E.C. No. 731

ESTIMATES COMMITTEE
(1972-73)

TWENTY-NINTH REPORT
(FIFTH LOK SABHA)

DEPARTMENT OF ATOMIC ENERGY

Action taken by Government on the Recommendations contained in the Hundred and Twenty-Ninth Report of the Estimates Committee (Fourth Lok Sabha) on the Department of Atomic Energy—Atomic Power

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INTRODUCTION

I, the Chairman of the Estimates Committee having been authorised by the Committee, present this Report of the Estimates Committee on action taken by Government on the recommendations contained in the Hundred Twenty-Ninth Report of Estimates Committee (Fourth Lok Sabha) on the Department of Atomic Energy—Atomic Power.

2. The Hundred Twenty-Ninth Report was presented to Lok Sabha on the 31st July, 1970. Government furnished their replies indicating action taken on the recommendations contained in that Report on the 30th January, 1971, 15th March and 4th July, 1972. The replies were considered by the Study Group 'E' of the Estimates Committee (1971-72) on the 17th February, 1972. The Study Group 'E' of the Estimates Committee (1972-73) considered further replies received from the Department on the 16th June, 1972, 24th November, 1972 and 1st December, 1972 and approved the draft Report on the 1st February, 1973. The Report was subsequently adopted by the Committee on the 12th February, 1973.

3. The Report has been divided into the following Chapters:

I. Report;

II. Recommendations which have been accepted by Government;

III. Recommendations which the Committee do not desire to pursue in view of the Government's replies;

IV. Recommendations in respect of which replies of Government has not been accepted by the Committee.

4. An analysis of the action taken by Government on the recommendations contained in the Hundred Twenty-Ninth Report of the Estimates Committee (Fourth Lok Sabha) is given in Appendix—IV. It would be observed therefrom that out of 75 recommendations made in the said Report, 34 recommendations *i.e.* 45.4 per cent have been accepted by Government. The Committee do not desire to pursue 19 recommendations *i.e.* 25.3 per cent in view of Govern-

"It has been stated in your reply, that an amount of Rs. 2.60 crores has been paid to the International General Electric as bonus in terms of the contract for increase in electrical output over the rated capacity.

(a) Please state the period when the payment of performance bonus was made to the International General Electric.

(b) Please state the reasons why the information about the payment to the contractors could not be supplied to the Estimates Committee earlier.

(c) Please state the basis on which the increase in electrical output over the rated capacity was worked out and with what results."

4. Government in their reply have stated—

(a) Payment of performance bonus was made on 24th March, 1970 to the International General Electric Company. This question was considered by the Atomic Energy Commission from time to time and the final payment was approved at their meeting held on March 6, 1970.

(b) At the time of furnishing the information to the Estimates Committee in October, 1969, the position regarding the payment of bonus to the contractors was not known. At the time of actual verification of the Report, it was assumed that beyond the verification of the facts mentioned in the information furnished earlier to the Committee no modifications could be introduced in the Report. It was only for this reason that the payment of bonus to International General Electric was not intimated at that time.

(c) Bonus was payable if (i) the Station's net electrical output exceeded the warranted value or (ii) the Station's net heat rate is below the warranted performance specified in the contract with International General Electric. The basis on which bonus was to be worked out was also specified in the Contract. The bonus was paid on the basis of a Station's net electrical output of 400 MW and the Station's net heat at 11,406.00 btu|kwh against the warranted values of 380 MW and Station's net heat rate of 11,860 btu/kwh respectively.

DAMAGES RECOVERED FROM INTERNATIONAL GENERAL ELECTRIC COMPANY FOR DELAYED COMMISSIONING OF TARAPUR PROJECT.

Recommendation (S. No. 16, Para 2.44).

5. The Committee in Para 2.44 of above Report had observed that Government had taken a long time in determining the amount of damages to be recovered from International General Electric on account of delay in the commissioning of the Project. The Committee desired this matter to be settled with expedition.

6. In their reply Government have stated that the matter has been settled in March, 1970. The delay in commissioning after making allowance for *force majeure* and other considerations for which, under the contract, General Electric are entitled to extension of time has been assessed and liquidated damages amounting to Rs. 12.35 lakhs have been recovered in accordance with the term of the contract.

7. The Committee called for the following additional information from the Government:—

"(A) It has been stated that the question of determination of damages to be recovered from the International General Electric on account of delay in the commissioning of the Tarapur Project was settled in March, 1970. The report of the Estimates Committee was presented to the House on the 31st July, 1970 and the report for factual verification was forwarded to the Department of Atomic Energy in April, 1970 and the process of acceptance of changes suggested by the Department continued till June, 1970.

Please state the reasons why the Estimates Committee could not be informed of the settlement made in March, 1970 at the factual verification stage.

(B) It has been stated that liquidated damages amounting to Rs. 12.35 lakhs have been recovered from the International General Electric whereas the Committee had been informed earlier that an amount of Rs. 143 lakhs had been withheld from payment No. 40 pending the determination of damages due from the contractors on account of delay in the commissioning of the Project.

Please state the various factors which were taken into consideration in assessing an amount of Rs. 143 lakhs in the first instance and the factors that had now been taken into consideration in recovering the damages of Rs. 12.35 lakhs from the contractors."

8. Government in their reply have stated—

(A) At the time of furnishing the information to the Estimates Committee in October, 1969, the position regarding liquidated damages was not taken. At the time of actual verification of the Report, it was assumed that beyond the verification of the facts mentioned in the information furnished earlier to the Committee no modifications could be introduced in the Report. It was only for this reason the damages recoverable from International General Electric were not intimated at that time.

(B) In accordance with the provisions of the contract with International General Electric this Department had withheld the payment No. 40 amounting to Rs. 143.00 lakhs for the delay in station turn-over, pending determination of the actual delay attributable to the Company. This was only a withholding of payment pending determination of the damages to be recovered. The matter was considered in detail by the Tarapur Atomic Power Station authorities and by the Atomic Energy Commission and it was decided that out of the total delay of 349 days, a period of 230 days was attributable to *Force Majeure* events and other items permissible according to the terms of the contract. The Company was liable to pay damages for the delay in accordance with the Article VIII-C-1 of the Contract for the balance period of 3½ months. Thus the amount payable after making due allowance for the grace period laid down, in terms of the contract was worked out as Rs. 12.35 lakhs.

CLOSURE OF STATION FOR RELOADING OF FUEL AND MAINTENANCE PROGRAMME

Recommendation (S. No. 20, Para 2.52).

9. The Committee in Para 2.52 of their above Report had stated that Maharashtra being endowed with ample hydro-power, the lakes were likely to overflow for a period of three to four months during monsoon. There would be no need to re-load fuel in the year 1970 and the first batch of fuel would be needed in July, 1971. Subsequent batches would be required annually from September, 1972. They had been informed that usual period of fuelling and maintenance programme was four to six weeks which the power generation economics took into account.

10. The Committee trusted that reloading of fuel and maintenance programme would be phased out in such a way that there would not only be no closure on account of lack of demand but even the closure for maintenance programme would be for the minimum period.

11. In their reply Government have stated that the recommendation is noted. The programme for reloading of fuel and maintenance will, as far as possible, be phased in such a way that there will be closure for the minimum period.

12. The Committee called for the following additional information from the Government:

"The Estimates Committee had recommended that the reloading of fuel and maintenance programme should be phased out in such a way that the Station was closed for the minimum period.

(a) Please state when the reloading of the fuel was undertaken and the period for which both the units of the Station were closed wholly or partially.

(b) The units of power generated since reloading of the fuel was undertaken, month-wise.

In their reply Government have stated:—

(a) The reloading of Unit-I of Tarapur Atomic Power Station commenced on August 17, 1971 and the unit has been out of operation since then. Unit-II is, however, operating almost continuously during this period except for three outages (i) 8th April, 1971 to 25th July, 1971 (ii) 19th November, 1971 to 25th November, 1971 and (iii) 15th February, 1972 to 25th February, 1972 for certain maintenance works. Its refuelling will be taken up in March, 1972.

(b) Unit-I has not generated any power since it was taken up for refuelling. The monthwise generation from Unit-II after 17th August, 1971 has been as follows:—

Months	*MWH*
16-8-1971 to 15-9-1971	109
16-9-1971 to 15-10-1971	105
16-10-1971 to 15-11-1971	98
16-11-1971 to 15-12-1971	81
16-12-1971 to 15-1-1972	98
16-1-1972 to 15-2-1972	72

DEFECTS NOTICED IN TARAPUR STATION

Recommendation (S. No. 23, Para 2.62).

13. The Committee in Para 2.62 of their above Report were happy to be informed that the Indian scientists and engineers had acquired sufficient expertise to operate and maintain Tarapur Atomic Power Station independently and that only a limited foreign experts for a minimum period would be required to assist the Indian staff.

14. In their reply Government have stated that the position as noted by the Estimates Committee is correct.

15. The Committee called for the following additional information from the Government:—

"The Committee were informed that Indian scientists and engineers had acquired sufficient expertise to operate and maintain Tarapur Atomic Power Station independently.

(a) Please state the nature of defects that have occurred in the Tarapur Station.

(b) What are the contractual obligations in the matter.

(c) Whether any foreign expertise will be needed for carrying out the repairs.

(d) The steps taken or proposed to be taken to make the Tarapur Station independent of foreign expertise.

(e) The extent to which the Station is dependent for spares on foreign sources and the steps taken or proposed to be taken to be independent in this regard."

16. Government in their reply have stated—(a) & (b) After the Tarapur Station became operative in February 1969, delivery of power started in April, 1969 and the Station was turned over for full commercial operation in October, 1969. From then on till August, 1970, there were no prolonged outages (outages of over four days).

Subsequent to August 1970, the instances of prolonged outages for the two units of Tarapur have been as listed below:—

S. No.	Period of outage	Unit	Power drop
1.	14-7-1970 to 29-8-70 . . .	I 210 MW	Planned
2.	2-9-1970 to 21-10-70 .	II 210 MW	Outages
3.	3-4-1971 to 25-7-71 .	II 210 MW	
4.	26-6-1971 to 8-7-71 . . .	I 210 MW	Planned
5.	19-11-1971 to 25-11-71 .	II 140 MseW	Outages
6.	17-8-1971 to late . . .	I 210 MW	
7.	15-2-1972 to 25-2-72 . . .	II 110 MW	Planned outage

The outages at S. Nos. 1 and 2 were planned outages for carrying out the first annual inspection/maintenance. The third outage from 3-4-1971 to 25-7-1971 was a major forced outage. This was initiated by a fault in the Maharashtra electrical system and the inability of the Gujarat grid system to withstand the surge, which resulted in a complete loss of power to the Station. Thereafter, an inadvertent operation by a Station Operator caused seizure of turbine bearings. To prevent recurrence of such loss of power, the requisite modifications to the protection schemes in the Maharashtra and Gujarat systems have been taken up. Within the Tarapur Station, several improvements have been made to provide safeguards against such occurrences. The outages from 26th June, 1971 to 8th July, 1971, 19th November, 1971 to 25th November, 1971 and 15th February, 1972 to 25th February, 1972 were planned; Serial Number 4 to attend to steam and water leaks (which occasionally occurs in power stations and, therefore do not call for any particular remedial measures) and the outage of Unit No. II in November 1971 and February 1972, to rectify low insulation of certain instrumentation cables caused by steam impingement.

In accordance with the requirements of the grid and the conditions prevailing in the area, the reactors at Tarapur are normally scheduled for shut down for annual refuelling during the monsoon months. Normally, the refuelling is expected to take about eight weeks for each reactor. However, it was expected that the first refuelling would take longer because certain essential work, which would not be required to be repeated at subsequent refuelling like the removal of what are known as poison curtains, had to be undertaken at the time of the first refuelling. Accordingly, the first unit of the reactor was closed down for refuelling on the 7th of August 1971 and would normally have been brought back in line by about end of November, 1971. However, when the reactor was opened for refuelling, it was noticed that certain internal components

known as "guide tubes" were displaced, having been unlatched from their moorings at the bottom of the reactor pressure vessel. Having thus become free to move vertically in the core, they had cause some damage to adjoining fuel elements and to two structural braces in the vicinity. The circumstances in which this happened are briefly described below.

The pressure vessel is capable of housing a core with 368 fuel bundles accommodated in 89 guide tubes. This design was part of the original specifications offered by General Electric. Subsequently, with improvements in fuel design, it was found that it would be possible to get the same output of power with 284 fuel assemblies, arranged within 69 guide tubes and consequently, the size of the pressure vessel because it was felt that the additional space available in a larger vessel would give some flexibility for future changes in core designs, particularly if plutonium were to be used instead of Uranium 235, which is used in the existing fuel elements for enrichment. Further, arrangements had already been made to fabricate the larger pressure vessel and the design and manufacture of a smaller vessel would have led to delay. However, the use of the larger pressure vessel necessitated the Introduction of about 20 peripheral guide tubes without any fuel elements inside them. Every precaution was taken by the manufacturer to secure them to the bottom of the pressure vessel. In spite of this, however, under the pressure of water in the pressure vessel, two of the peripheral guide tubes were displaced from their normal position, causing damage to two braces and to two fuel elements.

The repair work involved the use of special remote handling tubes, some of which had to be designed and fabricated locally. It also involved the use of remote viewing television under 70 to 75 of water in the narrow confines of a highly radiocative core. In consultation with General Electric, the design of the devices holding down these peripheral guide tubes has been improved and it has been decided to instal the improvements on all such guide tubes. This has proved to be an extremely complicated and time consuming operation.

General Electric have agreed that the original design for the holding devices was not quite adequate and that in some instances the installation of the guide tubes was also defective. In consideration of this, General Electric have agreed to supply the following free of costs:—

(1) Engineering Analysis.

(2) Some components necessary for carrying out the repairs.

(3) Assistance of experts at the site.

(4) Computer analysis.

General Electric have also suggested that the most effective and permanent solution would be to introduce additional fuel elements in the guide tubes, which will increase the weight on the guide tubes and thereby prevent their being displaced by water pressure, even if the holding devices fail. As this would involve additional investment on fuel and some change in core physics, the suggestion is under careful consideration. If found necessary or desirable, the suggestion will be adopted at the time of the next refuelling. In that event, General Electric have agreed to provide some more components (control rod drives and Low Power Range Monitors) free of cost, as also further safety analysis, thermal hydraulic analysis and physics analysis free of cost.

On December 15, 1971, the transformer of Unit-I developed an internal fault on energising. The causes of the accident have been investigated with the assistance of experts from outside the department as well as through a departmental enquiry. It has now been established that one of the tubes carrying sea water intended to cool the transformer oil developed a small hole. These tubes are made of cupro-nickel designed to resist the corrosive effective of salt water. Further, they are also enclosed by a thicker copper tube with outlets through which any water leaking from the inner tube is designed to flow out. Unfortunately, the actual leakage of water through the hole, which had developed in the inner tube, was neither prevented nor did it show up at the end of the tube as designed. During the period, the transformer was out of use, the reactor of Unit I being under repairs, the water found its way into the oil flowing through another tube, enclosing the double-walled tube carrying the cooling water. Gradually, the water accumulated in the oil in the transformer tank over a period of time. This reduced the di-electric strength of the oil and caused a short circuit when the Unit was energised.

The inadequacy of the design of the cooling system was brought to the notice of General Electric. Although the warranty period expired in 1970 and although the accident was partly due to error of judgement on the part of the operating staff, General Electric have agreed to reduce their normal price for the replacement materials, including the coils, and have offered at no cost to Government, technical supervision by their experts for the repair works at site. The estimated value of these concessions reduces the total cost of

repairs by about $85,000 (Rs. 6.38 lakhs). General Electric have also agreed to redesign the oil cooling system and provide necessary US instrumentation, all at no cost to the Station.

In order to avoid a recurrence of this problem the following steps are being taken:—

(a) The procedures connected with the maintenance, commissioning and operation of the transformer are being revised.

(b) The cooling system of the transformer is being designed to work on fresh water, instead of sea water as at present; and

(c) Suitable instrumentation is being introduced which will reduce the possibility of such incidents recurring.

(d) The rectifications and modifications on the reactor are being carried out by our own staff without any foreign supervision; the manufacturers are occassionally consulted for second opinion free of cost. In respect of the transformer, the services of General Electric Engineers were utilised to assess causes of damage and the repairs necessary. The direction during reassembly of replacement parts will be given by the manufacturers free of cost.

(e) Tarapur Station does not need foreign experts for operation and maintenance. On a few occassions they have been called in; this was done as a measure of abundant caution and in consonance with utility practice and not because it was unavoidable.

(f) As the station was constructed on a turnkey contract with a US firm, many of the equipments were imported. The station is, therefore, dependent for spares on foreign sources. However, every effort is being made to develop indigenous substitutes, wherever possible. Some of the spares and special tools are also manufactured in the departmental workshop in the Tarapur Station and at the Bhabha Atomic Research Centre, Trombay. Spares worth about Rs. 10 lakhs have already been substituted indigenously. A Committee consisting of four engineers has been recently formed in TAPS to intensify the indigenous substitution programme on the basis of the actual experience in operation.

17. The Committee note that:

(i) Liquidated damages amounting to Rs. 12.35 lakhs were recovered from the International General Electric Company, on account of delay in commissioning of the project;

(ii) A bonus of Rs. 2.60 crores has been paid to the International General Electric Company, on account of the net electric output of the Tarapur Atomic Power Station being higher and net heat rate being lower than the warranted performance of the Plant specified in the contract;

(iii) There have been forced outages of Unit I and Unit II for considerably long periods in addition to the planned outages of these Units;

(iv) A number of technical defects, like inadequate holding-down arrangement for Guide Tubes and seepage of sea water into Transformer Oil Cooling System have developed in the Plant which require rectification.

18. Thus on the one hand there have been break downs in the working of this Station since the commencement of commercial operation in October, 1969, apart from delay in the commissioning of the Project for which damages have been recovered from the International General Electric Company, on the other hand, the International General Electric Company has been paid bonus of Rs. 2.60 crores. In these circumstances, the Committee consider that all these matters i.e., recovery of liquidated damages, payment of bonus, the reasons for the frequent break-downs in the Plant and technical defects therein may be examined and reviewed at the highest level and adequate measures taken to find effective and permanent solution to the problem of break-downs in power supply so as to obviate their recurrence. The Committee would also like the Government to minimise dependance on foreign sources for spares and expertise and to take concerted measures so that the Plant may work successfully in future.

BUILDING OF ENRICHED URANIUM RESERVES TO OPERATE STATION DURING CONTINGENCIES

Recommendation (S. No. 10, Para 2.25)

19. The Committee in Para 2.25 of their Report had noted that enriched uranium had to be imported for the working of the Project for the entire life time of the Station. If for any unforeseen cir-

cumstances the supply of enriched uranium was cut off or denied due to world postures, the whole Project in that case would be jeopardised. They had, therefore, suggested that Government should explore the possibility of building reserve of enriched uranium to meet such contingencies.

20. In their reply Government have stated that the view of the Estimates Committee regarding the necessity of building reserves of enriched uranium to meet any stoppage of supply of enriched uranium for Tarapur due to unforeseen circumstances has been noted. Normally there is spare fuel in the country for 12—18 months operation without replenishment. Stockpilling of larger quantities would entail heavy interest charges on inventory. In this connection attention is also invited to para 1.35 of the brochure 'Atomic Energy and Space Research—A Profile for the Decade 1970-80' prepared by the Atomic Energy Commission. The research and development effort envisaged in the profile of development for the current decade include development of gas centrifuge technology for enrichment of uranium. At the time when the decision was taken for the establishment of Tarapur Atomic Power Station, plants for the enrichment of U-235 were considered out of question for India due to their high costs as well as their enormous cosumption of electric power. This analysis was based on the use of the gaseous diffusion process, but the marked progress of the gas centrifuge process since then is believed to have altered the situation.

21. The Committee called for the following further information:—

"It has been stated in reply:

The view of the Estimates Committee regarding the necessity of building reserves of enriched uranium to meet any stoppage of supply of enriched uranium for Tarapur due to unforeseen circumstances has been noted.

(a) Please state the progress made in the development of technology for the enrichment of uranium in the country.

(b) What are the financial and technical implications of developing this technology in the country?

(c) The steps taken by Government to build reserves of enriched uranium and on what terms and conditions India can expect enriched uranium from other countries."

22. Government in their reply have stated—

(a) Work on development of uranium enrichment technology has recently been initiated in Bhabha Atomic Research

Centre. A group has been constituted to undertake preliminary studies on the three processes of uranium enrichment which are either in use or in various stages of development in other countries. These include the gas diffusion, the ultra-centrifuge and the separation nozzle processes. Studies on the production and handling of uranium hexafluoride which is the uranium compound used in all the three processes have also been started. Based on these studies a small scale separation unit is expected to be installed in three to four years' time.

(b) It is difficult to indicate the cost of a small plant till all studies have been completed.

There are a number of technical problems involved in the development of this technology. The production and handling of uranium hexaflouride require highly corrosion resistant materials and leak-tight equipment. The gaseous diffusion process for enrichment involves development of high speed drives, of sylinders with high strength to weight ratio, and of efficient bearings and seals having a long life is necessary. The nozzle separation process involves fabrication of separation units with every close clearances and large capacity compressors. Development of some of the components is proposed to be carried out in Bhabha Atomic Research Centre while for others assistance from various other scientific organisations and manufacturing concerns is being arranged.

(c) As explained above, preliminary steps for development of technology for the enrichment of uranium in the country have been initiated. As explained earlier, while there is spare fuel in the country for 12 to 18 months operation without replenishment stock-piling of reserves of enriched uranium would entail heavy interest charges on inventory. Also as per the bilateral agreements, between India and the USA, the Tarapur Atomic Power Station would be operated on no other special nuclear material than that furnished by the Government of USA. The agreement also commits USA to supply fuel throughout the life of the Station. As such, no steps are being taken to obtain enriched uranium from other sources.

23. The Committee reiterate their earlier recommendation regarding the necessity of building reserves of enriched uranium for Tarapur to meet any stoppage in supply of enriched uranium for Tarapur due to unforeseen circumstances. They urge that the development of technology for the enrichment of uranium in the country should be speeded up and research carried out taking into account its various technological and financial impiications.

WRITTEN AGREEMENTS WITH STATES FOR SHARING, SALE OF POWER, ETC.

Recommendation (S. Nos. 17 and 19, Paras 2.17 & 2.19)

24. The Committee in Para 2.47 of their Report were concerned to note that Government had not so far entered into any written agreement with the Governments of Maharashtra and Gujarat with regard to the sharing of power, although such an agreement used to be there with the erstwhile composite State of Bombay to take power upto 80 per cent of the full load of the Tarapur Station. The Committee considered that the declared policy of equal measure and taking of power at 75 per cent load-factor announced publicly, which, according to the Department of Atomic Energy, was well understood by both the States, was not a satisfactory arrangement. In the light of experience regarding non-acceptance of rates worked out by the Atomic Power Authorities by bulk consumers and trouble about the management of the switch-yard, the Committee considered that a firm agreement with the beneficiary States on the question of sharing of power, basic assured load, tariff rate, phased programme for erecting transmission lines, switchyard, etc., should have been entered into before the Station had begun to flow commercial power. They recommended that steps should now be taken to enter into such an agreement with the concerned States without further loss of time.

25. In their reply Government have stated that no written agreement can be entered into until the capital cost of an atomic power station can be established with a reasonable degree of accuracy. Agreement could only be on the quantities of power to be supplied/drawn and the principles of costing. An agreement on these aspects already exists and the Maharashtra and Gujarat Electricity Boards are committed to draw in equal measure power upto full capacity of the Station. On the completion of the plant and determination of its cost, discussions were conducted with the State Electricity Boards for entering into formal agreements, covering a two part tariff on a base rate of 5.61 paise/kwh at 75 per cent annual

plant factor. The Electricity Boards are paying at a flat rate of 5.61 paise/kwh since 3-10-69 for the power drawn by them. The terms of the part two tariff are expected to be finalised shortly.

26. The Committee called for the following further information from the Government:

"The Estimates Committee had recommended that steps should be taken to enter into written agreement with the Government of Maharashtra and Gujarat with regard to the sharing of power.

(a) Please state whether written agreements in this regard have been concluded by now.

(b) If so, a copy of the same may be supplied.

(c) If not, the reasons therefor".

27. Government in their reply have stated:—

An understanding exists already regarding the sharing of power from the Tarapur Atomic Power Station equally between Maharashtra and Gujarat. This will be incorporated in the agreement to be concluded. The conclusion of the agreement is kept pending for finalisation of the two-part tariff on cost of power which is covered by S. No. 2.

28. The Committee in Para 2.49 of their Report had stated that they need hardly point out the obvious lesson that, in the Atomic Power Stations to be put up in future, the Department should ensure that there was a firm written agreement about the sharing of power, rates at which it was to be sold and management of the switchyard.

29. In their reply Government have stated that they note the Committee's recommendation and will endeavour to secure agreements with the concerned State Government. A practical difficulty on fixation of rates beforehand is likely to arise for our early stations where, until date of completion, the firm capital cost figures would not be available.

30. The Committee called for the following further information from the Government:—

"The Estimates Committee has recommended that the Department should ensure that there is a firm written agreement about the sharing of power, rates at which it is to be sold and the management of the switchyard.

Please state whether Government have reached firm agreements about Rajasthan and Kalpakkam power stations."

31. Government in their reply have stated that the matter regarding the sharing of power and the rates of supply has been under discussion with Rajasthan State Electricity Board. They have been informed that the power from Rajasthan Project will be available on a two part tariff basis, similar to Tarapur. No final agreement can be concluded until the exact price can arrived at. The selling price of power can be arrived at only after exact capital cost of the project is finally known. Pending finalisation of the tariff rates, the tariff for output from the Rajasthan Atomic Power Project Unit—1, during commissioning period upto December, 1972, has been finalised.

A firm agreement in respect of the power from Kalpakkam Power Station can similarly finalised only after the power station is commissioned.

32. The Committee appreciate the difficulties of Government in entering into a written agreement with the concerned States with regard to the sharing of power, rates at which it is to be sold etc. until and unless the date of completion and the firm capital cost figures of the projects are available. At the same time they feel that the problems which are likely to be posed after the completion of the project in case the cost of generation of power is on the high side as compared to other sources of power available in those areas, may prove difficult of solution unless there are written agreements on all important matters like sharing of power by the States, the rates at which power is to be supplied, etc. The Committee, therefore, reiterate their earlier recommendation that conclusion of the agreement with the concerned States should be finalised at the earliest. They would also like Government to lay down guidelines for entering into written agreements with State Governments etc. for sharing of power, rates of power etc. in respect of future stations well in advance.

FIXATION OF SELLING PRICE OF POWER FROM TARAPUR

Recommendation (Sr. No. 22 Para 2.57).

33. In para 2.57 of the Report the Committee had noted that the selling price of power per unit from Tarapur Atomic Power Project had been fixed at 5.61 Paise per kwh. This price was stated to have been agreed to by both the bulk consumers, viz., the Maharashtra and Gujarat Electricity Boards. It was presumed that the rate had been got approved with the concurrence of the Central Electricity Authority as required by the Atomic Energy Act.

34. The Committee however liked to be informed of the exact cost generation and the selling price of the power, as approved with the concurrence of the Central Electricity Authority.

35. In their reply Government have stated that basic selling rate of 5.61P|kwh has been accepted by the Maharashtra and Gujarat State Electricity Boards. The rate has been fiixed with the knowledge of the Central Electricity Authority but their formal approval is awaited. Deltails of the two part tariff based on the above accepted selling rate are being worked out and a formal notification under Section 22(1) (b) of the Atomic Eenergy Act will be issued in due course.

36. The Committee called for the following additional information from the Government:

A. The Estimates Committee had desired to be informed of the exact cost of generation and selling price of power from Tarapur as approved with the concurrence of the Central Electricity Authority.

(a) Please state whether the formal approval of the Central Electricity Authority in this regard has been obtaned.

(b) If so, the details thereof and, if not, the reason for the delay.

B. In reply it has been stated:—

"Details of the two part tariff based on the above accepted selling rate are being worked out and a formal notification under Section 22(1)(b) of the Atomic Energy Act will be issued in due course."

(a) Please state whether the notification has been issued.

(b) If so, a copy of the notification may kindly be supplied for information of the Committee.

(c) if not, what are the reasons for the delay."

37. In their reply Government have stated (A) & (B) The question regarding fixation of the selling price of power from Tarapur Power Station is still under discussion with the Central Electricity Authority (CEA) and the State Electricity Boards. The Central Electricity Authority has not yet given its final concurrence to our proposals. The notification under section 22(a) (b) of the Atomic Energy Act has not yet, therefore, been issued.

38. The Committee regret to note that Government have not informed the Committee of the exact cost of generation of power and that the question regarding fixation of the selling price of power from Tarapur Power Station is still under discussion with the Central Electricity Authority and the State Electricity Boards, although commercial operation of the Station began in October, 1969. They reiterate their earlier recommendation and would like to be informed of the exact cost of generation and the selling price of power, as approved with the concurrence of the Central Electricity Authority.

WRITTEN AGREEMENTS WITH STATES FOR SHARING, SALE OF POWER ETC. FROM RAPP.

Recommendation (S. Nos. 35 and 37, Paras 3.37 and 3.39)

39. The Committee in para 3.37 of their Report had regretted that no written agreements had so far been executed regarding the basic assured load, tariff rate, phased programme for erecting transmission lines, switchyard, etc. by the Atomic Energy Department with the Government of Rajasthan or the neighbouring States. They apprehended that in the absence of any written agreement, several complications might arise when the Atomic Plant was on stream.

40. In their reply Government have stated although no firm written agreement has been entered into, the Rajasthan Government has requested that the entire power from the Station may be allotted to that State. However, there is also scope for utilisation of power generated at the station in the neigbouring State as well. The establishment of facilities for the distribution of power in Rajasthan are under way. A 220 single circuit transmission line from the power Station to Udaipur and a 220 double circuit transmission line from the power Station to Kota and hence to Jaipur are being laid. An inter-State 220-KV transmission line between Jaipur and Delhi is also being planned.

Kind attention of the Committee is invited to the comments of the Government in reply to recommendations No. 17 and No. 19.

41. The Committee in para 3.39 had also suggested that with a view to operate the Station at the optimum load fact, the following steps should be taken well in advance so that by the time the power starts flowing from the Station, there was sufficient demand for the power and it worked as an economic unit:—

(i) Reinforcement of the transmission and distribution system;

(ii) Execution of formal agreements between Rajasthan Atomic Power Project and Rajasthan and other beneficiary State Governments regarding utilisation of power etc.

(iii) Timely development of the industries like copper complex at Khetri, Zinc smelter and production of phosphorous at Udaipur and setting up of other industries in and around Kota.

42. In their reply Government have stated that the various steps to be taken to ensure full utilisation of power as recommended by the Committee have been noted.

The establishment of facilities for the distribution of power in Rajasthan from the Rajasthan Atomic Power Project is under way. A 220 single circuit transmission line from the Power Station to Udaipur and a 220 double circuit transmission line between Jaipur and Delhi is also planned.

Every effort will be made to execute formal agreements as early as possible. As explained earlier, the main hurdle in this regard is the difficulty in fixing the cost of power in advance of the completion of the Station.

The development of Industries in the State is the responsibility of the State Governments concerned and it is hoped that timely action will be taken by them in this regard.

43. The Committee called for the following further information from the Government:

"(a) Please state whether firm written agreement regarding the basic assured load, tariff rate etc. has been entered into by the Department with the Government of Rajasthan and the neighbouring State.

(b) Whether the switchyard will be operated by the Department of Atomic Energy.

(c) Whether laying of transmission lines, between Udaipur, Jaipur and Delhi and Kota will be completed ahead of the plant or simultaneously and in time."

44. Government reply stated—

(a) The aspect regarding finalisation of a firm agreement on tariff is covered by the answer to the question No. 19. The Rajasthan State Electricity Board have assured us that they will ensure

the offtake of Rajasthan Atomic Power Project output at all times. If for this purpose a part of output is to be exported outside the State, they will conclude the necessary arrangements with the neighbouring States. The Department has, however, advised Northern Regional Electricity Board that the share of various States of the Rajasthan Atomic Power Project output should be determined through mutual discussions failing which the Irrigation and Power Ministry/Central Electricity Authority can be asked to decide the matter. The matter is under active consideration of the States in the region.

(b) The Switchyard at Rajasthan Atomic Power Project will be operated by the Department of Atomic Energy.

(c) The transmission line between Udaipur and Kota has been completed. The line between Jaipur and Kota is expected to be completed well before the commencement of the commercial operations of Rajasthan Atomic Power Project. This aspect is, however, being pursued vigorously with the Rajasthan State Electricity Board and the Irrigation and Power Ministry.

45. The Committee asked Government to supply further information about the decision taken or the progress made in laying transmission lines between Udaipur, Jaipur and Delhi and Kota.

46. The Government in their reply stated:—

The latest position regarding transmission lines between RAPP site and Udaipur; Jaipur and Delhi is as under:

(i) 220KV single circuit line from RAPP Site *via* Kota to Udaipur is complete.

(ii) Double circuit line from Kota to Jaipur is expected to be completed by December, 1972.

(iii) Only survey work is in progress in respect of single circuit line from Jaipur to Delhi.

47. The Committee recommend that in order that the Atomic Power Projects run as economic units, the question of sharing of power by the various States should be the responsibility of the Central Government and not left to the discretion or convenience of the State Governments where the Projects happen to be located and it should be settled in a way that power does reach the actual power users. In any case the matter should be settled well before the projects become critical.

48. The Committee regret to note that only survey work is in progress in respect of single circuit line from Jaipur to Delhi and that transmission lines between Delhi and Jaipur have not been laid so far although first unit of the Rajasthan Atomic Power Project has already started generating power. According to the Ministry of Irrigation and Power the laying of transmission lines was essential to enable the Station to operate as a baseload station. The Committee urge that the work regarding the laying of transmission lines between Delhi and Jaipur should be speeded up.

HEAVY WATER FOR ATOMIC POWER PROJECTS

Recommendation (S. Nos. 38 & 39, Paras 3.46 & 3.47)

49. The Committee in Paras 3.46 and 3.47 of their Report were constrained to observe that in spite of the realisation of urgency by Government in regard to the production of heavy water indigenously to meet the requirements of the two units of Rajasthan Atomic Power Project as also that of Madras Atomic Power Project, nothing substantial had been done in the matter so far.

50. The Committee regretted to note that unduly long time was either taken by Government to sanction the proposal of the Department of Atomic Energy to build a Heavy Water Plant or the Department itself had taken a long time to start the construction of the Heavy Water Pilot Plant at Kota. The Committee noted with concern that Heavy Water Pilot Plant of the Bhabha Atomic Reserach Centre which was set up as early as in 1963 to provide technical know-how for the large scale Heavy Water Plant at Kota had failed in its objective and had been the prime factor contributing to the delay in the setting up of the Kota Plant. The Committee felt that with a view not only to conserve foreign exchange but also obviate "International Safeguard" which were imposed in obtaining Heavy Water from abroad, Government should lay down a reasonable target date by which the construction of heavy water plants should be completed and production thereof started.

51. In their reply Government have stated that in March, 1966 the Cabinet approved the setting up of a Heavy Water Plant with a capacity of 200 tonnes/year to meet the requirements of nuclear power stations being set up. At that time the intention was to set up a plant utilising the available fuels *i.e.* washery-middlings and residual fuel oil. Investigations were made regarding the construction of a plant at various possible sites. At the same time, negotiations were also taken up regarding washery-middlings and Residual Fuel Oil for steam raising.

The feasibility of putting up a heavy water plant based on steam and electrical energy obtained from Rajasthan Atomic Power Pro-

ject I and II which have a built-in capacity for additional heat output was also studied as an alternative. In August, 1967 after taking into consideration all the relevant factors, the Atomic Energy Commission decided to set up only 100 tonnes/year plant supported by Rajasthan Atomic Power Project I & II, as a 200 tonnes|year plant would have curtailed electricity output of one of these units. The process to be adopted in both the original 200 tonnes|plant as well as the modified 100 tonnes/plant was based on the H2S-H2O exchange process developed, indigenously.

The setting up of the Heavy Water Plant at Kota involved certain modifications to the Rajasthan Atomic Power Station which needed the approval of Atomic Energy of Canada Limited who took a considerable time to conduct the necessary studies in this regard. A fresh project report had to be prepared taking into consideration all the above factors and the project could be sanctioned only in 1969.

It will be seen from the above that the delay was neither due to the failure of the pilot plant at the Bhabha Atomic Research Centre nor due to any lack of planning. In undertaking a project where solutions have to be found for the first time for technical problems, planning is at best based on assessment of progress at each state. Unlike repetitive projects, delays can occur and are to be regarded as an essential part of the process of acquiring new capability.

The pilot plant at the Bhabha Atomic Research Centre has yielded valuable know-how and has enabled us to take up with some confidence the responsibility for constructing a major commercial plant without foreign collaboration. The problems that arose stemmed primarily from the scaling up from pilot plant to large scale operations involving a factor of 24 in the case of the most important part of the plant. It is well known that chemical engineering operations like this involve data which can only be gained through experience with a large scale plant.

To make up the loss in production arising out of the reduction in the capacity of the plant at Kota from 200 tonnes to 100 tonnes, a plant based on the Ammonia-Hydrogen Exchange Process with an annual capacity of 67 tonnes of heavy water is being set up at Baroda using the Ammonia-Hydrogen Exchange Process. The question of setting up one or two more plants based on the same process, that is the Ammonia-Hydrogen Exchange Process, or other processes including the Hydrogen Distillation Process or the new processes under development are under consideration.

All efforts are being made to complete the plants as quickly as possible and it is now expected that the Baroda Plant will be commissioned in 1972-73 and the Kota Plant in 1974.

52. The Committee called for the following additional information from the Government:—

"It has been stated that all efforts are being made to complete the plants as quickly as possible and it is now expected that the Baroda Plant will be commissioned in 1972-73 and the Kota Plant in 1974.

(a) Please furnish a detailed note with regard to the progress made in the commissioning of the Kota Plant.

(b) What is the position with regard to the production of Heavy Water for the country's Atomic Power projects and will India be able to have its own Heavy Water by the time the Atomic Power Plants are commissioned?

(c) What are the implications of having Heavy Water on loan, lease or purchase and the extent to which India has been successful in negotiating its requirements, if any, for the project?

(d) What are the implications of transportation of Heavy Water from distance to the site of Atomic Power Project?

(e) How the cost of Heavy Water is going to be calculated in working out the cost of Atomic Power Project and the cost of generation of power and the reasons for effecting recent change in this regard."

53. Government in their reply have stated—

(a) Work on the Heavy Water Plant at Kota site has made satisfactory progress. The main towers of the plant has been contracted out and the fabricators have started work on the same. The civil work for the entire plant will be started in April or May, 1972. Equipment like pipes, valves etc. will be ordered very shortly for which tenders are under preparation. The site work has already started and the approach road, temporary site office, stores etc. are completed.

(b) The Heavy Water Plant under construction at Kota which is expected to be commissioned in 1974, will give an output of 100 tonnes of Heavy Water per year. The Heavy Water Plant under construction at Baroda will be commissioned in 1973 and is expected to give an output of 67.2 tonnes per year. A part of the output of the plant would be available for the second unit of the Rajasthan Power Station. The Third Plant designed on the same basis as the Baroda Plant will be ready at Tuticorin during 1974-75 to give an output of 71.3 tonnes of Heavy Water per year. A fourth plant is under consideration for construction in conjunction with one of the Fertilizer Corporation of India's Fertilizer Plants. Over and above these sources, the Heavy Water Plant at Nangal gives an average output of 12 to 14 tonnes of Heavy Water per year.

(c) In respect of the RAPP-I Unit, the requisite Heavy Water is being obtained on lease from Canada. The Heavy Water will be leased to us for a period of 10 years on payment of lease charges at 6 per cent on the capital cost of the Heavy Water. Option exists in the Agreement for us to purchase the Heavy Water if it is considered advisable. The Heavy Water is being supplied to us on the same basis on which India and Canada are cooperating on the construction of the reactor. Canada has been unable to supply the Heavy Water to us in time arising from their failure of their own heavy water plants and therefore as against this agreed supply of 230 tons, an initial quantity of only 130 tons is being supplied to us by Canada from stocks obtained by them from the United States. This will be replaced by Canadian-origin Heavy Water in due course. The balance of 100 tons will be supplied from Canadian sources when required by us. In obtaining American origin Heavy Water from Canada we have agreed to a regimen of safeguards administered by the IAEA.

Heavy Water is in very short supply internationally and is not available on terms of loans, lease or purchase except to a very limited extent. In respect of RAPP-II, Canada has now committed itself to the supply of the requisite quantity of 230 tons of Heavy Water. However, a formal Agreement has not yet been signed.

We have recently succeeded in signing an agreement for obtaining 80 tonnes of Heavy Water from the USSR. This Heavy Water will be used for the make-up requirements of RAPP-I and used for future reactors to the extent necessary.

(d) The transportation of Heavy Water is done in stainless steel drums and has to be handled carefully due to its high cost. Transportation has no other implications.

(e) The inventory of Heavy Water at a CANDU power reactor has a life of over 30 years. During the course of operation, except for certain quantities of Heavy Water lost by leakage and degeneration by admixture with ordinary water etc. the Heavy Water retains its characteristics. The Heavy Water which has leaked or become degenerated by admixture with ordinary water is collected and reconcentrated and can thereafter be used either in the same reactor or in some other reactor as a very small quantity is lost through the reactor stack and is not recoverable. In view of the fact that the same Heavy Water may be used in more than one reactor it has been considered necessary to pool all the available Heavy Water and treat it as a common asset of the Department made available to the power station on payment of interest charges on the cost of the inventory. The procedure proposed to be adopted is to pool all the available from different plants as well as if any by import and charge an appropriate percentage of interest from the power station.

The cost of reconcentration plant has been included in the capital cost of the Atomic Power Station. The operational cost of reconcentration plant has also been included in the operational cost of the Atomic Power Station. The small losses of heavy water are also included in the operational cost of the station.

In calculating the price of Heavy Water produced internally from our own plants, all charges including interest, depreciation and profit on the investment made on the Heavy Water Project are added. Therefore, by adopting this revised procedure no departure from normally accepted commercial principles is involved. This has been done in keeping with international practice and in view of the different plants and sources from which Heavy Water is available; and the fact that same Heavy Water may be used in different reactors at different times. However, every element of cost is taken into account in calculating the cost of generation of power. The

assumed price of Heavy Water in respect of Rajasthan Atomic Power Project and Madras Atomic Power Project is Rs. 550 per kg. and is based on the full cost of production including interest and depreciation on the Heavy Water Plant as well as a margin of profit on the capital invested in the Heavy Water Plants. In addition to this, a further small margin has also been added to the cost of Heavy Water to make provision for future escalations.

54. The total requirements of heavy water for the projects under construction is 920 tonnes and the average present output is 12 to 14 tonnes per year from Nangal. The Committee are concerned to note that it has not been possible to get heavy water for RAPP from the original source i.e. Canada because of the reported failure of the Canadian heavy water plants. They hope that firm arrangements in this regard will be made in time.

55. The Committee are of the opinion that efforts required to be made in making available heavy water for the country's Candu type projects are stupendous which need concerted measures. They are concerned to note that heavy water is in very short supply internationally and its non-supply may result in delayed commissioning of the projects. The Committee hope that problems connected with indigenous production of heavy water will be sorted out successfully and concerted efforts made to meet the targetted requirements of heavy water for the projects under construction indigenously at the earliest.

CHOICE OF POWER FOR FUTURE PLANS

Recommendation (S. No. 73, Para 6.44)

56. The Committee in Para 6.44 of their Report had noted that the cost of power generation from conventional sources *i.e.*, thermal and hydro and from the three Atomic Power Stations at Tarapur, Kota and Kalpakkam had been variously estimated by the Planning Commission, Ministry of Irrigation and Power and the Atomic Energy Department. They felt that with the present constraint on our financial resources there was need that the choice between nuclear, hydro and thermal power production should be made after a study of their relative economics both short term as well as long term. This was possible only after it was known what the cost of generation of power would be from each of the systems. The Committee had desired that the Committee constituted by the Ministry of Irrigation and Power to review the economics of power generation from different sources-hydro, thermal and nuclear etc.

should also go into the cost structure of the Atomic Power plants at Tarapur, Kota and Kalpakkam with a view to determine the unit cost of generation of power from each one of them. They trusted that the expert Committee would submit its Report at an early date and that Government should keep its recommendations in view while deciding the programme for nuclear power stations.

57. In their reply Government while agreeing with the views of the Estimates Committee that the choice between nuclear, thermal and hydro power production should be made after a study of their relative economics both short term as well as long term, have made the following points:—

(1) Atomic Energy is one of the most important developments in the last twenty years provided by science and technology. This field, therefore, have vast potential. That India should participate in it fully, on the basis of indigenous capability, is an important objective in itself.

(2) In doing so the contribution which nuclear energy can make to the energy resources of the country is also a most important consideration. India's resources of coal are not in substantial, but these too will be inadequate to achieve and sustain levels of power consumption that prevail today in the industrially advanced countries. In the long run, a country like India will have to turn to nuclear energy for supplying its expanding power requirements. While, therefore, the relative economics of nuclear power as compared to fossil fuel and hydro power is relevant in the long run, it is only one element and not the most important one. If we look at the experience of other countries and the strategy adopted by them to meet the growing power demand, it will be apparent that the role that nuclear energy as a source of power will continue to grow dramatically.

It is also relevant in this connection to remember that the early stages of the development of any technology involve considerably greater cost than at later periods when the technology is fully developed and any real comparison of relative economics should take the long term benefits into account.

58. The Committee called for the following further information from the Government:

"The Estimates Committee had desired that the Expert Body appointed by the Government of India would go into the cost structure of the Atomic Power Plants at Tarapur, Kota and Kalapakkam with a view to determine the unit cost of generation of power from each one of them.

(a) Please supply two copies of the Report submitted by the Committee appointed by the Government.

(b) What are the decisions taken by Government on the recommendations."

59. Government in their reply have stated:

(a) One copy of the Report is attached.

(b) The report which was submitted to the Ministry of Irrigation and Power is still under consideration in that Ministry and no decisions have yet been taken.

60. The Committee regret to note that the Report of the Power Economy Committee which was published in March, 1971 is still under consideration of the Ministry of Irrigation and Power and no decision on the Committee's recommendations has yet been taken. As the development of power generation industry is most essential for the rapid economic development of the country and its shortage result in ratardation of industrial and agricultural activity and economic progress, the Committee strongly feel that concerted efforts should be made to achieve the targets. The Committee cannot too strongly stress that the role to be assigned to the various sources of power i.e. hydel, thermal and nuclear for the Fifth and Sixth Plans should be clearly demarcated without further delay so that the Project proposals could be processed, executed and commissioned in time.

CHAPTER II

RECOMMENDATIONS WHICH HAVE BEEN ACCEPTED BY GOVERNMENT

Recommendation (Sr. No. 1, Para No. 1.11)

1.11. The Committee note that the nuclear power is assuming a role of increasing importance in the field of power generation all over the world. They understand that India's resources of coal and hydro-power are adequate for meeting the power requirements of the country in the foreseeable future. However, having regard to the present rate of growth in her population and the steady increase in the per capita consumption of energy, the position might become difficult after some time. In view of the fact that the coal deposits in India are restricted to a few coal bearing regions in the Bengal, Bihar, and Madhya Pradesh area far away from centres of consumption and the special characteristics of hydro-power which is derived from the seasonal character of rainfall during Indian Monsoon, it seems prudent to diversify resources of electricity and take advantage of nuclear power. In the matter of nuclear power, India is said to be fairly well endowed in view of the abundant supply of thorium and availability of uranium also. The Committee are of the view that the question of development of nuclear resources is mainly an economic one and that it would have to fit in with the overall plan for power development taking into account the available resources in the various regions of the country with the object of deriving optimum benefits through integrated operation of hydro, thermal and nuclear stations.

. Reply of Government

The recommendation which is in full conformity with the thinking of Government is accepted.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget dated 30-1-1971.]

Recommendation (Sr. No. 2, Para 1.17)

1.17. The Committee regret to note that there is divergence of opinion on the size of the installed generating capacity of power during the Fourth Five Year Plan between the Planning Commission

on the one hand and the Ministry of Irrigation and Power and the Department of Atomic Energy on the other. The former *i.e.* the Planning Commission have fixed the target for the Plant at 22 million kw while the need has been assessed at 26 million kw by the latter. They feel that targets in this respect should have been fixed much before the actual commencement of the Fourth Plan especially when the gestation period for nuclear and hydel projects is 5 years or more. The Committee are unable to appreciate the views of the Planning Commission while fixing the target at 22 million kw that "action will have to be taken to identify pockets of shortages, which they anticipate" and then take "prompt action to meet the power needs of those pockets". They consider that in the interest of perspective planning and because of relevance of power to the economy of a country, it is desirable to initiate action well in advance rather than wait for the contingency to occur and then take action. In view of the sufficient scope for India's economy picking up momentum and since "the value added through the use of energy is so great that consequences to the national economy as a whole of making a pessimistic forecast can be at least ten times more expensive than of an optimistic forecast", the Committee consider that the question of fixation of power targets for the Fouth Plan merits urgent and thorough consideration. They hope that the difference will be resolved amicably at an early date so that a realistic target is fixed and a firm decision reached about allocation of share of additional power generation to hydel, thermal and nuclear energy.

Reply of Government

The recommendation is noted.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971.]

Further information called for by the Committee

(a) The Committee desire to know whether the differences between the Planning Commission on the one hand and the Department of Atomic Energy and the Ministry of Irrigation and Power on the other with regard to the fixation of power targets for the Fourth Plan have been amicably settled and

(b) action taken by the Department to fulfil the plan targets.

Further reply of Government

(a) Yes. The Planning Commission has agreed that during the IV Plan period, work on the second unit of the Madras Atomic

Power Project should commence and that the planning on at least one more new station should be taken in hand. The Irrigation and Power Ministry have also agreed with this. In their projections for the ten year period 1970—80, that Ministry have stated that the nuclear power target for 1980 should be of the order of 4200 MW.

(b) Sanction for the second unit of Madras Atomic Power Project has since been accorded. The Site Selection Committee appointed by the Department in 1970 to select suitable sites for the future atomic power stations in the Northern, Western and Southern Electricity Regions has completed the work in the Northern Electricity Region. The report is expected to be submitted to the Atomic Energy Commission very shortly.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 15-3-1972].

Recommendation (Sr. No. 3, Para No. 1.21)

The Committee agree with the Chairman, Atomic Energy Commission, that the reactor system most suitable for the country would be the one for which we would not have to depend on foreign countries for fuel and other nuclear components and which would prove economically advantageous in the long run by making use of thorium which is available in plenty in this country.

Reply of Government

The Estimates Committee's agreement with the view of the Government regarding the utilisation of the most suitable reactor system for the country has been noted.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971.]

Recommendation (Sr. No. 4, Para No. 1.35)

The Committee note that the atomic energy programme as originally drawn up by the Atomic Energy Department covered a period of 16 years, *i.e.*, from 1964 to 1980 to enable the country to avail of the fast breeder reactor technology which is expected to be commercially available by that time. This programme has been altered to synchronize with Five Year Plans and scaled down by the Planning Commission. According to the Chairman, Atomic Energy Commission, this has upset their programme which is a closely knit plan and does not admit of any break-up piecemeal. Their commitment is for a longer period with the aim of building up

'plutonium inventory which will give indigenous technical know-how as well as industrial competence to make the components in the country so that from 1975—80 we can start one major unit of the fast breeder reactor'. The Committee are informed that the Planning Commission are having a dialogue with the Atomic Energy Department with a view to sort out their differences in this regard. The Committee hope that this will be done with expedition and a firm decision reached quickly.

Reply of Government

The Department of Atomic Energy notes that the Estimates Committee are in full agreement with the views of the Department regarding the long-term nature of the Atomic Energy Programme which is a closely knit plan and does not admit of any break-up piecemeal. The Atomic Energy Commission has prepared a profile for the development of Atomic Energy during the decade 1970—80. The Government has accepted the objectives of the specific programmes as set out in this profile and detailed steps to implement the proposals are under discussion with the Planning Commission.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971.]

Further information called for by the Committee

The Committee were informed that the Planning Commission were having a dialogue with the Atomic Energy Department with a view to sort out their differences in regard to the long term programme of having one major unit of the fast breeder reactor.

Please state the decision taken in this regard.

Further reply of Government

The Planning Commission has agreed to the construction of Fast Breeder Test Reactor in the Fourth Plan and a provision of Rs. 11.00 crores has been included for the purpose in the Fourth Plan. The project report is now completed and the sanction for setting up of the Fast Breeder Test Reactor as part of the Reactor Research Centre at Kalpakkam has also been accorded.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 15-3-1972]

Recommendation (Sr. No. 5, Para No. 1.42)

The Committee note that there have been large scale variations in the budgetary provisions made and the actuals in the Plan targets, although in some cases it was due to *force majeure* events like devaluation, imposition of customs duty etc., over which the Department of Atomic Energy had no control. The Committee realise that because of the newness of the field of nuclear power development in the country, our dependence on foreign collaboration and foreign finances and introduction of indigenisation in the power projects, there have been shortfalls in the achievement of the targets in the past. They, however, hope that with the experience gained and gradual elimination of dependence on foreign sources in the matter of consultancy, personnel, fuel, equipment etc., and with proper co-ordination and management at national level between the various connected agencies, the Department will be able to improve its performance in future.

Reply of Government

The Government is gratified to note that the Estimates Committee have appreciated the reasons for delay and shortfall in the achievement of the targets in the past, which was due to circumstances beyond its control. Every effort is being made to improve the performance in future.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Recommendation (Sr. No. 12, Para 2.28)

The Committee note that due to the efforts made by the Project authorities and because of the cooperation of the prime contractors *i.e.* International General Electric, a saving of $5,000,000 in foreign exchange could be effected.

Reply of Government

The Government is gratified to note that the Estimates Committee has appreciated the saving in foreign exchange effected in respect of Tarapur Atomic Power Station. Actually there have been further savings and now the loan stands at $ 72.688 million against the original loan $ 80 million *i.e.* a saving of $ 7.322 million.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971.]

Recommendation (Sr. No. 13, Para 2.37)

The Committee note that the repairs to hairline cracks in the stainless steel lining of certain reactor components had been completed by the International General Electric to the satisfaction of the Project Authorities and the warranty period in respect of parts and equipment affected has been suitably extended beyond the normal period of one year.

Reply of Government

Government has noted the observation made by the Estimates Committee.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971.]

Recommendation (Sr. No. 24, Para 2.63)

The Committee would also like to emphasise the need to exchange and rotate senior persons from Tarapur to Kalpakkam and other stations in order to profit from their experience and expert knowledge.

Reply of Government

This is already being done and will continue to be done.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971.]

Recommendation (Sr. No. 26, Para No. 3.8)

The Committee also note that Government's decision to go in for a natural uranium reactor for Rajasthan Atomic Power Project is in keeping with their objective to make use of a technology which will enable the country to be self-reliant in the future nuclear power production programme based on the use of plutonium and thorium of which India has a larger reserve.

Reply of Government

The Government of India is gratified to note that the Estimates Committee have appreciated the reasons for going in for natural Uranium Reactors.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971.]

Recommendation (Sr. No. 27, Para 3.9)

The Committee, cannot, however, resist the impression that the Department of Atomic Energy has taken *ad hoc* decisions in the setting up of power projects. While, in case of Tarapur, attractive initial capital outlay was the main consideration and global tenders were called for, in the case of Rajasthan it was not looked upon from the financial angle and no global tenders were called for. They, however, hope that the expenditure involved in the setting of the RAPP will be commensurate with the benefits to be derived in the shape of economic gain, self-reliance and technical experience.

Reply of Government

As has already been stated in answers to recommendations No. 6 and No. 7, the decision to establish Tarapur Atomic Power Station with enriched uranium as fuel was an isolated first step to demonstrate the economics of nuclear power. It was taken in the circumstances prevailing at that time and in view of the actual response to global tendering. The decision to have future nuclear power reactors on natural uranium as fuel was taken by the Atomic Energy Commission and endorsed by the Planning Commission after a careful evaluation of the various factors related to acquiring self-reliance in atomic energy. The tenders received for Tarapur had indicated the cost and technical merits of the graphite moderated gas cooled reactors (available from U.K. and France) Vs. the heavy water moderated and cooled reactors under development by Canada. The latter was favoured on account of high efficiency in the use of uranium and in the production of plutonium. There was no possibility of securing competitive tenders for what was exclusively a Canadian development. The technical collaboration agreement with Canada which was financed under the Colombo Plan has proved very beneficial to India and this can be judged by the capability that now exists with the Atomic Energy Commission on its own without foreign collaboration to put up CANDU reactors as at Madras.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971.]

Recommendation (Sr. No. 28, Para No. 3.11)

The Committee are concerned to note that the original estimates of the total cost of Rajasthan Atomic Power Project I and II have risen from Rs. 33.42 and 30 crores to Rs. 52.50 and 58.16 crores respectively and are further likely to be pushed up in view of the delay in the completion of the project. They fear that the increased cost of this project is bound to affect ultimately the cost of generation of power per unit. They would like to sound a note of warning that Government should take concerted measures to keep down the cost so that the Nuclear Power Project does not become an uneconomic proposition and the power generated can compete with conventional sources in price level.

Reply of Government

The recommendation noted. It is necessary to point out that in Rajasthan Atomic Power Project and Madras Atomic Power Project we are not only building power stations but indigenous capability and industrial infra-structure.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971.]

Recommendation (Sr. No. 29, Para 3.20)

The Committee note that for RAPP I and II, the Department of Atomic Energy had initially placed orders with the Hindustan Steel Ltd. for certain flat products using quality carbon steel, but these orders had to be transferred to a firm abroad as the material forthcoming from H.S.L. did not conform to the prescribed specifications. The Committee would like Government to look into the matter so that the requisite variety of steel for nuclear power station could be supplied from indigenous sources, thereby achieving self-reliance and saving valuable foreign exchange.

Reply of Government

Every effort is being made to secure the help and cooperation of the Hindustan Steel Ltd. in the production and supply of special types of steel required by nuclear power stations. The matter has been discussed in a series of meetings between the officials of the Power Project Engineering Division and Hindustan Steel Limited. Hitherto, the main difficulty in the way of Hindustan Steel Limited making investments for the production of such special types of steel was the lack of a long term commitment to the nuclear power pro-

gramme which in turn prevented the Department from making any long term commitments regarding the purchase of these special types of steel, if produced.

All possible steps are being taken to see that the requirements of the atomic power stations are met indigenously to the maximum extent possible.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971.]

Recommendation (Sr. No. 34, Para 3.31)

The Committee are surprised to note the wide variation in the estimated cost of generation of power by RAPP as furnished by the Department of Atomic Energy from time to time. According to the Planning Commission the cost of generation of power in RAPP should be considerably higher. The Committee need hardly stress the desirability and importance of working out the cost of generation of energy in advance as a firm estimate in this regard has an important bearing not only on the economics of the plants but also on the willingness of the consumer States to purchase it at reasonable rates.

Reply of Government

It is difficult to estimate accurately in advance the capital cost of an atomic power station due to the several varying international and national factors which affect it during the comparatively long period of construction. Changes in the exchange rate, escalation of prices, changes in design and modifications required due to improvements in technology which are bound to arise in the fast developing field of nuclear technology are illustrations of the many factors which continually affect the capital cost and consequently the cost of power generation by a nuclear power station.

The difference between the estimates of cost of power by the Department of Atomic Energy and by the Planning Commission

quoted in para 3.30 of the report is mainly due to the following:—

(a) *Fixed Costs*

The Planning Commission have failed to take the depreciation amounts which will be set apart annually on which interest will be earned. This point has been gone into at great length and the method of calculating cost on account of fixed charges adopted by the Department of Atomic Energy is no longer being disputed.

(b) *Fuelling Cost*

The figure of 0.62 p/kwh indicated by the Planning Commission was the gross fuelling cost based on the then assumed cost of uranium etc. Against the gross fuelling cost of 0.62 p|kwh credits to the extent of 0.28 p|kwh towards Plutonium and Cobalt produced in the reactor has to be taken into account. The net fuelling cost was, therefore, indicated as 0.34 p|kwh by the Department of Atomic Energy.

The revised capital cost of Rajasthan Atomic Power Station Units I & II have now been estimated at Rs. 60.40 crores and Rs. 66.85 crores respectively as against the former figures of Rs. 52.50 crores and Rs. 58.16 crores respectively. Based on these capital costs and the revised cost of fuel, the cost of power has now been estimated as under:

Fixed cost	5.29 p|kwh
Gross fuelling cost	1.43 p|kwh
Rebates for Plutonium and Cobalt	(—) 0.60 p|kwh
Net fuelling cost	0.83 p|kwh
Total cost of generation	6.12 p|kwh

An important point to be noted with particular reference to the economics of the plants and the willingness of the consumer States to purchase power from the atomic power station is that most of the factors which affect the cost of power generation in a nuclear power plant also affect the cost of power from fossil fuel plants and the relative economics of the two alternatives do not change appreciably.

The Government, however, accept the desirability and importance of working out firm estimates of the cost of power generation in advance and hope that with the experience gained in the construction of the Atomic power stations of the CANDU type currently being built they will be in a position to give estimates of the cost of power which are accurate to the extent to which they are not affected by factors beyond their control.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971.]

Recommendation (Sr. No. 41, Para No. 3.51)

The Committee note that after the commissioning of the Units I and II of the Rajasthan Atomic Power Project, no foreign personnel will be required to operate or maintain the Station.

Reply of Government

The position as noted by the Estimates Committee is correct.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget, dated 30-1-1971.]

Recommendation (Sr. No. 42, Para 3.52)

The Committee also note that the scientific and technical staff likely to be required for the operation and maintenance of the Rajasthan Project after the Station has turned over will be 348 whereas in case of Tarapur, the number of persons is 249 only. The Committee consider that requirements of the staff for the Rajasthan Station may be examined with a view to keep it as low as possible to ensure that the Station is run as an economic unit.

Reply of Government

The requirement of 348 scientific and technical staff indicated in respect of the Rajasthan Atomic Power Station included not only

the regular staff required for the operation and maintenance of the station, but also the additional manpower required while operation and phased commissioning will go on side by side. These additional members will be required for watching performance and correcting deficiencies and problems which may arise during commissioning and for about a year after each unit attains full power. The regular scientific & technical staff for operation and maintenance required thereafter is assessed as 211 only. The additional requirement during the initial period has been assessed on the basis of experience at Douglas Point.

Every effort will be made to keep the requirements to the minimum and to release as many of the additional personnel as possible in a phased manner, to the Madras Atomic Power Station or to meet other suitable requirements.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971.]

Recommendation (Serial No. 43, Para 4.5)

The Committee are glad to learn that in setting up the Madras Atomic Power Project, India for the first time will be having no foreign collaborator and that Indian scientists and engineers have acquired sufficient expertise and skill to undertake this task on their own.

Reply of Government

The Government is glad to note that the Estimates Committee have appreciated the efforts of the Department of Atomic Energy in getting self-reliance and in building up sufficient indigenous expertise to enable the Department to set up the Madras Atomic Power Station without any foreign collaboration.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971.]

Recommendation (Serial No. 44, Para 4.6)

The Committee also note that a serious attempt has been made to build self-reliance for our future nuclear power production programme regarding the use of indigenous fuel and heavy water, greater degree of indigenisation of equipment and machinery etc.

Reply of Government

The Government is gratified to note that the Estimates Committee have recognised the efforts made by the Department of Atomic Energy

towards self-reliance for setting up future atomic power stations.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971]

Recommendation (Serial No. 46, Para 4.13)

The Committee are glad to be informed that the valuable competence in nuclear power technology gained by Indian scientists and engineers at Tarapur and Kota will enable them to build the Kalpakkam Atomic Power Station on their own without any foreign collaboration or financial aid. In fact, this is said to be the first nuclear power project which is being handled by Indians utilizing resources from within the country and with indigenous component to the extent of 80 per cent. A large number of agencies, namely, Ministries of Industrial Development and Company Affairs, Foreign Trade, Finance, D.G.S. & D., D.G.T.D., public undertakings like Heavy Electricals, Bhopal, Bharat Heavy Electricals, Hardwar and Hindustan Steel Ltd., and industries in the private sector are involved in this project and hence the timely completion of the project will depend on the coordination and cooperation of all the parties concerned. It is challenging job calling for pooling of resources and the cooperative concerted efforts of the various agencies. The Committee hope that Government will keep a constant watch on the progress of the project with a view to ensure that all hurdles and bottlenecks in the way of its smooth execution are sorted out and possible delays eliminated.

Reply of Government

The views of the Estimates Committee with which the Government is in full agreement, have been noted. No effort will be spared to ensure the smooth execution of the project and to eliminate all possible delays.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971]

Recommendation (Serial No. 48, Para 4.20)

The Committee regret to note the wide gap in the budget estimates and the actuals. During the years 1965-66 to 1969 (upto ist September, 1969) while budgetary provisions had been made for a sum of Rs. 11.42 crores, the actual amount spent was to the extent of Rs. 3.64 crores only. The Committee hope that Government would in future frame a more realistic budget estimates as far as possible having regard to the various factors likely to affect the progress of the project.

Reply of Government

A statement indicating the reasons for shortfalls in expenditure year by year upto 1968-69 is enclosed. It will be observed that as

stated earlier, the main cause of the stretch in the project schedule as well as short falls in the expenditure was the difficulty in obtaining assistance to cover the foreign exchange cost of the project and the consequent decision to maximise indigenisation of the components and equipment required for the project. Several difficulties have also arisen in the process of getting the major nuclear and non-nuclear components fabricated in India for the first time which could not be anticipated in advance.

Every effort is being made to ensure that the Budget Estimates are as realistic as possible having regard to the various factors that are likely to affect the progress of the project.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Statement showing the reasons for saving in the voted grants for Madras Atomic Power Station Unit I.

Year	Voted grant	Actual expenditure (Figures in Rs. lakhs)	Reasons for shortfalls in expenditure
1965-66	50·00	1·34	The assistance for financing the foreign exchange part of the project was not available as earlier anticipated. Hence, the project had to be rescheduled to reduce the foreign exchange component to the minimum.
1966-67	158·00	22·59	Athough the preliminary works were undertaken the major civil works and fabrication of equipment could not progress as anticipated at the time of framing Budget Estimates due to rescheduling of the project on account of decision to maximise indigenisation.
1967-68	150·00	111·56	Civil works could not progress to the extent earlier anticipated on account of delay in land acquisition and procurement of equipment also slowed down a little due to difficulties in identifying indigenous capacity for fabrication.
1968-69	350·00	174·00	Unanticipated delays occurred in procurement of equipment due to (a) design changes (b) efforts to obtain Indian supplies and (c) other technical reasons. There was a general stretching out of the project schedule even for civil works in view of the above difficulties and difficulties in obtaining tensile steel, special steel etc. which were to be manufactured in India for the first time.

Recommendation (Serial No. 50, Para 4.31)

The Committee understand that in and around Madras there will not be much demand for nuclear power during the monsoon season on account of over-flowing of reservoirs in that region. In this respect, Kalpakkam and Tarapur stand on the same footing. The Committee also understand that in Madras there are two monsoons and the usual period which the power generation economics takes into account is 4 to 6 weeks only. The Committee trust that maintenance programme of the Station will be properly phased out and all other necessary steps taken by Government to ensure that there is no closure of the Station on account of lack of demand and alternatives found out to make the maximum use of the power made available from the Kalpakkam.

Reply of Government

The recommendation is noted.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Recommendation (Serial No. 53, Para 4.35)

The Committee hope that the strength of the staff, both engineering, scientific and technical and others has been assessed keeping in view the actual requirements of the Project and that Administration will ensure that there is no over-staffing right from the very beginning.

Reply of Government

The recommendation is noted. Every effort will be made to see that only minimum staff required is retained for the operation and maintenance of Madras Atomic Power Station.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Recommendation (Serial No. 54, Para 4.36)

The Committee suggest that Government may examine whether it would be desirable to keep a separate pools of erection and construction staff and staff required for normal operation and maintenance of the Project so that when the work is over expenditure on the former category of staff would not automatically become part of the operational staff thus burdening the undertaking with overstaffing and making it uneconomical.

Reply of Government

The recommendation is noted. The Department has already constituted an 'Atomic Power Authority' to take over and run the atomic power stations as and when they are completed. Operation and maintenance staff will be under the control of this authority, which will be distinct from the Power Projects Engineering Division which is responsible for Design, Planning and technical supervision at the construction stage of the projects and which will control construction staff.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Recommendation (Serial No. 57, Para 5.16)

The Committee note that as at present constituted the Commission has a preponderance of non-scientist members. They consider that the Commission as the policy making body at the highest level should also include a few eminent independent scientists either on a full-time or part-time basis so as to induct more expertise in the Commission and make it more broad-based and useful. The Committee have, no doubt, that such a step would be generally beneficial and would lead to better programming and appraisal of research and development work in the field of atomic energy.

Reply of Government

Government accepts the suggestion of making the membership of the Commission more broad based. The Commission has been expanded for the year 1971 from five to six by the addition of Professor S. Dhawan, Director, Indian Institute of Science, Bangalore. As a person distingished in Aeronautical Engineering and involved in advanced training and research. Professor Dhawan can contribute significantly to the Commission. The Government believes that with the addition of the new member the Commission is a very balanced one.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Recommendation (Serial No. 60, Para 5.30)

While conceding that both the Rajasthan and Madras Power Projects being in the development stage it would be advantageous to have a few common Members in the two Boards, the Committee feel that the very idea of having separate Boards for management is defeated when the Boards have common membership to the extent

of four out of a total of five members in position. They accordingly recommend that the two Boards should be reconstituted with the Project Head as one of the Members.

Reply of Government

The Boards of Management to administer the Rajasthan and Madras Atomic Power Projects have since been re-constituted in August, 1970. They now include the Project Heads. The composition of the new Boards is as under:—

Rajasthan Atomic Power Project	*Madras Atomic Power Project*
	Chairman
Shri H. N. Sethna, Director, Power Projects Engineering Division	Shri H. N. Sathna, Director, Power Projects Engineering Division.
	Representatives of the Department with special responsibility for administrative and financial matters.
Shri R. Bhaktavatsalu, Additional Secretary, Department of Atomic Energy.	Shri R. Bhaktavatsalu, Additional Secretary, Department of Atomic Energy.
	Shri N. S. Siva, Joint Secretary, Department of Atomic Energy, Madras.
	Scientists Engineers
Dr Brahm Prakash, Director, Metallurgy Group, Bhabha Atomic Research Centre]	Dr Brahm Prakash, Director, Metallurgy Group, Bhabha Atomic Research Centre.
Shri A. S. Rao, Director, Electronics Group, Bhabha Atomic Research Centre]	Shri A. S. Rao, Director, Electronics Group, Bhabha Atomic Research Centre.
Shri V. N. Meckoni Head Designs Group Power Projects Engineering Division.	Shri V. N. Meckoni Head, Designs Group Power Projects Engineering Division.
	Other Members
Shri V. Surya Rao Chief Project Engineer Rajasthan Atomic Power Project	Dr M. R. Srinivasan Chief Construction Engineer Madras Atomic Power Project.
Shri S. Fareeduddin, Officer on Special Duty, Heavy Water Projects.	

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Recommendation (Serial No. 61, Para 5.36)

The Committee hope that the constitution of Power Projects Engineering Division in Atomic Energy Department for undertaking the responsibility for the establishment of atomic power projects will lead to better coordination and economy and ensure better pooling of resources and expertise and experience. They have, no doubt that experienced engineers and scientists will be rotated among the three Power Projects according to the needs of the situation.

Reply of Government

The views of the Estimates Committee regarding the benefits to be derived from the establishment of the Power Projects Engineering Division have been noted. Their recommendation regarding the rotation of experienced engineers and scientists among the power projects according to the needs of the situation, is already being followed and will be continued.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Recommendation (Serial No. 62, Para 5.38)

The Committee note that a separate Atomic Energy Authority as a constituent unit of the Atomic Energy Department is soon going to be set up for managing the nuclear power plants in the country after the construction work was over. They hope that the proposed Authority will be a forward looking body able to run the Power Plants efficiently and economically.

Reply of Government

The views of the Estimates Committee regarding the functioning of this Authority have been noted.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Recommendation (Serial No. 63, Para 5.41)

The Committee suggest that Government should review the position regarding the continuance of Liaison Offices in Canada and France on a regular basis after the expiry of the present sanction.

Reply of Government

The recommendation is accepted.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Recommendation (Serial No. 66, Para 6.7)

The Committee trust that the Atomic Energy Department periodically review their manpower requirements so that they recruit and impart training to only such number of engineers and scientists as can be usefully and purposefully employed and not become redundant after some time.

Reply of Government

The recommendation is accepted.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Recommendations (Serial Nos. 67 and 68, Paras 6.15 and 6.16)

The Committee feel that Government have taken a long time in commencing the work on Nuclear Fuel Complex although the decision to set it up was taken as far back as in 1966. They are constrained to observe that lack of proper project planning and scheduling and lack of coordination amongst the various Ministries/Departments concerned have been the main factors responsible for delay in the commencement of the work on this Complex.

The Committee hope that the Government would now take all necessary steps to ensure that the Complex is completed according to schedule to meet the requirements of fuel for three Atomic Power Projects and to avoid dependence on foreign resources and to save the much needed foreign exchange.

Reply of Government

While noting the observations of the Committee it may be mentioned that as a result of the vigorous effort made after the commencement of work, considerable progress has now been achieved on most of the projects and the anticipated completion dates of the various plants are as under:

1. Uranium Oxide Plant	July 1971
2. Ceramic Fuel Fabrication Plant	September 1971
3. Zirconium Sponge Plant Zirconium Oxide Plant	Early 1972
Zircalzy Fabrication Plant	Will reach the stage for commissioning by early 1972.
4. Enriched Uranium Oxide Plant	1971-72
5. Enriched Uranium Oxide Fuel Fabrication Plant	end 1971
6. Special Materials Plant	1971-72

Every effort will be made to ensure that the Complex is completed in time to meet the requirements of fuel of the atomic power stations being set up.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Recommendation (Serial No. 71, Para 6.31)

The Committee note that India is contributing as much as 15.54 lakhs of rupees annually to the International Atomic Energy Agency. They trust that our association with International Atomic Energy Agency is fruitful and commensurate with the expenditure involved.

Reply of Government

India has benefited considerably by its membership of the International Atomic Energy Agency and through the active involvement and participation of a large number of scientists and engineers in the activities of the Agency. In keeping with the high position India has among nations advanced in atomic energy matters India has a permanent seat on the Board of Governors of the IAEA and a say in the international affairs related to this sensitive field.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Recommendation (Serial No. 72, Para 6.32)

The Committee understand that the Chairman, Atomic Energy Commission, is required to go abroad to participate in important activities of the International Atomic Energy Agency and attend conferences and seminars organised by that Agency and the U.N. Organisation regarding peaceful uses of Atomic Energy. As the Chairman, Atomic Energy Commission, is also Secretary of the Department of Atomic Energy he has under his administrative control a large number of Research Centres and Institutes, Departmental Undertakings and Atomic Power Stations, a large number of complicated problems are bound to arise necessitating his decision and personal guidance.

The Committee feel that in view of the fast developing activities of the Department in several directions simultaneously, the whole time presence and attention of the Chairman will become imperative. They, therefore, suggest that his visits abroad should be confined to the absolute minimum requirements.

Reply of Government

The Chairman's visits abroad to particpate in the activities of International Atomic Energy Agency or Conferences and seminars organised by the other organisations of the U.N. are confined only to such occasions when his presence is absolutely essential having regard to their importance. Other suitable representatives of the Department are sent to attend conferences and seminars wherever this is regarded as appropriate.

Atomic energy and space research have wide international, scientific, technological and political implications. The Chairman, Atomic Energy Commission cannot perform his responsibilities effectively without personally participating in meetings and consultations at the top level requiring visits abroad.

The recommendation of the Committee which are in conformity with the existing practice will be followed in future also.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Recommendation (Serial No. 74, Para 6.48)

The Committee note that Government are aware of the need to look afresh in the matter of selection of sites for nuclear power stations apart from sites recommended in the Report of the Hayath Committee submitted in January-February, 1962. More than 8 years have now elapsed and Government have since acquired experience in building Atomic Power Stations. The Committee hope that in addition to the technical considerations whch govern the setting up of a nuclear power station due notice will be taken of the following points:—

(i) Need for a rational policy in the national interest so that power generated reaches the areas of demand.

(ii) Need for rationalisation and strengthening of grids and continuous research to reduce loss in transmission over long distance.

Reply of Government

The Central Water & Power Commission carry out detailed load surveys which project the load demands in the various States on a long-term basis for a period of 10—15 years. They also carry out Annual Power Surveys for obtaining systems forecasts for the next few years and assessing the power position in the country as a whole. With the knowledge of the demand pattern thus derived and having regard to the availability of power potential both from

hydel and fossil fuel resources, the conventional power stations are set up as close to the areas of demand as possible.

Under Section 22 of the Atomic Energy Act 1962, the Department of Atomic Energy is responsible to develop a sound national policy in regard to atomic power and to co-ordinate such policy with the Central Eelectricity Authority and the State Electricity Boards. The co-ordination envisaged ensures that Atomic Power Policy fits into the over-all power policy developed by the Ministry of Irrigation and Power including the Central Electricity Authority and the Central Water & Power Commission and that the atomic power stations are set up in the broad regional areas indicated by the demand patterns and availability of power from other sources, the exact locations being subject to the several technical considerations which have to be taken into account. The Atomic Energy Commission also conducts studies like the one recently completed regarding the optimum mix of power generation from various resources in the Northern Electricity Region in which the State Electricity Boards concerned, and the Central Water & Power Commission were associated. These studies take into account all economic considerations like cost of generation and transmission of power and cost of transport of raw materials etc.

A technical Committee of experts for selecting suitable sites for atomic power stations in the Northern, Western & Southern Eelectricity Regions was appointed on September 30, 1970. The recommendations of the Estimates Committee have been brought to their notice for information and guidance.

The strengthening of the grids and continuous reserach to reduce losses in transmission of power over long distances comes within the responsibility of the Ministry of Irrigation & Power.

The Central Water and Power Commission brings out annual publications giving statistics of generation from different sources, transmission and distribution of electrical energy etc. These publications include information regarding the transmission and distribution losses in the various power systems in the country.

2. While planning and operating grids, the following measures are required to be taken for reducing the losses:—

(i) Choice of appropriate voltage for the transmission and distribution system.

(ii) Provision of suitable reactive compensation in the form of synchronous condensors/static capacitors at suitable locations in order to improve the power factor of the loads and thereby restrict the reactive power flow over the lines.

(iiii) Adoption of optimum conductor size for transmission and distribution losses.

(iv) Maintaining proper voltage levels at different points of the net work.

(v) Operating the system at high load factor.

3. The various State Electricity Boards/Power Supply Undertakings are constantly made aware of these measures and they are putting them into practice to the extent possible, in order to reduce the losses.

It may be mentioned that this question is also being examined by the Power Economy Committee appointed by the Ministry of Irrigation and Power. The report of the Committee is awaited.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Recommendation (Serial No. 75, Para 6.49)

They would also recommend that if atomic power is to be subsidized in the national interest, this should be done with the prior approval of Parliament.

Reply of Government

It is not proposed to subsidise atomic power at present. The financial proposals of all units of the Department of Atomic Energy are submitted to Parliament with the Annual Budget proposals for approval.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

CHAPTER III

RECOMMENDATIONS WHICH THE COMMITTEE DO NOT DESIRE TO PURSUE IN VIEW OF THE GOVERNMENT REPLY

Recommendation (Serial No. 6, Para 2.10)

The Committee feel that Government in their enthusiasm to demonstrate that atomic power could be generated at a rate which would be competitive with conventional sources of power in the country, in the setting up of Tarapur Project took a hasty step, not in keeping with the country's long-term objective, in accepting reactor based on enriched uranium. The enriched uranium is required to be imported for the life time of the Station and has thus made the country dependent on foreign resources. The Committee further feel that in view of the contract being on a turn-key basis, it is doubtful if the Tarapur Project has taken the country far enough in attaining the goal of self-reliance in the production of nuclear power.

Reply of Government

The decision to establish Tarapur Atomic Power Station with enriched uranium fuelled reactor taken in the early 1960's has to be judged having regard to the circumstances then prevailing. The very idea of using atomic energy for generating power was regarded with scepticism in the country at that time. It was, therefore, important to demonstrate on a firm basis the relevance of atomic power. A turn-key fixed price contract with an agreement guaranteeing the supply of enriched fuel for the life time of the Station was ideally suited for this first demonstration.

Even at that time, the need for exploring the establishment of power stations based on reactor concept which would use natural uranium was, no doubt, well understood. But the only established natural uranium reactor at that time where the Calder Hall type developed in Britain and those of a somewhat similar design developed in Britain and those of a somewhat similar design developed in France. The large size prototype power station with the CANDU heavy water reactor had not yet been established in Canada at that time. It would be of interest to mention that among the various proposals received in response to the global tender, there were two proposals from Canada based on natural uranium fuelled and heavy water moderated reactor concepts. But these proposals were not complete either in design or as to costs as no station using these concepts were in operation at that time anywhere in the world.

In fact, initially, it was decided that global tenders should be invited only for natural uranium reactors. Later, however, taking into consideration the state of development of reactor technology in the world, it was decided to invite proposals for enriched uranium reactors also to enable us to get an accurate idea of the capital and operating cost of such reactors as compared with similar costs of natural uranium reactors. In the event, the proposals received based on enriched uranium reactor from the American contractors proved extremely attractive even after taking into account the estimated cost of importing enriched uranium for periodical replenishment, which was not higher than the annual interest on the additional capital outlay in foreign exchange that would have been incurred if the most favourable tender for natural uranium reactor had been accepted. In any case, the proposals based on natural uranium reactors received from Great Britain and France were totally unsatisfactory from the financial angle.

In the above circumstances, and in view of the need which clearly existed at that time for taking a first step towards initiating nuclear power programme, the decision to establish a power station based on enriched uranium cannot be deemed to be hasty.

Even though the International General Electric of USA assumed the responsibility of the prime contractor to build the main station to its own design, Indian scientists and engineers were associated with the establishment of this atomic power station in several ways. They assumed responsibility for laying down enquiry specifications and later for evaluation of tenders, which called for a considerable amount of technical knowledge and judgment. They also assumed responsibility for the approval of the design basis and of design changes. For example, during the construction of the station, certain problems relating to metal|water reactions in the reactor emerged. Indian scientists and engineers suggested a number of devices for controlling their effect, which added significantly to the safety of reactor operation. Some of the Indian engineers were closely associated with the engineers of General Electric at their design changes. They were also associated with the engineers of the prime contractor in witnessing the fabrication of equipment in the manufacturer's shops and their testing in USA. They were similarly associated with the supervision of the work at the site at Tarapur. They were jointly responsible along with the site staff of General Electric for the detection of the hair-line cracks which developed in some of the stainless steel components of the reactors and played a significant part in determining the nature and extent of repairs that had to be undertaken. They witnessed, and in fact,

closely participated in the tests at the site during the commissioning of the Station. The experience and knowledge gained by Indian scientists and engineers, is therefore, not inconsiderable and will be of value in the setting up of and operation of power stations based on other reactor concepts. The Tarapur Atomic Power Station has, therefore, not only established the competitive nature of nuclear power but also provided in-valuable experience and knowhow in the building and more significantly of the operation of atomic power stations.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Recommendation (Sr. No. 7, Para 2.11)

The Committee are not convinced that the terms offered by the International General Electric Company were too attractive to be rejected specially when factors like fuel cost, the production of plutonium, achievement of self-reliance, saving in foreign exchange and the country's long-term objective are taken into consideration.

Reply of Government

The decision to accept International General Electric's (IGE) offer has to be judged having regard to the factors and circumstances prevailing at that time.

Initially, it was decided that global tenders should be invited only for natural uranium reactors. Later, however, it was decided to invite proposals for enriched uranium reactors as well, to enable the Atomic Energy Commission to get an accurate idea of the capital and operating costs of such stations as compared with the capital and operating cost of natural uranium reactors. The proposals received from Britain and France were, however, prohibitive in cost. The cost of the French proposal which was the best among natural uranium reactor proposals (on pre-devaluation basis) was Rs. 89.00 crores (inclusive of Rs. 59.30 crores as foreign exchange component) compared with IGE's Rs. 60.67 crores (inclusive of Rs. 44.24 crores as foreign exchange components). Even after taking into account the estimated cost of importing enriched uranium for periodical replenishment, which was no higher than the annual interest on the additional capital outlay in foreign exchange that would have been incurred if the French offer had been accepted, the offer of the IGE was extremely attractive.

It should also be noted that the large size prototype power station with CANDU heavy water reactor had not yet been established in Canada at that time and the Canadian proposals received for natural uranium reactors were neither complete in design nor firm in respect of financial implications.

The establishment of the Tarapur Atomic Power Station was an isolated but calculated first step to achieve the following advantages:—

(a) Gaining of sufficient experience by the Indian scientists and engineers in association with the prime contractors in building nuclear power stations which would be invaluable in setting up future power stations, even if they used different reactor concepts.

(b) Preparing the necessary ground for initiating the nuclear power programme based on natural uranium reactors by the time the technology of such reactors was expected to be firmly established.

As has been explained in reply to recommendation No. 6, the experience gained by Indian scientists and engineers associated with the setting up of the Tarapur Atomic Power Station has proved invaluable for training and acquiring self-confidence.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Recommendation (Sr. No. 11, Para 2.26)

The Committee are constrained to observe that the cost of the fuel for Tarapur Atomic Power Project, as given by Government on various occasions differ widely. They need hardly stress the importance of furnishing correct information in vital matters of national importance.

Reply of Government

As has been explained below, the apparent discrepancies in the figures quoted by the Estimates Committee arise from different contexts and point of time related to them.

The information furnished to Parliament Questions and to the Estimates Committee and their contexts are as under:—

Reference	Brief subject matter of the information called for	Information furnished in brief	Remarks
Lok Sabha Unstarred Question No. 23 answered on 25-7-1966.	Sales contract with USA for supply of Enriched Uranium fuel amount of Uranium to be supplied and the total cost.	*Initial fuel* Approximately 14,500 Kgs. of U. 235 to be supplied at a cost of about Rs. 11·25 crores (Rs. 15·00 million) *Annual Replenishment* cast Rs. 1.4 crores per annum.	*Initial fuel* 1. The sale contract with the US Atomic Energy Commission refers to supply of enriched uranium and not the finished fuel. Consequently only the cost of enriched uramium for the first load was given in the reply to Lok Sabha Unstarred Question No. 23, The reply did not include cost of fabrication, customs duty, interest charges payable till station-turnover etc. 2. The amount of uranium in the first load is dependent on the final design of the fuel elements. In 1966 the design was in the process of being finalised. The final figures were given in reply to Lok Sabha Unstarred Question No. 1189 answered on 20-8-1969 as Rs. 10.80 crores. *Annual Replenishment* The question asked for the cost of annual replenishment under the Fuel Sales Agreement. Under the agreement credits will be allowed by USA for Plutonium and depleted Uranium. Hence the net average annual cost of Rs. 1.4 crores was indicated.
Lok Sabha Unstarred Question No. 4189 answered on 20-8-1969.	Quantity of purified fissionable and reactor charge of nuclear elements imported into India annually and cost therefor.	*Initial fuel* 83 tonnes at a cost of Rs. 10.80 crores ($14-375) million).	*Initial fuel* 1. Same as 1 above. 2. The fuel design was finalised towards end of 1966. The figures of initial charge were furnished based on actuals.

Reference	Brief subject matter of the information called for	Information fur nished, in brief.	Remarks.
		Annual Replenishment 22 tonnes at a cost of Rs. 2.40 crores.	*Annual Replenishment* The information required was relating to the cost of fissionable charge imported into India and hence the gross cost of enriched uranium to be imported, namely, Rs. 2.4 crores was indicated in the reply. This included credit for Plutonium and depleted uranium.
Note to Estimates Committee on Tarapur Atomic Power Project.	The total cost of initial fuel charge consisting of fabricated fuel elements.	Rs. 24·61 crores consisting of: Cost of fuel. Rs. crores. 10·80 Interest till station turnover, fuel fabrication etc. 8·59 Customs duty. 5·22 24·61	Includes all charges relating to fabricated fuel elements comprising of the initial fuel charge.

The figure of Rs. 2.5 crores mentioned as the annual replenishment charges in the evidence before the Committee shows only a marginal difference from the figure of Rs. 2.4 crores mentioned in reply to Lok Sabha Unstarred Question No. 4189 answered on 20-8-1969. This marginal difference arose due to the change over to an annual fuel cycle from the previous nine monthly cycle.

The amount of Rs. 1.7 crores indicated in the evidence before the Committee as being the annual expenditure for fuel replenishment is made up as follows:

	Rs. crores.
Gross cost of enriched uranium to be imported.	2·4
Less credits for Plutonium and depleted uranium.	(—)1·0
Net cost of enriched uranium.	1·4
Add Indian expenditure on reprocessing of Plutonium/depleted uranium.	0·3
TOTAL	1·7

It would be clear from the above explanation that the differennces in figures are due to the fact that the various elements of cost included in replies furnished by the Department depended upon the precise questions answered on the various occasions.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Recommendation (Sr. No. 14, Para 2.38)

The Committee, however, observe that the Department of Atomic Energy in their Annual Report for the year 1967-68 and in the reply to a question answered in the Lok Sabha on the 27th March, 1968 did not supply the information about the appearance of cracks in the reactor and the loading of fuel that was due in December, 1967 while mentioning the progress made in the construction of the Tarapur Atomic Power Project.

Reply of Government

A Nuclear power reactor and its components are examined from the quality stand point repeatedly during fabrication as well as during tests. In the course of the final examination of the reactor pressure vessels towards the end of 1967, a few hairline cracks were noticed only in the lining of the pressure vessels. There was nothing to indicate that the trouble was not localised and that its rectification would entail delay of the start-up of the power plant. In a project of the magnitude and complexity of Tarapur, there are a number of jobs of rectification that are required before commissioning and final take over. Most of these are of no consequence to the date of completion.

Parallel rectification of the cracks during the time available was expected to be achieved. The Project authorities and the Prime Contractors *viz.* International General Electric were therefore hopeful of keeping to the original schedule date for station turn-over; *viz.* October, 1968 by working on around the clock basis.

By way of abundant caution, an examination was also instituted in other areas of the reactor where similar defects could have developed. As a result of these tests, seepage of water in the secondary steam generator became evident in April 1968. This had to be fully investigated and defective components had to be repaired or replaced. In May 1968 it became evident that the replacement of all the 6500 tubes was necessary, even though only 3 per cent of the arms of the tubes were actually found leaking (all these required and replacement were made at the cost of the International General

Electric) and that these repairs would delay the commissioning of the Station. On May 29, 1968 a Press announcement was made in this regard (Appendix II).

There was no indication in March 1968 when we answered the Lok Sabha question or during the preparation of the Annual Report for 1967-68 at about the same time that the repairs and replacement would be so extensive, and that there would be delay in commissioning.

Thus, it will be seen that there was no deliberate holding back of information from the Parliament at any time.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Recommendation (Sr. No. 15, Para 2.39)

The Committee regret to note that after taking a decision in 1958 to have an Atomic Power Station in western region of India and fixing a target of commissioning one of the two reactor units of 190 MW capacity by the end of the Third Five Year Plan, the Tarapur Atomic Power Station began to flow commercial power in October, 1969 only. Apart from the long time taken in the finalisation of the various agreements necessary for the execution of the Project there has been a delay of about one year in the commissioning of the project. They consider that a significant loss has been suffered by Government on the following counts:—

(i) The increased cost of the Project and the interest on capital during the extended period of construction;

(ii) The loss of possible profits that would have accrued to the Government, had the project begun to flow commercial power as per schedule i.e. in October, 1968;

(iii) Recurring loss in the cost of production of power;

(iv) Loss on account of lower intake of power by the switchyard and due to its closure.

Reply of Government

Enclosed Statement I indicates the various steps taken from the first decision in 1958-59 to establish an atomic power station in the Western Region till the completion of the contract with M|s. International General Electric Company in June 1964 and the time taken for each of the steps. It will be seen that there has been no undue delay

in respect of any of the steps except that negotiations for various agreements had to be necessarily protracted in view of the special difficulties in regard to safeguards mentioned by Chairman, Atomic Energy Commission in his evidence before the Committee and recorded in para 2.30 of the report.

The work on the power station could commence only in October 1964 owing to the intervening monsoon season and a tight time schedule for completion of the power station in 4 years was laid down. However, due to the various *force majeure* events listed in the enclosed Statement II and also due to the appearance of hairline cracks in certain stainless steel reactor components, there was delay in the achievement of criticality and start-up power in the two units of the atomic power station. There was further delay in the flow of commercial power due to defects in the Switchyard. The total delay on all these counts amounts to about a year and the station went into commercial operation in October 1969 as against the originally targetted date in October 1968. These difficulties and delays have already been noted by the Estimates Committee *vide* paragraphs 2.30 to 2.34 of the report.

Of the items mentioned in the recommendation, only items (i) and (iii) are readily quantifiable. The increased cost on the project and of interest during construction amounts to approximately Rs. 3 crores of about 4 per cent. The increase in cost of power is approximately 0.1 p/Kwh in 5.61 p/Kwh which is less than 2 per cent.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

STATEMENT I

Steps taken from the time of the first decision in 1958-59 to set up an atomic power station in the Western Region till the conclusion of the contract with the International General Electric Company in June 1964.

Step.	Date of Completion
(1) Formation of Power Group.	August 1959
(2) Selection of Tarapur site after detailed investigation of about 20 alternative locations on the western coastal region of India.	
Acceptance of the site and announcement in Parliament by the Prime Minister.	August 1960
(3) Global tender issued after completing tender specifications	October 1960
(4) Offers received.	End. Aug. 1961
(5) Technical and financial assessment of the offers Placing matter before Cabinet.	July 1962
(6) Letter of Intent issued to Prime Contractors (International General Electric)	September 1962
(7) Discussions with U.S. Government regarding the Bilateral Agreement for Co-operation.	
(8) Discussion with US AID regarding the grant of a loan (Application submitted in November 1962)	
(9) Agreements.	
(i) Indo-US Bilateral Agreement for co-operation	August 1963
(ii) US AID Loan Agreement.	December 1963
(iii) Fuel Sales Agreement; agreed upon (Signed in May 1966)	August 1963
(10) Contract negotiations with International General Electric completed.	March 1964.
(11) Measures taken before start of construction	April 1964.
(12) Contract signed.	May 1964
(13) Contract date (coming into effect of the contract)	June 1964.

STATEMENT II

Force Majeure *Events contributing to the delay in completion of the Tarapur Atomic Power Project.*

Sl. No.	Event of Description.	Date		Days
		Start	End	
(1)	Indo-Pakistan hostilities.	7-9-65	23-9-65	17
(2)	Seizure by Pakistan of equipment . .	19-9-65	June 66 (New components arrived June 66)	9 months
(3)	Strike at Tarapur	18-10-65	21-10-65	4
(4)	Strike at Tarapur . . .	9-12-65	31-1-66	53
(5)	Strike at M/s. Killog Co. (USA) . .	25-4-66	23-5-66	29
(6)	Strike at Washington Corporation (USA)	16-8-65	26-9-65	42
		1-4-66	15-5-66	45
(7)	Strike at Tarapur (Welders, equipment operators and mechanics)	11-7-66	7-9-66	59
(8)	Strike at the Customs (Clearing and Forwarding Agents)	1-11-66	6-11-66	6
(9)	Strike at Vendor's works (USA) (Schenectady Seam Instrument Corporation, Auto Sprinklers Duriron Coy).	10-2-66	8-1-67	3 months.
(10)	Strike at Maharashtra State Electricity Board .	7-2-67	10-2-67	4
(11)	Stoppage of startup power 230 K.V. (GEB) .	4-7-67	19-7-67	16
(12)	Strike by X-Ray Engineering. .	2-8-67	13-8-67	12

Recommendation (Sr. No. 18, Para 2.48)

The Committee are also of the view that the Tarapur Project Authorities should take over the management of the switchyard. The Central Government has invested hundreds of crores of rupees in all these power projects. With a view to ensure that the power which is produced therefrom is not allowed to go waste and that the station runs as an economic unit, it is essential that the problem of production, transmission and distribution of power are properly sorted out in advance.

Reply of Government

The Tarapur switchyard under the control of the Maharashtra State Electricity Board after rectification is now able to handle the

full output of the Station. Negotiations are in progress for taking over the ownership and control of the switchyard by the Station. The switchyards for Rajasthan and Madras are being constructed by the Department.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Further information called for by the Committee

The Committee were informed that negotiations were in progress for taking over the ownership and control of the switchyard from the Maharashtra Government by the Tarapur Station Authorities.

Please state the outcome of negotiations for taking over the ownership and control of the switchyard.

Reply of Government

The financial terms involved in taking over of the switchyard by the Department of Atomic Energy have been accepted by the Gujarat State Electricity Board. The Maharashtra State Electricity Board have not yet conveyed their acceptance to these terms.

The take-over of the switchyard by the Department of Atomic Energy is also contingent upon the removal of certain defects which exist in the switchyard. Work on the removal of these difficulties by the Maharashtra State Electricity Board is in progress. Only after the rectification is completed, will it be possible for us to take over the switchyard, subject to the agreement of the M.S.E.B.?

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 15-3-1972]

Recommendation (Sr. No. 25, Para 3.7)

The Committee note that for the setting up of RAPP—I, Cabinet gave approval in August, 1962, but work at site picked up momentum towards the end of 1964. Similarly, for RAPP-II, the Cabinet gave approval in June, 1965 but work at the site commenced in April, 1967. They would like to observe that an unusually long time was taken by Government in negotiating the agreements with the Canadian Authorities.

Reply of Government

The enclosed statement shows the various steps taken in the negotiations for conclusion of the technical co-operation, financing and consultancy agreements for setting up the Rajasthan Atomic Power Station (Units I & II). The delay was mainly due to the delicate nature of the negotiations with the Government of Canada for technical co-operation in the setting up of CANDU type reactors involving political questions like safeguards, inspection etc. The differences could be resolved only after several discussions at very high level. It was necessary to pursue the negotiations with a view to reduce the drain of scarce free foreign exchange. Had an attempt been made to reduce the time taken on the negotiations, there was a likelihood of jeopardising our position.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Statement showing chronologically the steps taken for entering into technical co-operation, financing and consultancy agreements in respect of Rajasthan Atomic Power Projects Units I & II).

UNIT I

1.	Cabinet approval for setting up unit I of Rajasthan Atomic Power Project.	August, 1962.
2.	Meeting of Chairman, Atomic Energy Commission with the Canadian Government Authorities for securing technical co-operation.	May 13 to May 17, 1963
3.	Finance Ministry approves the financial commitment involved.	June 4, 1963.
4.	Cabinet approval for draft agreement subject to modifications that might be suggested by Ministry of Law. .	August 7, 1963.
5.	Revised draft of certain articles proposed by Canada. .	August, 30, 1963.
6.	Cabinet decision that Dr. Bhabha and Shri Khera, the then Cabinet Secretary, should visit Ottawa to settle the text of the agreement.	October 30, 1963
7.	Technical co-operation agreement with Canada signed. .	December 1963.
8.	Consultancy agreement with Atomic Energy of Canada Limited (AECL) and Financing agreement with Export Credit Insurance Corporation (ECIC) concluded. . . .	April 1964.

UNIT II

1.	Cabinet approval for setting up RAPP Unit II . .	June 28, 1965
2.	Application by the Department of Economic Affairs for Loan for RAPP II submitted to Canada. . . .	August 5, 1965
3.	Discussions between the Atomic Energy Department of Canada and the Indian Department of Atomic Energy on the question of safeguards etc:	

(a)	Discussion with Dr. Tayler during his visit to India. .	February, 1966..
(b)	Discussion with Mr. J. L. Gray President, Atomic Energy of Canada Limited (AECL).	March 30, 1966..
4.	Cabinet approval for the basis on which negotiations for agreement on extension of co-operation to cover Unit II may be commenced.	May, 5, 1966.
5.	Extension of Indo-Canadian Co-operation agreement and consultancy agreement with Atomic Energy of Canada Limited (AECL) to cover Unit II.	December 16, 1966..
6.	Discussion with Export Credit Insurance Corporation (ECIC) regarding Loan for Unit II.	February 8, 1967.
7.	Loan agreement with ECIC signed. .	February 27, 1967.

Recommendation (Serial Nos. 30 & 31, Para Nos. 3.21 & 3.22)

The Committee further note that orders for machinery and equipment placed on Heavy Electricals India Limited, Bhopal and Heavy Engineering, Ranchi had also not been fulfilled. They are distressed to learn that none of these public undertakings were able to deliver the goods.

The Committee are convinced that to a considerable extent the delay in the execution of the Project has been caused by lack of coordination amongst the various Ministries|Departments concerned which they deprecate. They consider that in important matters like these, close coordination and cooperation of all Departments concerned is absolutely necessary and recommend that proper procedures should be laid for expeditious despatch of work especially where several Departments|Ministries are concerned.

Reply of Government

Every effort is being made as recommended by the Committee to get the supplies from various industrial undertakings expedited and the Department is in constant touch with the suppliers and the Ministries concerned. The difficulties in fabrication|manufacture of these major items stem from the facts that, (a) these are being undertaken for the first time in India and (b) the undertakings find it difficult to make long term commitments requiring heavy investments on their part in the absence of long term estimates of the demands likely to be made by the atomic power programme. The preparation of a 'Profile for the Development of Atomic Energy and Space Research for the Decade 1970-80' by the Atomic Energy Com-

mission recently and the approval in principle of the programme contained therein by the Government is a step towards remedying the situation.

[Department of Atomic Energy O.M. No. 5|4|(4)|70-Budget dt. 30-1-1971].

Recommendation (Sr. No 33, Para 3.27)

The Committee have a feeling that Government were rather hasty in taking up the RAPP without proper assessment of the technological development and infra-structure of the industry inside the country and the requisite skill and expertise in the particular field obtaining even in Canada. As a consequence, the project has been delayed for non-delivery of equipment in time. Moreover, several changes had to be made in the design during the process of construction of the nuclear and conventional portion of the project. They consider that a poor country like India can ill afford to pay a heavy penalty to the tune of rupees six crores owing to the aforesaid reasons.

Reply of Government

The feeling of the Committee that the Government were hasty in taking up Rajasthan Atomic Power Project when they did, seems to be based on the following impressions:—

(a) The infra-structure of Industry inside the country was not sufficiently developed.

(b) the requisite skill and expertise in the building of CANDU type reactors was not available even in Canada; and

(c) several changes had to be made in the design during the process of construction of the nuclear and conventional portions of the project.

To a large extent, the industrial infra-structure in a country develops along with the establishment of projects based on new technologies. It cannot be had ready-made even by waiting for any length of time. Even at a later point of time the same teething troubles would have had to be gone through because what was being aimed at was not just the acquisition of one or two reactors but the development of the national capability in building atomic power stations.

To have waited till a large-size CANDU type power station was built in Canada for initiating our own programme would have been self defeating in as much as the objective of building up a sufficient stock of plutonium in time to embark on further stages for the ultimate utilisation of thorium in accordance with the long term programme, would have been pushed further away from achievement.

As regards the design changes during the process of construction such changes are inevitable in a fast developing field like nuclear technology. Further, it was desirable for India to benefit from improvements made by Canada in the CANDU design and in fact Canada was under a contractual obligation to pass on this benefit to India.

[Department of Atomic Energy O.M. No. 5|4|(4)|70-Budget dt. 30-1-1971].

Recommendation (Sr. No. 36, Para 3.38)

The Committee note that Rajasthan Atomic Power Project was set up with a view to meet the future power requirements of Rajasthan and neighbouring States with a hope that there will be faster industrialisation in the region and that it will absorb the power generated therefrom in due course of time. The Committee also note that at present there is hardly any infrastructure to absorb the power expected to be generated at maximum load factor.

Reply of Government

The development of industrial infrastructure for the absorption of the power is essentially the responsibility of the State Governments concerned. As stated earlier, the Rajasthan State has requested for the allotment of full power from the station to that State. Claims have also been received for share of power from the other States in the Region like Punjab, U.P., etc. A steering group which included representatives of all State Electricity Boards in the Northern Electricity Region to study the optimum mix of power generation using various sources of power to meet the demand for power by 1978-79 as applicable to the Northern Electricity Region has come to the conclusion that in addition to the Rajasthan Atomic Power Station, which is already under construction, there would be need for setting up two more 400 MW. capacity atomic power stations in the region, purely on the basis of economic considerations.

[Department of Atomic Energy O.M. No. 5|4|(4)|70-Budget dt. 30-1-1971].

Recommendation (Sr. No. 40, Para 3.48)

The Committee are not able to appreciate as to why excessive provisions for crores of rupees have been made for heavy water in the budget estimates from year to year when actually a fraction of the amount could be spent. They feel that lack of planning and development of technical know-how in this regard and failure on the part of Government to achieve the fixed targets within a scheduled time has led to this over-budgeting.

Reply of Government

The heavy surrenders of budget provisions during each of the three years 1966-69 were mainly due to—

(a) the decision taken towards the end of 1967 to set up a 100 tonne|year plant using the surplus steam available from the Rajasthan Atomic Power Station; and

(b) the unanticipated delays and difficulties encountered in technical discussions with the Atomic Energy of Canada Limited regarding the modifications to the Rajasthan Atomic Power Station that became necessary as a result of the above decision.

The factors relating to technical know-how have been explained in reply to recommendations Nos. 38 and 39.

[Department of Atomic Energy O.M. No. 5|4|(4)|70-Budget dt. 30-1-1971].

Recommendation (Sr. No. 49, Para 4.23)

The Committee are concerned to note that the Department of Atomic Energy has not been able to work out so far a firm estimate of the cost of generation of power. They hope that the cost of generation of power will be worked out on a realistic basis at an early date so that the consumers know what they will be expected to pay for the electricity flowing out of the Kalpakkam Atomic Power Project.

Reply of Government

It is difficult to make a firm estimate of the cost of power in advance of completion of a nuclear power station, particularly for the one like the Madras Atomic Power Station in which maximisation of indigenous components is attempted for the first time. The setting up of the Station is assisting the development of a new capabi-

lity. Apart from factors like the exchange rate of currency, customs duty etc., which may alter substantially during the comparatively long period of construction involved, realistic estimates of the cost of indigenous fabrication can be made only when several power stations are built and there is sufficient experience on which reliance can be placed.

In terms of the most recently revised estimates for Madras Atomic Power Station Units I and II, an estimate has now been made of the cost of power from the Madras Atomic Power Station.

[Department of Atomic Energy O.M. No. 5|4|(4)|70-Budget dated 30-1-1971]

Further information called for by the Committee

It has been stated in reply:

"In terms of the most recently revised estimates for Madras Atomic Power Station Units I and II, an estimates has now been made of the cost of power from the Madras Atomic Power Station".

Please furnish the recent revised estimates and how the same compare with the cost of Rajasthan and Tarapur Atomic Power Projects and centrally-owned power suppliers in that area.

Reply of Government

The revised estimates for the Tarapur, Rajasthan and Madras Atomic Power Projects are as follows:—

Project	Total cost	Foreign Exchange component	Cost of Generation of power/ kwh	Selling price/ Kwh.
	Rs. Crores	Rs. Crores	Paise	Paise
TAPP	92·99	66·78	4·72	5·61
RAPP-I .	60·40	30·43	6·12	7·98
RAPP-II .	66·85	25·93		
MAPP-I .	77·10	15·36	6·58	8·59
MAPP-II .	70·63	15·17		

A comparative statement showing the cost of power generation from MAPP with coal fired thermal station at Ennore is given in Appendix III.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget, dated 15-3-1972].

Recommendation (Sr. No. 55, Para 5.10)

The Committee are not convinced by the justification given for the existence of a separate Department of Atomic Energy when the Atomic Energy Commission itself has been vested with the administrative and financial powers of the Government of India, besides being responsible for formulating the policy of the Department of Atomic Energy, preparation of the Budget of the Department and getting it approved by Government, and implementing the Government's policy in all matters concerning atomic energy. The Committee consider that the two bodies, which cover the same field and yet have separate secretariats, should have a clear-cut demarcation of duties and functions so as to avoid duplication and overlapping.

Reply of Government

The Department of Atomic Energy is an independent Ministry with a Secretary at its head, who advises and assists the Minister in-Charge. The Department is vested with the responsibility of carrying out all the traditional functions of a Ministry, which besides (i) assistance to the Minister in the formulation of policy, (ii) implementation of that policy, and (iii) obtaining the grants of Parliament required therefor, include the following functions:—

(a) Assistance to the Minister in the disposal of Parliamentary business;

(b) Discharge of statutory responsibilities, *i.e.* the administration of the Atomic Energy Act;

(c) Administrative and financial co-ordination of its activities—scientific, industrial, logistic and developmental; (please see footnote to this answer)*

(d) Relations with foreign countries, State Governments, local bodies, other Ministries of the Central Government;

(e) Personnel Planning and administration;

(f) Financial control;

(g) Watching the progress and performance of the various units of the Department responsible for the implementation of its plan and programmes.

The field of responsibilities of the Department of Atomic Energy is defined in the Allocation of Business Rules, and the procedure which this Department, like other Ministries, has to follow for the discharge of its functions, are laid down in the Transaction of Business Rules.

The Commission cannot carry out these functions in the absence of an organisation (the Commission has only a *single part-time non-Member Secretary* at the present time).

The Atomic Energy Commission deals with all facets of the policy and programme of the Department of Atomic Energy, including its external relations, its scientific and industrial policy and

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*The Scientific activities of the Department include the activities, not only of various departmental units, for example the Bhabha Atomic Research Centre, but also scientific institution for which it is administratively responsible, e.g., Tata Institute of Fundamental Research, Physical Research Laboratory, Indian Space Research Organisations, Saha Institute of Nuclear Physics, institutes concerned with higher Mathematics, etc.

Its industrial activities include the generation of nuclear power, the activities of the various commercial undertakings of the Department, namely Indian Rare Earths Ltd., Electronics Corporation of India Ltd., etc.

Its logistic activities include the search for atomic minerals, the development of uranium mines, the manufacture of fuel elements and of heavy water, the purchases of stores and equipment required for the Projects of the Department, acquisition and management of land, civil engineering support, etc.

Developmental activities include not only the development activities of production units, for example some of the Divisions of the Bhabha Atomic Research Centre, but also the encouragement of units, both in the public and private sector, to participate in the gradual indigenisation of equipment required for carrying out the programme of the Department.

planning, its personnel policy, its financial administration, etc. In this sense, it has a more direct and undiluted as well as continuing responsibility for the efficient implementation of the atomic energy programme, other than performance of day to day functions which is the responsibility of DAE Secretariat. The Commission, within the limits of the approved Budget, has the power of Government, both administrative and financial for carrying out the work of the Department.

The Secretary, as the head of the Department is charged with overall responsibility for the efficient performance not only of the functions listed at (a) to (g) above, but also of the three basic functions, viz., the formulation and implementation of policy and of obtaining requisite Parliamentary grants. In normal Ministries, the Secretary discharges these functions directly under the control and guidance of the Minister to whom he is responsible, that is without the interposition or association of a Commission. However, as the preamble to the setting up of the Commission states: "These developments call for an organisation with full authority to plan and implement the various measures on sound technical and economic principles and free from all non-essential restrictions or needlessly inelastic rules. The special requirements of atomic energy, the newness of the field, the strategic nature of its activities and its international and political significance have to be borne in mind in devising such an organisation." For example, the Department of Atomic Energy is responsible for all matters relating to its own personnel (as distinct from personnel whose services are obtained on deputation) without the concurrence of the Ministry of Home Affairs. It can carry out its own works programme and effect its purchases independently of the Ministry of Works, Housing and Supply. In these circumstances, it was felt necessary and desirable that in discharging the three basic functions of Government at the level of a Ministry, the Secretary should have the benefit of consultation with a high level body, viz., the Atomic Energy Commission. In order that on the one hand there is no dilution of the Secretary's responsibility and on the other, no abridgement of his powers, the Secretary in the Department of Atomic Energy is ex-officio Chairman of this body with powers to over-rule it, subject to specified conditions.

In the light of the above analysis, it would be seen that the Department of Atomic Energy and the Atomic Energy Commission perform complementary roles without involving duplication and overlapping. The progress of atomic energy in India and the high

position that India occupies amongst nations of the world in this field bears testimony to the effective functioning of these two bodies. [Department of Atomic Energy O.M. No. 5|4(4)|70-Budget dated 30-1-71].

Recommendation (Sr. No. 56, Para 5.15)

The Committee note that the activities of the Commission in the field of atomic energy are fast expanding and now include not only research and development of peaceful uses of atomic energy but also training of scientists, survey and prospecting for and mining of rare earths, running of industrial enterprises, *e.g.,* Indian Rare Earths Ltd., Electronics Corporation of India Ltd., setting up of atomic power plants, generation of atomic power and its sales etc. Besides the area of Commission's activities include fields which appear only remotely connected with its own field, *e.g.,* space research The Committee consider that it is hardly possible for the Commission, as at present constituted, to lay down policies and programmes in all these fields as also to supervise the administration of the programmes. In view of the fact that the Commission consists of besides the Chairman, only four part-time Members, it is inevitable that all the work of the Commission should devolve on the Chairman of the Commission. The Committee feel that this arrangement does not yield the desired results and recommend that Government should rationalise the functions of the Commission and suitably reorganise its composition with a view to include a few whole-time functional Members.

Reply of Government

The progress of Atomic Energy and Space Research in India has been remarkable. This is borne out by the fact that we are regarded among the first nine countries of the world in atomic energy. We are the first developing country to have atomic power and the fourth country in the world to have a full-scale plutonium separation plant of our own. Again, we are one of the very few countries where the entire gamut of atomic energy activities from the prospecting and surveying of uranium, thorium and other materials related to atomic energy right down to the utilisation of the end products of atomic energy including nuclear power and the application of radio isotopes to medicine, agriculture, food preservation and industry are all being exploited.

In Space Research, India started about fifteen years later than in atomic energy. By 1975, however, India will be amongst the 5 or 6 countries in the world to have its own capability of designing and building sophisticated rockets for launching satellites. The deve-

lopment of space research involves advanced technologies and an organisation "free from all non-essential restrictions or needlessly inelastic rules", just as much as the progress of atomic energy itself. The growth of the two under the overall umbrella of the Atomic Energy Commission as well as the Department of Atomic Energy has permitted India to make progress in space research as quickly as it has done. Some examples of this are as followed:—

(a) The manufacture of Centaure Rockets was first established at the Bhabha Atomic Research Centre, which was also given the responsibility of planning a new Rocket Fabrication Facility at Thumba and of training personnel for it.

(b) The Rocket Propellant Plant which makes solid fuel was also made the responsibility of the Chemical Engineering Division of the Bhabha Atomic Research Centre. After commissioning of the plant at Thumba, it is now operated under the aegis of the Indian Space Research Organisation (ISRO).

(c) When the construction of a 97 ft. antenna for the Arvi Satellite Communication Earth Station was undertaken by the Experimental Satellite Communication Earth Station of ISRO, the entire responsibility for the servo control systems was entrusted to the Electronics Division of the Bhabha Atomic Research Centre.

At the present time, there are now developing similar examples of the reverse feed back from the development of space technology.

While recognising the role which functional members can play, it is necessary to remember that the size of the Atomic Energy Commission has to be kept sufficiently compact in order to achieve efficient and rapid transaction of business. The Commission needs a mix of various experiences and expertise and adding more full time members would only prevent membership of those who occupy responsible positions in other organisations. Of the five members of the Commission, both the Chairman and the Member-in-charge of Research and Development work full time on the work of the Commission and they are backed up by the many full time senior specialists working in the units of the Atomic Energy Commission.

The Government believes that the Commission has functioned very effectively and the present status of atomic energy and space research bears this out.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget dated 30-1-71].

Recommendation (Sr. No. 58, Para 5.17)

The Committee also note that the same persons have been continuing as Members of he Commission year after year. They need hardly stress the desirability and advantage of inducting fresh experienced persons as Members of the Commission from time to time.

Reply of Government

It is no doubt true that some of the members have been members of the Commission for a long time. This has not been on the basis of a mere continuance but on the basis of repeated annual judgement and re-nomination to the Commission. The service of some of the members on the Commission for a long number of years is not a disqualification and the continued familiarity and commitment to the programmes of the atomic energy of these members has in fact lent continuity and strength to the deliberations of the Atomic Energy Commission.

['Department of Atomic Energy O.M. No. 5|4(4)|70-Budget dated 30-1-71].

Recommendation (Sr. No. 59, Para 5.26)

The Committee feel that the present arrangement is not conducive to proper financial control over an Organisation which has an annual estimated budget of the order of Rs. 93 crores during the current financial year. They are of the opinion that there is need for a whole-time Member for Finance in the Atomic Energy Commission. In this connection, the Committee would like to draw the attention of the Government to their recommendation re: reorganisation of the Commission made earlier in this Chapter.

Reply of Government

The Atomic Energy Commission has been functioning for many years now and judged by any norms or compared with the activities of any of the organisations in the country, its financial management can be considered very satisfactory. The great advantage of the present arrangement arises from the fact that it has ensured participation at the highest level, namely that of the Secretary to the Government of India, in financial matters of the Commission, while at the same time associating in such financial control a person with knowledge of the many wider issues of national development. The present Member for Finance has more over responsibility for advising Government on many issues of policy which are of relevance

to the country's entire development programme. Any change from the present arrangement would result in the loss of this wider policy guidance. For these reasons, no change is considered necessary.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget dated 30-1-71].

Recommendation (Sr. No. 69, Para 6.17)

The Committee note that in appointing M|s. M. N. Dastur and Company, the Department did not call for any tenders. According to them, they made an *ad hoc* selection on the basis of the adequacy of experience in handling similar projects'. From the sketchy information furnished to the Committee in January, 1970, they are not in a position to comment on the justification of the terms and conditions of the agreement entered into with the consultants and whether the progress so far made is according to the schedule.

Reply of Government

After surveying the field of available consultancy services in India a decision in favour of awarding the contract to M/s. Dastur and Company was taken on an evaluation of their past experience and expertise in the field of heavy metallurgical and chemical industries. It might be mentioned here that M/s. Dastur and Company were the engineering consultants for the Uranium Mill Project at Jaduguda and the Department were satisfied with their performance on this project. The Mill has been in continuous production for over 2 years now.

2. The salient features of the contract are as under:

(a) *Scope of Work*

(i) Preparation of a general engineering report.

(ii) Development of plant general layout.

(iii) Preparation of detailed shop layouts.

(iv) Preparation of designs for structural steel work and working drawing for civil work in buildings, and equipment foundations.

(v) Planning and design of water supply, power supply, drainage and sewerage to other units in areas such as the Electronics Factory, Administrative Block and Township.

(vi) Preparation of designs and drawings for utility systems such as water, power compressed air, steam, other gases, ventilation dust extraction and air conditioning within the Nuclear Fuel Complex.

(vii) Preparation of specifications for civil, structural, utility and electrical work together with approximate bill of quantities; evaluation of tenders and making recommendations for placement of orders.

(viii) Design (general) supervision at site.

(ix) Overall project coordination, progress planning and reporting.

(b) *Fees*

For the engineering services listed above, it was agreed that the consulting engineers would be paid a lumpsum fee of Rs. 26.00 lakhs (without escalation) payable in instalments as follows:—

(i) Rs. 3,00,000 (Rupees three lakhs only) as down payment on signing the Agreement.

(ii) Rs. 23,00,000 (Rupees twenty three lakhs only) in 10 (ton) equal quarterly instalments of Rs. 2,30,000 (Rupees two lakhs thirty thousand only) each commencing from the date of down payment. The second quarterly instalment falling due after 6 (six) months was, however, to be paid only upon submission of the engineering report, the third and subsequent instalments to be paid at the end of every quarter commencing from the date following that on which the second quarterly instalment was paid.

(iii) If, however, the construction was delayed beyond April 1970, and the Department of Atomic Energy required the services of the Consulting Engineers beyond such dates, an additional fee of Rs. 12,000 (Rupees twelve thousand only) per month shall be payable by the Department of Atomic Energy to the Consulting Engineers from the said date. This would be in addition to the fee payable vide (i) and (ii) above and shall be paid in advance every month on submission of bills. For periods of less than a month prorata adjustment will be made.

3. *The progress of work under the Contract*

According to the agreement, the design engineering of the Complex buildings and utility services as far as it lay within the scope and responsibility of the Consulting Engineers was to be completed within 30 months from the date of contract (October 1967) that is, by April 1970. However, since the signing of the contract the scope of the work had to be expanded due to the following:

(i) inclusion of Enriched Uranium Fuel Fabrication Facility in Ceramic Fuel Fabrication Plant building; and

(ii) inclusion of diversification of the Zircaloy Plant for production of seamless stainless steel tubes by utilising the spare extrusion capacity.

There have also been delays in furnishing data on foundations and utility requirements by certain indigenous as well as foreign suppliers of heavy equipment.

While the consultants undertook the increased work without additional fee, some delay in the following items of work was unavoidable:

(a) specifications for the utility pipe works;

(b) specifications for the power wiring of Uranium Oxide Plant, Ceramic Fuel Fabrication Plant and Zirconium Plant; and

(c) release of residual working drawings for Zirconium Fabrication Plant.

Items (a) and (b) above have since been completed.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget dated 30th January, 1971].

Recommendation (Sr. No. 70 Para 6.25)

From the preliminary report of the Working Group set up by the Department of Atomic Energy in 1967 on the Nuclear-Powered Agro-Industrial Complexes, it is evident that Agro-Industrial Complexes envisaged in the study in Kutch-Saurashtra area and Indo-Gangetic plaints are based on the following assumptions:—

(i) Setting up of nuclear power projects of about 1000-1200 MW capacity in these two areas.

(ii) Availability of power at rates of two paise per KW for fertilizers and 2.6 paise per KW for Aluminium.

(iii) Raising of resources to the tune of Rs. 1,030 crores in a period of 5 to 10 years.

The scheme would appear to be hypothetical as it is based on assumptions which are unfounded. The Committee, therefore, consider that the question of setting up Nuclear-Powered Agro-Industrial Complexes is not at present feasible in the context of the present progress made in the field of nuclear power development and due to lack of resources.

Reply of Government

Reply of Government

The Agro-Industrial Complex around low cost energy centre is a forward looking project. It has attracted considerable attention amongst planners and agencies involved in development. The concept is designed to permit not only the establishment of units capable of producing energy economically, but also for using their output for a variety of purposes relevant to increasing agricultural productivity. Most of the assumptions are based on reliable studies made elsewhere and an attempt has been made to adapt them to Indian conditions. These need not be hypothetical if implemented in an integrated manner as suggested. Government considers that the type of studies initiated on Agro-Industrial Complex merits serious consideration and a detailed report which has since been prepared is enclosed.

The resources needed for an Agro-Industrial Complex are certainly large. So are the potential benefits. Through proper phasing of the schemes involved in the complex and the generation of funds from those taken up first, it would be possible to reduce the requirements of funds from outside.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget dated 30th January, 1971].

CHAPTER IV

RECOMMENDATIONS IN RESPECT OF WHICH REPLIES HAVE NOT BEEN ACCEPTED BY THE COMMITTEE

Recommendation (Sr. No. 8, Para 2.18)

The Committee are constrained to note that the estimates of the station outlay furnished by the Department have varied from time to time. The Committee would like to emphasise the need to work out reasonably accurate and realistic estimates of the project.

Reply of Government

A Statement giving various estimates of the station cost furnished from time to time and the cost as apparent from the expenditure incurred upto 1968-69 and provision included in the revised estimate 1969-70 and Budget Estimate 1970-71 together with reasons for variations in these estimates is given in Appendix I. It will be observed from the statement that there has been no variation in the basic estimates of the station cost and such of the variations which have become apparent from time to time are only due to subsequent developments which could not be foreseen at the time of entering into contract with the International General Electric, the most important of these being devaluation and increase in the customs duty which are beyond the control of the Department of Atomic Energy. Other additions are due to certain improvements in design like inerting, the decision to purchase additional spares as a measure of prudence, the expenditure on additional facilities and services which became necessary as the Project progressed. As regards the expenditure incurred upto 1968-69 and to be incurred in 1969-70 and 1970-71, an additional amount of only Rs. 2 crores is involved. This is due to bonus payable to the International General Electric in terms of the contract for increase in electrical out-put over the rated capacity. Obviously, original estimates could not include this bonus as it related to the establishment of the station at the rated capacity only.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget dated 30th January, 1971].

Further information called for by the Committee

It has been stated in your reply that an amount of Rs. 2.60 crores has been paid to the International General Electric as bonus in terms of the contract for increase in electrical output over the rated capacity.

(a) Please state the period when the payment of performance bonus was made to the International General Electric.

(b) Please state the reasons why the information about the payment to the contractors could not be supplied to the Estimates Committee earlier.

(c) Please state the basis on which the increase in electrical output over the rated capacity was worked out and with what results.

Reply of Government

(a) Payment of performance bonus was made on 24-3-1970 to the International General Electric Company. This question was considered by the Atomic Energy Commission from time to time and the final payment was approved at their meeting held on March 6, 1970.

(b) At the time of furnishing the information to the Estimates Committee in October 1969, the position regarding the payment of bonus to the contractors was not known. At the time of actual verification of the report, it was assumed that beyond the vertication of the facts mentioned in the information furnished earlier to the Committee no modifications could be introduced in the Report. It was only for this reason that the payment of bonus to I.G.E., was not intimated at that time.

(c) Bonus was payable if (i) the Station's net electrical output exceeded the warranted value or (ii) the Station's net heat rate is below the warranted performance specified in the Contract with IGE. The bases on which bonus was to be worked out were also specified in the Contract. The bonus was paid on the basis of a Station's net electrical output of 400 MW and the Station's net heat

rate at 11,406.00 btu/kwh against the warranted values of 380 MW and Station's net heat rate of 11,860 btu/kwh respectively.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, Dated 30th March, 1972].

Recommendation (Sr. No. 16, Para 2.44)

The Committee observe that Government have taken a long time in determining the amount of damages to be recovered from International General Electric on account of delay in the commissioning of the Project. They would like this matter to be settled with expedition.

Reply of Government

The matter has been settled in March 1970. The delay in commissioning after making allowance for *force majeure* and other considerations for which, under the contract, General Electric are entitled to extension of time has been assessed and liquidated damages amounting to Rs. 12:35 lakhs have been reovered in accordance with the terms of the contract.

[Department of Atomic Energy O.M. No. 5|4|(4)|70-Budget dt. 30-1-1971].

Further information called for by the Committee

(A) It has been stated that the question of determination of damages to be recovered from the International General Electric on account of delay in the commissioning of the Tarapur Project was settled in March, 1970. The report of the Estimates Committee was presented to the House on the 31st July, 1970 and the draft report for factual verification was forwarded to the Department of Atomic Energy in April, 1970 and the process of acceptance of changes suggested by the Department continued till June, 1970.

Please state the reasons why the Estimates Committee could not be informed of the settlement made in March, 1970 at the factual verification stage.

(B) It has been stated that liquidated damages amounting to Rs. 12:35 lakhs have been recovered from the International Gene-

ral Electric whereas the Committee had been informed earlier that an amount of Rs. 143 lakhs had been withheld from payment No. 40 pending the determination of damages due from the contractors on account of delay in the commissioning of the Project.

Please state the various factors which were taken into consideration in assessing an amount of Rs. 143 lakhs in the first instance and the factors that had now been taken into consideration in recovering the damages of Rs. 12.35 lakhs from the Contractors.

Reply of Government

(A) At the time of furnishing the information to the Estimates Committee in October, 1969, the position regarding liquidated damages was not taken. At the time of actual verification of the Report, it was assumed that beyond the verification of the facts mentioned in the information furnished earlier to the Committee no modifications could be introduced in the Report. It was only for this reason the damages recoverable from I.G.E. was not intimated at that time.

(B) In accordance with the provisions of the contract with I.G.E. this Department had withheld the payment No. 40 amounting to Rs. 143.00 lakhs for the delay in station turn-over, pending determination of the actual delay attributable to the Company. This was only a wihholding of payment pending determination of the damages to be recovered. The matter was considered in detail by the Tarapur Atomic Power Station authorities and by the Atomic Energy Commission and it was decided that out of the total delay of 349 days, a period of 230 days was attributable to *Force Majeure* events and other items permissible according to the terms of the contract. The Company was liable to pay damages for the delay in accordance with the Article VIII-C-1 of the Contract for the balance period of 3½ months. Thus the amount payable after making due allowance for the grace period laid down in terms of the Contract was worked out as Rs. 12.35 lakhs.

[Department of Atomic Energy O.M. No. 5|4(4) 70-Budget dated 15-3-1972].

Recommendation (Serial No. 20, Para 2.52)

2.52. The Committee understand that Maharashtra being endowed with ample hydro-power, the lakes are likely to overflow for a period

of three to four months during monsoon. They are also given to understand that reloading of first batch of fuel will be needed in July 1971 only, which means that there will be no need to reload fuel in the year 1970. Subsequent batches will be required annually from September 1972. They have also been informed that usual period of fuelling and maintenance programme is four to six weeks which the power generation economics takes into account.

The Committee trust that reloading of fuel and maintenance programme will be phased out in such a way that there will not only be no closure on account of lack of demand but even the closure for maintenance programme will be for the minimum period.

Reply of Government

The recommendation is noted. The rogramme for reloading of fuel and maintenancee wil, as far as possible, be phased in such a way that there will be closure for the minimum period.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget, dated 30-1-1971.]

Further information called for by the Committee

The Estimates Committee had recommended that the reloading of fuel and maintenance programme should be phased out in such a way that the Station was closed for the minimum period.

(a) Please state when the reloading of the fuel was undertaken and the period for which both the units of the Station were closed wholly or partially.

(b) The units of power generated since reloading of the fuel was undertaken, monthwise.

Reply of Government

(a) The deloading of Unit-I of Tarapur Atomic Power Station commenced on August 17, 1971 and the unit has been out of operation since then. Unit-II is, however, operating almost continuously during this period except for three outages (i) 8-4-1971 to 25-7-1971. certain maintenance works. Its refuelling will be taken up in (ii) 19-11-1971 to 25-11-1971 and (iii) 15-2-1972 to 25-2-972 for certain maintenance works. Its refuelling will be taken up is, March 1972.

(b) Unit-I was not generated any power since it was taken up for refuelling. The monthwise generation from Unit-II after 17-8-1971 has been as follows:—

Month	MWh
16-8-1971 to 15-9-1971	109
16-9-1971 to 15-10-1971	105
16-10-1971 to 15-11-1971	98
16-11-1971 to 15-12-1971	81
16-12-1971 to 15-1-1972	98
16-1-1972 to 15-2-1972	72

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget, dated 15-3-1972.]

Recommendation (Sr. No. 23, Para 2.62)

The Committee are happy to be informed that the Indian Scientists and engineers have acquired sufficient expertise to operate and maintain Tarapur Atomic Power Station independently and that only a limited foreign experts for a minimum period will be required to assist the Indian staff.

Reply of Government

The position as noted by the Estimates Committee is correct.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget, dated 30-1-1971.]

Further information called for by the Committee

The Committee were informed that Indian Scientists and engineers had acquired sufficient expertise to operate and maintain Tarapur Atomic Power Station independently.

(a) Please state the nature of defects that have occurred in the Tarapur Station.

(b) What are the contractual obligations in the matter?

(c) Whether any foreign expertise will be needed for carrying out the repairs.

(d) The steps taken or proposed to be taken to make the Tarapur Station independent of foreign expertise.

(e) The extent to which the Station is dependent for spares on foreign sources and the steps taken or proposed to be taken to be independent in this regard.

Reply of Government

(a) and (b). After the Tarapur Station became operative in February, 1969, delivery of power started in April, 1969 and the Station was turned over for full commercial operation in October, 1969 From then on till August, 1970, there were no prolonged outages (outages of over four days). Subsequent to August, 1970, the instances of prolonged outages of the two units of Tarapur have been as listed below:—

Sr. No.	Period of outage	Unit	Power drop	
1	14-7-1970 to 29-8-1970	I	210 MW	Planned outages
2	2-9-1970 to 21-10-1970	II	210 MW	
3	8-4-1971 to 25-7-1971	II	210 MW	
4	26-6-1971 to 8-7-1971	I	210 MW	Planned outages
5	19-11-1971 to 25-11-1971	II	140 MW	
6	17-8-1971 to todate	I	210MW	
7	15-2-1972 to 25-2-1972	II	210 MW	Planned outages

The outages at S. Nos. 1 and 2 were planned outages for carrying out the first annual inspection|maintenance. The third Outage from 8-4-1971 to 25-7-1971 was a major forced outage. This was initiated by a fault in the Maharashtra electrical system and the inability of the Gujarat grid system to withstand the surge, which resulted in a complete loss of power to the Station. Thereafter, an inadvertent operation by a Station Operator caused seizure of turbine bearings. To prevent recurrence of such loss of power, the requisite modifications to the protection schemes in the Maharashtra and Gujarat systems have been taken up. Within the Tarapur Station, several improvements have been made to provide safeguards against such occurrences. The Outages from 26-6-1971 to 8-7-1971, 19-11-1971

to 25-11-1971 and 15-2-1972 to 25-2-1972 were planned; S. No. 4 to attend to steam and water leaks (which occasionally occur in power stations and, therefore, do not call for any particular remedial measures) and the outage of Unit No. II in November, 1971 and February, 1972, to rectify low insulation of certain instrumentation cables caused by steam impingement.

In accordance with the requirements of the grid and the conditions prevailing in the area, the reactors at Tarapur are normally scheduled for shutdown for annual refuelling during the monsoon months. Normally, the refuelling is expected to take about eight weeks for each reactor. However, it was expected that the first refuelling would take longer because certain essential work, which would not be required to be repeated at subsequent refuellings, like the removal of what are known as poison curtains, had to be undertaken at the time of the first refuelling. Accordingly, the first unit of the reactor was closed down for refuelling on the 17th of August, 1971 and would normally have been brought back on line by about end of November, 1971. However, when the reactor was opened for refuelling, it was noticed that certain internal components known as "guide tubes" were displaced, having been unlatched from their moorings at the bottom of the reactor pressure vessel. Having thus become free to move vertically in the core, they had caused some damage to adjoining fuel elements and to two structural braces in the vicinity. The circumstances in which this happened are briefly described below.

The pressure vessel is capable of housing a core with 368 fuel bundles accommodated in 89 guide tubes. This design was part of the original specifications offered by General Electric. Subsequently, with improvements in fuel design, it was found that it would be possible to get the same output of power with 284 fuel assemblies, arranged within 69 guide tubes and consequently, the size of the pressure vessel could be reduced. However, it was decided not to reduce the size of the pressure vessel because it was felt that the additional space available in a larger vessel would give some flexibility for future changes in core designs, particularly if plutonium were to be used instead of Uranium 235, which is used in the existing fuel elements for enrichment. Further, arrangements had already been made to fabricate the larger pressure vessel and the design and manufacture of a smaller vessel would have led to delay. However, the use of the larger pressure vessel necessitated the introduction of about 20 peripheral guide tubes without any fuel elements inside them. Every precaution was taken by the manufacturer to secure them to the bottom of the pressure vessel. In spite of this,

however, under the pressure of water in the pressure vessel, two of the peripheral guide tubes were displaced from their normal position, causing damage to two braces and to two fuel elements.

The repair work involved the use of special remote handling tubes, some of which had to be designed and fabricated locally. It also involved the use of remote viewing television under 70 to 75 of water in the narrow confines of a highly radioactive core. In consultation with General Electric, the design of the devices holding down these peripheral guide tubes has been improved and it has been decided to instal the improvements on all such guide tubes. This has proved to be an extremely complicated and time consuming operation.

General Electric have agreed that the original design for the holding devices was not quite adequate and that in some instances the installation of the guide tubes was also defective. In consideration of this, General Electric have agreed to supply the following free of costs:—

(1) Engineering analysis.

(2) Some components necessary for carrying out the repairs.

(3) Assistance of experts at the site.

(4) Computer analysis.

General Electric have also suggested that the most effective and permanent solution would be to introduce additional fuel elements in the guide tubes, which will increase the weight on the guide tubes and thereby prevent their being displaced by water pressure, even if the holding devices fail. As this would involve additional investment on fuel and some change in core physics, the suggestion is under careful consideration. If found necessary or desirable, the suggestion will be adopted at the time of the next refuelling. In that event, General Electric have agreed to provide some more components (control rod drives and Low Power Range Monitors) free of cost, as also further safety analysis, thermal hydraulic analysis and physics analysis free of cost.

2. On December 15, 1971, the transformer of Unit-I developed an internal fault on energising. The causes of the accident have been investigated with the assistance of experts from outside the department as well as through a departmental enquiry. It has now been established that one of the tubes carrying sea-water intended to cool the transformer oil developed a small hole. These tubes are made of cupro-nickel designed to resist the corrosive effect of salt water.

Further, they are also enclosed by a thicker copper tube with outlets through which any water leaking from the inner tube is designed to flow out. Unfortunately, the actual leakage of water through the hole which had developed in the inner tube, was neither prevented nor did it show up at the end of the tube as designed. During the period, the transformer was out of use, the reactor of Unit I being under repairs, the water found its way into the oil flowing through another tube, enclosing the double-walled tube carrying the cooling water. Gradually, the water accumulated in the oil in the transformer tank over a period of time. This reduced the dielectric strength of the oil and caused a short-circuit when the Unit was energised.

The inadequacy of the design of the cooling system was brought to the notice of General Electric. Although the warranty period expired in 1970 and although the accident was partly due to error of judgement on the part of the operating staff, General Electric have agreed to reduce their normal price for the replacement materials, including the coils, and have offered at no cost to Government, technical supervision by their experts for the repair works at site. The estimated value of these concessions reduces the total cost of repairs by about $85,000 (Rs. 6.38 lakhs). General Electric have also agreed to re-design the oil cooling system and provide necessary US instrumentation, all at no cost to the Station.

In order to avoid a recurrence of this problem, the following steps are being taken:—

(a) The procedures connected with the maintenance, commissioning and operation of the transformer are being revised;

(b) The cooling system of the transformer is being redesigned to work on fresh water, instead of sea-water as at present; and

(c) Suitable instrumentation is being introduced which will reduce the possibility of such incidents recurring.

(c) The rectifications and modifications on the reactor are being carried out by our own staff without any foreign supervision; the manufacturers are occasionally consulted for second opinion free of cost. In respect of the transformer, the services of GE Engineer were utilised to assess causes of damage and the repairs necessary. The direction during reassembly of replacement parts will be given by the manufacturers free of cost.

(d) Tarapur Station does not need foreign experts for operation and maintenance. On a few occasions they have been called in; this was done as a measure of abundant caution and in consonance with utility practice and not because it was unavoidable.

(e) As the station was constructed on a turnkey contract with a US firm, many of the equipments were imported. The station is, therefore, dependent for spares on foreign sources. However, every effort is being made to develop indigenous substitutes, wherever possible. Some of the spares and special tools are also manufactured in the departmental workshop in the Tarapur Station and at the Bhabha Atomic Research Centre, Trombay. Spares worth about Rs. 10 lakhs have already been substituted indigenously. A Committee consisting of four engineers has been recently formed in TAPS to intensify the indigenous substitution programme on the basis of the actual experience in operation.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget, dated 15-3-1972.]

Comments of the Committee

Please see paras 17 and 18 of the Report (Chapter I)

Recommendation (Serial No. 9, Para 2.24)

The Committee consider that the cost of the fuel element for the Tarapur Atomic Power Project is on the high side. They hoped that with the setting up of the Reprocessing Plant, which was being built to extract plutonium and residual uranium and the perfection of technology of using plutonium in reactors, the Station will be operated on plutonium fuel wholly or partially and the need for importing enriched uranium will be reduced, which will result in saving of foreign exchange.

Reply of Government

Plutonium produced in the Tarapur reactor would be adequate only for partially meeting the needs of enrichment for Tarapur fuel. Import of enriched uranium will certainly be reduced when plutonium is used.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971.]

Further information called for by the Committee

It has been stated that the import of enriched uranium will be reduced when plutonium is used.

(a) Please state the progress made in the building of the reprocessing plant at Tarapur.

(b) Please state whether the technology of using plutonium in power reaction has been perfected.

(c) The time by which India hope to operate the Tarapur Station wholly or partially on plutonium fuel.

Reply of Government

(a) Civil Works in the main plant building have been completed. Ancilliary Civil and Electrical Works are in progress. Erection of Plant equipment, piping and electrification work is expected to be mostly completed by the end of 1972-73. The plant is scheduled to be in operation by December, 1973.

(b) Studies for determining the feasibility of the use of Plutonium as fuel in the Tarapur Atomic Power Station are still in progress and it will take some more time to arrive at some definite conclusion in this regard.

(c) It will not be possible to run the Tarapur Atomic Power Station entirely with Plutonium as fuel. The question as to whether and if so to what extent Plutonium can be used as fuel in the Tarapur Atomic Power Station can be determined on the outcome of the techno-economic studies currently undertaken for the purpose.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 15-3-1972.]

Comments of the Committee

Efforts should be made in timely setting up of the reprocessing plant at Tarapur, perfecting and speeding up technology of using plutonium in power reactor and running the Station on the plutonium fuel to the maximum extent possible, with a view to save foreign exchange.

Recommendation (Serial No. 10, Para 2.25)

The Committee also note that enriched uranium has to be imported for the working of the Project for the entire life time of the Station. If for any unforeseen circumstances the supply of enriched uranium is cut off or denied due to world postures, the whole Project in that case will be jeopardised. They would, therefore, suggest that Government should explore the possibility of building reserve of enriched uranium to meet with contingencies.

Reply of Government

The view of the Estimates Committee regarding the necessity of building reserves of enriched uranium to meet any stoppage of supply of enriched uranium for Tarapur due to unforeseen circumstances has been noted. Normally there is spare fuel in the country for 12—18 months operation without replenishment. Stockpiling of larger quantities would entail heavy interest charges on inventory. In this connection attention is also invited to para 1.3.5 of the brochure 'Atomic Energy and Space Research—A Profile for the Decade 1970—80' prepared by the Atomic Energy Commission. The research and development effort envisaged in the profile of development for the current decade include developmnt of gas cntrifuge technology for enrichment of uranium. At the time when the decision was taken for the establishment of Tarapur Atomic Power Station, plants for the enrichment of U-235 were considered out of the question for India due to their high costs as well as their enormous consumption of electric power. This analysis was based on the use of the gaseous diffusion process, but the marked progress of the gas centrifuge process since then is believed to have altered the situation.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971.]

Further information called for by the Committee

It has been stated in reply:

'The view of the Estimates Committee regarding the necessity of building reserves of enriched uranium to meet any stoppage of supply of enriched uranium for Tarapur due to unforeseen circumstances has been noted'.

(a) Please state the progress made in the development of technology for the enrichment of uranium in the country.

(b) What are the financial and technical implications of developing this technology in the country?

(c) The steps taken by Government to build reserves of enriched uranium and on what terms and conditions India can expect enriched uranium from other countries.

Reply of Government

(a) Work on development of uranium enrichment technology has recently been initiated in Bhabha Atomic Research Centre. A

group has been constituted to undertake preliminary studies on the three processes of uranium enrichment which are either in use or in various stages of development in other countries. These include the gas diffusion, the ultra-centrifuge and the separation nozzle processes. Studies on the production and handling of uranium hexafluoride which is the uranium compound used in all the three processes have also been started. Based on these studies a small-scale separation units is expected to be installed in three to four years' time.

(b) It is difficult to indicate the costs of a small plant till all studies have been completed.

There are a number of technical problems involved in the development of this technology. The production and handling of uranium hexafluoride require highly corrosion resistant materials and leak-tight equipment. The gaseous diffusion process for enrichment involves development of the separating membranes having very fine and uniform pores and large capacity, highly efficient compressors. For the centrifuge process development of high speed drives, of cylinders with high strength to weight ration, and of efficient bearings and seals having a long life is necessary. The nozzle separation process involves fabrication of separation units with very close clearances and large capacity compressors. Development of some of the components is proposed to be carried out in Bhabha Atomic Research Centre while for others assistance from various other scientific organisations and manufacturing concerns is being arranged.

(c) As explained above, preliminary steps for development of technology for the enrichment of uranium in the country have been initiated. As explained earlier, while there is spare fuel in the country for 12 to 18 months operation without replenishment stockpiling of reserves of enriched uranium would entail heavy interest charges on inventory. Also as per the bilateral agreements, between India and the USA, the Tarapur Atomic Power Station would be operated on no other special nuclear material than that furnished by the Government of USA. The agreement also commits USA to supply fuel throughout the life of the Station. As such, no steps are being taken to obtain enriched uranium from other sources.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget, dated 15-3-1972].

Comments of the Committee

Please see para 23 of the Report (Chapter I)

Recommendation (Serial No. 17, Para 2.47)

The Committee are concerned to note that Government have not so far entered into any written agreement with the Governments of Maharashtra and Gujarat with regard to the sharing of power, although such an agreement used to be there with the earstwhile composite State of Bombay to take power upto 80 per cent of the full load of the Tarapur Station. The Committee consider that the declared policy of the Government regarding sharing of power by both the States in equal measure and taking of power at 75 per cent load-factor announced publicly, which, according to the Department of Atomic Energy, is well understood by both the States, is not a satisfactory arrangement. In the light of experience regarding non-acceptance of rates worked out by the Atomic Power Authorities by bulk consumers and trouble about the management of the switchyard, the Committee consider that a firm agreement with the beneficiary States on the question of sharing of power, basic assured lead, tariff rate, phased programme for erecting transmission lines, switchyard, etc., should have been entered into before the Station had begun to flow commercial power. They recommend that steps should now be taken to enter into such an agreement with the concerned States without further loss of time.

Reply of Government

No written agreement can be entered into until the capital cost of an atomic power station can be established with a reasonable degree of accuracy. Agreement could only be on the quantities of power to be supplied|drawn and the principles of costing. An agreement on these aspects already exists and the Maharashtra and Gujarat Electricity Boards are committed to draw in equal measure power upto full capacity of the Station. On the completion of the plant and determination of its cost, discussions were conducted with the State Electricity Boards for entering into formal agreements, covering a two part tariff on a base rate of 5.61 paise/kwh. at 75 per cent annual plant factor. The Electricity Boards are paying at a flat rate of 5.61 paise/kwh. since 8-10-1969 for the power drawn by them. The terms of the part two tariff are expected to be finalised shortly.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget, dated 30-1-1971]

Further information called for by the Committee

The Estimates Committee had recommended that steps should be taken to enter into written agreement with the Government of Maharashtra and Gujarat with regard to the sharing of power.

(a) Please state whether written agreement in this regard have been concluded by now.

(b) If so, a copy of the same may be supplied.

(c) If not, the reasons therefor.

Reply of Government

An understanding exists already regarding the sharing of power from the Tarapur Atomic Power Station equally between Maharashtra and Gujarat. This will be incorporated in the agreement to be concluded. The conclusion of the agreement is kept pending for finalisation of the two-part tariff on cost of power which is covered by Serial No. 11.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget, dated 15-3-1972].

Recommendation (Sr. No. 19, Para 2.49)

The Committee need hardly point out the obvious lesson that, in the Atomic Power Stations to be put up in future, the Department should ensure that there is a firm written agreement about the sharing of power, rates at which it is to be sold and the management of the switchyard.

Reply of Government

The Government notes the Committee's recommendation and will endeavour to secure agreements with the concerned State Governments. A practical difficulty on fixation of rates beforehand is likely to arise for our early stations where, until date of completion, the firm capital cost figures would not be available.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Further information called for by the Committee

The Estimates Committee has recommended that the Department should ensure that there is a firm written agreement about

the sharing of power, rates at which it is to be sold and the management of the switchyard.

Please state whether Government have reached firm agreements about Rajasthan and Kalpakkam Power Stations.

Reply of Government

The matter regarding the sharing of power and the rates of supply has been under discussion with the Rajasthan State Electricity Board. They have been informed that the power from Rajasthan Project will be available on a two-part tariff basis, similar to Tarapur. No final agreement can be concluded until the exact price can be arrived at. The selling price of power can be arrived at only after the exact capital cost of the project is finally known. Pending finalisation of the tariff rates, the tariff for output from the Rajasthan Atomic Power Project Unit-I, during commissioning period upto December, 1972, has been finalised.

A firm agreement in respect of the power from Kalpakkam Power Station can similarly be finalised only after the power station is commissioned.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 15-3-1972]

Comments of the Committee

Please see para 32 of the Report (Chapter I)

Recommendation (Sr. No. 21, Para 2.53)

Since Tarapur Project is a base-load station and the earlier agreement with the erstwhile composite State of Bambay envisaged the utilisation of the Station upto 80 per cent of the full load of the Station, instead of the present 75 per cent, the Committee hope that all necessary steps will be taken and alternatives found out to make the maximum use of the power made available by the Station.

Reply of Government

The recommendation is accepted. A two part tariff being finalised with the State Electricity Boards is to provide an incentive for maximum use of the available power.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget, dated 30-1-1971].

Further information called for by the Committee

It has been stated in reply that a two part tariff is being finalised with the State Electricity Board so as to provide an incentive for maximum use of the available power from the Tarapur Station.

(a) Please state whether the tariff has been finalised and, if so, a copy of the same may kindly be supplied for the information of the Committee.

(b) If the tariff has not been finalised so far, the reasons, therefore, may be stated.

(c) Please state whether the Tarapur Station had been operating on the base-load, i.e. 80 per cent or above of its installed capacity and, if not, what are the reasons therefor.

(a) and (b). At a meeting held on August 19, 1971, the following two-part tariff applicable from 1-1-1970 to 31-3-1972 was agreed to:—

Rs. 38.35 lakhs per month fixed charges plus 2.04 paise|kwh.

The provision was made for full surcharge as well as for a ceiling on the effective rate, should the availability from Tarapur be less than expeceted. However, the State Electricity Boards have recently represented that, owing to the currently extended outage, there should be a reversion to the flat tariff. The matter is under negotiation with the electricity boards.

(c) The Station did not operate on base-load, *i.e.* with the capacity factor of 80 per cent or above until November, 1970, partly due to the switchayard problems during 1970 Monsoon and also due to inability of the Gujarat State to absorb power steadily at full capacity. However, for four months from December 1970 to March 1971, the capacity factors rose above 80 per cent. From April 1971 onwards, one of the two units has been almost continuously out of Commission and as such the plant factor has been below 80 per cent of the total capacity.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget, dated 15-3-1972].

Comments of the Committee

The Committee are unhappy to note that the tariff which was to be applicable on 1-1-1970 till 31-3-1972 was agreed to at a meeting

of the concerned parties held on the 19th August, 1971. There is need for reaching settlements in advance in respect of other projects. The question of reversion to flat tariff which is under negotiation with the Electricity Boards should be finalised early.

Recommendation (Sr. No. 22, Para 2.57)

The Committee note that the selling price of power per unit from Tarapur Atomic Power Project has been fixed at 5.61 Paise per kwh. This price is stated to have been agreed to by both the bulk consumers *viz.* the Maharashtra and Gujarat Electricity Boards. It is presumed that the rate has been got approved with the concurrence of the Central Electricity Authority as required by the Atomic Energy Act.

The Committee would, however, like to be informed of the exact cost of generation and the selling price of the power, as approved with the concurrence of the Central Electricity Authority.

Reply of Government

The basic selling rate of 5.61 P|kwh has been accepted by the Maharashtra and Gujarat State Electricity Boards. The rate has been fixed with the knowledge of the Central Electricity Authority but their formal approval is awaited. Details of the two part tariff based on the above accepted selling rate are being worked out and a formal notification under Section 22(1)(b) of the Atomic Energy Act will be issued in due course.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget, dated 30-1-1971].

Further information called for by the Committee

(A) The Estimates Committee had desired to be informed of the exact cost of generation and selling price of power from Tarapur as approved with the concurrence of the Central Electricity Authority.

(a) Please state whether the formal approval of the Central Electricity Authority in this regard has been obtained.

(b) If so, the details thereof and, if not, the reasons for the delay.

(B) In reply it has been stated:—

"Details of the two part tariff based on the above accepted selling rate are being worked out and a formal notification under Section 22(1)(b) of the Atomic Energy Act will be issued in due course."

(a) Please state whether the notification has been issued.

(b) If so, a copy of the notification may kindly be supplied for information of the Committee.

(c) If not, what are the reasons for the delay.

Reply of Government

(A) and (B) The question regarding fixation of the selling price of power from Tarapur Power Station is still under discussion with the Central Electricity Authority (CEA) and the State Electricity Boards. The Central Electricity Authority has not yet given its final concurrence to our proposals. The notification under Section 22(1)(b) of the Atomic Energy Act has not yet, therefore, been issued.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 15-3-1972.]

Comments of the Committee

Please see para 38 of the Report (Chapter I).

Recommendation (Sr. No. 32, Para 3.26)

The Committee regret to note that the Rajasthan Atomic Power Units I and II, which were originally scheduled to be commissioned in 1969 and 1970-71, will now go into commercial operation by 1971 and 1973. This would mean that while the gestation period in respect of Tarapur Atomic Power Project was five years, in the case of Rajasthan Atomic Power Project Units I and II is seven years.

Reply of Government

The Rajasthan Atomic Power Station is being built departmentally with considerably greater participation by Indian Scientists and Engineers as well as Indian Industry than at Tarapur. This decision was taken advisedly and with the full knowledge that the gestation period is bound to be longer as compared with Tarapur as what was intended was not merely the setting of one or two atomic power stations, but the establishment of a new technology as a part of the long term nuclear power programme and the building up of national capability. The teething troubles connected with the initiation of a new line of development had to be faced at one time or the other and it was expected that the earlier it was faced, the lesser would be the cost. The technical improvements needed

during construction further enlarged the gestation period, but the experience gained by our engineers and scientists in the process is considered as fully commensurate with the additional cost due to delay. In any event, waiting for a further period in the initiation of the programme for the purpose of reducing the gestation period would have brought in the additional cost by way of escalation of prices, at the same time delaying the programme, with the effect of defeating its main objective.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget, dated 30-1-1971].

Further information called for by the Committee

(a) Please state the latest position about the commissioning of Rajasthan Power Project Units I & II.

(b) What are the reasons for the delay?

Reply of Government

(a) The first unit of Rajasthan Atomic Power Project is in the last stages of commissioning and is expected to be commissioned during April-May 1972. First power generation is expected during June-July, 1972.

The Second Unit of Rajasthan Atomic Power Project is expected to be commissioned during 1975.

(b) The reasons for delay are:

(i) delays in respect of major equipment and components both from Canadian and Indian sources;

(ii) delays arising from large-scale indigenous manufacture of equipment and components;

(iii) labour problems and strikes during 1970-71.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget, dated 15-3-1972].

Comments of the Committee

The gestation period in case of Rajasthan Atomic Power Project Units will be 8—10 years as compared to Tarapur which was 5 years only. The Committee view the delay in completion of the project with concern.

Recommendation (Sr. No. 35, Para 3.37)

The Committee regret to note that no written agreement has so far been executed regarding the basic assured load, tariff rate, phased programme for erecting transmission lines, switchyard, etc. by the Atomic Energy Department with the Government of Rajasthan or the neighbouring States. They apprehend that in the absence of any written agreement several complications might arise when the Atomic Plant is on stream.

Reply of Government

Although no firm written agreement has been entered into, the Rajasthan Government has requested that the entire power from the Station may be allotted to that State. However, there is also scope for utilisation of power generated at the station in the neighbouring States as well. The establishment of facilities for the distribution of power in Rajasthan are under way. A 220 single circuit-transmission line from the power station to Udaipur and a 220 double circuit transmission line from the power station to Kota and hence to Jaipur are being laid. An inter-State 220-KV transmission line between Jaipur and Delhi is also being planned.

Kind attention of the Committee is invited to the comments of the Government in reply to recommendations No. 17 and No. 19.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget dated 30-1-1971].

Recommendation (Sr. No. 37, Para 3.39)

The Committee suggested that with a view to operate the Station at the optimum load factor, the following steps should be taken well in advance so that by the time the power starts flowing from the Station, there is sufficient demand for the power and it works as an economic unit:

(i) Reinforcement of the transmission and distribution system;

(ii) Execution of formal agreements between Rajasthan Atomic Power Project and Rajasthan and other beneficiary State Governments regarding utilisation of power etc.;

(iii) Timely development of the industries like copper complex at Khetri, Zinc smelter and production of phosphorous at Udaipur and the setting up of other industries in and around Kota.

Reply of Government

The various steps to be taken to ensure full utilisation of power as recommended by the Committee have been noted.

The establishment of facilities for the distribution of power in Rajasthan from Rajasthan Atomic Power Project is under way. A 220 single circuit transmission line from the Power Station to Udaipur and a 220 double circuit transmission line from the Power Station to Kota and thence to Jaipur are being laid. An inter-State 220-KV transmission line between Jaipur and Delhi is also being planned.

Every effort will be made to execute formal agreements as early as possible. As explained earlier, the main hurdle in this regard is the difficulty in fixing the cost of power in advance of the completion of the station.

The development of Industries in the States is the responsibility of the State Governments concerned and it is hoped that timely action will be taken by them in this regard.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget dated 30-1-1971].

Further information called for by the Committee

(a) Please state whether firm written agreement regarding the basic assured load, tariff rate etc. has been entered into by the Department with the Government of Rajasthan and the neighbouring States.

(b) Whether the switchyard will be operated by the Department of Atomic Energy.

(c) Whether laying of transmission lines, between Udaipur, Jaipur and Delhi and Kota will be completed ahead of the plant or simultaneously and in time.

Reply of Government

(a) The aspect regarding finalisation of a firm agreement on tariff is covered by the answer to the question No. 9. The Rajasthan State Electricity Board have assured us that they will ensure the off take of Rajasthan Atomic Power Project output at all times. If for this purpose a part of the output is to be exported outside the State, they will conclude the necessary arrangements with the neighbouring State. The Department has, however, advised Northern

Regional Electricity Board that the share of various states of the Rajasthan Atomic Power Project output should be determined through mutual discussions failing which the Irrigation & Power Ministry/Central Electricity Authority can be asked to decide the matter. The matter is under active consideration of the States in the region.

(b) The Switchyard at Rajasthan Atomic Power Project will be operated by the Department of Atomic Energy.

(c) The transmission line between Udaipur and Kota has been completed. The line between Jaipur and Kota is expected to be completed well before the commencement of the commercial operations of Rajasthan Atomic Power Project. This aspect is, however, being pursued vigorously with the Rajasthan State Electricity Board, Northern Regional Electricity Board and the Irrigation & Power Ministry.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 15-3-1972].

The Committee asked Government to supply further information about the decision taken or the progress made in laying transmission lines between Udaipur, Jaipur and Delhi and Kota.

Government in their reply stated:—

The latest position regarding transmission lines between RAPP site and Udaipur, Jaipur and Delhi is as under:

(1) 220 KV single circuit line from RAPP site *via* Kota to Udaipur is complete.

(2) Double circuit line from Kota to Jaipur is expected to be completed by December 1972.

(3) Only survey work is in progress in respect of single circuit line from Jaipur to Delhi.

[Department of Atomic Energy Telex No. 5|4(4)|70-Budget, dated 4-7-1972].

Comments of the Committee

Please see paras 47 and 48 of the Report (Chapter I).

Recommendation (Sr. Nos. 38 & 39, Paras 3.46 & 3.47)

The Committee are constrained to observe that in spite of the realisation of urgency by Government in regard to the produc-

tion of heavy water indigenously to meet the requirements of the two units of Rajasthan Atomic Power Project as also that of Madras Atomic Power Project, nothing substantial has been done in the matter so far.

They regret to note that unduly long time was either taken by Government to sanction the proposal of the Department of Atomic Energy to build a heavy water plant or the Department itself has taken a long time to start the construction of the Heavy Water Plant at Kota. The Committee note with concern that Heavy Water Pilot Plant of the Bhabha Atomic Research Centre which was set up as early as in 1963 to provide technical knowhow for the large scale Heavy Water Plant at Kota has failed in its objective and has been the prime factor contributing to the delay in the setting up of the Kota Plant. The Committee feel that with a view not only to conserve foreign exchange but also obviate "International Safeguards" which are imposed in obtaining heavy water from abroad, Government should lay down a reasonable target date by which the construction of heavy water plants are completed and production thereof started.

Reply of Government

In March 1966 the Cabinet approved the setting up of a Heavy Water Plant with a capacity of 200 tonnes/year to meet the requirements of nuclear power stations being set up. At that time the intention was to set up a plant utilising the available fuels i.e., washery-middlings and residual fuel oil. Investigations were made regarding the construction of a plant at various possible sites. At the same time, negotiations were also taken up regarding washery-middlings and Residual Fuel Oil for steam-raising.

The feasibility of putting up a heavy water plant based on steam and electrical energy obtained from Rajasthan Atomic Power Project I & II, which have a built-in capacity for additional heat output was also studied as an alternative. In August, 1967 after taking into consideration all the relevant factors, the Atomic Energy Commission decided to set up only a 100 tonnes/year plant supported by Rajasthan Atomic Power Project I & II, as a 200 tonnes/year plant would have curtailed electricity out-put of one of these units. The process to be adopted in both the original 200 tonnes/plants as well as the modified 100 tonnes/plant was based on the H2S-H2O exchange process developed indigenously.

The setting up of the Heavy Water Plant at Kota involved certain modifications to the Rajasthan Atomic Power Station which needed the approval of Atomic Energy of Canada Limited who

took a considerable time to conduct the necessary studies in this regard. A fresh project report had to be prepared taking into consideration all the above factors and the project could be sanctioned only in 1969.

It will be seen from the above that the delay was neither due to the failure of the pilot plant at the Bhabha Atomic Research Centre nor due to any lack of planning. In undertaking a project where solutions have to be found for the first time for technical problems, planning is at best based on assessment of progress at each State. Unlike repetitive projects, delays can occur and are to be regarded as an essential part of the process of acquiring new capability.

The pilot plant at the Bhabha Atomic Research Centre has yielded valuable knowhow and has enabled us to take up with some confidence the responsibility for constructing a major commercial plant without foreign collaboration. The problems that arose stemmed primarily from the scating up from pilot plant to large scale operations involving a factor of 24 in the case of the most important part of the plant. It is well known that chemical engineering operations like his involve data which can only be gained through experience with a large scale plant.

To make up the loss in production arising out of the reduction in the capacity of the plant at Kota from 200 tonnes to 100 tonnes, a plant based on the Ammonia-Hydrogen Exchange Process with an annual capacity of 67 tonnes of heavy water is being set up at Baroda using the Ammonia-Hydrogen Exchange Process. The question of setting up one or two more plants based on the same process, that is the Ammonia-Hydrogen Exchange Process, or other processes including the Hydrogen Distillation Process or the new processes under development are under consideration.

All efforts are being made to complete the plants as quickly as possible and it is now expected that the Baroda Plant will be commissioned in 1972-73 and the Kota Plant in 1974.

[Deptt. of Atomic Energy O.M. No. 5|4(4)|70-Budget, dated 30-1-1971]

Further information called for by the Committee

It has been stated that all efforts are being made to complete the plants as quickly as possible and it is now expected that the Baroda Plant will be commissioned in 1972-73 and the Kota Plant in 1974.

(a) Please furnish a detailed note with regard to the progress made in the commissioning of the Kota Plant.

(b) What is the position with regard to the production of Heavy water for the country's atomic power projects and will India be able to have its own Heavy Water by the time the Atomic Power Plants are commissioned?

(c) What are the implications of having Heavy Water on loan, lease or purchase and the extent to which India has been successful in negotiating its requirements, if any, for the projects?

(d) What are the implications of transportation of Heavy Water from distance to the site of Atomic Power Project?

(e) How the cost of Heavy Water is going to be calculated in working out the cost of Atomic Power Project and the cost of generation of power and the reasons for effecting recent change in this regard.

Reply of Government

(a) Work on the Heavy Water Plant at Kota site has made satisfactory progress. The main towers of the plant have been contracted out and the fabricators have started work on the same. The civil work for the entire plant will be started in April or May 1972. Equipment like pipes, valves etc., will be ordered very shortly for which tenders are under preparation. The site work has already started and the approach road, temporary site office, stores etc., are completed.

(b) The Heavy Water Plant under construction at Kota which is expected to be commissioned in 1974 will give an output of 100 tonnes of Heavy Water per year. The Heavy Water Plant under construction at Baroda will be commissioned in 1973 and is expected to give an output of 67.2 tonnes per year. A part of the output of the plant would be available for the second unit of the Rajasthan Power Station. The third plant designed on the same basis as the Baroda plant will be ready at Tuticorin during 1974-75 to give an output of 71.3 tonnes of Heavy Water per year. A fourth plant is under consideration for construction in conjunction with one of the Fertilizer Corporation of India's Fertilizer Plants. Over and above these sources, the Heavy Water Plant at Nangal gives an average output of 12 to 14 tonnes of Heavy Water per year.

(c) In respect of the RAPP-I unit, the requisite Heavy Water is being obtained on lease from Canada. The Heavy Water will be leased to us for a period of 10 years on payment of lease charges at 6 per cent on the capital cost of the Heavy Water. Option exists

in the Agreement for us to purchase the Heavy Water if it is considered advisable. The Heavy Water is being supplied to us on the same basis on which India and Canada are cooperating on the construction of the reactor. Canada has been unable to supply the Heavy Water to us in time arising from their failure of their own hevay water plants and therefore as against this agreed supply of 230 tons, an initial quantity of only 130 tons is being supplied to us by Canada from stocks obtained by them from the United States. This will be replaced by Canadian-origin Heavy Water in due course. The balance of 100 tons will be supplied from Canadian sources when required by us. In obtaining American origin Heavy Water from Canada we have agreed to a regimen of safeguards administered by the IAEA.

Heavy water is in very short supply internationally and is not available on terms of loan, lease or purchase except to a very limited extent. In respect of RAPP-II, Canada has now committed itself to the supply of the requisite quantity of 230 tons of Heavy Water. However, a formal Agreement has not yet been signed.

We have recently succeeded in signing an Agreement for obtaining 80 tonnes of Heavy Water from the USSR. This Heavy Water will be used for the make-up requirements of RAPP-I and used for future reactors to the extent necessary.

(d) The transportation of Heavy Water is done in stainless steel drums and has to be handled carefully due to its high cost. Transportation has no other implications.

(e) The inventory of Heavy Water at a CANDU power reactor has a life of over 30 years. During the course of operation, except for certain quantities of Heavy Water lost by leakage and degeneration by admixture with ordinary water etc. the Heavy Water retains its characteristics. The Heavy Water which has leaked or become degenerated by admixture with ordinary water is collected and reconcentrated and can thereafter be used either in the same reactor or in some other reactor as a very small quantity is lost through the reactor stack and is not recoverable. In view of the fact that the same Heavy Water may be used in more than one reactor it has been considered necessary to pool all the available Heavy Water and treat it as a common asset of the Department made available to the power station on payment of interest charges on the cost of the inventory. The procedure proposed to be adopt-

ed is to pool all the available from different plants as well as if any by import and charge an appropriate percentage of interest from the power station.

The cost of reconcentration plant has been included in the capital cost of the Atomic Power Station. The operational cost of reconcentration plant has also been included in the operational cost of the Atomic Power Station. The small losses of heay water are also included in the operational cost of the Station.

In calculating the price of Heavy Water produced internally from our own plants, all charges including interest, depreciation and profit on the investment made on the Heavy Water Project are added. Therefore, by adopting this revised procedure no departure from normally accepted commercial principles is involved. This has been done in keeping with international practice and in view of the different plants and sources from which Heavy Water is available; and the fact that same Heavy Water may be used in different reactors at different times. However, every element of cost is taken into account in calculating the cost of generation of power. The assumed price of Heavy Water in respect of Rajasthan Atomic Power Project and Madras Atomic Power Project is Rs. 550 per Kg. and is based on the full cost of production including interest and depreciation on the Heavy Water Plant as well as a margin of profit on the capital invested in the Heavy Water Plants. In addition to this, a further small margin has also been added to the cost of Heavy Water to make provision for future escalations.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget dated 15-3-1972].

Comments of the Committee

Please see paras 54 and 55 of the Report (Chapter I).

Recommendation (Sr. No. 45, Para 4.12)

The Committee note that the probable date of completion of the Project has been revised thrice since it was taken in hand in 1965. From 1970-71, the date has now receded to 1973-74. Constant shifting of target dates indicates lack of realistic planning.

Reply of Government

In June 1965, the Cabinet approved the proposal to set up a 400 MWe power station at Kalpakkam subject to suitable arrangements being made to finance the foreign exchange cost of the pro-

ject. In August, 1965 the Department was hopeful of getting assistance for meeting the foreign exchange cost of the project from a developed country which had evinced keen interest in the project. Had the assistance materialised as anticipated at that time, the project could have been completed in about five and a half years time from then *i.e.* 1970-71.

In the event, due to the several unpredictable factors, the negotiations for assistance did not succeed and ultimately in mid-1966, it was decided to build only one unit of 200 MWe to begin with and to reduce the foreign exchange cost of the station to the minimum so that it could be met from the normal foreign exchange resources available. This decision meant not only the preparation of a fresh project report but also a survey of the indigenous industrial capability to fabricate the major components of the nuclear and conventional part of the project before preparing such a report. Thus, a financial sanction for the Unit I of the project could be issued only by December 20, 1967 which meant a delay of over two years in the effective commencement of the project.

As has been explained in the evidence before the Committee, since the major components are being fabricated for the first time in India, industries both in the public and private sectors are facing several difficulties in completing the jobs entrusted to them according to schedule. In most cases, the execution of the orders involve considerable capital outlay on their part and they could not undertake the heavy investment involved without firm long term commitments on the part of the Department. While there is a full understanding of the requirements between the agencies concerned on the one hand and the Department of Atomic Energy on the other, and every effort is being made to minimise delays, some slip-back in the schedule in the first effort for the development of indigenous capability on such a major scale was inescapable.

It will be observed from the above that the shifting of the targetted completion date has not been due to any lack of planning but due to circumstances and factors largely beyond the control of the Department.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget dated 30th January, 1971].

Comments of the Committee

The gestation period in case of MAPP I will be about 10 years as compared to Tarapur which was 5 years only. The Committee

appreciate that in a project which is being handled by utilising resources from within the country more time is bound to be taken. The Committee are extremely keen that there should be no avoidable delay and that the highest priority should be accorded by all sectors, (private as well as public) for making available raw materials, machinery, etc. in shortest time possible to the Atomic Power Stations so as to reduce the gestation period to the minimum.

Recommendation (Sr. No. 47, Para 4.16)

The Committee note with concern the big difference in the figures regarding capital outlay of the project as given to the Lok Sabha in 1967 and as furnished to them. The Committee feel that unless concerted and speedy action is taken to complete the project by the scheduled date, the estimated capital cost is further likely to go up with the passage of time.

Reply of Government

At the time when unstarred question 4724 was answered in the Lok Sabha in 1967 the cost of heavy water was treated as part of the total capital cost as initial heavy water inventory. Since then it has been decided in keeping with International practice that the heavy water will be held in stock by the Department and will be leased to the atomic power stations. The capital cost of atomic power station will not, therefore, include the cost of heavy water. The capital cost of Rs. 61.78 crores as given to the Estimates Committee is the same as the cost indicated in 1967 in reply to Parliament Question excluding Rs. 7.50 crores being the cost of initial inventory of heavy water.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget dated 30th January, 1971].

Comments of the Committee

The Committee reiterate their earlier recommendation that concerted and speedy action should be taken to complete project by the scheduled date so that the capital cost of the project did not escalate. They are anxious that power projects are brought upon stream in time as they have a direct bearing on development of industries in the area|region. The cost of MAPP I has risen from Rs. 61.78 crores to Rs. 77.10 crores. The present additional increase in the cost of the prpject, specially when Government in their earlier estimates had made a provision of Rs 6.46 crores and Rs. 6.14 crores towards contingency and escalation respectively, in the opinion of the Committee is wide.

Recommendation (Sr. Nos. 51 & 52, Paras 4.32 & 4.33)

The Committee feel that the Madras Atomic Power Project is beset with a number of problems which must be attended to right now rather than kept pending till the power begins to flow from the Station. In the first place, no written agreement has been entered into as to the rate at which the power will be purchased by the Tamil Nadu Government. Secondly, there is an urgent need to work out the economics of running the station at high baseload factor. The problem has assumed seriousness because the State Government has not entered into any written agreement about the assured baseload at which they will take the power. Running the Kalpakkam Station at a maximum baseload factor may pose a problem and in the long run it may not run at optimum load. Thirdly, the neighbouring States of Andhra Pradesh and Mysore want to have a share in the power from Kalpakkam as according to them the project has been constructed out of the finances of the Central Government. It is, therefore, desirable that a firm settlement amongst the claimants is reached in the matter. The Committee are of the opinion that there is need to lay down a definite policy by the Government about the sharing of benefits by States in respect of those projects which have been constructed solely from the finances of the Central Government.

The Committee apprehend that failure to find an early solution to the problems may lead to a situation which may have serious repercussions. The Committee trust that a satisfactory solution will be found to the various problems mentioned above without further loss of time.

Reply of Government

Energy from Unit I of the Madras Atomic Power Station has already been committed for supply to Tamil Nadu Electricity Board. As regards energy from Unit II, the claims of the various neighbouring States in the region are under discussion.

As already stated in Answer to recommendation No. 35 in regard to the Rajasthan Atomic Power Station, it is difficult to determine the firm cost of power from the atomic power station in advance due to several uncertainties involved. It has, therefore, not been possible to enter into written agreements. Every effort will be made to finalise such agreement as early as possible.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget dated 30th January, 1971].

Further information called for by the Committee

It has been stated in reply:

"Energy from Unit I of the Madras Atomic Power Station has already been committed for supply to Tamil Nadu Electricity Board. As regards energy from Unit II, the claims of the various neighbouring states in the region are under discussion."

(a) Please state whether Government have evolved any definite policy regarding sharing of benefits by States in respect of atomic power projects.

(b) What progress has been made in the finalisation of agreements with States concerned regarding rates of supply of power, sharing of power, etc.

Reply of Government

(a) On the basis of the decision arrived at in consultation with the Central Water and Power Commission, the entire net saleable power from the Kalpakkam Atomic Power Station was originally committed to be fed to Tamil Nadu grid, although no formal written agreement was entered into in this regard. The Governments of Andhra Pradesh and Mysore have been claiming some power from this Station on the ground that it is financed centrally. The following reply was given by the Ministry of Irrigation and Power to the Estimates Committee (1969-70) Fourth Lok Sabha:—

"Although Tamil Nadu has agreed to take all power available from the Kalpakkam Nuclear Power Station, Mysore and Andhra Pradesh States are also claiming some power supply from this Station on the plea that it is financed Centrally. It will certainly be of advantage if the Station is operated in an integrated manner with the neighbouring power system as such operation will ensure a high load factor of 75 per cent at which the station is expected to work.

In case it is decided to allocate power to the neighbouring States also from Kalpakkam, it should be on the basis of power shortages. The preference should be given to the State which can absorb power at very high load factor".

The entire question of sharing of power generated by the power stations set up by the Centre was discussed in a meeting held on 19th May, 1970 wherein representatives of the Department of Atomic Energy and the Ministry of Irrigation and Power and the Central Water and Power Commission were present. So far as Madras Atomic Power Station is concerned, it was decided that power from the first unit of Madras Atomic Power Station should be allocated fully to Tamil Nadu. 50 per cent of the power of the second unit to be commissioned in the Fifth Plan period could be fed into the regional grid for utilisation by the other states in the region. This arrangement was subject to arriving at an understanding with Tamil Nadu Government in view of the commitments already made.

The Ministry of Irrigation and Power has since decided to bring into effect the above proposal for sharing of power from the second unit of the Kalpakkam Atomic Power Station and has issued letters dated 23rd June, 1971 to the Government of Mysore, Andhra Pradesh and Kerala enquiring whether they would like to avail a share from 50 per cent of the output from the second unit of the Kalpakkam Atomic Power Station and if so to furnish fully justified proposals indicating the load demand anticipated and availability of power from States own sources. No final decision has been taken.

(b) The tariff has not yet been finalised as the exact selling price of power can be determined only after the units of the Station are commissioned and actual capital cost figures are available.

[Department of Atomic Energy O.M. No. 5|4(4)|70-Budget, dated 15th March, 1972].

Comments of the Committee

The Committee reiterate their earlier recommendation that a satisfactory solution to the problems of (i) entering into written agreement as to the rate at which the power will e purchased by the Tamil Nadu Government; (ii) working out the economics of running the Station at high base-load factor; and (iii) sharing of power by the neighbouring States will be found out without further loss of time, as failure in the matter, in their opinion, may lead to a situation which may have serious repercussions.

Recommendation (Sl. No. 64 & 65, Para 6.5 & 6.6)

The Committee note that the training programme conducted by the Bhabha Atomic Research Centre has proved satisfactory and adequately meets the present manpower requirements of the

Atomic Energy Department. The Committee are, however, informed that there are not sufficient men to meet the likely needs for future atomic power programme. They feel that training programme needs to be broad-based and, with that end in view, fundamentals of the nuclear physics, its theory and practice, should be taught in universities as part of B.Sc. (Hons.) and M.Sc. courses and nuclear technology and engineering should form part of engineering degree course. The best students amongst them should be selected and given training at Bhabha Atomic Research Centre.

The Committee also feel that the Atomic Energy Department should establish closer liaison with institutions of advanced learning like the MATSCIENCE, Madras, Indian Institute of Science, Bangalore, and certain universities which have been selected as centres for research and advanced studies in science with a view to make use of science personnel coming out of these institutes. They are further of the opinion that it will be desirable to associate leading scientists with the training programme.

Reply of Government

Government is already aware of the need for expanding the training programme of the Bhabha Atomic Research Centre, both in content and scope and to establish closer liaison with institutions of advanced learining like the Indian Institute of Techonology, Indian Institute of Science, Bangalore, etc. Keeping in view the need for suitably trained scientific and technical personnel for implementing the programme envisaged in the 'Profile for Development of Atomic Energy and Space Research during the decade 1970—80', prepared by the Atomic Energy Commission, the Department is currently examining various measures that should be taken to improve and reorient training in the Training School of the Bhabha Atomic Research Centre as well as in the various institutions of advanced learning mentioned above.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 30-1-1971].

Further information called for by the Committee

It has been stated in reply:

"Keeping in view the need for suitably trained scientific and technical personnel for implementing the programme envisaged in the 'Profile for Development of Atomic Energy and Space Research during the Decade 1970—80' prepared by the Atomic Energy Commission, the Department is currently examining various measures

that could be taken to improve and reorient training in the Training School of the Bhabha Atomic Research Centre as well as in the various institutions of advanced learning."

Please state the results of examination.

Reply of Government

For the implementation of the ten year Atomic Energy Programme 1970—80, it is estimated that about 3000 graduate engineers would be required. BARC Training School will be able to provide only about 100 engineers every year, i.e., only 1000 engineers in the 10 year period. Collaboration with the Indian Institute of Technology and Indian Institution of Science, Bangalore, to train additional number of engineers is envisaged on the consideration that the quality of engineering graduates produced by them is much better compared to those produced by other institutions. It is proposed that five M. Tech. students may be recruited every year from each of the five IITs and be given specialised training in nuclear engineering, nuclear electronics and other allied subjects during the final year of their M. Tech. Course. Similarly, ten B. Tech. students are proposed to be recruited every year, during the fourth year of their course, from each of the IITs and be given some orientation courses in the field of Atomic Energy during the final year of their B. Tech. Course. Further about 10 1st Class or IInd Class M.Scs or Ist Class B.Scs in Physics, Chemistry and Mathematics are proposed to be recruited every year and sent to each of the IITs to undergo the three year course in engineering. The total number of engineers that could be trained thus in 10 years will be about 1250. The remaining requirement of about 750 graduate engineers with specialised experience will be recruited directly. The extent of collaboration was discussed at a meeting of representatives of IIT, Kanpur, IIT, Bombay, IIT, Madras, Indian Institute of Science, Bangalore, B A R C., and T.I.F.R. It was agreed that such schemes would be possible. The details of the collaboration are still to be finalised, especially regarding the projects which could be carried out by IITs.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 15-3-1972].

Comments of the Committee

The Committee hope that the details of the programme for training engineers in collaboration with the Indian Institute of Techno-

logy and Indian Institute of Science, Bangalore will be finalised soon and that it will now be implemented in right earnest.

Recommendation (Sr. No. 73, Para 6.44)

The Committee note that the cost of power generation from conventional sources i.e., thermal and hydro and from the three Atomic Power Stations at Tarapur, Kota and Kalpakkam has been variously estimated by the Planning Commission, Ministry of Irrigation and Power and the Atomic Energy Department. They feel that with the present contraint on our financial resources there is need that the choice between nuclear, hydro and thermal power production should be made after a study of their relative economics both short term as well as long term. This is possible only after it is known what the cost of generation of power would be from each of the systems. The Committee note that the Ministry of Irrigation and Power has already constituted a high Power Committee of Experts *inter alia* "to review the economics of power generation from different sources—hydro, thermal and nuclear under prevailing conditions and expected future trends to indicate, the factors which must prevail in the choice of schemes for expansion of generation and supply in each region of the country in future". The Committee would like that the above expert body also goes into the cost structure of the Atomic Power plants at Tarapur, Kota and Kalpakkam with a view to determine the unit cost of generation of power from each one of them. They trust that the expert committee would be submitting its Report at an early date and that Government would no doubt keep its recommendations in view while deciding the programme for nuclear power stations.

Reply of Government

While agreeing with the views of the Estimates Committee that the choice between nuclear, thermal and hydro power production should be made after a study of their relative economics both short term as well as long term, Government wishes to make the following points:—

(1) Atomic Energy is one of the most important developments in the last twenty years provided by science and technology. This field, therefore, has vast potential. That India should participate in it fully, on the basis of indigenous capability, is an important objective in itself.

(z) In doing so the contribution which nuclear energy can make to the energy resources of the country is also a most important consideration. India's resources of coal are not in substantial, but these too will be inadequate to achieve and sustain levels of power consumption that prevail today in the industrially advanced countries. In the long run, a country like India will have to turn to nuclear energy for supplying its expanding power requirements. While, therefore, the relative economics of nuclear power as compared to fossil fuel and hydro power is relevant in the long run, it is only one element and not the most important one. If we look at the experience of other countries and the strategy adopted by them to meet the growing power demand, it will be apparent that the role that nuclear energy as a source of power will continue to grow dramatically.

It is also relevant in this connection to remember that the early stages of the development of any technology involve considerably greater cost than at later periods when the technology is fully developed and any real comparison of relative economics should take the long term benefits into account.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 15-1-1971].

Further information called for by the Committee

The Estimates Committee had desired that the Expert Body appointed by the Government of India would go into the cost structure of the Atomic Power Plants at Tarapur, Kota and Kalpakkam with a view to determine the unit cost of generation of power from each one of them.

(a) Please supply two copies of the Report submitted by the Committee appointed by the Government.

(b) What are the decisions taken by Government on the recommendations.

Reply of Government

(a) One copy of the report is atteched. As a very limited number of copies alone were prepared, only one copy is supplied.

(b) The report which was submitted to the Ministry of Irrigation and Power is still under consideration in that Ministry and no decisions have yet been taken.

[Department of Atomic Energy O.M. No. 5/4(4)/70-Budget, dated 15-3-1972].

Comments of the Committee

Please see para 60 of the Report (Chapter I).

NEW DELHI;
February 27, 1973.
8th Phalguna, 1894 (*Saka*).

KAMAL NATH TEWARI,
Chairman,
Estimates Committee.

APPENDIX I

Statement showing the various estimates as furnished from time to time and reasons for variation.

The occasion and time of the Estimate	Amount in Rs, crores	Reasons for variation from the previous estimate
1. While approaching U. S. AID for financial assistance. 1962 .	48·50	..
2. At the time of signing contract with the I.G.E.	48·77	Marginal adjustments arising out of negotiations.
3. As given in the Brochure in Tarapur Atomic Power Station 1968		
(*a*) Pre-devaluation .	49·00	Due to inclusion of a subsequent improvement in design *viz.*, inerting.
(*b*) Post-devaluation .	65·00	Due to devaluation and increase in Customs duty assessed roughly as Rs. 10·00 crores and Rs. 6·00 crores respectively.
4. As given in the evidence before the Committee, 1969	66·00	Due to (*i*) purchase of additional capital spares as a measure of prudence Rs. 0·56 crores) (*ii*) Additional facilities services etc. not contemplated originally (Rs. 0·40 crore)
5. According to expenditure incurred during 1968-69, Revised Estimate 1969-70 and Budget Estimate 1970-71.	68·00	Due to requirement of bonus payable to I. G. E. amounting to about Rs. 2·60 crores in terms of the contract for increase in electrical output over the rated capacity.

APPENDIX II

Recommendation (Sr. No. 14, Para 2.38)

Enclosure to action taken note on recommendation No. 14

GOVERNMENT OF INDIA

DEPARTMENT OF ATOMIC ENERGY

Bombay: May 20, 1968

On completion of the construction phase of work on the Tarapur Atomic Power Station, a thorough test has been carried out on all the components. During this check certain minute imperfections have been discovered in some metal parts for which corrective actions are presently being taken. The commercial operation of the 380,000 KW station will thus be delayed beyond its scheduled commissioning date in October, 1968.

The Tarapur Station is being built by the International General Electric Company and they are solely responsible for carrying out all corrective actions in this connection. The station is very similar to other large nuclear stations being built in USA and elsewhere. Similar defects have been discovered in the Reactor Vessel at the Oyster Greek station under construction by IGE in New Jersey, USA where a delay in commissioning the plant has already occurred. These unexpected imperfections are confined to furnace-sensitized stainless steel material.

Extensive examination of components has been made utilizing specialists from the Department of Atomic Energy as well as from numerous technical facilities in the USA. A repair programme is underway which is intended to restore all critical components to a quality level equal to, if not superior to, that of the original design. The programme includes the replacement of components or else removal of all defects from critical components. Those parts which will have defects ground out will be overlayed with a corrosion resistant stainless steel.

Careful evaluation of the safety implications of the defects together with repair programme has been made, and it has been

found that no compromise of safety or expected power output of the plant is involved.

International General Electric and their construction agents, Bechtel India Limited are working round the clock on the difficult and intricate repair activity. Because of the problem, the startup of the Tarapur Station will be delayed beyond the original schedule. It is now estimated that fuel loading will occur in the fourth quarter of 1968. Atomic power will be generated soon after the first of the year and station turnover for commercial operation is expected sometime in March/April 1969.

The Department of Atomic Energy is deeply conscious of the difficulties that will be caused to consumers in the States of Gujarat and Maharashtra through a delay in the commissioning of the plant by about 4—6 months, which it is now not possible to prevent. However, it is obviously necessary to do everything humanly possible to ensure safety and long reliable operation of a plant of this nature. It has, therefore, taken what appears to be the best course in the long term interests of the project.

APPENDIX III

Recommendation (Sr. No. 49 Para 4·23)

Comparative Statement of Generation Cost and Selling Price of Power From

(1) 2×120 MWe coal-fired station at a new undeveloped site,
(2) 2×120 MWe coal-fired station as an extension to an existing station, and
(3) MAPP-1 & 2 at Kalpakkam

with varying price of coal and nuclear fuel in 1970 and 1975

	2×120MW coal-fired station				MAPP—1 & 2 2×235 MWe Nuclear		
	Undeveloped new site		Extension to		MAPP-1	MAAP-2	MAPP-1 & 2 combined
Cost in Rs. per K.We installed;	2200		1950		3190	2840	3020
	(1970(	(1975)	(1970)	(1975)	(1975)	(1975)	(1975)
Cost of fuel	Rs.74/Te	Rs.85/Te	Rs.74/Te	Rs.85/Te	Rs 575 Kg.	Rs. 575 Kg.	Rs. 575 Kg.
Generation Paise/ kwhr cost	7·60	8·17	7·26	7·83	6·94	6·22	6·58
Profit of 3% Paise/ kwhr on capital	1·23	1·23	1·09	1·09	2·15	1·86	2·01
Selling price Paise/ kwhr . .	8·83	9·40	8·35	8·92	9·09	8·08	8·59

Basis adapted in respect of nuclear as well as coal-fired stations

1. Plant load factors assumed as 75%.
2. Interest as 6% averaged over assured life time of 25 years for plant.
3. Interest during construction included.
4. 10 % residual value for plant.
5. Straight line method of depreciation.
6. Cost of nuclear fuel Rs. 575/Kg. in 1975.
7. Cost of Singareni coal of 8600 BTU/lb at Ennore Rs. 75/Tonne in 1970 and Rs. 85/Tonne/in 1975.
8. Plant efficiency (I) coal-fired—35% (III) MAPP-26·5%

[Department of Atomic Energy O. M. No. 5/4 (4)/70-Budget, dated 15-3-1972].

APPENDIX IV

(*Vide* Introduction)

Analysis of the action taken by the Government on the recommendations contained in the 129th Report of the Estimates Committee.

(Fourth Lok Sabha)

I.	Total number of recommendations	75
II.	Recommendations which have been accepted by Government (*vide* recommendations at S. Nos. 1, 2, 3, 4, 5, 12, 13, 24, 26-29, 34, 41-44 46, 48, 50, 53, 54, 57, 60-63, 66-68—71, 72, 74 and 75)	
	Number	34
	Percentage to total	45·34 %
III.	Recommendations which the Committee do not desire to pursue in view of Government's reply (*vide* recommendations at S. Nos. 6, 7, 11, 14, 15, 18, 25, 30, 31, 33, 36, 40, 49, 55, 56, 58, 59, 69 and 70)	
	Number	19
	Percentage to total	25·33%
IV.	Recommendations in respect of which replies of Government have not been accepted by the Committee (*vide* recommendations at S. Nos. 8, 9, 10, 16, 17, 19, 20, 21, 22, 23, 32, 35, 37, 38, 39, 45, 47, 51, 52, 64, 65 and 73)	
	Number	22
	Percentage to total	29·33%

MGIPND—RS I—3180 (E) L.S. 3-3-73—1200