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**HEAVY WATER PLANT,
TUTICORIN**

DEPARTMENT OF ATOMIC ENERGY

**PUBLIC ACCOUNTS
COMMITTEE**

HUNDRED AND SIXTY-NINTH REPORT



**LOK SABHA SECRETARIAT
NEW DELHI**

**HUNDRED AND SIXTY-NINTH
REPORT**

**PUBLIC ACCOUNTS COMMITTEE
(1988-89)**

(EIGHTH LOK SABHA)

**HEAVY WATER PLANT, TUTICORIN
DEPARTMENT OF ATOMIC ENERGY**



Presented in Lok Sabha on 28.4.1989

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**LOK SABHA SECRETARIAT
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PART II*

Minutes of the sittings of the Public Accounts Committee held on:

- (i) 11 January, 1988
- (ii) 26 April, 1988

* Not printed. One cyclostyled copy laid on the Table of the House and 5 copies placed in Parliament Library.

PUBLIC ACCOUNTS COMMITTEE

(1988-89)

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* Appointed as Chairman w.e.f. 5.9.1988 vice Shri C. Madhav Reddy resigned from Chairmanship of the Committee.

@ Appointed w.e.f. 7.12.1988 vice Shri Kalpnath Rai ceased to be member of the Committee on his appointment as a Minister of State.

INTRODUCTION

1. I, the Chairman of the Public Accounts Committee, as authorised by the Committee, do present on their behalf, this Hundred and Sixty-Ninth Report on Paragraph 2 of the Report of the Comptroller and Auditor General of India for the year ended 31 March, 1987, Union Government (Scientific Departments) relating to Heavy Water Plant, Tuticorin.

2. In this Report the Committee have noted that the sanction for Heavy Water Plant, Tuticorin was issued in September 1971 with the targetted date of completion fixed for January, 1975. However, the Plant was commissioned in July 1978 after a delay of $42\frac{1}{2}$ months. The Committee have viewed with great concern the delay of $42\frac{1}{2}$ months in completion of the project which was initially planned to take 44 months and strongly deprecated such enormous time overruns. As such delays in similar other projects can completely throw out of gear the plan to reach a capacity of 10,000 MW of nuclear power by 2000 A.D. The Committee have recommended that for executing projects of this type an appropriate body (such as Steering Committee) may be constituted to ensure meticulous coordination with different authorities, advance planning combined with careful anticipation of the possible impediments.

3. The Committee have noted that the installed capacity of 71.3 MT of Heavy Water was derated on the recommendation of Technical Committee to 49 MT/annum. The derating of capacity was done due to the content of deuterium content in the feed synthesis gas supplied by SPIC being not upto the required capacity (105 ppm against design expectation of 125 ppm) apart from shut downs. The production performance of HWPT has been far below the anticipated level in the last 8 years, the best being 42.7 of installed capacity at one time and the average 20.6%. The Committee are disappointed to note persistent failures of HWPT in achieving reduced production targets with the result that even derated capacity is still to be achieved.

The Committee have observed that according to DAE the cost of production of Heavy Water at Tuticorin worked out to Rs. 4120 per kg; Audit has stated that based on actual expenditure and production it worked out to as high a figure as Rs. 13,800 per kg. The Committee have regretted that DAE could not furnish calculations to indicate how their figure of Rs. 4120 per kg. has been arrived. The Committee have considered it as another instance of lack of proper accounting procedure.

4. The Report of the Comptroller and Auditor General of India for the year ended 31 March, 1987, Union Govt. (Scientific Departments) was laid on the Table of the House on 25 April, 1988. The Committee (1988-89) examined the para 2 thereof at their sitting on 11 January, 1989. The Committee considered and finalised the Report at their sitting held on 27 April, 1989. Minutes of these sittings of the Committee form Part II of the Report.

5. For reference, facility and convenience, the observations and recommendations of the Committee have been printed in thick type of the body of the Report and have also been reproduced in a consolidated form in Appendix II of the Report.

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

7. The Committee would also like to express their thanks to the officers of the Department of Atomic Energy for the cooperation extended by them in giving information to the Committee.

NEW DELHI;
April 27, 1989
Vaisakha 7, 1911 (Saka)

AMAL DATTA
Chairman,
Public Accounts Committee.

REPORT

HEAVY WATER PLANT, TUTICORIN

This Report is based on paragraph 2* of the Report of the Comptroller and Auditor General of India for the year ended 31 March, 1987 (No.7 of 1988), Union Government (Scientific Departments) regarding "Heavy Water Plant, Tuticorin".

Introduction

1.2 The Indian nuclear power programme aims at an installed capacity of 10,000 MW by 2000 AD through the establishment of a chain of thermal reactors with pressurised heavy water used as moderator and coolant.

1.3 According to the Department of Atomic Energy, pressurised heavy water reactors have the following advantages over other types currently in commercial use.

- (i) Higher fuel burn-up can be attained leading to low uranium consumption about half of that of light water reactors.
- (ii) Good yield of plutonium to extend energy fuel for second phase programme would be available earlier.
- (iii) Low overall excess reactivity by use of natural uranium di-oxide fuel, thus providing an inherently safe design feature.
- (iv) On-power refuelling facility of the design.
- (v) Lower fuelling cost.

1.4 The Committee enquired from the Secretary, Department of Atomic Energy the reasons for the selection of pressurised heavy water natural uranium reactors and not light water-enriched uranium route. The Secretary stated that India has a relatively low uranium reserve and general information, unclassified information, etc. available on economics of uranium isotope separation in 1960's indicated that unless there is a large plant, the economic situation would be very unfavourable. In addition, as the uranium enrichment plant requires a large amount of power, it was felt that a minimum economic scale plant for enriched uranium would be using 10,000 or 15,000 MWs of power and it would require large amount of uranium to be processed altogether for economics to be favourable.

* Vide Appendix I

1.5 The Secretary, Department of Atomic Energy, also stated that engineering capability required in light water reactors for making a very high pressure vessels, large pumps with Zero leakage etc., was completely beyond the realm of engineering capability that India could foresee in sixties and even seventies. Another factor that contributed to adoption of Heavy Water Reactor was that according to the Department, the Department was looking for a reactor system that would give the highest plutonium yield as a by-product and it was found that heavy water reactor gives a high yield of plutonium.

Heavy Water Plant, Tuticorin—Adoption of Ammonia Hydrogen Exchange Process

1.6 Large scale heavy water plants based on hydrogen sulphide water exchange process had been set up in the United States in the 50's and Canada in the 70's. In view of the sensitive nature of the technology involved, none of the countries were willing to participate in a collaborative venture for setting up similar plants in India. Hence in the early 60's it was decided to undertake research and development efforts in BARC for the development of hydrogen sulphide water exchange process. Based on the research and development work, a decision was taken to set up the first hydrogen sulphide water exchange process plant at Rawatbhata, Rajasthan adjacent to Rajasthan Atomic Power Station. Since this was the first plant being built indigenously, it was considered prudent to await operational experience with this first plant, before considering setting up additional plants based on this technology.

1.7 The Secretary, DAE, further clarified during evidence in this regard that the United States had set up heavy water production plants using hydrogen sulphide water exchange process, but access to these plants was just not possible. The Secretary further stated that it is a very difficult process because hydrogen sulphide is a very corrosive gas and therefore a long time was taken to understand that technology.

1.8 The Secretary also stated that in order to cater to the projected requirement of heavy water, it was necessary to consider other available processes also for exploitation.

1.9 In the early 70's, the Ammonia Hydrogen exchange process for production of heavy water had been developed by France and demonstrated in their pilot plant of 20 tonnes/year capacity at Mazingarbe. A French consortium, M/s Gelpra, was willing for a collaboration with the Department of Atomic Energy for designing, engineering and transferring the technical know-how for a large-sized heavy water plant. The French government also came forward to make available French credit for financing the plant to be set up. At this time, there were proposals for establishing a large number of fertilizer plants in the country, with which heavy water plants based on the Ammonia

water exchange process, could be integrated. It was in this context that a decision was taken to set up HWP Tuticorin in 1971 by adopting Ammonia Hydrogen exchange process. A technical collaboration agreement was entered into with M/s Gelpra in April 1971 according to which the plant was scheduled to be commissioned in January 1975. The HWP was decided to be attached to the single stream ammonia plant of Southern Petrochemical Industries Corporation Ltd. (SPIC) at Tuticorin. The financial sanction for the plant was issued in September, 1971.

1.10 The Secretary DAE also stated during evidence that Ammonia Hydrogen exchange route is good because this process requires less capital investment than the Hydrogen Sulphide route and India is one of the very few countries in the world where ammonia production is going on in large scale.

Delay in Completion of Project

1.11 The sanction for HWP Tuticorin was issued in September, 1971 with the targetted date of completion fixed for January, 1975. However, the plant was commissioned in July 1978 after a delay of $42\frac{1}{2}$ months. Delays experienced in activities which fall in the critical path sequentially listed were as under:

1. Delay in completion of civil works	24 months
2. Delay in completion of structural work	8 months
3. Delay in completion of erection of equipment	5 months
4. Delay in completion of commissioning	$5\frac{1}{2}$ months
Total delay	$42\frac{1}{2}$ months

1.12 Each of the above listed major activities individually had taken longer time than originally estimated or as mentioned above. However, the contribution of each activity sequentially to the delay in the overall project completion schedule is indicated above.

Delay in acquisition of land and soil testing

1.13 As per schedule, acquisition of land and soil testing were to be completed within 4 months of collaboration agreement entered into with M/s. Gelpra, i.e. by September 1971. However, it was completed only in April 1972 (7 months' delay). According to the Department of Atomic Energy, one of the

reasons for delay was that SPIC changed the location of site within its premises. During the preliminary joint discussions with Gelpra and SPIC, the requirement of land to accommodate the essential plant units such as compressor house, main plant structure, cracker unit, control room etc. which were in the scope of design and supply of Gelpra had been assessed at 100M × 100M. It was then thought that Heavy water plant would be able to utilise some of the SPIC facilities such as Nitrogen plant, workshop, fire station, canteen facilities etc. However, during subsequent discussions with SPIC, it was found that it was not feasible to depend on SPIC for provisions of all the above facilities. The total requirement of land was accordingly worked out approximately at 200M × 240M, in order to locate all the facilities in one area. The venue had also to be shifted from that originally earmarked, since adequate open land was not available at the original location.

1.14 The Committee enquired, why at the initial stage requirement of plot of land was 100M × 100M and later on the requirements were assessed at 200M × 240M which was more or less seven times more. The Chief Executive, Heavy Water plant, Tuticorin stated in this regard that the first estimate of land was made in the 1970 when there was a joint sitting between concerned parties. According to the Chief Executive at that time, a clear idea was available as far as the space requirement for the main plant alone was concerned and for some of the auxiliaries it was not possible to firm up total space requirements. He further stated that it was thought that SPIC would be in a position to give additional land to cater to this requirement. When finalisation for all the auxiliaries, requirement was done, SPIC was not in a position to give land in that particular area but else where, not contiguous to the main plant. As a result the site was changed and final requirement of land was assessed at 200M × 240M.

Delay in completion of civil and structural works

1.15 The civil and structural works which were due for completion in 10 months by December 1973 were completed only in July 1976 after a delay of 32 months. An arbitrator who was appointed to settle disputes with the contractor held the Department of Atomic Energy responsible for a delay of 10 month for non-supply of approved drawings and supply of requisite steel and contractor was allowed Rs.2.05 lakh by way of wage escalation.

1.16 The delay of 32 months in completion of structural work by contractors has been attributed by the Department to the following reasons:

1	2	3
1. Late issue of drawings by Hwp even after contract period*. (*These drawings were issued in a phased manner at different times and were further subjected to revision/additions because of revision of loading data/Layout of equipment by M/s. Gelpira during the course of work)	About 6 to 7 months	
2. Non-availability of matching steel supplies by Deptt.	4 to 6 months	
3. Impact of workers going on strike at the manufacturers end.	2 months	
4. Delay in transportation of fabricated steel from the work shops of manufactures at Bombay & Madras to Site due to railway strike.	5 Months	
5. Increase in total tonnage of fabrication erection from 1800 to 1961	2 months	
6. Shortage of industrial gases, electrodes, power, etc.	2 months	
7. Shortfall on the part of M/s. Richardson & Crudas Contractors to maintain production schedule as follows:		
(i) Delay in submission of shop drawings	4 to 5 months	
(ii) Delay in fabrication and erection	9 to 10 months	

1.17 The various factors which contributed to the delay have been briefly summarised as under by the Department.

- (i) All the process equipments, including the main isotopic exchange tower measuring 2.5M in diameter and 42 metres in length and weighing about 425 tonnes, are accommodated within the steel structures of the main plant. The dimensions of the structures for accommodating the process equipment, including the massive Isotopic Exchange were 16M width, about 84 M in length and 60 M in height. The design, fabrication etc. of such massive structures (involving fabrication) etc. of such massive structures were finalised by the consultants based on the structurals normally available in the country and got approved by collaborators. However, when procurement action was initiated, it was found that certain heavy structurals were not available from SAIL. The fabrication drawings had, therefore, to

be revised, to suit the available steel sections, and were got re-approved by the collaborators.

- (ii) Due to complexity involved in the fabrication of these massive structures, and the accuracy required in the fabrication, only very few fabricators with necessary shop facilities at Bombay and Madras could be entrusted with the work.
- (iii) Delay occurred in fabrication jobs due to various factors such as non-availability of required steel sections, and other difficulties such as power cuts, labour problems etc. faced by the fabricators.
- (iv) Difficulty faced in the transport of the fabricated structures to the site at Tuticorin, which involved transport from Bombay to Madras, transshipment from broad gauge to metre gauge at Madras, and obtaining approvals from the Railway Authorities for loading of over dimensional consignments etc.
- (v) Though the fabricators despatched the fabricated items in the proper sequence for erection, these were not received at site in the same sequence, leading to delays in erection.

1.18 Some of the specific contributory causes for delays are further considered below:

Delay in transport of fabricated materials

1.19 A major portion of the fabrication job was done in the fabricators' works in Bombay. These fabricated items had to be transported from Bombay to Tuticorin. This involved change over from broad gauge to metre gauge (near Madras), because of which considerable delay was experienced owing to non-availability of wagons when required and the clearances which had to be obtained from the Railway authorities for the loading of the over-dimensional items in the metre gauge wagons. The items also got mixed up in the course of transshipment, as a result of which the fabricated items did not arrive at site in the sequence required for erection. This alone led to a stretch of five months in the time taken for erection.

Delay on the part of indigenous fabricators/equipment suppliers

1.20 Orders placed with Bharat Heavy Plates and Vessels Ltd. (BHPV) in September 1972 for fabrication of the equipment included supply of 14 items of equipment at a cost of Rs. 34.04 lakhs. In terms of various purchase orders placed, the vendor was to procure all the raw materials including imported items required for fabrication of the equipment covered under the various purchase orders and there was no free issue of raw materials involved.

However, during the periodical visits of the officers of Heavy Water Project to the BHPV's works, it was found that the progress made by the vendors in importing the raw materials was not encouraging. At that time, there were import restrictions affecting the import of special steel materials such as carbon steel plates of special quality, Heat exchanger Tubes, Forgings etc. Consequently, one of the major bottlenecks faced by BHPV was in the timely import of such items after complying with procedural formalities. When the vendor approached the heavy water project authorities for necessary help in the matter, possibilities of making available to it some of the imported materials in stock with HWPs were explored and certain items like pipes and pipe fittings etc. were identified for diversion to the vendor. These items supplied by HWP were utilised by the vendor for fabrication of the equipment covered under some of the purchase orders placed on them. Order for supply of 14 items of equipment at a cost of Rs. 34.04 lakhs by October/November 1973 had ultimately to be cancelled.

1.21 A decision to revert 7 out of the 14 items to M/s. Gelpra was taken in September 1973, at the prices already quoted and included in the contract with them. These items were shipped by the foreign collaborators as per schedule i.e., in September 1974.

1.22 The order for the remaining items was placed on M/s. Toyo Engg. Corporation, Japan in November 1973. these items were also shipped by the suppliers in August 1974 as scheduled.

1.23 There were other indigenous vendors also who delayed supplies of various equipments to HWPT, leading to overall delay in execution of the project. The question of levy of liquidated damages was reported to have been considered and decided on the merits of each case. One of the considerations was that in such cases, involving pioneering efforts, should not lead to a situation which would deter the parties from taking up similar orders in future. However, in case of Bharat Heavy Plates and Vessels Ltd. the liquidated damages were recovered from the party. Explaining the reasons for cancellation of orders of 14 items of equipment from BHPV and ultimate resort to import, the Chairman, Atomic Energy Commission stated during evidence that BHPV had their own procurement system and they agreed to procure special type of steel required for equipments ordered by Department of Atomic Energy. According to the Chairman AEC since, BHPV had a lot of management problems, the undertaking could not make much progress in this regard. In the end reversion to foreign suppliers took place to expedite procurement of several finished equipment.

Delay due to increased imports

1.24 Several items which were planned for indigenous production could not be so procured and had to be imported resulting in delay. According to

information supplied by the Department of Atomic Energy, the Department has all along adopted a policy of maximising the procurement from indigenous sources, of items of equipment, components etc. required for all its activities including R&D, nuclear power programmes, etc. This policy is stated to have been followed not only for saving foreign exchange, but also for building up indigenous capability, so as to minimise dependence on foreign sources for supply of items which are of a critical nature and are subject to export restrictions imposed from time to time by foreign countries on various consideration.

1.25 The Committee enquired whether it was a fact that due to poor vendor capability market survey the Department of Atomic Energy could not build indigenous capacity. The Chairman AEC stated in this regard: "I would say that assessment of vendor capability was done quite meticulously, and thoroughly. But I think our expectation of these industries was higher than what realities bore out. Many of them, of course, had their own internal problems of management, external circumstances and so on and so forth, but there is also the inherent complexity of the task".

1.26 The Committee also enquired, if the Department of Atomic Energy have been able to build up data base on vendor capabilities in various fields. The information supplied by the Department of Atomic Energy on 31 January, 1989 indicated that the DAE does have a data-base on vendors on whom orders are placed on behalf of the major constituent units of the department including the Heavy Water Projects. This data-base is prepared by the Directorate of Purchase & Stores, which itself is a constituent unit of the Department.

1.27 In the context of attaining the targetted capacity of 10,000 MW by 2000 A.D. through atomic power plants, the Committee can hardly emphasise the importance of effective and realistic planning and timely execution of projects connected with development of atomic energy in the country. The Committee view with great concern the delay of $42\frac{1}{2}$ months in completion of the project which was initially planned to take 44 months and strongly deprecate such enormous time-overruns. Such delays in similar other projects can completely throw out of gear the plan to reach a capacity of 10,000 MW by 2000 AD.

1.28 The Committee are surprised to note that out of overall delay of $42\frac{1}{2}$ months as much as 32 months were on account of civil and structural works which were expected to take not more than 10 months. From the several reasons given for the delays it is obvious that the schedule of 10 months was arrived at without taking note of various basic impediments. The Committee have come to the inescapable conclusion that there has been a most casual approach in the matter of preparation of project estimates and the processing thereof. In the context of the experience in

this case, the Committee recommend that for executing projects of this type an appropriate body (such as a steering committee) may be constituted to ensure meticulous coordination with different authorities, advance planning combined with careful anticipation of the possible impediments.

1.29 Among the important reasons advanced for delay in the completion of civil and structural works are delays in acquisition of land, difficulties in procurement of certain heavy structurals necessitation revision of fabrication drawings, non-availability of required steel sections, difficulty in transport of fabricated materials, inability of indigenous manufacturers to supply import substitutes etc.

1.30 As regards acquisition of land, the Committee have been informed that the land requirement for the plant was initially assessed at 100Mx100M and later it was raised by nearly 7 times to measure 200M × 240M. The explanations such as initial intention to share facilities with SPIC, lack of clear idea on space requirements for auxiliary facilities, etc., are indicative of absence of detailed planning and lack of essential information. At this stage the Committee can only express their anguish on the failure of the Department to assess the requirement of land due to conceptual failure to envisage the total project design.

1.31 As regards steel, the Committee cannot but express their unhappiness that a project of national importance like HWP was delayed due to non-availability of matching steel. The Committee recommend that there should be a standing direction to treat such projects as core projects in the matter of allocation of steel and other scarce materials.

1.32 As regards transportation of fabricated materials, the Committee are shocked to note that two Government Organisations involved in the matter viz. the Railways and the Department of Atomic Energy, failed to tackle the issue by holding dialogue at an appropriate level and plan the despatch and receipt according to an agreed programme resulting in avoidable delay in execution of a vital project.

1.33 As regards inability of indigenous manufacturers to supply 14 items, the Committee are not convinced by the reasons advanced for import of 14 finished items or the delay in arrangement of import. The Committee strongly feel that an exercise should have been undertaken to identify the problems likely to be faced in the manufacture of the various items and timely solution thereof devised at the planning stage itself. The Committee would therefore urge that planning is done in utmost detail after carefully considering and taking into account all possible impediments.

Cost Overrun

1.34 Initially, the cost of the project was estimated at Rs.2.132 lakhs in 1971. However, after the project was commissioned in July 1978, a revised financial sanction for Rs.3741 lakhs was issued in June, 1979 (an increase of 130% over the initial estimated cost). The total capital cost of the project stood at Rs.38.48 crores (gross). The initial estimate included foreign exchange provision of Rs. 7 crores, but the total expenditure actually incurred in foreign exchange for the project was Rs.19.36 crores as against the estimated foreign exchange expenditure of Rs.20.57 crores in the revised estimate. The total expenditure incurred on the project with break-up of various sub-heads alongwith foreign exchange component is shown in the table below:

Total Expenditure incurred on HWP (Tuticorin)

<i>Sr. No.</i>	<i>Sub head of Expenditure</i>	<i>Actual Exp.FE Component (Rs. in lakhs)</i>	
1.	Establishment and office contingency	179.15	—
2.	Plant contingency	105.42	—
3.	Civil & Structural works	183.62	—
4.	Erection	112.96	—
5.	Machinery, equipment and materials including insurance, freight and Customs Duty	2342.31	1191.00
6.	Supervision of erection and commissioning	430.40	413.00
7.	Engineering design and consultancy	331.62	332.00
8.	Plant commissioning expenditure	162.10	—
	Total Gross	3847.58	1936.00
	Loss cost of spares	(—) 110.92	
	Total (Net)	3736.66	1936.00

Increase in expenditure on civil and structural work

1.35 The increase in the estimated expenditure on civil and structural works was 36 per cent, i.e. from Rs.141 lakhs to Rs.192 lakhs. This increase in expenditure on civil and structural works was attributed to the following reasons:

Rs. in lakhs

(i) Due to increase in the quantum of structural steel work on account of modifications required to suit equipment and piping layout firmed up subsequently	30.00
(ii) Escalation in the prices of construction materials such as bricks, stone aggregate, cement etc. which were in short supply	7.00
(iii) Acquisition and development of additional land with an independent approach road to plant site. This involved considerable filling of the low lying areas, formation of the approach road and providing sewage.	8.00
(iv) A few additional works such as civil works for 110 kv switchyard/control room, stores, time office etc.	6.00

Increase in cost on machineries

1.36 The initial estimated cost in respect of machinery was Rs.1398.90 lakhs. It was revised to Rs. 2346.00 lakhs. Total increase of cost under machineries was thus Rs.947.10 lakhs.

1.37 The factors responsible for increase in the cost of machinery and equipment by Rs. 947.00 lakhs were categorised by the Department as under:

	<i>Rs. in lakh</i>
(i) Revisions in the customs tariff	313.21
(ii) Increase due to variation in the exchange rate	265.57
(iii) Increase in ocean freight and insurance	45.40
(iv) Increase in the scope of FOB supplies	*282.34
(v) Increase in Railway freight and inland transportation	40.48
Total	947.00

1.38 The Committee enquired the reasons for considerable increase in foreign exchange component from Rs. 7 crores in the initial estimate to Rs.19.36 crores, the Secretary DAE stated in this regard that "this is because of disappointments on local supplies and reversion to foreign supply because local supply did not come in time or there were practical difficulties in making some of these items."

* This includes cost of spares to the extent of Rs. 117 lakhs (Which were subsequently decapitalised on completion of the project and taken to revenue)

1.39 The Chief Executive of Heavy Water Plant stated during evidence that the actual expenditure on the plant was Rs.37.36 crores and that Rs.2.54 crores have been spent on various improvements to the plant after commissioning. After taking into account the interest on the investment, the total capital investment has been placed at Rs.48.93 crores.

Increase in cost due to extension in commissioning period

1.40 The commissioning period of the plant was initially estimated to be 2½ months and the original estimate did not include any provision for commissioning expenses because it was thought that the commissioning was to take place in a short period and expenses were expected to be marginal. However, since the commissioning period of the plant extended to 10 months, an expenditure of Rs.102 lakhs had to be separately booked and capitalised for consumption of raw materials and utilities such as water, boiled feed water, electricity lubricants etc. Similarly due to extension in commissioning period an additional amount of Rs.360.47 lakhs had to be paid to M/s. Gelpra as supervision charges though there was a provision of Rs.70 lakhs only in the original estimate.

1.41 Justifying the extension of commissioning period the DAE stated in a note to the Committee that the 2½ months commissioning period provided in the agreement was based *inter alia* on assumption of uninterrupted and ready availability of synthesis gas from SPIVC, as well as stable and uninterrupted power supply from the grid. For fulfilment of performance guarantees, HWP was to ensure a minimum supply of 80% feed synthesis gas flow on a continuous basis, for a minimum period of 12 days for a test run. Because of severe external constraints caused by frequent interruption in the supply of synthesis gas from the Ammonia Plant of SPIC and power failures from the grid, the conditions needed for undertaking the test runs could not be realised within a period of 2½ months, and commissioning period according to the department thus got extended to 10 months.

Increase in cost due to import of spares

1.42 The original estimates had no provision for import of spares. According to technical agreement with M/s Gelpra there was provision for providing spares for only two years operation by M/s Gelpra and accordingly spares worth Rs. 16.4 lakhs were supplied by M/s Gelpra. Additional spares valued at Rs. 23.868 lakhs were imported subsequently in a phased manner.

1.43 The spare parts philosophy of the Deptt. of Atomic Energy followed in the heavy water plants in brief can be summarised as under:

1. Up to two years requirements of spares which are indigenously available are maintained in inventory, based on their expected consumption and the lead time for their procurement.
2. In the case of imported items, other considerations such as the longer lead time involved in procurement uncertainties in supplies due to export embargo restrictions placed by foreign countries, possibility of obsolescence of equipment/items used in the plant are taken into account in arriving at the quantum of spares to be maintained. Taking these aspects into consideration, generally the policy is to build up inventories upto 5 years requirements, depending on individual items concerned.
3. In addition, certain tailor made items used only in heavy water plant, Tuticorin are maintained, to avoid long shut-downs of plant in the absence of ready availability for replacement of such items.

1.44 The actual cost of spares consumed during the period 1981-82 to 1987-88 was Rs. 3.75 crores and the cost of spares still in stock in HWP Tuticorin as on 1.4.1988 was of the order of Rs. 5.3 crores.

Year-wise break-up of utilisation of spares was as under:

<i>Year</i>	<i>Rs. lakhs</i>
1981-82	17.43
1982-83	62.20
1983-84	70.02
1984-85	121.14
1985-86	21.79
1986-87	15.02
1987-88	67.67

1.45 The Committee enquired why spares accumulated are very large, the Secretary DAE stated "I would mention to the Hon. Members of the Committee that the Department of Atomic Energy has had a very good track record in regard to maintenance technology. In fact we have experienced people for maintaining the complex equipment. We have a very good scientific and rationale policy with regard to spare procurement. It does happen that we are living in situation of export embargo. Some countries will supply something today and may stop supplying it."

1.46 The Secretary DAE added "Our policy is to keep as minimal as we can. It is prudent financial management. But we had an acute situation and in order to deal with that situation, we had to keep contingency spares."

Financial Assistance of Rs. 382 lakhs to SPIC

1.47 At the instance of DAE, an amount of Rs. 382 lakhs was advanced by HWPT to SPIC for increasing the capacity of the Ammonia plant of SPIC from 1000 MT per day to 1100 MT per day (to have an installed capacity of 71.3 MT per annum of Heavy Water Plant). The DAE stated in this regard that at the time it was decided to set up a Heavy Water Plant at Tuticorin, by integrating it with SPIC, the designed production capacity of SPIC ammonia plant was 1000 MT per day. According to the department, this would have limited the estimated production capacity of Heavy Water Plant to about 64 MT per annum. If the production capacity of SPIC ammonia plant, was increased to 1100 MT per day, an additional production of about 7 MT per annum of heavy water was estimated to be achievable without any additional changes in the Heavy Water Plant. According to the calculations of the department, if this production was realised, it would have amounted to a recurring revenue of about Rs. 80.15 lakhs per annum at the then estimated cost of heavy water. The department therefore thought it advantageous to advance the amount to SPIC.

1.48 Accordingly, an agreement was entered into with SPIC in this regard which included provisions for repayment of the amount advanced in instalments. The instalments fixed as per this agreement stipulated payment of Rs. 80.22 lakhs per annum for the first 10 years and Rs. 51.57 lakhs after the 10th year onwards subject to the SPIC ammonia plant operating at design capacity of 1100 TPD. If, however, the production of ammonia was less, then the said amount of Rs. 51.57 lakhs payable by SPIC would be proportionately reduced.

1.49 The Department stated that the advance of Rs. 382 lakhs paid to SPIC, was fully recovered and additional recoveries as above, throughout the life of the Ammonia Plant are also being made.

1.50 The Committee enquired what was the need to advance Rs. 382 lakhs to SPIC for scaling up their ammonia capacity from 1000 MT/day to 1100 MT/day. The Chief Executive of Heavy Water Plant stated during evidence:

“As far as the requirement for SPIC to scale up their production capability is concerned, that was based on our design requirement of 48 metric tonnes/hr. of synthesis gas. They had originally thought of the plant capacity of only 1000 tonnes of ammonia per day. The point here is since we need this gas at 48 metric tonnes per hour, SPIC plant capacity had to be increased to 1100 tonnes of ammonia per day.”

1.51 The Committee are greatly concerned at the disquieting picture that has emerged in regard to financial estimation of cost of THW project. While the estimate initially framed in 1971 was for Rs. 21.32 crores the expenditure on the project swelled to Rs. 38.48 crores (gross) by the time

project was commissioned in July 1978 and sanction for revision was obtained in June 1979, nearly one year after the project was commissioned. Expenditure was incurred over and above the sanctioned cost for several years without sanction of the competent authority. The Committee strongly deprecate such unauthorised expenditure of such magnitude which was moreover incurred over several years without any concern whatsoever for observing the barest of regularity and discipline. The Committee would, therefore urge the Government to ensure observance of strict financial discipline by insisting on preparation of realistic estimates of project costs, control of expenditure within the estimated cost and timely revision wherever necessary.

1.52 The Committee take strong exception to the fact that even in respect of FE component, the Department incurred substantial expenditure to the extent of over Rs. 12 crores without getting the advance sanction of the competent authority. The FE component originally sanctioned was for Rs. 7 crores whereas the amount actually spent was Rs. 19.36 crores which was regularised by the post facto sanction of expenditure to the extent of Rs. 20.57 crores in foreign exchange accorded in June 1979. As this irregularity occurred a decade back, the Committee can, at this stage, only record their displeasure and at the same time recommend that the Government should issue instructions to the effect that revision of estimates wherever necessary should be made and sanction of the competent authority obtained well in time.

1.53 The Committee also note that out of the net increase in FE component to the extent of Rs. 12.36 crores over the initial sanction (Rs. 19.36 crores-Rs. 7 crores) the Department has been able to give details to the Committee in regard to excess to the extent of Rs. 8.81 crores only, comprising of increase in (i) exchange rate Rs. 2.66 crores, (ii) ocean freight Rs. 0.45 crore, (iii) foreign purchases Rs. 2.82 crores, and (iv) commission Rs. 2.90 crores. The Committee records its strong displeasure at the cavalier attitude of the DAE towards maintenance of proper accounts and its accountability to Parliament.

1.54 The Committee note with dismay that the commission payable to the foreign consultants went up from Rs. 70 lakhs as provided in the original estimates to Rs. 360.47 lakhs due to extension in commissioning period from the original 44 months to more than 86 months. The Committee are convinced that this excessive payment of commission could have been substantially reduced, if not avoided for the highly unrealistic time schedule drawn for commissioning the project having regard to the then prevailing power situation. The Committee strongly recommend that in respect of projects involving foreign collaboration, meticulous care must be taken in drawing the time schedule after taking into account the local conditions in a proper perspective.

1.55 The Committee are surprised to note that the initial estimate did not include any provision for spares, though uncertainties in supply due to export embargo restrictions are identifiable factors to be taken into consideration in planning any project. The Committee deprecate such casual assessment of costs at the initial planning stage and subsequent upward revision on consideration that were very much valid when the project was cleared.

Performance of the Plant

1.56 The Production performance of HWPT has been far below the anticipated level in the last 8 years, the best being 42.7% of installed capacity at one time and the average 20.6%.

1.57 The installed capacity of HWPT was 71.3 MT/annum when it was commissioned in July 1978. The capacity of 71.3 MT/annum was based on availability of inputs viz., deuterium content in the feed synthesis gas at 125 ppm, the feed rate of synthesis gas at 48 tonnes per hours, and an operating period of 8,000 continuous hours. These specifications were based on similar naphtha based fertilizer plants elsewhere. The work of Heavy Water Plant as well as the fertilizer plant based on naphtha was taken up simultaneously - for construction. However, due to various process and technical constraints faced by SPIC in their plant right from the initial stages of operation, the required quantity of synthesis gas as well as deuterium concentration in the synthesis gas as per the design intent were not realised.

1.58 The Committee enquired during evidence as to who examined the SPIC process, and at what stage it became apparent that they would never be producing the type of synthesis gas which was anticipated. The Secretary, LAE stated in this regard that "apparently what has happened is that detail of the fertilizer process were not similar to the fertilizer process that the French had used. It is clear that the details of these processes have had an effect at that point of time which was not understood by SPIC or the atomic energy people".

1.59 According to information supplied on 31.1.1989, the DAE stated in this regard that Deuterium concentration in the feed synthesis gas largely depends on the feed stock utilised for production of synthesis gas, the process technology adopted in the Fertilizer Plant for production of ammonia and the effective recycling of the deuterium rich steam condensate into the process.

1.60 The feed stock utilised in the Fertilizer Plant at Mazingarbe, France, was Naphtha and based on the process adopted by them for manufacture of ammonia, the deuterium concentration in synthesis gas was established by them to be 125 ppm. Since, the feed stock proposed to be used in the Fertilizer Plant of the SPIC was also Naphtha, at that time there was no reason for the

Department, per se, to expect a lower deuterium concentration in the synthesis gas from SPIC.

1.61 As regards the process technology, at the time discussions were held with SPIC for setting up of the Heavy water Plant at Tuticorin and freezing of the design for the heavy water plant, SPIC had not frozen the technology they would adopt for production of ammonia, including the scheme for recycling of the process condensate and the type of machinery and equipment they proposed to instal, particularly the synthesis gas compressor. The likelihood or extent of shortcomings arising from the choice of equipment and technology adopted by SPIC was not anticipated. The lower concentration of deuterium in the synthesis gas than what was expected became apparent only after the commissioning of the SPIC ammonia plant.

1.62 Several modifications are reported to have been carried out to overcome these problems, so as to achieve sustained operation and production. Earlier, it was the experience that, after every shutdown, 3 days were required to line up the system after the synthesis gas was made available, 4-5 days thereafter, to achieve 70 per cent concentration of nuclear grade heavy water, and a further 10 days to reach 99.8% concentration. Thus the plant had to operate for a continuous period of 17/18 days before product withdrawal could commence. In order to avoid loss of production caused by shut downs before reaching nuclear grade concentration and thereby avoid loss of separative work already realised, it was decided to commence withdrawal of the heavy water even at 70 per cent concentration and upgrade it to nuclear grade concentration separately. This facility (as part of the Plant) was commissioned in October 1984. By this means, it has been possible to improve the production since 1984-85.

1.63 In view of the various problems seriously affecting the production of heavy water, the Board of Management of HWPS appointed a technical committee consisting of members from Gujarat State Fertilizer Company, Bhabha Atomic Research Center, Power Projects Engineering Division and Heavy Water Projects in 1982 to analyse the causes for shortfall in production of heavy water and to suggest remedial measures to improve the performance of the plant.

1.64 The above technical committee found out major constraints affecting production of heavy water as follows:

- (i) The maximum possible capacity at SPIC was only 44 tonnes of synthesis gas against the designed capacity of 48 tonnes per hour.
- (ii) The limitations on booster compressor of the heavy water plant resulted in inability to handle all the gas produced by the ammonia plant.

- (iii) Occasional high co-co₂ in the feed gas resulted in higher pressure drop in towers.
- (iv) The feed gas had a low deuterium content of 105 ppm against design expectations of 125 ppm.
- (v) Unstable power supply, voltage fluctuations and power failures as well as extended power cuts.

1.65 Remedial measures for these problems recommended by the technical committee were as follows:

- (i) Replacement of the gear box of booster compressor to increase the effective capacity without overloading the motor.
- (ii) Continuous analysis of co-co₂ in the incoming gas and corrective action to avoid choking of purifiers and towers and modifications in the operation of purifiers to take care of higher impurity levels.
- (iii) Recycling of process condensate in the Ammonia Plant to the maximum extent possible.

1.66 Taking the above into account, the Technical Committee determined the maximum achievable production capacity of the plant after incorporation of the modifications, at 49 MT/annum provided uninterrupted and steady power was available to the plant.

1.67 The Secretary DAE stated during evidence in this regard that the fertilizer plant has to operate not only at a specified pressure but also at a lower pressure. The amount of synthesis gas available is lower than what was assumed and feed gas to the plant has a different degree of enrichment. The availability of fertilizer plant itself is lower than what was assumed. The technical committee looked into all these questions and recommended achievable capacity of 49 tonnes/annum. All the recommendations of the Technical Committee he stated, have been implemented except one where a public sector firm took a long time in delivering the equipment. According to the Secretary DAE the stream factor and the production in the last year and this year has been substantially better and HWPT has almost achieved the production capacity recommended by the Technical Committee.

1.68 The modifications recommended by the Technical Committee including the installation of the synthesis gas recirculator are reported to have been incorporated only by January 1989. The effect of these modifications on the production is expected to be realised in about 3 to 4 months.

1.69 The details of the additional expenditure on the improvements which have been effected are given in the statement below:

<i>Sr. No.</i>	<i>Item</i>	<i>Total Exp. (Rs. lakhs)</i>	<i>Remarks</i>
1.	Installation of Upgrading Plant	99.72	To upgrade the off grade heavy water - of about 50-60% concentration withdrawn from the main Plant - to the nuclear grade quality.
2.	Synthesis Gas Recirculator	100.00* (Estimate)	To produce additional reflux ammonia to main Isotope Exchange Tower for improving its deuterium recovery efficiency.
3.	Improvements Modifications in the piping system	51.08	To recirculate the return synthesis gas to Heavy Water Plant in the event of short shut down of SPIC thereby improving the stream factor of the Heavy Water Plant.

1.70 The Committee enquired why even after derating the capacity to 49 tonnes/annum only 70% concentration heavy water is produced and not 100% nuclear grade heavy water. The Secretary DAE stated that the decision to take out off grade heavy water from the plant was based on the perception of the frequency and failure of the plant and because converting 60 to 70% heavy water into nuclear grade is a very easy thing. He added that this decision was based on past experience of interruptions in the plant whereby all the separation work that has been done went to naught and upgrading of heavy water is not a serious thing but it is a very small matter.

Onstream Days

1.71 The HWPT depends on external inputs from the single stream ammonia plant of SPIC to which it is attached. Thus, the maintenance shut downs of the heavy water plant have to be synchronised with the scheduled shut downs of the fertilizer plant (SPIC). Taking this into consideration and the minimum time required for achieving equilibrium conditions for operation of heavy water plant, after which the product(Heavy Water) withdrawal could be commenced the possible on stream days in a year is taken as 300 days.

* The final payments to the vendor are yet to be effected.

According to Audit, out of 2550 available on stream days only 1284 on stream days could be utilised by HWPT - during the period of 8 $\frac{1}{2}$ years of operation.

1.72 Explaining the position in this regard, the Department has stated that during the period of 8 $\frac{1}{2}$ years of the operation of the plant, the contribution to the shut downs by the shut down of SPIC ammonia plant was 32.36%, by power failures was about 21.23% and by HWPT shut down was about 46.41% which was due to various reasons. The performance of the plant during the last three years is reported to be continuously satisfactory as the plant has achieved an average stream factor of about 90%. The year wise on stream days from 1979-80 to 1987-88 are given below:

<i>Year</i>	<i>On stream days achieved</i>
1979-80	163.5
1980-81	169.5
1981-82	169.8
1982-83	107.2
1983-84	148.0
1984-85	269.0
1985-86	238.0
1986-87	296.0
1987-88	274.0

1.73 The reasons for shortfall in on stream days yearwise have been analysed as under by the Department:

<i>Year</i>	<i>Due to SPIC</i>	<i>Due to power failure</i>	<i>Due to HWP</i>
1979-80	68	7	126 *
1980-81	107	8	81
1981-82	140	6	50
1982-83	18	65 \$	173 @
1983-84	23	122 **	72

<i>Year</i>	<i>Due to SPIC</i>	<i>Due to power failure</i>	<i>Due to HWP</i>
1984-85	68	6	22
1985-86	81+21 =102*	4	21
1987-88	78	5	8

* Out of this, 80 days were lost due to lock-out of the factory.

@ Out of this 114 days were lost due to failure of cracker tubes.

§ Out of this 49 days were lost exclusively due to power restrictions imposed by Tamil Nadu Electricity Board during the period 12/1982 to 2/1983.

** There was total power cut by Tamil Nadu Electricity Board from April 1983 to July 1983.

* Annual turn around of 81 days.

1.74 The Committee have been informed that the failure to reach the rated capacity of 1.3 MT. of heavy water per annum was mainly due to content of deuterium in the feed synthesis gas being not upto the required capacity (105 ppm against design expectation of 125 ppm) apart from shut-down. The Committee have also been informed that neither SPIC nor atomic energy people had understood initially that absence of similarity in fertilizer processing adopted in India and in France had the effect on the quality of the feed synthesis gas. At the same time, the Committee note that for ensuring improvements in performance of SPIC, special financial assistance was rendered to it. In the circumstances, the Committee fail to understand how the foreign collaborator also did not point out this main factor at the initial stage and why quality of gas was not tested before assumption on contents of deuterium were made for determining the capacity. The Committee have also been informed that when the design for THWP was finalised, the SPIC had not yet finalised the technology for production of ammonia, type of machinery etc. and that the lower concentration of deuterium became apparent only after commissioning SPIC's ammonia plant. The Committee are concerned to note that Government proceeded with a project of such magnitude on assumed levels of performance without proper scientific analysis. The Committee urge the Government to draw adequate lessons from their experience in this case and ensure that the planning of such costly projects is not done in such slipshod fashion which makes for failure and constitutes big drainage of public money.

1.75 The Committee are disappointed to note persistent failures by THWP and SPIC in achieving the revised lower capacity of 49 M. T. per annum production targets with the result that even the derated capacity is still to be achieved. Against the possible "on stream days" of operation for

300 days in a year, the actuals were less than 200 days upto 1983-84, as low as 107 days in 1982-83; though substantial improvements were achieved later, it had gone down from 296 on stream days in 1986-87 to 274 on stream days in 1987-88. Since the plant has to operate continuously for 7-8 days to achieve even 70% concentration of nuclear grade heavy water, the Committee note that frequent shut-downs for one reason or other, irrespective of whether they were due to THWP or SPIC, are responsible for reduction in onstream days. The Committee are concerned to note in this regard that both SPIC and HWP are responsible in shortfall in onstream days. The Committee trust that both SPIC and THWP will work in coordination to ensure that shut-downs are minimal and production is maximised.

Cost of Production of Heavy Water

1.76 The cost of production of heavy water worked out according to the revised financial sanction of Rs. 3741 lakhs, was Rs. 1145 per kg. based on (i) production capacity of 71.3 MT per annum, (ii) estimated stream factor of 8000 hours, (iii) availability of inputs as per specification and (iv) the cost of inputs prevalent at that time (1978). With reference to the derated capacity of 49 MT/annum the cost of production of heavy water was assessed at Rs. 1666 per kg.

1.77 The Department however, stated in September 1987 that cost of heavy water at the achievable capacity worked out to Rs. 4120 per kg. According to Audit, on the basis of actual annual production the cost would be Rs. 13800 per kg. Apart from low production level which has increased the cost of production, increased capital deployment, increased consumption of utilities and spares etc. have also contributed to high cost. The maintenance cost including spares has been assessed by Audit at Rs. 1301 per kg. on the basis of average annual production. The high cost of maintenance has been attributed to the relatively increased wear and tear due to frequent shut downs and start up of the plant.

1.78 On the principles adopted for ascertaining cost of production, the Department clarified the position as under:

“The cost of heavy water transferred from operating plants to the Heavy Water Pool Management in each year, is worked out on the basis of the actual costs incurred on the various inputs such as electricity, naphtha, Potassium metal, demineralised water steam etc., fees paid to SPIC labour, spares and maintenance of plant and equipment, including maintenance costs on housing colony and administrative expenses. In addition, depreciation on plant and machinery, based on the straightline method, assuming the plant life to be 15 years, is also charged in arriving

at the cost of production. Heavy Water produced continues to remain the property of the Government and when it is used in nuclear power reactors, annual lease charges are levied."

1.79 The actual cost incurred and production achieved of Heavy Water are not indicated as a matter of Government Policy. However, the cost of important inputs has been indicated by the Department in percentage terms based on actual costs incurred during the year of operation 1987-88:

	<i>Heavy Water Plant Tuticorin</i>
Electricity	39.91%
Natural Gas/Naphtha	11.05%
Utilities	8.89%
Spares & Maintenance	5.75%
Labour & Management overheads to RCF	12.36%
Depreciation of straightline method	22.04%

1.80 The Committee enquired how assumed cost of heavy water is calculated. Secretary DAE in reply stated as follows. "We have been doing the calculations on the basis of certain assumed level of production. The fact that we do not produce at the rate that we are expected to or do not operate the plant or the number of hours expected does not mean that we are losing production all the time. Earlier all our production calculations have been done on an assumed life of 15 years. Now we think the economic life of plant could be 20 or 25 years. The fact that we have lost some production earlier will be made good in later years because requirement of heavy water exists."

1.81 The Secretary DAE so observed: "It differs from plant to plant, but we have a pool price and we pool the heavy water and its pricing also. The production cost of Nangal is of the order of half the price. The weightage of Nangal product is very small and the bulk of production is of Tuticorin, Baroda and Thal Vaishet and there is some amount coming from Kota".

Proforma Accounts

1.82 Though HWPT was commissioned in July 1978 it has not yet been declared commercial and no proforma accounts have been prepared. The Department has contended that it is not essential that the proforma accounts should be maintained in all cases where the operations of a department of Government include undertakings of a commercial character and that it is for the Government to decide whether subsidiary or proforma accounts should be maintained in respect of such undertakings. The applicable provision in Government regulations are reported to be as under:

“According to the provisions of Article 119 of Audit Code, when the Accountant General becomes aware of the existence of a commercial undertakings in any department or finds that funds are provided for it in the estimates, he should ascertain the exact nature and scope of the activities of the undertakings, with a view to determining whether it is essential or advisable to maintain suitable subsidiary and proforma accounts. If he considers that maintenance of these accounts is desirable, he should communicate his views to the Government for consideration. In case Government decides that subsidiary accounts should be maintained, it may entrust the preparation of a system of accounts to one of its own officers.”

1.83 The Department further claimed that heavy water being a strategic material, the information relating to the production (e.g. production figures, cost of production, etc.), as well as the documents relating to these items, are treated as sensitive and that the disclosure of such information will not be in the public interest. Heavy water is also treated as the property of the Government, which is on lease to the Nuclear Power Corporation and in these circumstances, the Department stated that orders have not been issued by the Department for the maintenance of Proforma Accounts for the Heavy Water Plants.

1.84 While according to the Department of Atomic Energy the cost of production of Heavy Water at Tuticorin worked out to Rs. 4120 per kg., Audit has stated that based on actual expenditure and production, it worked out to as high a figure as Rs. 13,800 per kg. as against the estimated cost of Rs. 1145/- per kg. with reference to full capacity and Rs. 1,666 per kg. with reference to the derated capacity. The Committee regret to note that the Department could not furnish calculations to indicate how their figure of Rs. 4120 per kg. has been arrived. The Committee consider the inability of the DAE to substantiate their own figure of per kg. cost of production as another instance of lack of proper accounting procedure which in turn is due to their disregard of accountability on their part. The Committee strongly deprecate such attitude. The Committee expect to be furnished with appropriate details in this regard, duly vetted by Audit.

Since the average production cost is dependent on expenditure incurred vis-a-vis quantity produced, and the production rate is not uniform from year to year, the Committee feel that the cost of production per kg. would be varying from year to year. For a realistic assessment of cost of production and for control thereof, the Committee consider it essential that for each year appropriate proforma account on commercial principles should be compiled.

1.85 The Committee are in agreement with the contention of the Department that a pooled price for supply of Heavy Water has to be charged, irrespective of the plant in which the heavy water is manufactured. However, for purposes of financial review of the performance of the respective plants, the Committee consider it necessary that as already recommended, proforma accounts will have to be compiled.

1.86 Since the proforma account is intended to give only financial results of operation of the power system, the Committee do not understand how preparation thereof would result in release of any sensitive data. The Committee consider such claim as a way of evading accountability by escaping scrutiny of audit and this Committee under the guise of sensitivity, public interest etc. The Committee recommend that the issue may be reviewed and in case the Department of Atomic Energy do not agree to the stand, the matter may be referred to Ministry of Finance for an examination of the issue and issue of appropriate instructions under intimation to the Committee.

1.87 As the Committee could not complete the scrutiny of cost of heavy water which in turn is an essential item in the cost of nuclear power the Committee are unable to complete this part of their report and accordingly this part remains an interim report to be finalised after the relevant cost data are made available to them.

NEW DELHI;

27 April, 1989
7 Vaisakha, 1911 (Saka)

AMAL DATTA

Chairman,
Public Accounts Committee.

APPENDIX I

(Vide para 1 of Report)

*Paragraph 2 of the Report of the C & AG of India
for the year ended 31 March, 1987—
Union Government (Scientific Departments)*

2. Heavy Water Plant, Tuticorin

2.1 Introduction

The Indian Nuclear Power Programme aims at an installed capacity of 10,000 M. W. by 2000 A. D. through the establishment of a chain of natural uranium fuelled thermal reactors with pressurised heavy water (PHWR) used as moderator and coolant. Heavy Water is a compound of the heavier isotope of hydrogen, called deuterium and oxygen (D_2O).

Department of Atomic Energy (DAE) had estimated the total requirement of heavy water for the entire programme (10,000 MW) as 13,000 Tonnes and there were five operating plants at various locations.

According to DAE, Tuticorin plant produced 20.6 per cent of installed capacity in the last 8 years. The performance, problems and remedies put through to scale up production etc. at Tuticorin Heavy Water Plant (THWP) are discussed in the following paragraphs.

2.2 Scope of Audit

This review covers the performance of THWP during the period July 1978 to March 1986 and the major reasons for the delay in commissioning the plant.

2.3 Organisational set up

The heavy water plants are managed by the Heavy Water Projects division of the DAE. The heavy water manufactured and acquired are pooled and costed and leased to the individual nuclear power projects. There are heavy water projects in Nangal, Baroda, Talcher, Tuticorin, Kota, Thal Vaishet and Manuguru. The last one is under construction. The Nangal plant is with National Fertilizers Limited and Thal Vaishet is with Rashtriya Chemicals and Fertilizers Limited.

2.4 Highlights

- It was anticipated that each heavy water plant could be set up within 4-5 years. This was not achieved and Tuticorin plant took 7 years.

- There were delays in completion of structural works, plant erection, fabrication of equipments etc. The departmental delays even resulted in the award of damages by the arbitrator.
- The delays increased capital cost from the original Rs. 21.32 crores to Rs. 48.93 crores including interest during construction. An analysis of expenditure showed that in 5 out of the 9 cases the variation was more than 65 *per cent*. In the case of civil and structural work the variation was 36 *per cent*. Since commissioning had been delayed by about 10 months additional supervision charges of Rs. 3.60 crores had to be paid to M/s Gelpra.
- The Tuticorin plant achieved an average annual production of 20.6 *per cent* against its installed capacity in the last 8 years.
- The plant has been able to operate on an average for about 150 days against 300 available days *per annum* in the last 8½ years. The loss of production is in the order of Rs. 123.97 crores.
- The Heavy Water Board had attempted a series of repairs, replacement and modifications to the plant to improve production at additional cost. Coupled with low production, it has changed the economic profile of the plant.
- DAE itself has admitted that the cost of heavy water would be Rs.4120 per kg. based on achievable capacity. On the basis of actual average annual production, the cost would be Rs.13,800 per kg.
- The plant has also attempted a change in strategy of production by initially producing off-grade heavy water which is subsequently upgraded outside the plant.
- The consumption of spares and maintenance cost was high and Rs.190 lakhs had been spent *per annum* on an average. This means a maintenance cost of Rs.1301 per kg. of heavy water produced on an average.
- The power consumption in 1984-85 and 1985-86 was high and the expenditure on this alone was Rs.1650 per kg. in the latter year on the basis of actual production.
- Though the plant has been in production for about 8 years, no proforma account is being prepared.
- Southern Petrochemical Industries Corporation (SPIC) delayed repayment of the financial assistance afforded to them. Since the agreement did not envisage payment of any interest for delayed repayments SPIC was absolved and loss to the Government till 31st March 1985 was Rs.8.65 lakhs.

- No compensation is being collected from SPIC for obtaining cooler Ammonia in return, than what they originally supply. To an Audit query, DAE stated that the matter was being pursued.

2.5 *Import of know-how*

It was initially decided in January 1971 that THWP would have a certain capacity which was subsequently scaled up as it was found feasible to increase the production of ammonia from 1000 tonnes per day to 1100 tonnes per day in the fertilizer plant at SPIC. The total capital cost was estimated as Rs. 2132 lakhs including a financial assistance of Rs. 382 lakhs to SPIC for agreeing to increase the ammonia production.

A technical collaboration agreement was entered into with M/s Gelpra, a French Consortium, for a turn-key project and an agreement was entered into in April 1971 with the plant scheduled to be commissioned by January 1975. The agreement provided for various *guarantees* and warranties for machinery supplied, utilities to be consumed, maintenance of production levels etc.

The plant was commissioned in July 1978 instead of January 1975 with a delay of $42\frac{1}{2}$ months. However M/s Gelpra was absolved of all their contractual obligations, guarantees, warranties etc. through an amending agreement entered into in November 1978 because the plant could not be run and tested on sustained basis due to power shut-down etc. THWP did not reach the level of production indicated in the technical agreement and even the consumption of utilities and spares were higher than those anticipated. Thus, the technology transfer was incomplete at the time of the termination of the contract and the foreign collaborator had to be absolved of his contractual responsibilities.

2.6 *Delays*

The delay of $42\frac{1}{2}$ months was due to a variety of causes and some of the illustrative cases of delays are mentioned below:

(i) Delay in acquisition of land and soil testing

As per the schedule, acquisition of land and soil testing were to be completed within 4 months i.e. 24th September 1971. However, this was completed only in April 1972. The DAE stated in October 1987 that SPIC changed the location of the site within its premises leading to delay. There was also some delay in acquisition since the land to be acquired was under salt cultivation.

(ii) Delay in completion of structural work

Firm 'Y' was awarded the structural steel work at plant building and was to complete the job in 10 months, i.e. by December 1973. The work was completed only in July 1976, i.e. after a delay of 32 months. The sole arbitrator held (April 1982) that the delays in the submission of the approved drawings and supply of the requisite steel were mainly responsible for the prolongation of the contract. He held the DAE to be exclusively responsible for a delay of 9-10 months and the contractor was allowed Rs.2.05 lakhs by way of wage escalation. DAE stated that the delay was due to complexity of the structure, steel shortage, transportation and delay in getting the approval of the collaborator.

(iii) Delay on the part of indigenous fabricators/equipment suppliers

A public sector undertaking was to supply 14 items of equipments by October/November 1973 for a total value of Rs.34.04 lakhs. Subsequently the order was cancelled since no production work had commenced even by October/November 1973 and import was resorted to. No claim for liquidated damages had been made (October 1986) because the exact effect of the delay could not be assessed since there were also delays in the completion of other items of work like civil work, erection of structures etc. In addition, there were other instances of delay in receipt of equipment from indigenous suppliers. A list of important cases where the purchase value of the equipment is more than Rs.5 lakhs and where delays had occurred is appended

DAE accepted the facts (September 1987) and stated "keeping in view our efforts to induce Indian vendors to take up fabrication of complex structures and equipment to exacting specifications, levying of penalty would have been counter-productive".

(iv) Delay due to increased imports

The agreement with M/s Gelpra provided specific items of machinery/equipment which were to be indigenously procured. However, a later survey revealed that all these items could not be indigenously procured according to specifications and had to be imported. This resulted in delay. Had the survey been done in time and decisions taken earlier the delay could have been reduced. DAE stated that reordering on foreign vendors by itself did not delay the completion of the project.

2.7 Cost overrun

The initial financial sanction issued in September 1971 indicated the project cost as Rs.2027 lakhs with foreign exchange component of Rs.690 lakhs. This was revised to Rs.2132 lakhs with a foreign exchange component of Rs.1142 lakhs when the production was scaled up. However a variety of reasons

including delays led to cost escalation and a revised financial sanction for Rs.3741 lakhs was issued in June 1979. This was exclusive of capital cost on spares of Rs. 117 lakhs which has been deducted from capital account. The total capital cost including Interest During Construction (IDC) was Rs. 4893 lakhs and the variation with reference to the original cost was Rs. 2761 lakhs or 130 per cent.

An analysis indicated additional expenditure of more than 65 per cent occurring in the case of 5 out of the 9 sanctioned heads. There was 36 per cent increase in the case of civil and structural work. The additional expenditure was also heavy in the case of imported machinery and equipment, supervision charges paid to M/s Gelpra etc. The details are given at pages 31 and 32 of this Report.

The commissioning period provided in the agreement was 2½ months and the supervision charges provided were Rs.70 lakhs. Since the period of commissioning was extended to 10 months, additional payment of Rs.360.47 lakhs had to be made to M/s Gelpra inclusive of variations in exchange rates. The extension was attributed to frequent interruptions in the supply of synthesis gas by SPIC and power failures, over which THWP had no control.

The original estimate did not provide for any plant commissioning expenses presumably on the ground that the commissioning was to take place in a short period and the expenses were expected to be marginal. However, since the period of commissioning extended to 10 months and the actual consumption of raw materials and utilities such as water, boiled feed water, electricity, lubricant, etc. was on a high scale, the expenditure of Rs. 162 lakhs had to be separately booked and capitalised. Similarly in the original estimate no provision for import of spares was provided as the technical agreement with M/s Gelpra provided for supply of 2 years spares valued at FF 16,40,000. However subsequently spares valued at FF 23,86,898 were imported. DAE stated that additional spares were required to suit Indian conditions and they were also required to minimise outages.

2.8 Performance of the plant

According to the perspective plan (1985-2000) prepared by DAE, the Baroda Plant, set up with M/s Gelpra collaboration, faced problems right from the erection stage. There were also delays in the supply of fabricated equipments, design defects, leakages, failures of pumps, cracking of equipments, explosion, etc. The problems encountered were typical of a new technology and step by step advance was made towards better performance. Since a new technology was being absorbed and since French Pilot Plant had been operated only for 2 years, in retrospect, the decision to contemporaneously set up two plants at Baroda and Tuticorin was not ideal.

<i>Sl. No.</i>	<i>Item</i>	<i>Original cost</i>	<i>Revised cost</i>	<i>Difference +increase -decrease</i>
				(Rupees in lakhs)
1.	Establishment and office contingency	96.80	160.00	+63.20
2.	Plant contingency	40.80	99.80	+59.00
3.	Civil and structural work	141.00	192.00	+51.00
4.	Erection	105.00	121.20	+16.20
5.	Machinery	1398.90	2346.00	+947.10

Reasons

Delay in completion of the plant by 43 months

- i) Increase in foundation, civil and structural works;**
- ii) Need for pile foundation;**
- iii) Acquisition and development of additional land with independent approach to plant site;**
- iv) Additional structural steel and piping layout firmed up subsequently and escalation in the cost of steel, labour and material;**
- v) Additional civil works for switchyard, control room, stores etc.**

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General upward trend in cost.

- i) Increase in cost of FOB supplies combined with variation in exchange rate: 470.75**
- ii) Additional stores: 77.26**
- iii) Insurance and ocean freight: 45.40**
- iv) Increase in customs duty: 313.21**

6. Supervision of erection and commissioning	70.00	450.00	+380.00
7. Engineering design and consultancy	279.50	344.00	+64.50
8. Plant commissioning expenses		145.00	+145.00
9. LESS cost of spares operational items to be decapitalised on commercial operation of the plant		(-) 117.00	(-) 117.00
Total	2132.00	3741.00(+)	1609.00

v) Railway freight and inland transportation:	40.48
	<u>947.10</u>
i) Extended stay of personnel of consortium:	243.00
ii) Variation in exchange rate:	110.00
iii) Increase in the allowance payable in India and cost of extension of bank guarantee:	<u>27.00</u>
	<u>380.00</u>

Variation in exchange rates.

Cost of raw materials and utilities consumed during
trial run and commissioning.

Cost of spares since decapitalised (March 1979).

DAE stated in September 1987 that the technology was a newer one and the reactor programme drawn up by DAE envisaged additional production of heavy water and there was no time to wait for Baroda plant to become operational. The Baroda plant which was taken up in 1970 finally became operational in 1980 and THWP became operational in 1978. The production performance of THWP was far below the anticipated levels in the last 8 years. The best production was 42.7 per cent of the designed capacity and the average has been 20.6 per cent even after 8 years. The shortfall in production amounted to Rs. 186.67 crores.

DAE stated (September 1987) that the accepted achievable capacity of the plant is now different and the shortfall in production should therefore be compared with the above achievable capacity. IN the year 1986-87 about 73 per cent of the effective capacity was achieved and it was expected to improve further. But the effective capacity which the DAE is referring to is the revised one and not the original one for which investments had been made.

The reasons for shortfall in production have ben identified as under:

- (i) the content of deuterium in the feed synthesis gas was not upto the required quality;
- (ii) the content of deuterium in the depleted gas was richer in quality; and
- (iii) frequent shut-down due to external and internal causes like interruptions in the supply of feed gas and mechanical problems.

Several modifications were carried out to overcome these identified problems including recycling of the depleted gas which was expected to increase the production. Additional major equipments like heat exchanger, buffer vessel, quick open valves, isolation valves, safety valves, etc. were ordered (September 1979) at a cost of Rs.28.66 lakhs. The scheme was only partially implemented because of difficulties encountered during the actual modifications. Also there was improved power supply which made the actual modifications redundant. The total expenditure on partial modification and dismantlement amounted to Rs.51.08 lakhs.

Earlier, it was the experience that after every shut-down 3 days were required to line up the system after the synthesis gas was made available and 4-5 days thereafter to achieve 70 per cent concentration of nuclear grade heavy water and further 10 days to reach 100 per cent concentration. Thus the plant had to operate for a continuous 17/18 days to put the system through. In order to abridge the start up operations, it was decided to reduce the concentration of heavy water to be produced to 70 per cent nuclear grade and upgrade it separately. The above change was attempted during 1979-80 and 1980-81 and it was estimated that production value would go up by Rs.450 lakhs. DAE sanctioned (November 1981) the upgradation facility at an estimated cost of Rs.95.05 lakhs. The facility was commissioned in October 1984 at a total cost of Rs.99.70 lakhs.

Since the production did not match the rated capacity, despite the above modifications the Heavy Water Board (Board) constituted a sub-committee (December 1982) to study the causes. The sub-committee recommended remedial measures/modifications to be carried out in two phases at an estimated cost of Rs.250 lakhs. The plant authorities stated in February 1987 that all recommendations except the one for increasing the liquid-gas ratio and provision of captive power plant had been implemented. Despite the implementation of these recommendations, heavy water production was far below the designed capacity.

The poor production at THWP was also the subject of comment of the Estimates Committee (1983-84) who in their 82nd Report (7th Lok Sabha) observed "The Committee find that the Heavy Water Plants at Tuticorin and Baroda which were commissioned in July 1978 and in July 1980 with an installed capacity of 71.3 MT and 67.2 MT respectively have not been working at full capacity because of technical problems. The Committee are of the firm view that when the demand for heavy water to support the nuclear energy programme is picking up so fast, we cannot afford to let the existing heavy water plants languish". But the production could not be substantially improved. Ultimately, the Board recommended (July 1986) derating the achievable capacity of the plant which was accepted by the Atomic Energy Commission.

DAE had also approved (June 1986) further modification at a cost of Rs.100 lakhs involving recirculation of a part of the synthesis gas going through the converter for increasing the ammonia conversion ratio so that additional ammonia required for the reflux could be obtained from the existing system. On this account the improvement in production was expected to reach at least the derated capacity. DAE stated (September 1987) that recirculation pump was expected to be delivered by October 1987.

In addition the plant operational days were also below the norms and in the last 8½ years it has operated only for 1284 days as against 2550 available days. The loss of production in 1266 days is calculated to be Rs.123.97 crores.

In the light of the actual average annual production the technology absorption and stabilisation of operational procedures seem doubtful. The plant authorities stated (February 1987) that at the time of entering into contract with SPIC the deuterium concentration in the feed gas and the quantity of gas to be supplied by SPIC could not be predicted as the SPIC plant had not come into being.

2.9 Cost of Production

The plant commissioned in July 1978 has not yet been declared commercial and no proforma accounts have been prepared. DAE agreed to consider the

commercial notion of the project and stated that the plant would be declared commercial as soon as sustained operation and production levels were reached.

At the time of setting up of the plant (September 1971) the cost of indigenous production of heavy water was estimated to be Rs.500 per kg. which compared favourably with the then landed cost of Rs.670 per kg. Even after the revision of the project cost (June 1979) the unit cost of production was worked out at Rs. 1145 per kg. But many instalments of additional investments and shortfall in production have considerably escalated the cost of production.

DAE stated (September 1987) that cost of production of heavy water at the achievable capacity works out to Rs. 4120 per kg. and the investment including interest during construction per annual tonne is Rs.99.80 lakhs. This is only notional now because the actual average production is much less than the achievable (derated) capacity taken for the purposes of calculation by the Department.

On the basis of actual average annual production the cost would be Rs.13800 per kg. Apart from low production levels which had increased the cost of production, increased capital deployment, increased consumption of utilities and spares etc. had also contributed to high cost. The consumption of spares and maintenance cost as per the accounts for the period 1978-86 are given below:

<i>Year</i>	<i>Spares</i>	<i>Maintenance (Other than spares)</i>	
<i>(Rs. in lakhs)</i>			
1978-79	—	30.08*	
1979-80	—	19.76*	
1980-81	—	107.82*	
1981-82	122.92	6.58	
1982-83	164.97	4.09	
1983-84	159.63	2.16	
1984-85	250.93	17.66	
1985-86	126.01	13.08	
Total	824.46	201.23	1025.69
Average per annum	164.89	25.15	190.04

*Includes spares also

The maintenance cost including spares has been Rs.1301 per kg. on the basis of average annual production. The high cost of maintenance had been attributed to the relatively increased wear and tear due to frequent shut downs

and start-ups of the plant. DAE however stated (October 1987) that approximately only 20 per cent of the spares have been consumed so far. This means a huge inventory of Rs.660 lakhs which is about 4 years consumption and represents blockade of capital.

Amongst the other inputs electricity is important because the project is energy intensive. During 1984-85 and 1985-86, the consumption of power was more than twice the limits indicated in the project report. The cost of this input was Rs.262.37 lakhs and Rs.456.28 lakhs respectively. In the latter year the expenditure was Rs.1650 per kg. on the basis of actual production.

In 1985-86 the total cost utilities amounted to Rs.1100.97 lakhs or Rs.4000 per kg. on the basis of actual production.

As per the original agreement with M/s Gelpra 35 persons exclusive of maintenance personnel were to be employed to run the plant. However, DAE assessed (December 1971) the requirement to be 350 persons on commissioning the plant. The men in position after the plant became operational were 373 in 1978-79 and 457 in 1985-86. The personnel cost has been on the increase both on account of numbers and on account of normal increase in salaries and wages. Contrasted against the derated production the personnel cost for per tonne of heavy water would be mounting. DAE stated (September 1987) that the revised requirement of staff is 523 and the Gelpra assessment was not valid in the operational context of THWP.

2.10 Other interesting points

(i) Payment of extra financing charges of FF 215,000 due to delays

The contract entered into with Gelpra provided for supervision charges of FF 2,260,000 for erection and commissioning of the plant. This was increased to FF 12,260,000 later. An amended contract of November 1978 provided for payment of FF 215,000 for any delay in payment. There was delay in making the payment of FF 2,500,000 being the last instalment resulting in additional payment of FF 215,000 (Rs.3.99 lakhs).

DAE stated (September 1987) that supervision charges were released late to have additional hold over them so that they would expedite the commissioning and conduct the performance test. The objective of the DAE was not achieved and the foreign technicians were released before commissioning. Also the above amendment was entered into in November 1978 when the plant was already delayed by 42 months.

DAE further stated that due to continued unstable power supply, the commissioning of the plant got delayed considerably and the period upto which the foreign engineers and technicians were required to be maintained at

site was not definitely known. A decision was, therefore, taken to terminate the contract with an amendment which was signed in November 1978 in order to minimise the total payments.

(ii) Loss of interest on belated repayment by SPIC

In terms of agreement between THWP and SPIC, the latter had to repay at Rs. 80.22 lakhs *per annum* for the first ten years from the date their ammonia plant went into commercial operation to liquidate the financial assistance of Rs. 382 lakhs given to them. THWP claimed (July 1983) interest from SPIC on belated repayments. SPIC rejected (April 1985) the claim stating that the agreement did not envisage any such payment of interest.

Failure to make suitable provisions in the agreement resulted in a loss of Rs. 8.65 lakhs upto 31st March 1985. DAE stated that they had no comments.

(iii) Undue benefit accruing to SPIC due to limitations in claiming compensation

The agreement between THWP and SPIC provided specifications of the synthesis gas to be returned by THWP to SPIC and *inter alia* stipulated that if the temperature of the gas returned by THWP was lower than the temperature of the gas supplied by SPIC, SPIC should pay compensation to THWP on a mutually agreed basis. So far, THWP has not claimed compensation on this account.

DAE stated (September 1987) that SPIC is neither agreeable to pay any compensation for the additional frigories nor to receive the synthesis gas from THWP (Tuticorin) at higher temperature as it adversely affects their plant operation as a result of increase in pressure of their refrigeration system. The matter is still being pursued with SPIC.

*List of important cases where the purchase value is more than Rs. 5 lakhs and where delay has occurred
[Referred to in para 2.6(iii)]*

<i>Sl. P.O. No./Date</i>	<i>Value (In Rupees)</i>	<i>Description of equip- ment/ item</i>	<i>Name of the supplier</i>	<i>Due date of delivery and erection</i>	<i>Actual month of receipt</i>
1. HWP/PAB/7PO/1757 dated 27-10-1972	9,86,997	Pressure Vessels and heat exchanger	M/s BHPV	1-11-1973	Between 4-5-1975 and 26-5-1976
2. HWP/FAB/11/PO/1749 dated 26-10-1972	8,04,224	-do-	-do-	1-9-1973	Between 24-2-1975 and 27-3-1982
3. HWP/FAB/1/PO/1584 dated 29-9-1972	11,70,000	-do-	-do-	1-10-1973	Between 26-4-1974 and 26-5-1976
4. HWP/FAB/3/PO/1585 dated 29-9-1972	31,55,817	-do-	-do-	1-10-1973	Between 3-5-1975 and 27-6-1976
5. HWP/FAB/2/PO/1589 dated 29-9-1972	24,47,177	Pressure vessels	-do-	1-11-1973	Between 24-2-1975 and 27-5-1976
6. HWP/FAB/7/PO/1591 dated 29-9-1972	12,08,499	Heat exchanger	-do-	-do-	Between 16-10-1974 and 14-7-1976
7. HWP/FAB/9/PO/1651 dated 12-10-1972	5,48,800	-do-	M/s IAEC, Bombay	8-10 months from the date of receipt of free issue materials	18-2-1977

8.	HWP/CAP/129/PO 2378 dt. 9-2-1973	2,45,891	EOT Crane 10 ton	M/s New Stan- dard & CO., Bombay
9.	HWP/CAP/106/PO/ 1694 dt. 30-10-1972	11,79,375	EOT Crane 100 ton	M/s Chitram & Co., Madras
10.	HWP/FAB/14/PO/ 2592 dt. 24-3-1973	3,83,600	Fab. of steel works	M/s R & C Ltd. Bombay
11.	PDN/HWP(T)/MIA/152 PO/3655 dated 24-1-1974	10,30,000	Relay panels	M/s ECIL, Hyderabad
12.	PDN/HWP/Ele/308/ PO/4442 dated 18-2-1974	3,58,470	Cable	M/s Orient Power Cables Ltd., Bombay.
13.	PDN/HWP/EEQ/59/PO 3201 dt. 23-7-1973	12,27,852	Bus Duct with alumi- nium bar	M/s Seimens India Ltd., * Bombay
14.	PDN/HWP/CAP/105 PO/1657 dt. 11-10-1972	8,86,280	Cooling tower	M/s Paharp Cooling, Bombay
15.	PDN/HWP/CAP/144 PO/2345 dt. 31-1-73	2,57,790	Air Compre- ssors with allied accessories	M/s Ingersoll (India) Pvt. Ltd., Bombay
16.	PDN/HWP/CAP/204/ PO/3734 dt. 17-10-73	1,10,525	Starpless Vacuum Ultrafilter expens	M/s Pennwalt India Ltd., Bombay.

15-10-1973/
30-12-1973

16-11-1973 16-8-1975

24-12-1973

July 1974 28-2-1978

20-5-1974
amended to
20-6-1974
31-7-1974

Between 14-8-1974 and 11-4-1975

1-9-1974 Between 16-2-1976 and 27-4-1977

30-6-1974

31-5-1974

Sl. No.	P.O. No./Date	Value (In Rupees)	Description of equip- ment/ item	Name of the supplier	Due date of delivery and erection	Actual month of receipt
17.	PDN/HWP/EER/37/PO/ 4208 dt. 22-2-74	1,05,750	Polower design	M/s Aircondi- tioning Ltd., Calcutta.	15-7-1974	
18.	PDN/HWP/FAB/8/PO/ 3329 dt. 14-8-73	12,02,700	Mec. lifting device	M/s New Stan- dard Engineer- ing Co. Ltd., Bombay.	14-6-1974	24-8-1977
19.	PDN/HWP/FAB/16/PO/ 3579 dt. 18-9-73	1,55,125	Vessels & Heat Exchanger	M/s Bwevest Engg. Works, Coimbatore	25-3-1974	
20.	PDN/HWP/FAB/16/PO/ 3650 dt. 26-9-73	1,34,930	Steam Condenser	M/s Dakabhai Ambalal, Bombay.	26-7-1974	
21.	PDN/HWP/PPF/118/ PO/4645 dt. 14-3-74	2,25,858	Multicore PVC covered instrument	M/s Teednut (Hind) Ltd., Bombay-34.	14-7-1974	
22.	PDN/HWP/PPF/41/PO/ 3819 dt. 13-11-73	1,10,013	Elbows and Herds	M/s Shah Patel & Co., Bombay.	10-3-1974 7-2-1975	
23.	PDN/HWP/Elc/308/PO/ 4441 dt. 18-2-1974	11,14,126	Aluminium Cordn. core Heavy Duty cables	M/s Seimens India Ltd., Bombay.	August 1974	4-12-1974

APPENDIX II

Statement of Recommendations and Observations

<i>Sl. No.</i>	<i>Para No.</i>	<i>Ministry/Deptt. concerned</i>	<i>Conclusions/Recommendations</i>
1	2	3	4
1	1.27	Atomic Energy	<p>In the context of attaining the targetted capacity of 10,000 MW by 2000 A.D. through atomic power plants, the Committee can hardly exphasise the importance of effective and realistic planning and timely execution of projects connected with development of atomic energy in the country. The Committee view with great concern the delay of 42½ months in completion of the project which was initially planned to take 44 months and strongly deprecate such enormous time-overruns. Such delays in similar other projects can completely throw out of gear the plan to reach a capacity of 10,000 MW by 2000 AD.</p>
2	1.28	Atomic Energy	<p>The Committee are surprised to note that out of overall delay of 42½ months as much as 32 months were on account of civil and structural works which were expected to take no more than 10 months. From the several reasons given for the delays it is obvious that the schedule of 10 months was arrived at without taking note of various basic impediments. The Committee have come to the inescapable conclusion that there has been a most casual approach in the matter of preparation of project estimates and the processing thereof. In the context of the experience in this case, the Committee</p>

<i>1</i>	<i>2</i>	<i>3</i>
3	1.29	Atomic Energy
4	1.30	Atomic energy
5	1.31	Atomic Energy

recommend that for executing projects of this type an appropriate body (such as a steering committee) may be constituted to ensure meticulous coordination with different authorities, advance planning combined with careful anticipation of the possible impediments.

Among the important reasons advanced for delay in the completion of civil and structural works are delays in acquisition of land, difficulties in procurement of certain heavy structurals necessitating revision of fabrication drawings, non-availability of required steel sections, difficulty in transport of fabricated materials, inability of indigenous manufacturers to supply import substitutes etc.

As regards acquisition of land, the Committee have been informed that the land requirement for the plant was initially assessed at 100Mx 100M and later it was raised by nearly 7 times to measure 200M x 240M. The explanations such as initial intention to share facilities with SPIC, lack of clear idea on space requirements for auxiliary facilities, etc., are indicative of absence of detailed planning and lack of essential information. At this stage the Committee can only express their anguish on the failure of the Department to assess the requirement of land due to conceptual failure to envisage the total project design.

As regards steel, the Committee cannot but express their unhappiness that a project of national importance like HWP was delayed due to non-availability

<i>1</i>	<i>2</i>	
6	1.32	Atomic Energy
7	1.33	Atomic Energy
8	1.51	Atomic Energy

of matching steel. The Committee recommend that there should be a standing direction to treat such projects as core projects in the matter of allocation of steel and other scarce materials.

As regards transportation of fabricated materials, the Committee are shocked to note that two Government Organisations involved in the matter viz. the Railways and the Department of Atomic Energy, failed to tackle the issue by holding dialogue at an appropriate level and plan the despatch and receipt according to an agreed programme resulting in avoidable delay in execution of a vital project.

As regards inability of indigenous manufacturers to supply 14 items, the Committee are not convinced by the reasons advanced for import of 14 finished items or the delay in arrangement of import. The Committee strongly feel that an exercise should have been undertaken to identify the problems likely to be faced in the manufacture of the various items and timely solution thereof devised at the planning stage itself. The Committee would therefore urge that planning is done in utmost detail after carefully considering and taking into account all possible impediments.

The Committee are greatly concerned at the disquieting picture that has emerged in regard to financial estimation of cost of THW project. While the estimate initially framed in 1971 was for Rs. 21.32 crores the expenditure on the project swelled to Rs. 38.48 crores (gross) by the time project was

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Atomic Energy

commissioned in July 1978 and sanction for revision was obtained in June 1979, nearly one year after the project was commissioned. Expenditure was incurred over and above the sanctioned cost for several years without sanction of the competent authority. The Committee strongly deprecate such unauthorised expenditure of such magnitude which was moreover incurred over several years without any concern whatsoever for observing the barest of regularity and discipline. The Committee would, therefore urge the Government to ensure observance of strict financial discipline by insisting on preparation of realistic estimates of project costs, control of expenditure within the estimated cost and timely revision wherever necessary.

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The Committee take strong exception to the fact that even in respect of FE component, the Department incurred substantial expenditure to the extent of over Rs. 12 crores without getting the advance sanction of the competent authority. The FE component originally sanctioned was for Rs.7 crores whereas the amount actually spent was Rs. 19.36 crores which was regularised by the post facto sanction of expenditure to the extent of Rs. 20.57 crores in foreign exchange accorded in June 1979. As this irregularity occurred a decade back, the committee can, at this stage, only record their displeasure and at the same time recommend that the Government should issue instructions to the effect that revision of estimates wherever necessary should be made and sanction of the competent authority obtained well in time.

1	2	3	4
10	1.53	Atomic Energy	<p>The Committee also note that out of the net increase in FE component to the extent of Rs.12.36 crores over the initial sanction (Rs. 19.36 crores — Rs.7 crores) the Department has been able to give details to the Committee in regard to excess to the extent of Rs.8.81 crores only, comprising of increase in (i) exchange rate Rs.2.66 crores, (ii) ocean freight Rs.0.45 crores, (iii) foreign purchases Rs.2.82 crores and (iv) commission Rs.2.90 crores. The Committee records its strong displeasure at the cavalier attitude of the DAE towards maintenance of proper accounts and its accountability to Parliament.</p>
11	1.54	Atomic Energy	<p>The Committee note with dismay that the commission payable to the foreign consultants went up from Rs.70 lakhs as provided in the original estimates to Rs . 360.47 lakhs due to extension in commissioning period from the original 44 months to more than 86 months. The Committee are convinced that this excessive payment of commission could have been substantially reduced, if not avoided but for the highly unrealistic time schedule drawn for commissioning the project having regard to the then prevailing power situation. The Committee strongly recommend that in respect of projects involving foreign collaboration, meticulous care must be taken in drawing the time schedule after taking into account the local conditions in a proper perspective.</p>
12	1.55	Atomic Energy	<p>The Committee are surprised to note that the initial estimate did not include any provision for spares, though uncertainties in supply due to export embargo restrictions are identifiable factors to be taken into consideration in</p>

<i>1</i>	<i>2</i>	<i>3</i>
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Atomic Energy

planning any project. The Committee deprecate such casual assessment of costs at the initial planning stage and subsequent upward revision of consideration that were very much valid when the project was cleared.

The Committee have been informed that the failure to reach the rated capacity of 1.3 M.T. of heavy water per annum was mainly due to content of deuterium in the feed synthesis gas being not upto the required capacity (105 ppm against design expectation of 125 ppm) apart from shut-down. The Committee have also been informed that neither SPIC nor atomic energy people had understood initially that absence of similarity in fertilizer processing adopted in India and in France had the effect on the quality of the feed synthesis gas. At the same time, the Committee note that for ensuring improvements in performance of SPIC, special financial assistance was rendered to it. In the circumstances, the Committee, fail to understand how the foreign collaborator also did not point out this main factor at the initial stage and why quality of gas was not tested before assumption on contents of deuterium were made for determining the capacity. The Committee have also been informed that when the design for THWP was finalised, the SPIC had etc. and that the lower concentration of deuterium became apparent only after commissioning SPIC's ammonia plant. The Committee are concerned to note that Government proceeded with a project of such magnitude on assumed levels of performance without proper scientific analysis. The Committee urge the Government to draw adequate lessons from their

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Atomic Energy

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Atomic Energy

experience in this case and ensure that the planning of such costly projects is not done in such slipshod fashion which makes for failure and constitutes big drainage of public money.

The Committee are disappointed to note persistent failures by THWP and SPIC in achieving the revised lower capacity of 49 M.T. per annum production targets with the result that even the derated capacity is still to be achieved. Against the possible "onstream days" of operation for 300 days in a year, the actuals were less than 200 days upto 1983-84, as low as 107 days in 1982-83; though substantial improvements were achieved later, it had gone down from 296 onstream days in 1986-87 to 274 on stream days in 1987-88. Since the plant has to operate continuously for 7-8 days to achieve even 70% concentration of nuclear grade heavy water, the Committee note that frequent shut-down for one reason or other, irrespective of whether they were due to THWP or SPIC, are responsible for reduction in on stream days. The Committee are concerned to note in this regard that both SPIC and HWP are responsible in shortfall in on stream days. The Committee trust that both SPIC and THWP will work in coordination to ensure that shut-downs are minimal and production is maximised.

While according to the Department of Atomic Energy the cost of production of Heavy Water at Tuticorin worked out to Rs. 4120 per kg., Audit has stated that based on actual expenditure and production, it worked out to as high a figure as Rs. 13,800 per kg. as against the estimated cost of Rs. 1145/- per kg.

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with reference to full capacity and Rs.1,666 per kg. with reference to the derated capacity. The Committee regret to note that the Department could not furnish calculations to indicate how their figure of Rs.4120 per kg. has been arrived. The Committee consider the inability of the DAE to substantiate their own figure of per kg. cost of production as another instance of lack of proper accounting procedure which in turn is due to their disregard of accountability on their part. The Committee strongly deprecate such attitude. The Committee expect to be furnished with appropriate details in this regard, duly vetted by Audit.

Since the average production cost is dependent on expenditure incurred vis-a-vis quantity produced, and the production rate is not uniform from year to year, the Committee feel that the cost of production per kg. would be varying from year to year. For a realistic assessment of cost of production and for control thereof, the Committee consider it essential that for each year appropriate proforma account on commercial principles should be compiled.

The Committee are in agreement with the contention of the Department that a pooled price for supply of Heavy Water has to be charged, irrespective of the plant in which the heavy water is manufactured. However, for purposes of financial review of the performance of the respective plants, the Committee consider it necessary that as already recommended, proforma accounts will have to be compiled.

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17	1.86	Atomic Energy; Finance	<p>Since the proforma account is intended to give only financial results of operation of the power system, the Committee do not understand how preparation thereof would result in release of any sensitive data. The Committee consider such claim as a way of evading accountability by escaping scrutiny of audit and this Committee under the guise of sensitivity, public interest etc. The Committee recommend that the issue may be reviewed and in case the Department of Atomic Energy do not agree to the stand, the matter may be referred to Ministry of Finance for an examination of the issue and issue of appropriate instructions under intimation to the Committee.</p>
18	1.87	Atomic Energy	<p>As the Committee could not complete the scrutiny of cost of heavy water which in turn is an essential item in the cost of nuclear power the Committee are unable to complete this part of their report and accordingly this part remains an interim report to be finalised after the relevant cost data are made available to them.</p>

**LIST OF AUTHORISED AGENTS FOR THE SALE OF LOK SABHA
SECRETARIAT PUBLICATIONS**

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ANDHRA PRADESH		WEST BENGAL	
1.	M/s. Vijay Book Agency, 11-1-477, Mylargadda, Secunderabad-500361.	13.	M/s. Manimala, Buys & Sells, 123, Bow Bazar Street, Calcutta-1.
BIHAR		DELHI	
2.	M/s. Crown Book Depot, Upper Bazar, Ranchi (Bihar).	14.	M/s. Jain Book Agency, C-9, Connaught Place, New Delhi. (T. No. 351663 & 350806).
GUJARAT		15.	M/s. J. M. Jaina & Brothers, P. Box 1020, Mori Gate, Delhi- 110006. (T. No. 2915064 & 230936).
3.	The New Order Book Company, Ellis Bridge, Ahmedabad-380006. (T. No. 79065).	16.	M/s. Oxford Book & Stationery Co., Scindia House, Connaught Place, New Delhi-110001. (T. No. 3315308 & 45896).
MADHYA PRADESH		17.	M/s. Bookwell, 2/72, Sant Niran- kari Colony, Kingsway Camp, Delhi-110009. (T. No. 7112309).
4.	Modern Book House, Shiv Vilas Palace, Indore City. (T. No. 35289).	18.	M/s. Rajendra Book Agency IV-DR59, Lajpat Nagar, Old, Double Storey, New Delhi- 110024. (T. No. 6412362 & 6412131).
MAHARASHTRA		19.	M/s. Ashok Book Agency, BH-82, Poorvi Shalimar Bagh, Delhi-110033.
5.	M/s. Sunderdas Gian Chand, 601, Girgaum Road, Near Princes Street, Bombay-400002.	20.	M/s. Venus Enterprises, B-2/85, Phase-II, Ashok Vihar, Delhi.
6.	The International Book Service, Deccan Gymkhana, Poona-4.	21.	M/s. Central News Agency Pvt. Ltd., 23/90, Connaught Circus New Delhi-110001. (T. No. 344448, 322705, 344478 & 344508).
7.	The Current Book House, Maruti Lane, Raghunath Dadaji Street, Bombay-400001.	22.	M/s. Amrit Book Co. N-21, Connaught Circus, New Delhi.
8.	M/s. Usha Book Depot, 'Law Book Seller and Publishers' Agents Govt. Publications 585, Chira Bazar Khan House, Bombay-400002.	23.	M/s. Books India Corporation Publishers, Importers & Expor- ters, L-27, Shastri Nagar, Delhi-110052. (T. No. 269631 & 714465).
9.	M&J Services, Publishers, Repre- sentative Accounts & Law Book Sellers, Mohan Kunj, Ground Floor 68, Jyotiba Fuele Road, Nalgaum-Dadar, Bombay-400014.	24.	M/s. Sangam Book Depot, 4378/4B, Murari Lal Street, Ansari Road, Darya Ganj, New Delhi-110002.
10.	Subscribers Subscription Services India, 21, Raghunath Dadaji Street, 2nd Floor, Bombay-400001.		
TAMIL NADU			
11.	M/s. M. M. Subscription Agen- cies, 14th Murali Street, (1st floor) Mahalingapuram, Nungam- bakkam, Madras-600034. (T. No. 476558).		
UTTAR PRADESH			
12.	Law Publishers, Sardar Patel Marg, P. B. No. 77, Allahabad, U.P.		

