original estimate (1970) .	263·40	
1974 S.E.	677·55	
Increase		414·15
1977 R.E.	1959·05	
Increase over 1974 S.E.		1281·50

2. The increase in 1974 S.E. was due to (i) increase in quantities and provision of additional items on account of detailed designs & (ii) high tendered rates. Open excavation increased from 1,29,000 cum. to 10,42,000 cum., underground excavation from 1,16,150 cum. to 1.38,100 cum., steel for supports reinforcements etc. from 3220 MT to 3430 MT & concrete from 33,060 cum. to 47,010 cum.

The major increases due to various reasons are given below:—

		Rs. lakhs
(*a*)	Increase in quantities of major items .	78·62
(*b*)	High tendered rates of major items . . .	277·70
(*c*)	Additional items *e.g.*, shortcreting, timber, supports etc. .	28·00
	Total	384·32

3. The reasons for increase in 1977 R.E. over 1974 S.E. are indicated below—

(a) *Boring of Tunnel.*—The quantity of excavation has increased from 1.29 lakhs cum. to 1.50 lakhs cum. This increase is mainly due to extension of tunnel by 692 m. beyond the intake shaft. Secondly, because of weak strata encountered, there have been excessive overbreaks and consequently more cement concrete filling.

Due to methane gas explosion at face 5 of the tunnel, M/s. Patel Engineering Company refused to continue with the excavation of the remaining length of about 3 kms. of the reach between faces 4 & 5. They also gave up work in the reach between faces 0 & 1 due to excessive flow of water and total change in geological conditions.

It has been decided to construct the reaches between faces 4 & 5 departmentally by mechanised method and after installation of heavy ventilation system, remote gas monitoring equipments etc. which has increased between faces 0 & 1 has now been proposed to be done by knife cutter shield not previously done for any tunnel in India which has also increased the estimated cost of work.

The tunnel being gassy, M/s. Patel Engineering Company had to be given enhanced rate for continuing with the work in the tunnel reaches between faces 2 & 3 and 6 & 7. This also raised the cost of works.

(b) *Permanent steel supports.*—The quantity has increased from 3,100 MT in S.E. to 5,631 MT in the present R.P.E. The huge variation in quantity is due to the necessity of providing more steel supports in the tunnel due to the weak strata involved. In the original estimate the provision for permanent steel supports was made only at the shear zones where crushed rock was anticipated. In the present revised estimated, because of unstable soil strata encountered, the provision of steel support has been made throughout the length of the tunnel at close spacing of 300 mm. to 500 mm. c/c. This has resulted in a substantial increase in the cost of steel support.

(c) *Plain and reinforced cement concrete.*—The quantity of R.C.C. has increased from 8560 cum. to 20,834 cum. in the R.E.P. 1977. In the sanctioned estimate the concrete lining provided was with plain cement concrete only except in the shear zones where the cruhsed rock would be met. Now the reinforced cement concrete has been provided throughout the full length of the tunnel.

The increase in the quantity of concrete lining is because of the difference in thickness of the lining. The thickness has increased from 150 mm. to 300 mm. as per the latest design requirement considering the adverse condition of the soil strata encountered.

(d) *Steel reinforcement.*—The quantity has increased from 180 MT to 2142 MT. As mentioned above the quantity has increased because of the provision of steel reinforcement throughout the length of the tunnel lining.

(e) *Pressure grouting.*—There has been excessive requirement for pressure grouting because of the unexpected flowing ground strata at faces 0, 1, 2 & 3 in the tunnel. Instead of rock the strata encountered is silt and shingle saturated with water necessitating pre-grouting for consolidating the same before taking up tunnelling. Pressure grouting has also been resorted to in other weak reaches encountered so far. The quantity has been increased from 2000 bags of cement to 1,85,670 bags as per present experience.

(f) *Price escalation.*—The escalation in prices of materials and wages of labour also increased the cost considerably.

Identification and quantification of the reasons for increase

The factors responsible for increase in the cost of works (*viz.* switch over to mechanised construction, change of agencies for construction, preparation of estimates for works by new agencies *i.e.* the Department and M/S. NPCC on the basis of present day costs of material, labour, electricity charges, etc. and for new items of works and revised quantities) have superimposed their effects on one another and, as such, the reasons for increase defined proper quantification individually. Most

of the increase had to be lumped together for the purpose as given below:—

		Rs. lakhs
(*i*)	Increase in cost of construction due to change in the method of construction, change of agencies, higher rates paid for work in gassy tunnel, estimates based on present day costs, new items of work, revised quantities, etc.	812·16
(*ii*)	Increase due to extra items involved in M/s. Patel Engg. Co.'s works.	103·61
(*iii*)	Inease due to rise in price index in M/s. Patel Engg. Co.'s works .	318·34
(*iv*)	Increase due to W/C Estt. and contingency as % of works . . .	47·40
	TOTAL	1281·51

(*d*) *Penstock*

		Rs. lakhs	Rs. lakhs
1.	Original estimate (1970) . .	127·00	
	1974 S.E. (Stage I & II)	332·51	
	Increase		205·51
	1977 R.E. (Stage I & II) . .	636·76	
	Increase over 1974 S.E.		304·25

2. The provision in original estimate (1970) was for Stage I comprising 2 Generating Units. While the 1974 S.E. mentioned above covers both stages I & II comprising 3 Generating Units. The other reasons for increase are (i) increase in quantities brought about by detailed designs and (ii) high tendered rates. The quantity of steel for penstock increased from 3000 tonnes to 3534 tonnes, open excavation from 21 lakhs cuft. to 64 lakhs cuft. and cement concrete from 2.24 lakhs cuft. to 3.52 lakhs cuft. The major increases due to various reasons are indicated below:—

		Rs. lakhs
(*a*)	Increase in quantities mentioned above .	31·58
(*b*)	High tendered rates	78·29
(*c*)	Additional provision for Stage II .	80·57
	Total	199·44

3. The reasons for increase in 1977 R.E. over 1974 S.E. are indicated below:—

(a) *Earthwork in excavation.*—The quantity of earthwork has increased from 1,72,800 cum. in S.E. to 3,81,335 cum.

in the present R.P.E. Moreover, harder material including rock has had to be excavated which was not taken into account in the earlier estimate. All this has been due to change in alignment of the reach between anchor blocks 8 and 10 as per the suggestion of Resident Geologist. Land slides particularly in reaches between anchor blocks 4 and 7 also increased the quantity of earth work.

(b) *Reinforced cement concrete.*—The quantity has increased from 9500 cum. in S.E. to 20,460 cum. in the present R.P.E. The foundations of anchor blocks and saddles had to be lowered by one to two metres and their design changed.

(c) *Penstock.*—Increase in cost of steel and other construction materials has increased the cost of penstocks.

(d) *Provision of extra items.*—Extra items in R.P.E. has come to 8 Nos. which were not there in the sanctioned estimate.

(e) *Price escalation.*—Rise in price index of construction materials, P.O.I. and wages of labour has also contributed to the increase in the estimated cost of works.

The reasons for increase have been broadly identified and quantified as under:

		Rs. lakhs
(*i*)	Increase in quantities due to change in design found necessary due to extremely adverse geological conditions	105·02
(*ii*)	Increase due to extra items found necessary due to adverse geological conditions	87·67
(*iii*)	Increase due to rise in price of materials including steel for penstocks as well as rates of works items	95·12
(*iv*)	Increase due to W/C Estt. and contingency based on percentage provisions	16·44

(*e*) *Power House :*

		Rs. lakhs	Rs. lakhs
1.	Original estimate (1970) . .	91·50	
	1974 S.E.	96·43	
	Increase		
	1977 R.E. (Stage I & II)	370·14	
	Increase over 1974 S.E.		273

2. The provision in original estimate (1970) was for stage I comprising two Generating Units of 35 MW each, while the 1974 S.E. covers both stages I & II comprising three Generating units of 35 MW each. The other reasons for increase are (i) increase in quantities brought about by detailed designs and (ii) high tendered rates. The quantities of excavation increased from 21,380 cu.m. to 52,800 cu.m., cement concrete from 4710 cu.m. to 7310 cu.m., structural steel and reinforcement from 225 tonnes to 628 tonnes and brick work from 249 cu.m.to 505 cu.m. The major increase due to various reasons are given below:—

(*a*)	Increase in quantities of main items .	Rs. 11.34	akhs
(*b*)	High tendered rates	45·83	lakhs
(*c*)	Provision of additional items *e.g.*, pressure grouting, rubber seals and asphalt seals, glass block panels etc. . . .	Rs. 2·25	lakhs
(*d*)	Provision made for II stage Civil Works	Rs. 10·00	l khs
	Total	Rs. 69 42	lakhs
(*e*)	Less reduction due to elimination of certain items .	Rs. 5·00	lakhs
	Net increase	Rs. 64 42	l khs

3. The broad reasons for increase in 1977 R.E. over 1974 S.E. are mentioned below:—

(a) *Earthwork.*—The quantity has increase from 52,800 cu.m. to 1,25,000 cu.m. The increase is because of change in the length of the Power House at the end of the 3rd Unit to accommodate electrical equipments. The excavation involved was right from top of hill to base level of Power House. Because of the unstable slopes, benches had to be provided in cutting at different levels involving more volume of earth and wider area of excavation. The original ground level assumed at R.L. 463.45 was not correct. The original ground level was up R.L. 490. Moreover, flatter slopes had to be given for stability. All these account for variation in the quantity of this item.

(b) *Drilling holes upto 50 mm. dia in rock and grouting.*— The quantity has increased from 240 R.M. to 8,100 R M. in this R.P.E. The revised provision is as per the design drawing issued by Central Water Commission. The reasons for this wide variation in quantity is that the

Anchor Rods have been provided throughout the Power House foundation including service bay, whereas, in the earlier estimate the provision of Anchor Rods was for machine foundation only.

(c) *Reinforced cement concrete in Power House Unit Bays.*—The quantity of R.C.C. has increased from 5780 cu.m. to 7688cu.m. in present R.P.E. 1977. The present estimate has been revised as per the latest drawings supplied by C.W.C.

(d) *R.C.C. work in auxiliary rooms including retaining walls.*—The quantity has increased from 1350 cum. to 4685 cu.m. The reason for this variation is due to extension of the retaining wall in the side of the auxiliary room. Secondly the present estimate has been based on the design drawings issued by C.W.C.

(e) *R.C.C. work in Service Bay.*—The quantity has increased from 180 cu.m. to 1720 cu.m. The reason for this variation is that when excavation was going on in Machine bay at about R.L. 450, the rock at R.L. 463.45 in the Service Bay collapsed suddenly because of unstable nature of the strata. Under the circumstances the whole area covered by Service Bay had to be back filled with concrete.

(f) *Extra Items.*—The provision of extra items in the R.P.E. 1977 has also increased the cost. There are about 15 extra items which were not included in the S E. There was no provision for the Switchyard in the S E. The Civil works of the Switchyard have now been provided under this sub-head as extra items.

(g) *Price escalation.*—Escalation in prices of materials and wages of labour also contributed to increase in cost.

(h) A lump sum provision of Rs. 10 lakhs was made under Power House in Stage II which on detailed estimate has worked out to Rs. 36.65 lakhs.

The reasons for increase have been broadly identified and quantified as under:—

		Rs. lakhs
(*i*)	Increase in quantity due to change in design due to geological conditions	107·29
(*ii*)	Increase due to additional items not considered earlier	80·59
(*iii*)	Increase due to rise in price index	70·09

(*b*)	Increase due to W/C Estt. and contingency based on percentage of works.	15·72
(*f*) *Tail Race Channel*		Rs. lakhs
1.	Original estimate (1970)	8·10
	1974 S.E.	8·06
	Increase	NIL
	1977 R.E. .	24·52
	Increase	16·46

2. The increase in 1977 R.E. is due to (i) detailed designs done on the basis of actual conditions (Rs. 8.40 lakhs) and increase in cost due to price escalations (Rs. 8.06 lakhs).

K Building

1.	Original estimate (1970) . .	34·50
	1974 S.E. . .	88·54
	Increase	54·04
	1977 R.E. . . .	428·12
	Increase over 1971 S.E.	339·58

2. The increase in 1974 S.E. was mainly due to (i) very high tendered rates (Rs. 39.72 lakhs), (ii) enhanced provision for lumpsum items such as water supply, electrical installation etc. (Rs. 12.02 lakhs) and (iii) increase in provision for W/C establishment and contingencies (Rs. 2.15 lakhs).

3. The broad reasons for increase in 1977 R.E. over 1974 S.E. are given below:—

The rate of permanent buildings (Rs. 430.00 per m2) meant for O&M staff was adopted the same as that for temporary buildings in the sanctioned estimate. The actual tendered rates for these buildings were very high (Rs. 1552.00 per m^2). The permanent buildings are built of R.C.C. structures and brick walling and are situated very much in the interior of the hills. The increase on this account is of the order of Rs. 72.0 lakhs. Provision made for temporary buildings in the sanctioned estimate had to be increased on the basis of actual requirements. This contributed to about Rs. 28 lakhs increase.

After the accident, the Technical Committee recommended more supervisory staff as well as safety personnel Buildings being constructed for them account for about Rs. 72.55 lakhs.

Buildings found necessary for Departmental Construction amounted to about Rs. 93.20 lakhs.

The reasons for increase have been broadly identified and quantified as under:—

		Rs. in lakhs
(*i*)	Increase due to quantity of work .	158·89
(*ii*)	Increase due to increase in rate	130·98
(*iii*)	Increase in other items like colony roads, etc. . . .	44·10
(*iv*)	increase due to provision made for W/C Estt. on percentage basis	5·61
	Total . . .	339·58

M- Plantation

		Rs. in lakhs
1.	Original Estimate (1970)	3·00
	1974 S.E.	5·00
	Increase	2·00
	1977 R.E.	1·22
	Increase over 1974 S.E. . .	3·78

2. The provisions in the 1970 and 1974 Estimates were based on L.S. basis. In the 1977 Revised estimate, provision for trees along intake channel and the road from Ithai Bazar to Barrage have been made on proper estimate.

O-Miscellaneous

		Rs. lakhs
1.	Original Estimate (1970) . .	36·00
	1974 S.E. . . .	89·70
	Increase .	53.70
	1977 R.E. . . .	404·73
	Increase over 1974 S.E. . .	315·03

2. The increase in 1974 S.E. was due to estimating the Lumpsum requirements more accurately according to the site conditions and enhanced prices of labour and material such as petrol, tyres etc. The major increases were on account of running of vehicles (Rs. 15

lakhs), lighting (Rs. 11.60 lakhs), security arrangements (Rs. 8.45 lakhs), water supply (Rs. 7 lakhs), labour compensation etc. (Rs. 6 lakhs), telephones (Rs. 2.6 lakhs) and running and maintenance of hospitals and dispensaries (Rs. 2.0 lakhs).

3. The broad reason for increase in 1977 R.E. over 1974 S.E. are mentioned below:

The completion of the project foreseen in the 1974 sanctioned estimate was March, 1976 for Stage I and March, 1978 for Stage II. The revised target date of commissioning is March,1982. This has contributed towards increase in the cost of 0. Miscellaneous items.

Moreover, departmental construction has necessitated heavy increase in the requirement under various items which has materially increased the cost. Items like running and maintenance of transport and other vehicles have gone up by Rs. 106.00 lakhs. Running and maintenance of dispensaries has increased by about Rs. 18.50 lakhs. The colony has very much increased and the increase on account of lighting of the colony is of the order of Rs. 75.80 lakhs. Expenditure on Security Police has gone up by Rs. 82.0 lakhs on the basis of claims preferred by Manipur Government. Other infra-structural facilities like school, telephone and water supply added about Rs. 27.00 lakhs towards the increase. The above total up to about Rs. 309.30 lakhs of increase (out of Rs. 315.03 lakhs).

Q-Special T & P

Rs. lakh

1.	Original estimate (1970)	37·50
	1974 S.E.	28·89
	Increase	—8·61
	1977 R.E.	442·90
	Increase over 1974 S.E.	414·01

2. Provisions made under this head represent only the residual values of the equipments purchased for the project. The reduction in 1974 S.E. is due to adjustments made in the requirement of machinery between the Department and the contractor.

3. The broad reasons for increase in 1977 R.E. over 1974 S.E. are mentioned below:

The unexpected and trecherous geological conditions and advent of methane gas necessitated change in the method construction of about 3.7 km. length of the tunnel which is now proposed to be done by the most sophisticated and flame-proof machinery and equipments like point exca-

vators. Knife Cutter Shield, flame-proof locos, etc. as also installation of heavy ventilation and remote gas monitoring system. The entire tunnel being gassy, flame-proof electrical and gas monitoring equipments had to be supplied to the contractors free of cost. These are the main reasons for increase in cost under Q. Special Tools and Plant.

R-Communication

		Rs. in lakhs	
1.	Original estimate (1970)	32·75	
	1974 S.E.	79·44	
	Increase		46·69
	1977 R.E.	110·16	
	Increase over 1974 S.E.		30·7

2. The increase in 1974 S.E. was due to provision of wider roads (22 ft. instead of 16 ft.) from colony to worksites for about 20 miles as also adoption of higher mileage rates because of rise in prices of labour and materials.

3. The increase in 1977 R.E. over 1974 S.E. is mainly due to increase in provision for culverts (Rs. 10 lakhs), approach roads (Rs. 7 lakhs), substitution of old culerts by bigger ones (Rs. 4.8 lakhs) and protection walls (Rs. 5.0 lakhs).

S—Power Plant and Electrical Systems

(a) **Generating Plant and Machinery**

		Rs. in lakhs	
1.	Original estimate (1970)	241·97	
	1974 S.E.	813·99	
	Increase		572·02
	1977 R.E.	1111·27	
	Increase over 1974 S.E.		297·28

2. The increase in 1974 S.E. is mainly due to (i) inclusion of the 2nd stage for the IIIrd Generating units (Rs. 267.99 lakhs), (ii) adoption of the cost of two Generating units of st ge I on the basis of budgetary provision made by M|s. BHEL (Rs. 188 lakhs) and (iii) adoption of rates for auxiliary and other equipments and erection charges on current prices (Rs. 112 lakhs).

3. The increase in 1977 R.E. over 1974 S.E. is mainly due to (i) finalisation of the cost of Generating units being supplied by M|s.

BHEL (Rs. 203 lakhs) and (ii) increase in cost of auxiliary equipments and erection and commissioning charges (Rs. 92 lakhs).

(b) Transmission

		Rs. in lakhs	
1.	Original estimate (1970) .	17·59	
	1974 S.E. . .	44·98	
	Increase . . .		27·39
	1977 R.E. . .	58·96	
	Increase over 1974 S.E.		13·98

2. The increase in 1974 S.E. is due to provision made for 25 miles (40 kms.) of transmission lines as against 10 miles considered in the original estimate, as per revised requirement based on the studies made by the Central Water and Power Commission.

3. The increase of Rs. 13.98 lakhs in 1977 R.E. over 1974 S.E. is mainly due to escalation in the prices of material and labour.

Percentage Provisions

(Covering items like I. Maintenance, Losses on stock, II-Establishment, III. Tools & Plants, Audit and Accounts charges, and Abetment of land revenue)

		Rs. in lakhs	
1.	Original estimate (1970)	97·57	
	1974 S.E.	302·66	
	Increase		205·09
	1977 R.E.	804·66	
	Increase over 1974 S.E.		502·20

2. The provisions under these heads are made on percentage basis. The increases in the provisions under these Heads in the 1974 S.E. and 1977 R.E. are due to increases in the costs of works in these estimates.

APPENDIX II

(*Vide* para 3.22 of the Report)

Note on Committee set up on the execution of Hydro-Electric Project Y. K. Murthy Committee to examine the procedure for investigations and implementations multipurpose and Hydro-electric Projects

Terms of Reference

(i) Keeping in view the recommendations of the Experts Committee headed by Shri J. P. Neegamwala which has examined the rise in costs of irrigation and multipurpose projects, to lay down details of preparatory work necessary for obtaining sanction for multipurpose and hydro-electric projects, as also the procedures for according such sanctions;

(ii) Identify the contents of a detailed project report;

(iii) Indicate the extent to which investigations should be carried out, designs finalised and estimates for materials, equipment and manpower prepared before investment decisions are taken;

(iv) Recommend the extent to which infrastructure activity should be undertaken before an investment decision on the project is taken;

(v) Suggest changes in funding and administrative arrangements to avoid time and cost over-runs.

Recommendations

(1) Adequate steps should be taken for collection of basic field data required for assessing the technical and economical feasibility of irrigation, power and Multipurpose projects.

(2) A close coordination of the data collection agencies for planning water resources projects is essential.

(3) A central data bank should be set up for the storage, retrieval and analysis of data collected by various agencies.

(4) The reports in respect of irrigation, power and multipurpose projects should be prepared in the following three stages:—

(a) Reconnaissance report;

(b) Feasibility report; and

(c) Definite Project report.

(5) It is necessary to prepare reconnaissance reports for all potential projects in the river basins in the country. A scheme should be introdu ed in the plan for this purpose to ensure the preparation of such reports on a time bound basis.

(6) Since the basic plans and designs may be on a preliminary form at the stage of the feasibility reports, adequate contigency allowance should be included to ensure that the project can be built within the estimated cost.

(7) Adequate attentions should be paid to the creation of basic infrastructures fa ilities prior to taking up the project works.

(8) For a major multipurpose project costing over Rs. 30 crores it would be necessary to employ atleast 2 or 3 engineering Divisions in addition to the assistance that could be obtained by them from Organisations like Survey of India, Geological Survey of India etc. For major projects costing over Rs. 100 crores it may be necessary to have one or more field circles.

(9) Unit prices of major items of construction material and labour adopted in the preparation of the estimate should be indicated in separate table in the project report.

(10) It is necessary to introduce at the definite project stage "contingency allowance" to take care of uncertainties about underground conditions. This however should be separately indicated and not included in the cost estimates of the project.

(11) As the detailed investigations of multipurpose and power projects require stay in remote out of the way places for long periods, the terms of this posting should be made very attractive.

(12) At the State Level a multi disciplinary team of experts shall analyse the data and prepare the project reports.

(13) A High Level Committee shall be set up at the State Level to guide and oversee the engineers at the state in carrying out investigations of projects and preparation of project reports.

(14) The State Governments shall set up a well equipped design office with adequate experties for preparing the project reports.

(15) A High Level Committee of experts shall be set up at the Centre to advise the State Governments in the investigations of project and preparation of project reports.

(16) In respect of interstate projects, steps should be taken by the concerned states to arrive at an agreed solution in the initial stages of the project investigation itself. Where necessary, the assistance from Central Government could be taken.

(17) Advanced planning of manpower requirements for the construction, operation and maintenance should be carried out.

(18) A schedule for financing matching with the construction, programme should be drawn up.

(19) An adequate monitoring organisation should be set at the state as well as at the centre to keep a watch on the progress of the project.

(20) A Cell should be set up in each state/State Electricity Board for effecting cost control in the project.

Action taken by Government. thereon

The above report was submitted to Govt. only recently i.e. May, 78 and is under examination.

NAEGAMWALA COMMITTEE ON RISE IN COSTS OF IRRIGATION AND MULTIPURPOSE PROJECTS

Terms of Reference

(a) The adequacy or otherwise of the existing arrangements for the investigation and formulation of irrigation and multipurpose projects, preparation of feasibility reports and estimates thereof and construction programme including assessment of benefits;

(b) the reasons for rise in the estimated costs of projects leading to their frequent revisions and recommend;

(c) modification or revision in procedure for more realistic preparation of project feasibility reports and estimates as also improvement in the present system of implementation of projects to ensure their completion within the sanctioned estimated costs and according to the scheduled programmes of completion.

Recommendations

Investigation and planning of projects

1. For investigation of projects in general, each State should have a broad-based organisation involving all disciplines (engineering, geology, hydrology, revenue, ariculture, etc.) so that work

is done by persons experienced and expert in each of the specialised fields.

(Chapter 9, paragraph 125)

2. Immediate steps may be taken to set up a standing Committee for the development of basic data required for planning water resources projects; such a committee must establish liaison with appropriate data; the committee must prepare annual programmes for data collection and analysis.

(Chapter 5, paragraph 61)

3. A minimum standard for factual information which a project report must meet before it can be considered for acceptance should be established.

(Chapter 5, paragraph 61)

4. Steps should be taken to see that researches are continued to improve techniques of data analysis; programme of in-service trainning to impart recent technical know-how in this subject must also be developed.

(Chapter 5, paragraph 61)

5. Steps should be taken to improve data status.

(Chapter 5, paragraph 61)

6. Steps should be taken to set up national and regional water data banks for the storage, retrieval and analysis of data collected by various agencies.

(Chapter 5, paragraph 61)

7. Adequate monetary incentives as well as other compensatory benefits should be provided in order to attract bright and enthusiastic officers to come forward and undertake field investigations assignments under arduous conditions of life.

(Chapter 9, paragraph 126)

8. Suitable funds should be allocated for investigating properly the projects proposed. A part of this allocation could be on earmarked basis for investigation of specific important and complex projects.

(Chapter 9, paragraph 127)

9. Very big projects costing over Rs. 30 crores require a more strict treatment. In their case the first stage should invariably by

the sanction of the Investigation Estimate on the basis of the preliminary project report or reconnaissance report. The outlay on such an estimate could be as much as 5 per cent of the anticipated total cost of the scheme and should be sufficient to enable a well-manned organisation to be set up at the project site for carrying out through investigations and preparing detailed estimates in terms of accurate data on quantities, etc. The organisation should be headed by a senior engineer who could be expected to take over the execution of the project also in due course.

(Chapter 9, paragraph 128)

10. The C.W. & P.C. should associate itself closely with the investigation organisations set-up by the States and give them necessary guidance and assistance in their work.

(Chapter 9, paragraph 129)

11. The guidelines laid down by C.W. & P.C. for the minimum investigations to be carried out before preparation of project report and estimate for approval of the planning Commission should be strictly followed for preparing the reports and estimates of all major irrigation and multipurpose projects in the county.

(Chapter 9, paragraph 124)

12. C.W. & P.C. should prepare and issue guidelines for investigation of drainage part of the schemes.

(Chapter 12, paragraph 165)

13. Studies regarding outputs of indigenously manufactured earthmoving machinery should be carried out by C.W. & P.C. and norms laid down.

(Chapter 13, paragraph 188)

14. Selection of construction equipment and choice of construction procedures is a specialist's job. Steps should be taken by the State Governments for pooling the experts available with them and creating a cell which should advise and help the project formulation agencies in the preparation of construction schemes, equipment selection and plant layouts.

(Chapter 14, paragraph 210)

15. State Governments should make a more thorough arrangement for collection and maintenance of the basic data required for working out the benefit-cost ration *viz.* cost of inputs like seed

manure, etc., value of outputs like produce, fodder, etc. and operation and maintenance charges of irrigation projects.

(Chapter 6, paragraph 83)

16. There should be some one like the area development authority in every State who should be responsible to continuously watch all the developments brought by irrigation so as to maintain an integrated view, of the area. In every State socio-economic studies for evaluation of benefits derived from the projects after completion should be taken up and done periodically by suitable agencies in association with the planning departments, universities, etc. This would help in framing future policies to effect further improvements.

(Chapter 6, paragraph 85)

17. With a view to reducing pressure on the financial resources of the country and ensuring economic utilisation of the capital and equitable distribution of projects, these should be planned in phases and taken up phase by phase.

(Chapter 13, paragraph 183)

18. To avoid change in scope of a project (such as, increases in area to be irrigated, increase in power generation capacity or increase in flood control benefits) during construction the project should be planned more comprehensively at the early stage.

(Chapter 11, paragraph 152)

19. There is no objection in principle to the change in scope during construction provided the incremental cost is justified *vis-a-vis* the next best available alternative. There is, however, serious repercussion of this change. Because of increase in scope the cost goes up and the entire planning of resources is thrown out of gear. Whether to agree to the changes in scope has to be decided taking into account the economic constraints availability of funds and resources in the context of overall planning. On this consideration changes in scope may be avoided.

However, changes in scope during construction may be allowed in situations where, by not making changes in the project feature, the chances of effecting increase in scope are permanently jeopardised.

In case changes in scope have to be accommodated after the approval of the project, the additional works should wherever possible be sanctioned as separate schemes whose costs have only to be arithmatically added to the earlier project to find out the total cost.

When it is not possible to bring up a separate scheme to cover the changes in scope, the estimate of the project with the increased scope should be sanctioned as a "modified project" and not merely as revised estimate.

(Chapter 11, paragraph 152)

Preparation of project feasibility reports and estimates

20. No change in the existing administrative procedure to prepare plan estimates at current prices is called for. However, as an instrument of planning it would be unrealistic if no arrangements are made to take notice of the crucial factor of inflation. For this purpose a suitable cushion should be devised which may fit in with the governmental financial mechanism. Approval of a scheme takes some time. Commencement of real construction work after approval also takes time. Then comes the construction period to cover the increase owing to economic changes over the long period, an appropriate indicator of price rise (i e. an adjustment factor) should be constructed and the increase so obtained added to the estimate as a "supplementary provision" for adjusting cost estimates of plan projects.

(Chapter 8, paragraph 102)

21. An adjustment Factor of 7 per cent per year should be adopted in working out the 'Supplementary provision' for adjusting the cost estimates of plan projects. In applying this factor the estimated cost of the project should be relieved of the cost of land and only 50 per cent of this factor should be considered for the period of actual construction. (Rs regard cost of land, recommendation No. 26 refers).

(Chapter 8, paragraph 111)

22. The adjustment factor should be reviewed from time to time after taking into consideration all aspects of the economic situation in the country. For this purpose the Central Water & Power Commission should have a permanent study cell for collection of data and preparation of Construction Cost Index for the works of river valley projects.

(Chapter 8, paragraph 112)

23. To cover cost increase due to changes in design and additional requirements at the time of detailed design and construction which invariably occure in river valley projects because of their complex nature additional provisions should be made in the estimate prepar-

ed at the feasibility report stage under a head which may be called "Margin of error".

(Chapter 12, paragraph 158)

24. The margins of error obtaining for different types of works should be constantly studied and periodically reviewed for adoption of any revised standards in future.

(Chapter 12, paragraph 166)

25. A Central Committee consisting of concerned officials may be formed and assigned the task of evolving a standard approach for adopting the rate of compensation for land which would recognise (i) a fair deal to those affected and (ii) prevent any artificial increase in the cost of land.

(Chapter 13, paragraph 172)

26. There is no uniform policy regarding scale of rehabilitation measures. A broad national policy on rehabilitation should be laid down with provisions for reasonable modifications being permissible on the merits of each case.

(Chapter 13, paragraph 178)

27. Once full compensation has been made for the land and property acquired, any additional expenditure incurred towards creating a new and better environment for those displaced on account of construction of the project is purely on social and welfare considerations and is not a proper charge to construction. Although, there may not be any alternative but to charge this to the project cost, it may be excluded for benefit cost analysis.

(Chapter 13, paragraph 179)

28. Planning for construction equipment should be given due importance right from the stage of formulation and the project report should contain a complete blue-print of construction procedures and types of equipment proposed to be used in the execution of the project.

(Chapter 14, paragraph 210)

29. Realistic assessment of the outputs of indigenous earthmoving equipments should be made while estimating the unit costs.

(Chapter 13, paragraph 188)

30. Along with the preparation of feasibility report for a project, a feasibility plan for drainage should also be made available and cost thereof provided in the estimate.

(Chapter 12, paragraph 165)

31. Programme Evaluation and Review Technique (PERT) and Critical Path Method (CPM) net work may be attempted right from the project formulation stage so that programmes so drawn up can form part of the project report.

(Chapter 14, paragraph 200)

32. For guarding against inadequate provisions in project estimates, more care should be exercised in framing the estimates by those concerned with their preparation, as also those who check them. Advantage may be taken of the finalised cost figures incorporated in the completion reports of already executed projects. In this context the Committee strongly recommends that the preparation of completion reports, which has not been given adequate importance in the past, should be insisted upon to be finalised within two to three years of commissioning the project.

(Chapter 10, paragraph 141)

33. The set up for technical examination of projects in the C.W. & P.C. needs to be streamlined and suitably strengthened. It has also to be seen if examination of the same aspect in the project report by two departments can be dispensed with to avoid delay.

(Chapter 4, paragraph 44)

34. It is understood that in pursuance of the suggestion made in the report on 'Criteria for Appraising the Feasibility of Irrigation Projects' published by the Planning Commission in 1965, a Working Group was constituted by the Planning Commission comprising irrigation experts, economists and planners for preparing a manual of standard procedures and methods for working out the benefit cost ratio. It is further understood that the draft manual so prepared is under wide circulation for eliciting comments and suggestions. While finalising the manual the Planning Commission may go into the question of the procedure for assessment of benefits in depth and indicate clearly the data which will be required to be collected for the purpose of working out the benefits and costs, illustrating at the same time the methodology to be followed step by step in arriving at the benefit-cost ratio. The cost of developing land for irrigation when it newly comes to a ewgion should not be missed in working out the B.C.C. Ratio.

(Chapter 6, paragraph 82)

Implementation of projects:

35. In connection with the setting up of Control Boards for the construction of irrigation and multipurpose projects, the view and

recommendations of the Irrigation Commission are endorsed for acceptance.

(Chapter 14, paragraph 191)

36. For a major valley project there must be a Chief Engineer or a Project Manager posted exclusively for its execution.

(Chapter 14, paragraph 192)

37. It is essential that the person in charge of execution of a project is vested with appropriate authority—both administrative and financial so that he may discharge his responsibilities unhesitatingly. There is thus a very cogant case for delegating more powers to the Chief Engineer/Project Manager even when there exists a Control Board for overall direction as regards planning and execution. A team of officials including technical officers from various projects in the country may be set up to go into the question of delegation of enhanced powers to the Chief Engineer/Project Manager and his executives and draw up a model for adoption in the Projects to be taken up in future.

(Chapter 14, paragraph 193)

38. There should not be too frequent changes in the key personnel entrusted with the execution of the projects.

(Chapter 14, paragraph 194)

39. For a successful implementation of the development programme, there is a strong need to have competent project managers. To create a nucleus of such experts, senior technical officers who show an antitude for project management should be earmarked for special training.

(Chapter 14, paragraph 197)

40. A comprehensive institute should be set up in the Centre and preferably in C.W. & P.C. for training in the water resources sector of all officers-engineers, geologists, accountants, planners and managers who are engaged in project works. At the State level also there should be training facilities in the water resources sector for junior officers of the rank of supervisors, junior engineers etc. The existing facilities like water Resources Development Centre at Roorkee and Administrative Staff College at Hyderabad should be utilised fully till such time a comprehensive institute at the Centre for training in water resources sector come up.

(Chapter 14, paragraph 197)

41. The use of all the modern management techniques based on "System" approach in the implementat on of river valley projects in strongly advocated.

(Chapter 14, paragraph 198)

42. For the introduction of the modern management techniques it would be necessary to have properly qualified staff in the organisation. Moreover, persons at all levels of management will have to be fully conversant with these techniques. Adequate arrangement should, therefore, be made for the training of project personnel for this purpose.

(Chapter 14, paragraph 198)

43. A detailed plan of work should be chalked out and schedules drawn up visualising each important activity and taking into account the limitations and inter-relationship of one group of activities with another by the use of modern programme in techniques.

(Chapter 14, paragraph 200)

44. It is necessary in case of major projects to adopt the modern systems and techniques of Material Management and Inventory Control.

(Chapter 14, paragraph 201)

45. It is important to establish Cost Engineering Cells on major projects as already advised by the Ministry of Irrigation and Power which will go a long way in controlling costs and keeping the estimates upto date.

(Chapter 14, paragraph 206)

46. A Management information System designed to provide information on cost and time for use by the project Managers for decision-making be devised.

(Chapter 14, paragraph 207)

47. For exercising efficient financial control during execution of river valley projects, performance Budgeting System should be adopted.

(Chapter 14, paragraph 209)

48. Ministry of Irrigation and Power may take necessary steps at the highest level to bring pressure on the manufactures of indigenous equipment which are in both private and public sectors for giving better service to their customers.

(Chapter 13, paragraph 189)

49. In allocation of financial resources irrigation and multipurpose projects should receive very high priority and adequate funds so that all projects approved by the Planning Commiss on are completed in optimal time and further escalations in cost due to protacted construction period are avoided.

(Chapter 13, paragraph 185)

50. Advance programmes for stock-piling of construction materials and spare parts should be made very carefully by engineers with experience and foresight.

(Chapter 14, paragraph 218)

51. Some reasonable advance stock-piling of construction material and spare parts should be permitted.

(Chapter 14, paragraph 218)

52. Wherever possible, a cement factory situated near a project requiring a very large quantity of cement for its construction could be linked to the project.

(Chapter 14, paragraph 219)

53. In deciding the agency for execution of project the following policy should be followed:—

In general, for big jobs, execution through departmental agencies should be encouraged.

Projects which are of complex nature and where there is possibility of changes being effected as a result of further investigations during reconstruction stage, should invariably be executed by departmental agency.

Projects which are fairly well defined can be get executed through contractual agencies if suitable contractors come forward.

(Chapter 14, paragraph 217)

54. For expediting the acquisition of land and to prevent delays in the execution of projects and consequential rise in costs the recommendations made recently by the Land Acquisition Review Committee set up by the Government of India are endorsed for implementation.

(Chapter 13, paragraph 171)

55. Special land acquisition officers should be earmarked for major projects so that they can give their undivided attention to the project work. (Chapter 13, paragraph 171)

Action taken on the recommendations:

The most important recommendations of the Committee was that "guidelines laid down by CW&PC for investigations to be carried out before preparations of the project reports and estimates for approval of the planning Commission should be strictly followed for preparing the reports and estimates of all major irrigation and multipurpose projects in the country". As a result of the above recommendations, to enable investigations work to be carried out along the right lines and for preparation of realistic cost estimate, the Central Water Commission had circulated in August 1975 and July, 1976 respectively two booklets—" Guidelines for investigation of Major Irrigation and Hydro Electric Projects" and Broad guidelines for preparation of project estimates for major irrigation and multipurpose projects" to the various State Governments State Electricity Boards. The former booklet contains the guidelines laying down the minimum investigations necessary for major irrigation and hydro-electric projects keeping in view the instructions issued from time to time by the Planning Commission on the formulation of new projects. The booklet on "Guidelines for preparation of estimates furnishes items of the estimated together with suggestions on the methods of preparation of detailed and realistic project estimates, Adherence to these guidelines would go a long way in carrying out systematic investigations of projects and preparation of a detailed project report with realistic estimates of cost. The Indian Standards Institution has also finalised a number of standards and guidelines for carrying out investigation of projects and preparation of detailed project report. These deal with a number of subjects such as—

(a) The details of investigations to be carried out.

(b) The details of topographical survey.

(c) Geological Survey.

(d) Material Survey.

(e) Organisational set up for carrying out investigation

(f) Methodology for preparation of the project report etc.

In July, 1976 the Conference of the Chairman, State Electricity Boards while considering the report noted that there was no uniformity of approach in the investigation of projects and preparation of project reports and recommended that a Committee be set up to make a detailed examination of the procedures for investigating and implementing multipurpose and hydro-electric projects ,and

inter alia, make recommendations to reduce the cost and time over-runs. Accordingly, the Ministry of Energy (Deptt. of Power) set up the V. K. Murthy Committee in September, 1976 to further study and to make recommendations in this regard. The Committee's recommendations, which were submitted in June, 1978 are being examined.

APPENDIX-III

(*Vide* para 3.35 of the Report)

Note on reasons for the delay in finalising the special terms and conditions and concluding an agreement with Patel Engineering Company

The following events, described in chronological order, will explain the reasons for delay in finalising the special terms and conditions for concluding the agreement with firm 'P':—

1. On receipt of the approval for award of the above work to firm 'P' *vide* erstwhile Ministry of Irrigation and Power letter No. 11(55)/70-EL.III, dated 11th August, 1971, the latter of intent' was issued to the firm by Chief Engineer on 20-8-1971, wherein the firm was directed to commence the work and they were intimated that other formalities regarding signing of the agreement were being finalised.

2. Subsequent to the issue of letter of intent, the firm 'P' made correspondence with the project authorities under the communications dated 6th November, 11th November, 1st December, 1971 and 5th February, 1972 regarding clauses pertaining to 'Payment of Advances', 'Use of materials from excavation', 'Assistance in moving sites', 'Requirement of power', 'Schedule of material supplied by the Government' and clauses 5-A, 10-D and 10-E.

3. The special conditions of the contract were finalised in various discussions held with the contractor. A copy of the finalised special conditions was forwarded by Chief Engineer to firm 'P' under his letter dated 14-8-72 and 'P' was requested to convey his acceptance Chief Engineer expedited the firm again on 14-3-1973.

4. In their letter dated 24-4-1973, firm 'P' forwarded the following to the project:

(i) their draft containing all conditions except 2 conditions;

(ii) list of amendments made to conditions listed in (i) above;

(iii) 2—'Special risk' conditions which were yet to be finalised.

5. The modifications proposed by the firm 'P' were considered by Tender Sub-Committee and discussions were held with the firm.

In their letter dated 17-5-1973, firm 'P', submitted revised draft of conditions, *viz.* (i) Clause 5(a)—"Special Risks", (ii) Excepted Risks; and (iii) Clause 10-D "Price Escalation". The firm 'P' reiterated that the revised draft had been prepared by them so as to accommodate the observations of the Tender Sub-Committee and that had the objections been raised by the department prior to start of the work, they would not have agreed to have any revision of the above special conditions.

6. In reply, the Chief Engineer informed the firm 'P' on 13-9-1973 that the clauses modified in light of discussions held in July, 1973 had been sent to the Ministry for approval and therefore it was not possible to make any modifications as suggested.

7. After correspondence and discussions, the firm 'P' in their letter dated 7-3-1974 addressed to Chief Engineer, conveyed their concurrence to the conditions of the contract except for the following 4 conditions which were still under finalisation in consultation with the Ministry of Law:—

(i) Clause 5(a)—'Special Risks'.

(ii) Everything at Contractor's Risk—

(a) Excepted Risks.

(iii) Payment of Advance—

b(ii) Imported Equipment.

(iv) Completion Period.

8. In their letter dated 29-4-1974, the Firm 'P' returned the copy of draft agreement indicating therein the typographical errors which had been duly rectified by them and some additions made to the clauses including variation in clause 39 "Variation in cement and other materials" and clause regarding "Payment of advance".

9. On 31-7-1974, Chief Engineer *inter alia* intimated to 'P' that in regard to the clause for "Payment of Advance", the Ministry of Law had suggested a modification to the clause to facilitate the contractor to claim relief from Income Tax in view of the objection raised by 'P' regarding the ownership of the equipment being made in the name of the President of India.

10. Under letter dated 10-8-1974, the firm 'P' replied that they agreed to clause 39 but as regards the advance clause, they intimated that it was legally not possible to transfer the ownership of their machinery and equipment to the President of India.

11. Chief Engineer forwarded on 21-10-1974 to firm 'P' a copy of the special conditions to accompany the agreement based on the discussions held with the Solicitor to the Government of India and requested them to enter into the agreement immediately.

12. In their letter dated 5-11-1974, the firm 'P' forwarded final draft of special conditions to accompany the tender wherein all corrections said to have been agreed to had been included and they requested the Chief Engineer that the same may be incorporated in the agreement.

13. In reply, Chief Engineer informed firm 'P' on 18-11-1974 that there were a few typographical errors and few modifications made in the firm's copy and few insertions left out and also it was not clear whether the clause "Payment of Advance" sub-para 'C' had been agreed to by Solicitor to Government of India, Ministry of Law. He, therefore, requested the firm 'P' to depute his representative to come to Delhi for further discussions with the Solicitor so that the clauses could be finalised and agreement signed by the end of the month.

14. After discussions with the Solicitor, Ministry of Law, the firm 'P' in their letter dated 4-1-1975 informed the Chief Engineer that sub-clause (iii) of "Payment of Advance" might be deleted and enclosed clause substituted in its place. With regard to signing the Trust Receipt, the firm was agreeable to do so on the footing that such Trust Receipt shall be treated as forming part of the contract document and the Deed of Pledge in general and clause 9 shall be in particular. The firm also returned 'Deed of Pledge' duly initialled.

15. Vide letter dated 8-1-1975, the Chief Engineer intimated to firm 'P' that some discrepancies|omissions had been noticed in the amended clause (iii) under the head 'Payment of Advance' and in the Trust Receipt and requested 'P' to incorporate the corrections in the forms which may be duly typed on stamped papers of required value and to send the same alongwith the tender documents at the earliest for finalisation of the agreement.

16. In the meantime, as a result of two explosions on 25-1-1975 which occurred at face 5 of the Head Race Tunnel, 14 persons lost their lives, including one of the Engineers of the firm 'P'. The firm referred to the above accident in their letter dated 11-2-1975 and stated that their rates did not allow for tunnelling in such dangerous gas and requested Chief Engineer to do everything necessary to make the tunnelling conditions normal and safe from such dangerous gas, free of cost to them.

17. Vide their letter dated 28-2-1975, firm 'P' conveyed their acceptance to the amendments as suggested by the Project except a few amendments in Deed of Pledge and Trust Receipt which were returned initialled after carrying out amendments.

18. Chief Engineer informed the firm 'P' telegraphically on 23-7-1975 that serious view being taken by Ministry for delay in signing agreement and requested for immediate action failing which payments would be stopped.

19. Vide letter dated 4-8-1975, the firm 'P' invited reference to their earlier letter dated 14-2-1975 mentioned in para 15 above and stated that they had no experience in tunnelling under explosive gaseous conditions and it was therefore not possible for them to execute tunnel under such dangerous and hazardous conditions.

20. A number of communications were exchanged with the firm and discussions held in various meetings. On 15-12-75, the firm again reiterated that the geological conditions involved in the tunnelling operations were entirely different than those envisaged in the tender documents and that encounter of highly explosive Mathene gas was altogether a new phenomenon. The firm, therefore, offered following two alternative proposals:—

Proposal I:

The present contract be finalised on mutually accepted basis and the firm be compensated suitably for additional costs for works already executed by them and the Government might prepare a new set of specifications for the entire works and invite fresh tenders.

Proposal II:

As an alternative to above, the firm proposed the following:—

(i) to finalise the present contract after compensating them suitably for additional costs for works already executed by them so far;

(ii) thereafter, the firm will execute the works on faces 1, 2, 3, 6 & 7 (excluding all works between faces 4 & 5) on the following basis—

(a) The Expert Committee to give advice on tunnelling technique, equipment, construction methods and safety precautions,

(b) new rates and terms be negotiated with the firm for works from gate shaft towards face No. 1 & 2.

21. Vide their letter dated 13-2-1976, the firm 'P' intimated to Chief Engineer that they would execute all works except works in faces 4 & 5 which might be awarded to other agencies and if Department proposed to award work at faces 3 & 6 also to the other agencies, as the working points for these faces were common to faces 4 & 5, they would have no objection to their transfer.

22. In their letter dated 10-3-1976, the firm intimated that they have no objection to hand over their surplus equipments for work between faces 4 & 5 on mutually agreed basis. The firm also stated that for the work of tunnelling between faces 1 & 3, it would be necessary to have advice of the Specialist from abroad, which the Government should arrange free of cost, besides other matters on execution of work.

23. Chief Engineer sent a self-contained note with copies of relevant correspondence on 17-3-1976 to the office of the Control Board for further decision by the Control Board/Ministry. The case was referred by the office of the Control Board to Ministry of Energy on 13-4-1976, who intimated that Technical Committee had been set up to advise on the method of undertaking tunnel job and to give continuous guidance and also foreign expertise was being consulted for speedier methods of tunnelling work. The Ministry of Energy also informed that since the project was to be handed over to National Hydro Electric Power Corporation shortly, the Chairman & M.D. designate had been requested by them to visit the project site and examine the organisation capability of the Beas Project and National Projects Construction Corporation for undertaking the work. The Ministry directed that in the meanwhile the advice of the Ministry of Law might be obtained regarding the action that could be taken against the firm 'P' under the clauses of the draft agreement.

24. Accordingly, the case was referred by the Control Board office to Ministry of Law on 25-7-1976. As desired by them a self-contained note was submitted to Ministry of Law on 24-8-1976. Certain clarifications called by Ministry of Law were also furnished on 16-9-1976. The advice of the Ministry of Law was received on 25-9-1976. The Department of Power sought further advice of the Ministry of Law on 8-12-1976 who rendered their advice on 21-12-1976. The Ministry of Law advised that in the peculiar facts and circumstances obtaining in the case, the advisable course was either to issue a show-cause notice without any precipitate action under clause (iii) of the agreement or to send a communication to the contractor calling upon him to fulfil his obligations under the contract.

25. In view of the advice of the Ministry of Law that the precipitate action should not be taken in the present case, Ministry of Energy (Department of Power) directed the Control Board office on 29-12-1976 to bring the Law Ministry's advice regarding legal status of the contract to the notice of the Chairman and Members of the Loktak Committee (High Power Loktak Organisational Committee which had been constituted in July, 1976) and that in view of the proposed negotiations with the contractor, the proposals mentioned above for issue of show-cause notice etc. might be deferred . Accordingly, the relevant papers were sent by the Control Board office to all the Members of Loktak Tunnel Organisational Committee on 6-1-1977 for their consideration and decision.

26. The revised rates and conditions proposed by M|s. Patel Engineering Co. were considered by the High Power Organisational Committee and examined in detail by a Negotiating Committee set up by the above Committee in February, 1977. The Negotiating Committee after careful examination of the proposals of M|s. Patel Engineering Co. for additional rates and extra conditions, a study of comparable rates to the extent available on other jobs and comparison of rates indicated by another public sector undertaking, undertook negotiations with M|s. Patel Engineering Co. Enquiries were also made from other prominent contracting agencies, *e.g.* Hindustan Construction Co., National Projects Construction Corporation and Thapar Intrafor Co. While M|s. Hindustan Construction Co. refused to take up the work under existing geological and gassy conditions, National Projects Construction Corporation and Thapar Intrafor Co. quoted abnormally high rates. The Negotiating Committee arrived at agreed rates and conditions which, in their considered judgement and opinion, were reasonable. The opinion of the Law Ministry was also obtained as to whether revision of rates in the contract was tenable since no formal agreement had been signed till then with M|s. Patel Engineering Co.

27. In the circumstances obtaining, the only pragmatic view that could be taken was to come to a negotiated settlement with the existing contractor in order to expedite the completion of the work. On the basis of the negotiated rates, which were approved by the Board of Directors of National Hydro Electric Power Corporation (which took over the liabilities of the Government consequent on its coming into existence in 1976) the value of the residual portion of the contract settled with M|s. Patel Engineering Co. worked out to Rs. 639.78 lakhs. A formal agreement was accordingly signed with M|s. Patel Engineering Co. on 11th August, 1977

CHAPTER—IV

Conclusions|Recommendations

S. No	Para No. of the Report	Ministry/Department Concerned	Conclusions/Recommendations
1	2	3	4
1	1.10	Energy (Deptt. of Power)	The Committee note that as per project report prepared in 1967, the first unit of the project was anticipated to be commissioned by March 1974. The target date for commissioning the first unit was shifted to March 1976 in the first revised estimate of 1974. According to the schedule of programme drawn up for the second revised estimate of 1976, the target date of commissioning was December, 1980. The Government have now stated that the project would be commissioned in March 1982. The Committee are unhappy to note that the shifting of date of commissioning of the project from time to time has not only delayed its commissioning but has also resulted in the increase in the cost of the project. Initially, it was expected that the estimated cost of the project would be to the tune of Rs. 10.90 crores but as per revised estimate of 1977 the project would cost Rs. 80.63 crores. The Committee have gone into the details of

various factors responsible for delaying the commissioning of the project in subsequent paragraphs of the report. At this stage they could like to point out that Government took about 2 years time in according approval to the project. The project report prepared in December, 1967 was received in the Ministry of Irrigation and Power in January, 1968 and accorded sanction in February, 1970. To their surprise the Committee find that the Central Water and Power Commission took 8 months to complete the techno-economic appraisal of the project and the question of sharing of the benefits of the power generated from the project among the beneficiary States and the question of taking up the project in the Central sector remained under consideration of the Ministry for as long as one year. Thereafter, the Planning Commission took another six months to give their clearance for the Project. The Committee regret that the urgency of the commissioning of the project according to schedule was not realised from the very beginning. The delay in according sanction is to a great extent responsible for the escalation in the cost of the project The Committee would like the Ministry of Energy to streamline the existing procedure for processing and appraisal of the Project Reports at various stages so that minimum time is taken in according sanction to the projects thereby avoiding cost escalation as also delays in the completion of the projects.

2 2·15 Energy (Deptt. of Power) The Committee note that the original project estimate in 1967 was of the order of Rs. 10.90 crores. It was revised to Rs. 32.94 crores

			in 1974 and to Rs 80.63 crores in 1977. Since the cost escalation in the second revised estimates of 1977 was about 150 per cent of the estimate of 1974, the Committee have a feeling that the first revised estimate was deliberately kept within limits to secure its approval. In any case, they would like to stress that the estimates of the projects involving huge outgo from the Exchequer should be prepared realistically so that Government may have a clear picture of the financial commitments involved therein.
3	2·16	-do-	The Committee have been informed that the second revised estimate prepared in 1977 and cleared by the Central Electricity Authority|Central Water Commission in May 1978 is still under examination and consideration of Government for according approval. As about two years have elapsed since the estimate was revised and also in view of the fact that expenditure had already exceeded Rs. 47 crores by 30 June, 1978, it is imperative that the revised administrative approval and expenditure sanction should be accorded without any further delay.
4	3·55	-do-	From the facts brought to their notice, the Committee are sorry to note that the work on such a big project was started admittedly without proper geological investigations. The investigations done were sub-standard and not adequate for making a firm design Although caution was sounded in the geological report that rock conditions for tunnelling were likely to be ideal and tunnelling would be hazardous, no serious attention was paid to it. In the Committee's view information obtained by drilling more holes as suggested and

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			pressure testing the drill holes, might have helped the geologist and the designer to understand better the geo-technical problems involved in the tunnelling. The net result of the lapse on the part of the project planning authorities was that not only the completion of the tunnel was delayed but also the estimated cost of the tunnel has skyrocketed to an astounding level.
5	3·56	Energy (Deptt. of Power)	It has been pointed out to the Committee by no less a person than the Chairman of the Central Water Commission himself that "the (geological) investigations that are being done not only in Loktak but in other parts of the country also are definitely sub-standard in our country", and that is why "we are getting into problems of cost over-runs and time over-runs in our projects." The other point that he made was that "the persons who were put on the (geological) investiga ions are those who are not wanted in the depar.ment." Agreeing with this view even the Chairman of the Central Electricity Authority informed the Committee that ".he people who are posted in investigation organisations are the people who are to be punished; it is not a rewarding post." He further stated that "we are not suffering so much for faulty investigation as due to inadequacy of the investigation."
5	3·57	-do-	The Committee are greatly perturbed at the state of affairs disclosed as above which are confirmed by the results shown in the

case of the Loktak Project. At this stage they can only deplore the inadequate geological studies made before designing the project and also due attention not being paid to the caution struck in the geological investigation report, howsoever inadequate it was. The Committee strongly feel that due to inadequate investigations, there has been not only inordinate delay in the completion of the project but also an eight fold increase in its cost which could have been avoided to some extent, if investigations had been properly done. They recommend that Government should ensure that proper and adequate geological investigations are made of project sites so as to give clear directions to the designers of the project. They would also like the Ministries concerned to pay full attention to the geological investigation reports before clearing the projects. In this context they would also like to emphasise that since many of the State Governments do not have adequate expertise in project design and planning, the planning and designing of projects ivolving substantial expenditure from the exchequer should not be entirely left to them. For this purpose, the Centre should make available, on a more liberal basis, services of their own experts in the field.

7 3·58 -do- The Committee note that the other reason responsible for the delay in completing the tunnelling work was the emergence of methane gas. Methane gas made its first appearance in face 5 of the tunnel in December 1972. At that time no efforts were made to identify the exact nature of the gas. The seriousness of the gas was realised when two workers received burn injuries in July 1974. The precautionary measures as suggested by the Director General of Mines

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			Safety were conveyed to the project authorities in October, 1974 and the project authorities had in the most casual and routine manner conveyed the same to the contractor. The Committee are sorry to note that before these precautions could be fully implemented, a major explosion occurred on 25 January, 1975 resulting in the death of sixteen persons. It was only after this explosion that Government set up a Committee to investigate into and ascertain the causes of the explosions. This Committee found that the officers of the firm employed for the construction work did not seem to possess adequate experience in dealing with situations such as methane gas emissions and for taking timely preventive and safety measures. The Committee regret that precautionary measures were not taken by the contractor and the project authorities when emergence of methane gas was first noticed in 1972 which resulted in the death of workers due to explosions and brought the work on the project to a grinding halt for well over two years.
8	3·59	Energy (Deptt. of Power)	The tender for tunnel and surge shaft was awarded to M|s. Patel Engineering Company Ltd., Bombay for Rs. 571.05 lakhs in preference to M|s. Hindustan Construction Company, Bombay who had quoted a higher rate. Although the Chief Engineer had pleaded that an attempt should be made to negotiate with M|s. Hindustan Construction Company, Bombay to bring down its tender cost as near as possible to that of M|s. Patel Engineering Company Ltd, Bombay in

view of the reputation of the former in tunnel work, the project authorities did not negotiate with M|s. Hindustan Construction Company as in their view M|s. Patel Engineering Company Ltd. were leading tunnel contractors and were in this field for a longer period than M|s. Hindustan Construction Company. It was stated before the Committee that M|s. Patel Engineering Company Ltd. were known to be a firm of standing and considerable experience in the work of tunnelling. The Committee are constrained to note that the assessment made by the project authorities about the capability of M|s. Patel Engineering Company Ltd. in the tunnelling work did not come true. The firm declined to complete the tunnelling after explosion inside the tunnel due to emergence of methane gas in January 1975 on the plea that they had no experience in tunnelling having such extensive gaseous conditions and had no trained and qualified personnel and suitable and necessary equipment to do such work. Various reasons have been advanced to justify the stand taken by the firm but the fact remains that work between faces 4 and 5 and faces 0 and I is now being done departmentally and the original contract for the whole work has been modified in favour of the Contractor. According to the modified contract, the value of the contract for the completion of 45 per cent of the total work is Rs 639.78 lakhs against the tendered value of Rs. 571.05 lakhs for the entire work. In the circumstances, the Committee have a feeling that M|s. Patel Engineering Co. Ltd. are being unduly protected by the authorities at various levels. The Committee would like the Ministry to ensure that contractual obligations cast on the firm are being strictly enforced.

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9.	3·60	Enregy (Deptt. of Power)	The Committee are constrained to note that although the contract for the project estimate for the tunnel and surge shaft was awarded to M|s. Patel Engineering Co. Ltd. in February 1971, the formal agreement was signed with the contracting firm only in August 1977, *i.e.*, after a lapse of 6 years. As for the full 6 years the firm was not bound down to any contractual obligation, it is not unlikely that they would have utilised this advantage in negotiating fresh terms and conditions even in the course of the execution of the project. The suspicion arises from the fact that the contractors were unwilling to render work on faces 4-5 and 0-1 and demanded higher costs for a considerably reduced size of work and that both the demands of the contractors had to be accepted by the authorities. That this situation was allowed to drift for so long is a sad commentary on the wisdom and efficiency of the authorities responsible for the execution of the project. The Committee would like the Ministry to put a stop to such practice and devise procedures making for the signing of the contract immediately on the award of work or soon thereafter.
10.	4·26	-do-	The Committee regret to note that the project estimates for Ithai barrage and power channel were not prepared ralistically. For Ithai barrage, the project estimate was Rs. 13.13 lakhs, the amount indicated in tender notice was Rs. 20 lakhs and the lowest tender of M/s. National Projects Construction Corporation accepted was Rs. 30.62 lakhs. The expenditure incurred upto August, 1977 was

		Rs. 72.38 lakhs and as per second revised project estimate it would be Rs. 149.11 lakhs. Similarly, for the power channel the provision in the original project estimate was Rs. 124 lakhs, the amount mentioned in the tender notice was Rs. 240 lakhs and the work was awarded to M/s. National Projects Construction Corporation for Rs. 6000.57 lakhs. The latest revised cost of the power channel as per second revised estimate was Rs. 1482.13 lakhs. The reasons for the variation between the estimates and the actual expenditure incurred for the construction of Ithai barrage were stated to be *inter alia* the change in the design of the structures necessitated by the desire of the Manipur Government to reclaim more land and consequent increase in quantities and items of work, increase in the cost of construction materials like cement, steel, P.O.L. and increase in labour costs. The change in the design was affected when the construction work was in progress. The main reason for the increase in the cost of power channel was attributed to the sloughing conditions of the soil which resulted in the revision of the channel design. Besides the change in designs, other factors namely increase in the cost of construction materials like steel, cement etc. were stated to be responsible for the increase in cost of construction.
11.	4·27	-do- The Committee find it difficult to appreciate the cost escalation from Rs. 13.13 lakhs to Rs. 149.11 lakhs in the case of Ithai barrage project and from Rs. 124 lakhs to Rs. 1482.13 lakhs for the power channel. Despite the various reasons and explanations offered for this phenominal increase, the Committee consider that much of the escalation was due to project planning being seriously faulty and without perspective.

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12.	5·9	Energy (Deptt. of Power)	The Committee are unhappy to note that the work of fabrication and erection of penstocks scheduled to be completed by 1974 is still in progress. According to the present position of the work, it is expected to be completed by 31st March, 1981. The delay in completion of work is attributed firstly to unstable strata met within certain reaches of the penstock and secondly to the delay in the completion of Face 7 of the tunnel near its outlet. These two factors not only delayed the completion of work but also led to increase in the quantities of work and consequent cost escalation. The Ministry of Energy have admitted that the report of geological investigation on which the project was formulated did not give any indication of unstable strata in the region of the penstock alignment. It was only subsequently when the work was in progress that unstable strata was noticed in certain reaches of the penstock. The Committee regret to observe yet another case of faulty geological investigation resulting in delay in the execution of work and increase in the cost of work from Rs. 109.85 lakhs to Rs. 636.76 lakhs i.e. about 600 per cent more than the initial estimated cost. The Committee consider the delay of more than 6 years in completion of this work as unjustifiably long and hope every effort will be made to complete the work well before the target date now fixed i.e. 31st March, 1981.
13.	6·10	-do-	The Committee find it interesting that the tender of M/s. Gammon India Ltd. was rejected by the tender committee on the plea that its tendered cost was Rs. 79.88 lakhs against the estimated cost of Rs. 40

		lakhs whereas the same work was later on awarded to M/s. National Projects Construction Corporation—a public sector undertaking—at the tendered amount of Rs. 84.75 lakhs. The Committee note that the cost of construction of the power house was originally estimated at Rs. 40 lakhs, the work was awarded at the tendered amount of Rs. 84.75 lakhs, while the latest estimated cost of the work is Rs. 370.14 lakhs. The variation between the cost as originally estimated and the latest estimated cost works out to more than 900 per cent. Whatever be the explanation, the Committee regard it as amazingly ridiculous and hardly doing any credit to the officers and personnel engaged in the estimating work for the project.
14.	6.11	-do-	The Committee have in this report pointed out various lapses, irregularities, omissions and inactions which are, in the opinion of the Committee, directly responsible for the delayed execution of the Loktak Project and an eight fold increase in its cost. Apart from the various suggestions for action made elsewhere in the report, the Committee recommend that a high level enquiry committee may be appointed to go into various lapses etc. pointed out in this report as also in the Audit Paragraph with a view to fix responsibility therefor and, in the light of its finding, lay down guidelines for the execution of projects in future.

GMGIPMRND—LS II—239 LS—25-4-79—1204.