EIGHTY-SECOND REPORT

ESTIMATES COMMITTEE (1983-84)

(SEVENTH LOK SABHA)

DEPARTMENT OF ATOMIC ENERGY—GENERATION OF ELECTRICITY

Presented to Lok Sabha on 25April, 1984

LOK SABHA SECRETARIAT
NEW DELHI

April, 1984/Vaisakha, 1906 (Saka)

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(1983-84)

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INTRODUCTION

I, the Chairman of Estimates Committee having been authorised by the Committee to submit the Report on their behalf, present this Eighty-Second Report on the Department of Atomic Energy—Generation of Electricity.

2. The Committee took evidence of the representatives of the Department of Atomic Energy on 3rd and 4th January, 1984. The Committee wish to express their thanks to the officers of the Department for placing before them the material and information which they desired in connection with the examination of the subject and giving evidence before the Committee.

3. The Report was considered and adopted by the Committee on 16 April, 1984.

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

NEW DELHI;
April 24, 1984
Vaisakha 4, 1906 (S)

BANSI LAL,
Chairman,
Estimates Committee.

CHAPTER 1

DEVELOPMENT OF NUCLEAR POWER

A. *Formulation of National Policy*

1.1 The Indian Atomic Energy Programme was launched mainly to supplement the limited convantional energy resources to meet the long term power needs of the country and to utilise nuclear techniques in agriculture, industry, medicine and other areas. The Atomic Energy Commission was constituted in 1948 as the policy making body of the Government of India for the development and utilisation of atomic energy. The Atomic Energy Establishment was set up at Trombay in 1957 (renamed as the Bhabha Atomic Research Centre) for carrying out research in basic sciences; to develop nuclear technologies based on indigenous resources and demonstrate their economic viability. The production of nuclear fuels and control instruments, reactor components, plant and machinery, research equipment and high purity metals and materials required for the atomic energy programme is undertaken either under the aegis of the Department of Atomic Energy or by the industry with technical assistance from the Department.

1.2 Section 22 (1) (a) of the Atomic Energy Act, 1962 (33 of 1962) had stipulated that :—

"Notwithstanding anything contained in the Electricity (Supply) Act, 1948, the Central Government shall have authority :—

(a) to develop a sound and adequate national policy in regard to atomic power, to coordinate such policy with the Central Electricity Authority and the State Electricity Boards constituted under sections 3 and 5 respectively of the Act and other similar statutory corporations concerned with the control and utilisation of other power resources, to implement schemes for the generation of electricity in pursuance of such policy and to operate atomic power stations in the manner determined by it in consultation with the Boards or Corporations concer-

ned, with whom it shall enter into agreement regarding the supply of electricity so produced."

1.3 The Committee wanted to know whether a sound and adequate National Policy on Atomic Energy as contemplated in the Act had been formulated and placed before Parliament, Secretary Department of Atomic Energy stated in evidence :—

"The atomic energy policy is generated by the Department of Atomic Energy and placed before the Cabinet and the fulfilment of the policies and the general nature of the policies are discussed in Parliament. This is the connection we have got with respect to Parliament. We also explain our policies in the consultative committee meetings and the performance budget."

1.4 The Committee enquired whether the Department of Atomic Energy was shy of placing the National policy before Parliament and did not want to take Parliament into confidence because of the failure of the Department in the field of Atomic Energy Programme. The Secretary, Department of Atomic Energy pleaded that :—

"I would not agree to that. Our development in the field of atomic energy is a great success. Because of the political implications, every other country has become very concious; they do not want India to become a nuclear power, and they have tried their best to stop us from progressing in this field, but in spite of all this, we have gone ahead tremendously. We have got our Madras Reactor going on, Madras II will also be commissioned in 1985. Under these circumstances, it would be a tremendous pessimism, if we call it a failure."

1.5 On the question of keeping the Parliament informed the witness submitted that :—

"As regards keeping the Parliament informed about our activities, the convention has been that we submit all the information through questions in Parliament, and the Performance Budget goes into every detail. In fact, I would feel unhanpy if the Parliament does not know all that we are doing. I would be happy if the system is changed."

1.6 Section 22 (1) (a) of the Atomic Energy Act 1962 (33 of 1962) has vested Powers in the Union Government "to develop a sound and adequate

National Policy in regard to Atomic Power." The Committee recommend that Government should formulaet a comprehensive and sound National Policy on Atomic Power and place it before Parliament.

B. Programme for development of Nuclear Power

1.7 The Department of Atomic Energy has reported that in the world as a whole nuclear power accounted for 9 per cent of all world electricity. The corresponding figure for India is 2.5% (approx). As against this, the share of electricity supplied by nuclear power in other countries in 1981 was France (37.7%), Finland (35.7%), Sweden (35.3%), Switzerland (28.1%), Belgium (25.3%), Bulgaria (24.7%), Japan (17.3%), Germany (Fed.Rep) (14.6%) UK (12.7%) USA (11.9%), Canada (10.0%), Pakistan (5.5%), etc.

1.8 Though the Atomic Energy Commission had in 1968 envisaged commissioning of 2700 MW of unclear power capacity by 1980, so far a total capacity of 860 MW (i.e. 420 MW at Tarapur Atomic Power Station and 440 at Rajasthan Atomic Power Station) has been established indicating a shortfall of as much as 68 per cent.

1.9 The Department o Atomic Energy intimated, in a note, that "keeping in view the limited industrial infrastructure capable of supporting the nuclear programme and the restrictive practices in international trade in nuclear materials, the programme envisaged in 1968 had to be reassessed. It is currently proposed to build a series of PHWRs of 235 MWs units also to be followed by those of 500 MW units size in a phased manner, so as to achieve an installed capacity of 10,000 MWs by 2000 A.D. In the current Plan period, provision exists for commencing work on six Reactors. These Reactors would be of the standardised Narora type.

1.10 The Committee wanted to know the relative economics of nuclear power generation viz-a-viz generation of Hydro and thermal power. In reply, the Secretary, Department of Atomic Energy revealed :—

> "The fuel cost in respect of nuclear energy is very small although capital cost is 25 per cent more."

1.11 The Committee referred to the assessment made by late Dr. Bhabha that 70 per cent of energy requirements could be met by nuclear power and enquired by what time that target would be met. In reply, the witness said :

"We think that atleast by the end of the century, 10 per cent of our power should come from nuclear. We are planning for 10,000 MW by the end of the century. We will go in for 500 MW units. We should be starting construction of first 500MW unit by 1987 and finishing by 1996. We will produce substantial quantities of plutonium, which we want to put into the breeder system. I believe that our problems regarding power would be solved with the breeder system. 70 per cent of our total energy at some stage in the next century would be met by the nuclear.

1.12 Asked what were the "restrictive practices" in international trade which had caused a set back to our nuclear power programme, the witness explained :

"The biggest problem which has forced us to develop our own programme is the restrictive practice which has become most unfriendly and uninternational. Previously they started restricting on heavy water. Now they are applying to anything. Typical example is that of nuts and bolts."

1.13 Asked what steps are proposed to be taken to improve the industrial infra-structure so that it is capable of supporting the country's nuclear programme, the representative of the Department of Atomic Energy explained that :—

"We have, in a number of instances, given development contracts to public sector organisations like BHEL and even to small and medium private organisations. We give them development contracts to provide a prototype and once it is acceptable then we ask them to take up production. In some instances, the industries are paid money which we recover in subsequent orders over a period of time. We have tried to locate the weaknesses and inadequacies and make good these cases. As a result of this, delays take place in many of these. One of the problems that manufacturers face in India is about quality of items bought from other barties. But quality is not appropriate.

Secondly, many of our manufacturers face critical input shortages like power. A large furnace in Trichinopoly could not be charged at all for want of coal for two months. Sometimes we have shortages of exygen and argon gas. We are constantly trying to overcome these deficiencies by keeping some buffer stocks with us.

But one of the problems which we have to encounter is the weakness in the general infrastructure in the country. We would not say that because of that we are not going ahead."

1.14 Considering the infrastructural constraints, the Committee desired to know if the Department was hopeful of achieving the target of 10,000 MW by 2000 AD. In reply, the representative assured :—

"We think with the resources available, the infrastructure build up, notwithstanding some limitation, that we are at a stage where we are poised for a growth. Now we are speeding up the programme. The Department is quite confident of taking up this programme of 235 MWs followed by 500 MW. We have standardised all the Narora type reactors. Of course, the confidence is based on the fact that Madras Station is working well. When this reactor is working very well, the next action that we have to take is that the industry must be ready to make the components for it; and we are meeting all the industrialists to discuss how these things can be done quickly."

1.15 The Committee understand that nearly 9% of all World electricity is being generated from nuclear Power. The corresponding figure for India is 2.5% only. As against this, the share of electricity generated from nuclear power in other countries in 1981 was about 37.7%, in France, 35.7%, in Finland, 35.3% in Sweden, 28.1% in Switzerland, 25.3% in Belgium, 24.7% in Bulgaria, 17.3% in Japan, 14.6% in Federal Republic of Germany, 12.7% in U. K., 11.9% in U.S.A., 10.0% in Canada and 5.5% in Pakistan. Even though India is producing 30 times more nuclear power than Pakistan, in terms of percentage, electricity generated from nuclear power in India is less than half of that of Pakistan. In this connection, the Committee wish to recall that late Dr. Bhabha had claimed that 70% of energy requirements of India could be met by Atomic Energy. Although capital cost of nuclear power plants is estimated to be 25% more than Thermal Plants, the overall cost in respect of nuclear energy is quite less. In view of this the Committee see no reason why India should not tap the atomic energy source for generating electricity in a big way to meet the evergrowing power needs of the country.

1.16 The Committee find, that though the Atomic Energy Commission had in 1968 envisaged commissioning of 2.70 MW of nuclear power capacity by the end of 1980, so far only a total capacity of 860 MW (i. e. 420 MO at Tarapur Atomic Power Station and 420 MW at Rajasthan Atomic Power Station) has been established indicating a shotfall of as much as 68%. According to the Department of Atomic Energy, this shortfall had been

dne to two constrainuts, viz. limited industrial infrastructure capable of supporting the nuclear programme and the restrictive practices in internaiional trade in nuclear materials. The Department has assured the Committee that, on a reassessment of the programme, they have now set a target of generating 10000 MW of nuclear power (i. e. 10 per cent of power from all sources) by the turn of the century. The Committee hope and trust that the Department would make concerted efforts to achieve this target.

1 17 The Secretary, Department of Atomic Energy informed the Committee in evidence that countries with whom India had entered into an agreement for supply of enriched uranium had not only failed to ensure uninterrupted supply of that material but had started placing restrictions on supply of heavy water and spare parts for Tarapur Atomic Power plant. The Committee could well imagine the extent to which all this inhibits our progress towards enlarging nuclear power generation for constructive purposes. Nevertheless they hope that Government would take suitable steps to get over the situation. It is needless to say that it would be prudent to diversify our sources of supply to avoid dependence on one source.

C. Institutional Frame Work

1.18 It is stated that the design, construction and operation of the nuclear power stations is administered by a Central Board of Management headed by Director, Power Projects Engineering Division and 13 other members though the primary responsibility therefor is that of Power Projects Engineering Divjsion (PPED) of the Department of Atomic Energy. Besides, Government have recently set up an Atomic Energy Regulatory Board.

1.19 The Committee wanted to know if there was over-lapping of functions and responsibilities between the Central Board of Management and PPED and if so, was it not high time that the functions of design and construction of the Atomic Power Plants should be separated from their operation and there should be a separate agency to operate the plants on commercial lines. In reply, the Secretary, Department of Atomic Energy stated in evidence that:—

> "Since I took over as Chairman a few months ago, we are planning a total re-organisation of the system to make it more efficient. Firstly, the Board of Management for power projects is chaired by the Director, PPED, and not the Secretary. As

Chairman, I have created two apex Committees, one for power and another for research and development to integrate the activities to both. So, the question of overlapping functions do not come, there is integration of functions.

With respect to design and construction, PFED is making proposals for changes. He will have a Director only for construction, as suggested here, and a Director only for maintenance and operation. Another important unit of it will be design, which will have a Study Group. It has to look forward to the future design of new reactors. In other words, while we certainly agree that this should be brought about, we are making arrangements within the system.

1.20 Asked what functions have been assigned to the Atomic Energy Regulatory Board, the witness said :—

"This work has been looked after by the Safety Review Committee, which comes under the Department of Atomic Energy now. They were doing all the job. Since we want to separate the user from the regulator, as a new system the Regulatory Board has been appointed. The same people are not looking after it, other people looking after. it. The specific reason for this is that the safety aspect is not looked after by ourselves but by a third party so that they are very objective in ensumry that we do not overlook the radiation hazard or safety considerations.

This Board has come into force. The Chairman has taken over on the 2nd January. The other members are also decided upon. They would be meeting one of these days. The Chairman of the Board is Dr. Dey, who was the Director of the Indian Institute of Technology, Bombay. Another person is Prof. E. C. Sparrow of Tata Consultants, then, Shri Mekone of the Safety Review Committee of the Atomic Energy Commission; then Dr. Gupta, Head of the Radiology Division of the Post-Graduate Institute at Chandigarh. All are outside people except Shri Mekone. Shri P. N. Krishnamurthy, who was dealing with radiology matters in Trombay, will be the fulltime Member—Secretary of the Board."

1.21 Under the Atomic Energy Act, the Department of Atomic Energy is required to coordinate its policy on Atomic Energy with the Central Electricity Authority and the State Electricity Boards and similar Statutory

Corporations, to implement schemes for the generation of electricity and to operate atomic power stations in consultation with the Boards or Corporations concerned. Asked how was this coordination being done at present, the representative of the Deparment stated in evidence :—

> "We have good coordination with the Central Electricity Authority and also with the Ministry of Energy (Deptt of Power). At present in the Site Selection C mmittee of the department of Energy, we have Member (Planning), CEA as the Member: then there is Director of the Power Projects that is, myself who is a Member of the Western, Northern and Southern Regional Electricity Boards. Then, I am a Member of the Working Group on Power Planning which was set up under the Chairmanship of the Secretary, Department of Power. On tariff, the Member from CEA plays an important role. So we do not believe that we have faced any problem in respect of coordination with the CEA and we think that the present systems are good."

1.22 The Committee expressed concern that the coordination between Atomic Energy Department and the State Electricity Boards was very weak and it had resulted in a number of constraints which had really complicated the problem. Sharing the concern, the Secretary stated :—

> "What you say is partially true. But then our own State Electricity Boards in between one State and another they behave as though they belong to two different countries."

1.23 The Committee find that at present the designing, construction and operation of the nuclear power stations in the country is being administered by a Central Board of Management, though the primary responsibility thereof continues to be that of the Power Projects Engineering Division of the Department of Atomic Energy. Recently Government have set up an atomic Energy Regulatory Board. Under the Atomic Energy Act, the Department of Atomic Energy is required to coordinate its policy on Atomic Energy with the Central Electricity Authority and the State Electricity Boards etc., to implement schemes for the generation of electricity, and to operate atomic power stations in consultation with the Boards or Corporations concerned. However, while there is a good measure of coordination with the Central Electricity Authority this cannot be said of the coordination with the State Electricity Boards. The Committee recommend that the existing machinery for coordination should be strengthened in order that planning and execution

as well as generation of electricity from nuclear power projects may not in any manner be inhibited.

D. *Plan outlays*

1.24 Department of Atomic Energy have reported that following plan outlays were made for development of Atomic Power Generation :

		Rs./crores
(a) Third Five Year Plan		51
(b) Fourth Five Year Plan		132
(c) Fifth Five Year Plan		231
	1978—79	16
	1979—80	55
(d) Sixth Five Year Plan		450

1.25 A summary of Sixth Plan outlay (requirement and approved) as furnished by the Department of Atomic Energy is reproduced below :

Scheme	Approved outlay by Planning Commission	Expenditure	
		1980—81 to 1981—82 (Actual)	Total Expenditure (anticipated)
	Rs. in Crores		
1. On going			
1.1 Power Project	239.32	114.36	
1.2 Ancillary	18.10	6.49	
1.3 Miscellaneous	12.89	1.16	
2. New Schemes			
2.1 Power Project	150.00	10.04	
2.2 Ancillary	21.94	—	
2.3 Miscellaneous (Development) Design etc.,	7.75	—	
TOTAL :	450.00	132.05	491.17

1,26 As against the Plan outlay of Rs. 450 crores, an expenditure of Rs. 132.05 crores has already been incurred during the two years 1980—81 and 1981—82. An expenditure of Rs. 359.12 crores is projected for the remaining 3 Years of the Plan (i. e. 1982—85). Thus the total outlay would be of the order of Rs. 491.17 crores showing an excess of Rs. 41.17 crores (about 10%) over the Plan provision. Asked to explain the excess, the represesentative of the Department of Atomic Energy stated :

> "At the time when Plan is made these projects would not have been sanctioned. It is the usual procedure. Sanctions for two projects have been given We had to wait before we process the sanction. We find that the long term cycle activities are not Site related as much as to the manufacture of equipment. We expect to take decisions on the sites very soon."

1.27 The Committee asked if the Plan outlays were not adequate would it be possible to achieve the target of 10,000 MW of Nuclear Power by the end of the century. In reply, the witness said :

> "I think you are trying to get on one issue whether funds will be made available. The country is in any event going ahead with a certain power programme, consisting of coal and hydro stations. Since we realise, we cannot depend on coal we have to accelerate nuclear power. Some of the investments that would have been made in the coal power sector would have been in the nuclear sector. Although we have a h gher investment in the nuclear stations, about 25% the running cost being so much cheaper, it will tilt the balance."

1.28 The Committee find that the size of the Plan outlays for development of Atomic Power has been going up in every successive Five Year Plan. In the Third Five Year Plan, a modest allocation of Rs. 31 crores for development of Atomic Power Generation was made. This was increased to Rs. 132 crores in the Fourth Five year Plan and to Rs. 331 crores in the Fifth Five Year Plan. In the year 1978-79 and 1979-80 funds to the extent of Rs. 16 crores and Rs. 55 crores respectively were allocated for this programme. In the Sixth Five Year Plan, a still larger outlay viz. Rs. 450 crores was made. It has been reported to the Committee that during the first two years of the Sixth Five Year Plan an expenditure of Rs. 135.05 crores had already been incurred and that the expenditure during the remaining 3 years of the plan was likely to be of the order of Rs. 359.12 crores aggregating to a total expenditure of Rs. 491.17 crores during the entire plan period. There will be

thus an excess of Rs. 41.17 crores (about 10 per cent) over the plan provision. The Committee are not clear as to what extent this increase has been due to cost escalation and whether the physical achievement would be higher than cont templated initially in the Sixth Plan. In any case, they would impress on the Department the need for a realistic projection of requirements to the Planning Commission for formulation of Five Year Plans in future.

CHAPTER II

GENERATION OF NUCLEAR POWER

A. Utilisation af Generation Capacity

2.1 The Atomic Energy Commission had in 1968 envisaged commissioning of 2700 MW of nuclear power capacity by 1980. By 1980, however, a total capacity of 860 MW was installed i. e. 420 MW at Tarapur Atomic Power Station and 440 MW at Rajasthan Atomic Power Station. The Tarapur APS, with a capacity of 2 units of 210 MW started commercial production in October, 1969. Rajasthan APS consists of 2 Reactor Units of 220 MWe. each. The first unit went into commercial operation in December, 1973 and the second unit in April, 1981. Another 940 MW capacity is stated to be under installation at Madras Atomic Power Project (470 MW) and Narora Atomic power Project (470 MW).

2.2 As against the installed capacity of 860 MW—at Tarapur and Rajasthan Atomic Power Stations, the actual generation of power during the last 5 years 1979—80 to 1983—84 had been as under :—

Year	*TARAPUR APS*		*RAJASTHAN APS*		
	Installed	Gross Generation installed (million Kwh)	Capacity Factor%	Gross Generation (million Mwh)	Capacity Factor%
1979—80	420 MW	1745.607	440 MWe	—	1130.981	—
1980—81	,,	1773.699	,,	—	1034.792	—
1981—82	,,	1963.723	,,	53.38	1357.172	27.42
1982—83	,,	1470.000	,,	39.29	551.000	26.75
1983—84 (Anticipated)	,,	1920.000	,,	52.18	1745.000	45.15

2.3. While under tilisation at Tarapur has been attributed by the Department of Atomic Energy to "uncertainty in supplies of enriched Uranium requiring reduction in operating power level to conserve available fuel," the major factor inhibiting full utilisation of installed capacity at Rajasthan APS has been stated to be "equipment problems both of conventional and nuclear equipment in the Station and grid operating conditions."

2.4. The Committee enquired what steps the Department had in view to find an abiding solution for ensuring uninterrupted supplies of enriched uranium to Tarapur, the representative of the Department of Atomic Energy stated in evidence :—

> "So far as Tarapore is concerned, we have achieved the life-time capacity factor in excess of 50 per cent. If you take the entire life of the Station and compare its operating record, it is in excess of 50 per cent, which is very good compared to all the reactors of that design, built at about that point of time. Tarapur had achieved a number of years 75 to 77 per cent capacity factor, in excess of 60. Subsequent to that, we have had to reduce the maximum operating power level at Tarapore to 160 MW from 210 MW because of the need to conserve the available fuel. Of course, the fuel constraint has now been removed and we are getting from France the fuel that we required for Tarapore. However, there are certain equipment problems that have been since encountered. It is our feeling that it is better to restrict the power level of the Tarapore reactor at 160 MW. The functioning of Tarapore reactor is good. The first unit had run for over 5 months non-stop, which is really one of the longest for any unit in the country. So, Tarapor operates in a reliable way, but the power is restricted to 160 MW."

2.5 In regard to equipment problems being faced at Rajasthan APS, the representative of the Department stated :—

> "I have already mentioned about the turbine generator, where it is necessary get the machine from Canada. The financing arrangement could not have been foreseen or we had no choice in the matter in those days. Improvements in other areas of equipment have taken place. That is why we find the second unit in Rajasthan is operating..... Rajasthan unit I was working upto August-September, 1981 when this problem came. It was temporarily fixed up and we started the unit in January, 1982 but that parti-

cular fixing did not last and the unit had to be taken out for servicing in March, 1982. Since then it is out of action."

2.6 Explaining the grid operating conditions being faced at Rajasthan APS, the representative of the Department stated :—

"The grid operating conditions relate to voltage control on the grid; another is availability of sufficient power when the reactor requires to be started. The frequency and voltage situations have improved in the last two years, no doubt. Nevertheless, there are occassions when the northern regional grid experiences high frequency, for example, when the bigger units have a lot of water running through them. This happened earlier this year during, the monsoon period. At other times, a little later, during the summer period, when the generation is less than the load demand, we do have situations of low frequency. Both these have to be avoided. Of course, the situation has improved now from the earlier days.

With regard to reliable start off power we are now asking the Rajasthan Electricity Board to have a separate line from their hydro electric power to Rana Pratap Sagar and have a separate transformer so that when we need to start off, we can utilize it. Because, now our experience has been when we start off, the voltage in the system is so low that the crucial parts to start the reactor just cannot start up; they grip up because they draw excessive current. Now things are improving. We are constanly working with the Electricity Board and the CEA in all matters."

2.7 The representative informed the Committee that in March, 1982, Government had appointed a Committee headed by Dr. N. V. Prasad, formerly Chairman of ONGC and Secretary (Energy) on the working of Rajasthan APS. The Committee submitted its Report in July, 1982. The witness confided that according to this Report :—

(a) While the choice of Heavy Water Reactor was a sound one, the fact that Reactor at Rajasthan AP was prototypical reactor was lost sight of by the Deptt. of Atomic Energy, Rajasthan State Electricity Board and the State Government;

(b) Kotah was not a suitable location. The site for this plant should have been closer to the infra-structural availability, say, Bombay.

(c) Practically all the power for Rajashan APS was coming from one place;

(d) Organisational system should be decentralised.

(e) Calibre of the technical and scientific personal available is of a high order and direct proper management, support construction activities can be rightly improved.

2.8 Asked how much time Government would take to implement the recommendations made by Prasad Committee, the representative pleaded :—

> "I do not know. It is necessary to implement all the recommendations bocause we had certain systems before us and these systems had changed in a period of time due to historical reasons. So, it is not a question of how much time we take to introduce these changes but whether we are introducing these changes at the best and at the right time. Lot of things depend on the man in charge. This cannot be overlooked. We are going through the Prasad Report. We are considering how best these recommendations could be implemented with respect to managerial affairs.
>
> We have implemented some other recommendations fully.
>
> We have implemented most of the technical suggestions made which, of course, again cost Rs. 20 crores. But I think the more important aspect was the organisational one which we are trying to implement to find out where the weaknesses are and we are changing the personnel."

2.9 The Committee find that during the last 3 years (1981-82 to 1983-84) while the Tarapur Atomic Power Station worked to a capacity factor ranging between 39 to 53 per cent, the capacity utilisation that Rajasthan Atomic Power Station ranged between 27 and 45%. According to the Deptt. of Atomic Energy the under utilisation at Tarapur had been due to uncertainty in supplies of enriched uranium requiring reduction in operating power level to conserve available fuel. In the case of Rajasthan Atomic Power Station the major factor inhibiting full utilisation of installed capacity has been stated to be equipment problems both of conventional and unclear equipment in the Station and grid operating conditions. The Committee were assured in evidence that the fuel constraint at Tarapur has since been overcome and that they will now be getting fuel from France for that Station. It has however been stated that it would be better to restrict the power level

of the Tarapur reactor at 160 MW as against its installed capacity of 210 MW. As a matter of fact, Tarapur Plant had in earlier years achieved a capacity factor of as much as 75 to 77% and the Committee hope that optimal production will be ensured in future.

2.10 The Committee are perturbed to find that while Unit No. 2 at Rajasthan Atomic Power Station had been working somewhat smoothly, Unit No. I had been posing equipment problems This Unit worked upto August-September, 1981 and when the equipment problem surfaced, it was temporarily fixed up and the Unit started functioning again in January, 1982, but as that particular fixing did not lost the Unit had to be taken out for servicing in March, 1982. Since then this Unit is reported to be out of operation. According to the Committee headed by Dr. N. V. Prasad which had gone into the working of the Rajasthan Atomic Power Station the location of this plant was not a right one. That Committee has also pointed out that the fact that the reactor at Rajasthan was only a prototypical reactor was lost sight of by the authorities concerned. It has also been pointed out that another constraint in the case of this plant has been that all the power for this plant came from only one source. The Committee were assured during evidence that most of the technical recommendations made by the Prasad Committee have already been implemented at an estimated cost of Rs. 20 crores. The Committee recommend that the Prasad Committee's recommendations relating to Organisational weaknesses may also be processed and conclusive action taken without further loss of time.

B. *Outages in Atomic Power Stations*

2.11 The Department of Atomic Energy have intimated that during the last 4 years outages in the Tarapur Atomic Power Station and Rajasthan Atomic Power Station have been as under :

NO = No. of outages
DL = Days lost

Year	TAPS Unit—I		TAPS Unit—II		RAPS Unit—I		RAPS Unit—II	
	No	DL	NO	DL	NO	DL	NO	DL
1979	6	67.1	6	106.0	14	63.8		
1980	6	117.9	13	79.2	19	102.58		
1981	2	115.3	9	83.7	14	209.38	21	54.61
						(from April, 1981)		
1982	8	20.5	7	113.5	4	222.27	8	180 36

These outages are mainly attributable to malfunctioning of Equipment.

2.12 Asked from which source the equipment for Tarapur and Rajasthan Atomic Power Plants was obtained, the Department intimated that :—

> "For the Tarapur Atomic Power Station which was a turn key contract a majority of the equipment was obtained from United States. For the Rajasthan Atomic Power Station Unit—I a majority of equipment was obtained from Canadian suppliers. Rajasthan Atomic Power Station Unit—II some of the Critical equipment such as calandria end shields and steam generator were manufactured in India and many other equipments. The turbines for both the units were supplied by Canada."

2.13 The Committee are concerned to note that during the last four years both Tarapur Atomic Power Station and the Rajasthan Atomic Power Station have suffered a number of outages resulting in loss of working days. In 1982 alone Unit II of Tarapur Atomic Power Station lost as many as 113.5 days, Unit-I and Unit-II of Rajasthan Atomic Power Station lost 222.27 days and 180.36 days respectively. The Committee recommend that effective steps may be taken to see that whatever equipment we have is maintained well by periodical inspections and rectifications of defects as and when they occur. In any case it should be ensured that there is no lapse or element of human error in keeping the equipment at these plants in working order.

C. *Cost of Power Generation*

2.14 The current tariff rate for supply of power by Tarapur Atomic Power Station to Maharashtra and Gujart Electricity Boards is 18.91 paise/KWH, the tariff for power supplied by Rajasthan Atomic Power Station is 28.36 paise/KWH. It has been stated that the unit energy cost for these stations is presently being worked out assuming a return of 12 per cent. The actual return in the case of Tarapur Atomic Power Station has been 15.83% in 1978—79, 6.82% in 1979—80 and 6.23% in 1980—81 and in the case of Rajasthan Atomic Power Station it was (—) 1.58% in 1978—79, 8.25% in 1979—80 and 3.90% in 1980—81.

2.15 During evidence, the Committee inquired how the "actual return" has been less than the expected 12 percent. The representative of the Department stated :—

> "The calculation of the tariff structure is based on the report of the Venkataraman Committee. This is because when the Tarapur

Station started generating power in 1970, there was no other Central Generation Station. In fact, even Badarpur and NTPC came later. Venkataraman Committee report prescribes the way in which the cost is to be worked out. That prescribes 12% return, The question with regard to actual return which is shown here arises only because the tariff is worked on the basis of certain capacity factor being attained. If in a good year, we attain a higher capacity factor, then we end up having a higher return. If, in another year, for some other reasons, we get Less than notional capacity factor we have to achieve, then we may have a lower return in that particular year. If I were to give a satisfactory answer for Tarapur Reactors in the last many years, I must say that Tarapore has more than paid off and we have generated also quite a good surplus over a period of time after meeting all payments and interest and depreciation. Financially, Tarapore is a wholly satisfactory enterprise.

Rajasthan—I is an unfortunately differant case as it had to face many problems.

Rajasthan—II is promising to be a fairly good activity."

2.16 The Committee wanted to know if the State Electricity Boards were prompt to make payment for the electricity generated and supplied to them from Atomic Power Station. In reply, the representative of the Department confined that :—

"In the case of Rajasthan, we have two problems. Even that we have generated and supplied. Money is not being paid. They owe us Rs. 32 crores and this is also affecting us because notwithstanding all the pressure that we apply on the Rajasthan Electricity Board at the level of the Chairman and the Chief Minister, we are not getting repayment at all. They owe us Rs. 32 crores besides the interest charges. It is really mounting. We are in a very difficult situation in the case of Rajasthan."

2.17 Asked how was it that the tariff rates in different States vary even in the case of one and the same Atomic Power Station. In reply, the representative of the Depertment explained :

"It is because each Station has got its own capital cost structure and, therefore, Tarapore is a station built long time ago at a low cost.

Rajasthan was built later and then Kalpakkam. The capital cost in each case is taken into account.

Venkataraman Committee allows for depreciation and interest at a certain rate and 3% net-return is what they have allowed for besides all the other costs. That is the way we are calculating the tariffs in both Rajasthan, Tarapore and Kalpakkam. There is no violent fluctuation in the tariff."

2.18 Asked whether there was considerable increase in depreciation, the representative of the Department replied :

"That depends on capital base. It is purely a national capital. That is, the Principles are the same. 90% of the cost of the Plant is written down."

2.19 The Committee asked that in view of our agreement with the United States or probably anticipating that there might be some difficulties in our agreement with France and at some stage we might be required to rely more on our indigenous fuel, whether the Department had set apart any depreciation fund. The representative of the Department stated :

"This comes up only for fuel. Fuelling cost in Tarapore has gone up and there will be revision with Meharashtra and Gujarat because the current Price in respect of France is higher than that of USA. In the case of heavy water reactor, the revision comes because of heavy water make-up cost. As the rate of heavy water goes up with time we have to charge more but there is no violent increase. It is only gentle increase."

2.20. The Committee find that the current tariff rate for supply of power by Tarapur Atomic Power Station to Maharashtra and Gujarat Electricity Boards is 18 91 paise/KWH, the tariff for power supplied by Rajasthan Atomic Power Station is 28.36 paise/KWH. The Committee have been informed that the actual return in the case of Tarapur Atomic Power Station has been 15.83% in 1978-79, 6.83% in 1979-80 and 6.23% in 1980-81 and in the case of Rajasthan Atomic Power Station it was (—) 1. 58% in 1978-79, 8.25% in 1979 80 and 3.90% in 1980-81. Thus although it was expected to have 12 per cent return it has not materialised except in one year and that too in the case of Tarapur Station only. The Committee feel that it should be possible to achieve the desirable rate of return if only the cost of opera-

tion is controlled and sustained power production at the optimal level of capacity utilisation ensured in future.

D. Waste Management Facilities

2.21 For the management of radioactive wastes generated during the operation of nuclear power stations and for ensuring that release of radio activity to the environment is well below the stringent criterie laid down by the Safety Authorities. the following ancilliary units were to be set up :—

(i)	Tarapur Waste Menagement Facilities Augmentation Phase III.	Work on the scheme will be taken up during 1983-84 and is expected to be completed by 19. 8-89.
(ii)	Waste Immobilisation Project, Tarapur.	Project is expected to be completed by August, 1983.
(iii)	Solid Storage Surveillance Facility, Tarapur	The project is expected to be completed by September, 1983.
(iv)	Centralised Waste Management Facility, Kalpakam.	The project is expected to be completed by December, 1982.
(v)	Waste Immobilisation Plant Kalpakam.	The project will be taken up in 1984 and completed by 1990-91.
(vi)	Spent Resin Fixation Facility.	The project is expected to commence in 1983 to be completed by 1987.
(vii)	Repository for Immobilisation Waste Projects.	This project is expected to be completed by 1991.

2.22 The Committee asked if the projects had been completed and commissioned. The representative of the Department stated :—

> "The Waste Immobilisation Project at Tarapur is under commission now and will be fully operational in 1984. For the Solid Storage Surveillance Facility, Tarapur, the construction will be completed in 1984 and the plant will be commissioned in the first quarter of 1985. The Centralised Waste Management Facility, Kalpakam was completed in 1983.
>
> For the Waste Immobilisation Project at Tarapur the sanctioned cost was Rs. 6.40 crores. There is no addition. For the Solid

Storage Surveillance Facility project the amount sanctioned in 1978-79 was Rs. 10.10 crores. The present estimated cost is Rs. 15 crores, because certain further facilities have become necessary. For the Centralised Waste Management Facility at Kalpakam the sanctioned cost is Rs. 4.64 crores. There is no change.

These projects are adequate for the management of radio-active wastes of the existing plants, but not for the long term future ones.

There are two situations. Tarapur and Kalpakam have power stations and other facilities. So, only in the case of Tarapur and Kalpakam we look upon waste management as common to both. In other places, like Narora, waste management is part and parcel of the project".

2.23 The Committee cannot resist the impression that adequate attention was not paid by Project Authorities to ensure that the units meant for management of radio-active wastes generated during the operation of nuclear Power Station and for ensuring that release of radioactivity to the environment is well below the stringent criteria laid down by the safety authorities, were completed on time and without any cost overrun. For example, the Waste Immobilisation Project and the Solid Storage Surveillance Facility Unit at Tarapur which were expected to be completed by August, 1983 and September, 1983 respectively are so much behind schedule that they are expected to be operational only at the end of 1984. The Committee recommend that project implementation machinery should be geared up to ensure that such important units for the Atomic Power Plants are not held up. The Committee also recommend that in future it should be ensured that waste management units ab-ibitio become part of an Atomic Power Project and are set up alongwith the project.

CHAPTER III

PROJECTS UNDER CONSTRUCTION

A. *Delays in Completion of Projects*

3.1 Department of Atomic Energy have intimated that Atmic Power Projects under construction are expected to be completed/commissioned by the time noted against each :—

	Date of commencement of work on the project	Percentage of work done so far	Schedule date of Completion	Expected date of Completion/ Commissioning of the project
1. Madras Atomic Project-Unit I	Dec., 1967	99.6%	Dec. 75	July, 88
2. Madras Atomic Power Project (Unit-II)	May, 1971	86%	Nov. 76	March, 85
3. Narora Atomic Power Project (Units I & II)	March, 1976	62.5%	March 81 March, 82	Unit I, 87 Unit II, 88
4. Kakrapara Atomic Power Project Unit I & II	July, 1981	7.0%	—	1990-91

3.2 The Committee asked whether it was not a matter of grave concern that Atomic Power Project under coustruction in the country were behind schedule by periods varying from 5 to 10 years and that prolonged gestation periods involved had resulted in frequent increases in project costs.

3.3 Sharing the concern expressed by the Committee, the representative of the Department of Atomic Energy said in evidence :—

> "The concern expressed over gestation period is genuine. We entirely agree that we must find ways and means of containing the gestation period. This is possible if we standardise reactor design and build them in a series. The French for example, built 32 reactors sanctioned as a package at the same time and they were able to do it within a gestation period of five years. We are also projecting this idea that we should have a commitment on a batch of reactors of 12 at a time built to a standard design. That is going to be a very important factor in containing the gestation period."

3.4 Asked, whether it was a fact that other countries are able to put up such plants within 5 years, the witness stated :—

> "Even the advanced countries would not be able to construct the reactor within five years. The USA is taking ten years to build up a reactor."

3.5. According to the data furnished by the Department of Atomic Energy, the cost estimates of Nuclear Power Projects under construction have been revised from time to time as per details given below :—

	Madras APP (Unit I)	Madras APP (Unit II)	Narora APP (Unit I & II)	Kakrapar APP (Unit I & II)
(1) Date of approval of Project	Dec. 67	May 71	Jan. 74	July 81
(2) Original Project Cost	61.78	70.63	209.89	382.52
(3) Ist Revision of Cost Estimate	77.09 (March 71)	103.92 (Nov. 79)	399.64	—
(4) 2nd Revision of Cost Estimate	107.87 (Nov. 79)	127.04* (Oct. 82)	—	—
(5) 3rd Revision of Cost Estimate	118.83* (Oct. 82)	—	—	—
(6) Expenditure upto 31.3.82	105.64	86.22	181.61	10.05

* approved by Atomic Energy Commission to be submitted to Cabinet.

3.6 Increases in the investment costs from original sanctioned costs have been attributed by the Department to the following factors besides general inflation :—

(i) increase in Scope of work including design changes.

(ii) increases in cost of fuel and D20 (Heavy water).

(iii) augmentation of upgrading facilities.

(iv) increases/augmentation of housing facilities.

3.7 The Committee wanted to know why increase in scope of work including design changes had become necessary after the project was taken in hand. In reply, the representative of the Department of Atomic Energy explained during evidence that :

> "The initial estimates of the two reactors at Madras and those at Narora were sanctioned at different points of time, for 1967, 1971 and 1974. Revisions have become necessary in 1980.
>
> The first unit of Rajasthan Atomic Power Station was really a prototype. At the time work was commenced on that reactor, the equivalent reactor in Canada had not gone into operation. One was not at all knowing what would be the problems. Even the Canadians found the need for many improvements. It was not as though one was having a perfect design. After we started the reactor, we found the need for changes. One is how to conserve the heavy water because of escapes from the high pressure—high temperature—flow heavy water system. Some amount of heavy water comes out of the systems through valve glands, the shaft seals of pumps and so forth and that goes into the atmosphere. Now-a-days, the heavy water cost is anywhere around Rs.5,000 a KG. With that price every little bit of heavy water is to be conserved. We have to see how to recover the heavy water from different parts of the reactor building and how to make the systems leak tight. Other changes became necessary as a result of various new requirements in safety. The design evolved in 1960 and 1970 is required to be substantially improved upon from the point of view of safety. Many more requirements on the safety of the designs and equipment have come about as a result of experience elsewhere. We have to take note of these factors.

We are not looking at a technology that is completely established. These changes have become inevitable. If you look at nuclear investment costs in other parts of the world, you will find that they had a similar experience. They have to upgrade safety-designs and equipment substantially. We have also had a similar situation in our programme. That is the genesis for the design changes."

3.8 It is a matter of great concern that the Atomic Power Projects under construction in the country viz. Madras Atomic Power Projects (Unit I & II), Narora Atomic Power Projects (Unit I & II) Kakrapara Atomicc Power Projects (Unit I & II) are behind schedule by periods varying from 5 to 10 years resulting in frequent increases in projects costs estimates. The oreginal project cost of Unit I & II at Madras was Rs. 61.78 Crores and 70.63 crores respectively. According to the 3rd revision of cost estimates in October, 1982, the revised cost of Unit I will be around Rs. 180.83 crores and according to the second revision (October, 1982) of cost estimates of Unit II the revised cost will by Rs. 127. 04 crores. As against this the expenditure incurred upto 31.3.82 on Unit I amounted to Rs. 105. 64 crores and that on Unit II Rs. 86.82 crores. In the case of Narora Atomic Power Project, the original project cost of Rs 209.89 crores has had to be revised to Rs. 399.64 crores Besides, general inflation, the main reasons for increase in projects cost have been attributed to (i) increase in scope of work including design changes (ii) increases in cost of fuel and heavy water (iii) augmentation of upgrading facilities and (iv) increases/augmentation of housing facilities In any case delays in execution of projects result in not only pushing up the project cost but also in loss of production. The Committee, therefore, recommend that the implementation of Atomic Power Projects may be streamlined and modern techniques of management to ensure that Atomic Power projects taken in hand are completed and commissioned on time in future.

B. Future Programme

3.9 According to Press Reports Government had indicated at the meeting of the Consultative Committee attached to the Department of Atomic Energy held on 24 December, 1983 that it would be going in for 4 Super Nuclear Power Stations of 2,000 MW capacity each in four regions. viz., South, East, North and West.

3.10 The Committee wanted to know if Government had given up its earlier idea of having four reactor clusters of 235 MW each in Southern,

Western and Northern Regions. In reply, the Secretary, Department of Atomic Energy explained in evidence that :—

> "The words 'Super Nuclear Power Stations' were there in the Press Report about the Consaltative Committee meeting. None of us used these words.
>
> If you go on choosing stations on an *ad hoc* basis, then you will find that infrastructure will take several years. We want to avoid that. So, it is not a change of strategy, but it is a strategy of building systems in a short period of time. If you make the stations in large numbers and put them in clusters, then it will be cheaper."

3.11 Asked whether Government was satisfied that nuclear power generation in the eastern region which had a huge coal belt would be economical, the witness said :—

> "We have a feeling that a time will come when the cost of coal will be so high that even putting a nuclear plant at the pithead will be cheaper. Moreover during monsoons, transportation of coal may becomes a problem. And due to labour problem coal may not be dug out. So, we should have a mix and that a little bit of nuclear will be an ideal thing."

3.12 The Committee enquired if the proposed Units would feed the regional power grids, the witness was of the view that :—

> "As far as distribution of power is concerned, I do not recognise different states. Power is for the whole of India. We should plan our strategy in such a manner that one day there should be one common grid for the whole country. That should be the ideal situation."

3.13 Asked whether it was a fact that these large sized units would be capital intensive, the witness stated :—

> "The moment it begins to operate it becomes a money earner. Last year we earned Rs. 140 crores by sale of power from nuclear. If we put these plants fairly fast, we will be earning so much money that we will be buying all these plants in no time.
>
> I have a feeling that if you do not put this amount of investment, your economy will collapse any day. You require power. If the

power develops, the industry develops and in turn the economy develops. If we get food and power, we can get over many of the problems. Once a power line goes to the remotest areas where water is not available, then there will not be the problem of water there."

3.14 The Committee desired to know if there should not be a national grid for distribution of nuclear power. In reply, the witness opined :—

"National grid is inescapable. But it involves many things, because electricity is not a central subject."

3.15 It transpired during examination by the Committee that Government have given up their earlier idea of having four reactor clusters of 235 MW each in Southern, Western and Northern region and that now the Department of Atomic Energy propose to go in for nuclear power stations of 2000 MW in clusters in each of the four regions viz. South, East, North and West. It was claimed that setting up of nuclear power stations in large numbers and putting them in clusters would be cheaper. The putting up of nuclear power stations in the Eastern region also has been justified on the basis that it could help to have a mix of thermal and nuclear power stations to cater to the needs of the region just in case sufficient coal is unavailable for any reason. The Committee welcome this approach.

3.16 The Secretary Department of Atomic Energy observed in evidence that "power is for the whole of India. We should plan our strategy in such a manner that one day there should one common grid for the whole country. That should be an ideal situation." The Committee would recommend that the feasibility and the advisibility of setting up an integrated power grid for the entire country may be examined in consultation with the State Governments.

CHAPTER IV

TECHNOLOGY FOR NUCLEAR POWER PLANTS

A. *Technology in Existing Plants*

4.1 The 3 Nuclear Power Projects under construction at present in the country viz., Madras Atomic Power Project (Units I & II), Narora Atomic Power Project (Units I & II) and Kakrapara (Units I & II) are of "natural uranium fuelled pressurized Heavy Water Reactor design". There is no foreign collaboration entered into for these projects. The import content is approximately 10 per cent and lower. It has been pointed out by the Department that "100% indigenisation though technically achievable would not be economically viable."

4.2 The Committee desired to know whether the Reactor design followed in India was the latest and if not, what latest designs were being followed by other advanced countries. In reply, representative of the Department of Atomic Energy said in evidence that :

> "We think that the reactors that are being built at Narora would be comparable to the reactors being built in other countries, Canada and other countries.
>
> We have already touched on what the impact of the 10% import was, and as we said, some of these items are specialised raw materials which are not within the atomic energy family, like steel making or heavy metallurigcal work. Since the organisations here are reluctant to make high quality special raw materials for us, we are constrained to import them, but we are constantly endeavouring to see that as much of this could be made in the country should be made in the country."

4.3 Asked what would be the extra cost involved if import content of 10 per cent was also done away with. What broadly are the items imported, the witness pleaded :

> "It is difficult to quantify the cost, but we agree that the general intention should be to see that we import as little as we can.

Specialised high quality raw materials, for example, very thick stainless steel plate, high quality tubes etc."

4.4 The Committee asked whether by importing a part of the critical equipment, howsoever small in value, we would not be completely dependent on the foreign suppliers for servicing and replacement, and that this would be repeating the mistake we did in the case of Tarapur Plant. In reply, the witness assured "we agree that the general intention should be to see that we import as little as we can."

4.5 The three nuclear power projects *viz.* Madras Atomic power project (Unit I & II), Narora Atomic Power project (Units I & II) and Kakrapara Atomic Power project (Units I & II) which are under construction at present in the country are of "natural uranium fuelled, pressurised heavy water reactor design." The Committee find that though no foreign collaboration has been entered into for these projects, the import content in these projects is likely to be about 10%. According to the Department of Atomic Energy "100% indigenisation though technically achievable would not be economically viable." The Committee are not impressed by this view. The Committee feel that by importing a part of the critical equipments, howsoever small it may be in value, we would be completely dependent on the foreign suppliers for servicing and replacement and that this would amount to repeating the same mistake we did in the case of Tarapur Plant. Unfortunately, the experience in the case of Tarapur Plant has not been a happy one. The Committee would therefore, urge Government to consider seriously why even this 10% of import content should be there especially when 100% indiginisation is not only desirable but also achieveable.

B. *Fast Breeder Reactors*

4.6 Based on the limited uranium deposits and more abundant thorium deposits in the country, an integrated strategy of first using natural uranium with heavy water type reactors followed by a fast breeder reactor was visualised at the outset of India's Nuclear Power programme and still holds good. It has been reported that a Fast Breeder Reactor is being constructed at the Reactor Research Centre at Kalpakkam. This project is expected to be completed by 1984. The work on the preliminary design of a prototype FB Reactor is in progress. The Prototype F. B. Reactor, is in progress it has been stated, is expected to be commissioned by the middle of 1990. By the first decade of 21st century the first of the commercial fast breeder reactors of 500 MWe will be contributing to India's nuclear programme.

4.7 The Committee wanted to know the progress made in this direction. In reply, the Secretary of the Department of Atomic Energy stated in evidence that :

> "Feasibility report on a Fast Breeder reactor has been prepared. A fast breeder test reactor will operate by the end of this year. But the fast breeder prototype reactor will be operating in 1995. It is a new type of reactor and would require considerable time in the design and construction. The expenditure is about Rs. 750 crores spread over 15 years."

4.8 The Committee referred to the doubts expressed in certain quarters that Fast Breeder reactors were neither safe nor stable and asked what the factual position was. In reply, the Secretary, Department of Atomic Energy confided that :

> "Then, I have a feeling that 'certain quarters' were not properly informed. There was an article in the Illustrated Weekly which made a big flash for the first time. The doubts that a nuclear explosion will take place is out of question. It is against the laws of physics. Fast breeder reactors have been working in France and Russia quite satisfactorily and in fact, these countries are pushing them to their ultimate limits. We are interested in it because this is mainly the only way of using our thorium deposits. There is an inherent safety in the system. I explained the whole position to the reporter who met me, but he, it appears, did not understand the whole thing."

4.9 Asked if it was a fact that the cost of Power in the case of Fast Breeder Reactor would be higher than that of Thermal Reactor, the witness revealed :

> "There is no doubt that the cost of power in the case of fast breeder reactors would be higher change of thermal reactor. Because, it is the prototype and not done on commercial pay in. All prototypes are expensive. Capital cost is high; the running cost pay not be that high because the fuel costs are almost negligible. However, you have to reprocess that fuel. We can only say that after 15 years, it may not be higher."

4.10 The Committee recall that based on the limited Uranium deposits and more abundant thorium deposits in the country an integrated strategy of

first using natural uranium with heavy water type reactors followed by a fast breeder reactor was visualised at the outset of India's nuclear power programme. It has been reported by the Department of Atomic Energy that India's first Fast Breeder Reactor being constructed at the Reactors Research Centre at Kalpakam is expected to be completed by 1984. However, the Fast Breeder Prototype reactor is expected to be commissioned only by the middle of 1990. The design and construction of this Prototype Reactor would entail an expenditure of Rs. 750 crores spread over 15 years. When the Committee referred to the doubts expressed in certain quarters that the Fast Breeder reactors were neither safe nor stable, the Secretary Department of Atomic Energy pointed out that such reactors have been working satisfactorily in France and Russia and that such fears were unfounded. The Committee agree that setting up of fast breeder reactor is perhaps the only way of using our thorium deposits. The Committee stress the need to see that the programme of design and construction of Prototype fast breeder reactor is Completed on schedule and there is no let up at any stage.

CHAPTER V

NUCLEAR FUEL COMPLEX

5.1 The Nuclear Fuel Complex (NFC) was set up in Hyderabad in 1972 to cater to the fuel requirements of India's power reactor programme. The power reactor programme in India is based on the use of natural Uranium as fuel and only the Tarapur Atomic Power Station uses Enriched Uranium. NFC comprises of the Fuels Division and the Tubes Division.

A. Fuels Division

5.2 The Fuels Division is captive to the requirements of the Department of Atomic Energy and consists of the following facilities :—

1. Zirconium Oxide Plant
2. Zirconium Sponge Plant
3. Zircaloy Fabrication Plant
4. Uranium Oxide Plant
5. Ceramic Fuel Fabrication Plant
6. Enriched Fuel Fabrication Plant
7. Enriched Uranium Oxide Plant

5.3 The main production plants of the Nuclear Fuel Complex, namely the Natural Fuel Fabrication Plant, the zircalloy Fabrication Plant and the Enriched Fuel Fabrication Plant of the N.F.C. were commissioned during the years 1972-73 with installed capacity of 100 M.T., 50 M.T. and 24 M.T. The present fuel fabrication facility at NFC is reported to be sufficient to meet the requirements of the existing nuclear power reactors and the Madras Atomic Power Project Unit I. The Fuels Division of NFC is being expanded in a phased manner to meet the increased fuel requirement of the nuclear power programme.

5.4 The Tarapur Atomic Power Station, unlike other power stations, uses enriched Uranium as fuel. The enriched Uranium, in Uranium hexaflouride form, is imported. The Enriched Uranium Oxide Plant converts this into Uranium Oxide and the Enriched Fuel Fabrication Plant fabricates the fuel for subsequent use in the power station. The Enriched Fuel Fabrication Plant, which went into production in 1973, is adequate to meet the needs of the Tarapur Atomic Power Station.

5.5 The manufacturing facility at the Zircaloy Fabrication Plant includes an extrusion press for the production of Seamless Zircaloy tubes. An extrusion press with a capacity for extruding 20,000 to 30,000 Tonnes per annum was acquired to provide the force of 3000 tonnes which was required.

5.6 The Committee desired to know to what extent the Nuclear Fuel Complex had been able to meet the requirements of the country's nuclear power programme. In reply, a representative of the Department of Atomic Energy stated in evidence :

> "Ever since this NFC has been established no fuel has been imported for heavy water reacto. Now fuel is not a scarcity item at each of the reactor stations."

> Nuclear power programme as has been drawn up we have worked out the year-wise requirements of Fuel at NFC. During the last three years we have been able to produce 56 tonnes of fuel, 84 tonnes of fuel and 100 tonnes of fuel this year. Secondly, Sir, the fuel is not produced in far too excess and stored for a long period as we have established indigenous production facilities."

5.7 Asked if at any stage nuclear programme was likely to suffer because of inability of Nuclear Fuel Complex to meet the country fuel requirements, the witness assured that :

> "So far we have been fortunate and I would also like to submit that we have mastered the technology and, as such, that situation will not arise. Further, we are involved in the constant research for improving the fuel."

5.8 Asked if these plants were working to full capacity and if not, what had been the shortfall in capacity utilization of each plant during each of the last 3 years, and what were the reasons for the underutilisation, the representative of the Department stated :—

> "The fuel production has been regulated keeping in view the fuel needs of the different reactors and all through ever since the commissioning of the NFC, the fuel has been available in sufficient reserves at the reactors including the Tarapur reactor, and at no point of time the fuel was short. As regards the natural uranium oxide fuel, in 1980-81 the production was to the extent of 50%, in 1981-82 to the tune of about 60% and in 1982-83 it is 85%

utilisation of the capacity. As I said, we regulated our production suiting the needs of the reactors. In the enriched uranium fuel, there was a set back in terms of utilisation because of non-availability of the enriched uranium from U. S. That was the period in the last two-three years when we went through a lot of uncertainty regarding the supply. The actual production of enriched duel in 1980-81 was about 2.5 tonnes, 1981-82 it is 32 tonnes.

In 1980-81 it was around 10% utilisation and in 1981-82 it was 50% more than the capacity and in 1982-83 it is about 15%."

5.9 The Committee enquired if working of Tarapur Plant had been adversely affected due to non-availability of enriched Uranium from USA. In reply, the witness asserted "Tarapur reactors have not suffered the least because of fuel availability as there are sufficient resources at Tarapur."

5.10 As regards capacity utilisation of the Zircaoy Fabrication Plant, the witness revealed :—

"In Zirca lloy Plant the capacity utilisation in 1980-81 was about 32%, in 1981-82 abuot 50% and in 1982-83 it was more than 50%."

5.11 Asked about the reasons for under-utilisation, the witness stated :—

"That is because of the requirement of the fuel at the reactor sites."

5.12 It has been stated that the development work on MOX (Mixed Oxide Fuel Plutonium Oxide and Uranium Oxide) as alternative fuel for nuclear reactors has been carried out and the possibility of using MOX in the light water Reactors has been established. The MOX technology is now available for possible future use.

5.13 The Nuclear Fuel Complex was set up in Hyderabad in 1972 to cater to the Fuel requirements of India's power reactor programme. The power reactor programme in India is based on the use of natural uranium as fuel and only the Tarapur Atomic Power Station uses enriched uranium. The complex comprises of two Divisions namely the Fuel Division and the Tubes Division. The main production plants of this fuel division viz. Natural Fuel Fabrication plant, the Zircalloy Fabrication Plant and the

Enriched Fuel Fabricating Plant of the Complex were commissioned during the year 1972-73 The Committee find that these 3 plants of the Fuel Division have not been working to their full capacity. During the last 3 years (1980-81 to 1982-83) the capacity utilisation at the natural Uranium Oxide Fuel Plant had been 50%, 60% and 85% respectively. In the enriched Uranium Fuel Plant, the utilisation was only 10 per cent in 1980-81, 50% in 1981-82 and 15% in 1982-83. In the Zircalloy Plant the capacity Utilisation in 1980-81 was about 32%, in 1981-82 about 50% and in 1982-83 it was more than 50 per cent. The Committee were given to understand that the fuel production at the nuclear fuel complex had been regulated keeping in view the fuel needs of the different reactors and that all through ever since the commissioning of the Complex in 1972 the fuel has been available in sufficient reserves at the reactors including the Tarapur reactor.

The Committee were assured that even at Tarapur Plant where there was set back in terms of utilisation because of non-availability of the enriched uranium from U. S., the working of that Plant was not allowed to suffer.

5.14 The Committee are glad to note that the Development work on MOX (Mixed Oxide fuel Platinum Oxide and Uranium Oxide) as alternative fuel for nuclear reactor has been carried out and the possibility of using it in the light water reactors has been established. The Committee would await the steps taken to adopt this technology in view of its obvious advantages.

B. *Tubes Division*

5.15. As extrusion Press has spare capacity and it was therefore decided to take up production of seamless stainless steel tubes and ball bearing tubes, which were not being manufactured indigenously. The Tubes Division was thus started as a commercial activity of NFC and was undertaken as an import substitution venture. The Tubes Plants are in production only for a few years and are yet to stabilise. The Stainless Steel Tubes Plant has been commissioned in 1978 and the ball bearing plant was commissioned in October, 1981. Necessary steps are being taken to improve capacity utilisation and control over cost simultaneously with increasing sales and competitiveness of the produce compared to the imported product.

5.16 The Committee wanted to know whether Extrusion Press had been incurring losses. In reply, the Secretary, Department of Atomic Energy explained :—

"The Ministry of Industry asked us to go into the production of seamless stainless steel tubes and ball bearting tubes mainly because we had the necessary technology for doing it. We took it up because the country needed it. Ball bearings tubes are not our needs. The capacity was meant to be supplied to the whole country. But it so happened that due to the high cost of the billets that are supplied to us, the demand for both of these is much below that we could produce. Customers are not buying from us, they are buying from foreign sources because that is cheaper. As a result I may bring to your attention that we are not commercially satisfied We produce it because it is a very important material needed for the country. Because of the low production levels in the c se of stainless tubes, the loss in 1980-81, was Rs. 1.2 crores and in 1982-83 Rs. 2.3 crores. For ball-bearings because of low production the losses were Rs. 6.70 lakhs and 84 lakhs respectively".

5.17. Asked whether differential in price was the solecause for having more demand for imported material or quality-wise also there was difference. the representative of the D partment stated :—

"Quality-wise we have produced when it comes to different grades of steel. Even nuclear quality we have produced which is more stringent specification-wise but the major constraint or difficulty is in terms of price and delivery. Where it is related to the delivery of the alloy steel, we do not make the bacic alloy steel billets. We get them from the established alloy steel plants like Durgapur ASP or Midhawiar Musce VISL. The other point I would like to make is that there is a total ban on import of seamless stainless steel tubes and the duty is enhanced to the tune of 320%. If both these could apply, then NFC would not have any difficulty in making up a commercially viable project".

5.18. Asked whether for production at NFC imported billets were required, the representative of the Department stated :—

"We can take the indigenous billets but at a very high cost. If we are allowed to import the billets at a nominal duty, we can also make the product comparable to imported finished tubes. But we have to take the indigenous billets which are much higher in cost ranging from 100% to 300%. We have to take it from the indigenous alloy steel producers. On the finished product the duty

is 300 per cent. But there is exemption for essential industries like power, fertilizers etc where the duty is only 40 per cent. So, we are not able to compete and get orders from them".

5.19 Explaining further, the Secretary Department of Atomic Energy stated :—

"However, we are going to the different users and asking them to buy our products in preference to foreign products and thus help an indigenous industry. But the tax structure is against us and the initial cost is also against us. We are trying to have discussions with the user Ministries and user companies to help us out of this problem, which is not really of our making, but passed on to us".

5.20 Asked why the indigenous billets were costlier as compared to imported billets, the representative of the Department stated :—

"That is vary much debated in the discussions of the Steel Ministry and the Heavy Industries Ministry. The problem is that in most of these electric furnances the steel and power cost much higher because the ferro alloys and ferro chrome that are used are costly. Even the graphite electrods for the steel Industry has high cost. These are the factors which make the Indian product costly, compared to imported steel. Another factor is, when it comes to finished products, in the case of some of these imported items these are not the real costs, but the dumping costs, because they do not want to lose globel orders, sometimes they use the dumping cost to keep customers with them. To that extent, they are unrealistic prices, with which we have to compete".

5.21 The Committee then observed that if these were the considerations, then the recurring losses would continue so as long as these facts were there. Agreeing with this, the representative of the Department stated :—

"Government is seized of this problem. We are having monthly type of reporting system and efforts are being made to solve the problem. As a first step, a total ban has been put on the import of seamless and stainless tubes. So, efforts are being made to make this commercially viable. But it should be realised that the Department of Atomic Energy has very little to do with this and

it is more concerned with the Steel Ministry, Heavy Industries Ministry and the DGTD."

5.22 The Committee then pointed out that the only way out was to impose or increase duty on the import of finished products. The representative of the Department stated :—

"If the import is completely stopped, the alloy steel makers will compaign very strongly against it. We have now a very powerful organisation like defence production. They will compaign that billet import should not be permitted. So, we have to reconcile the position. We have to take high cost billet and produce tubes. The only remedy available is high duty on the finished product and implementing it."

5.23 When asked why was the installed capacity much more than the requirement, the representative of the Department stated :—

"The installed capacity was fixed taking into account the demand within the country. Now it is a question of forcing the users to take it from the NFC. There will be a certain element of extra cost. It is only a question of time element. We shall do this very soon."

5.24 In a Note furnished after evidence, Department of Atomic Energy furnished the following comparative data showing cost of tubes manufactured at NFC and the Landed cost of imported tubes with 40% duty for project and 33% duty for non-project import :

COMPARATIVE STATEMENT OF PRICES OF SS TUBES VS IMPORTED TUBES

Prices in Rs./Kg.

Grade	Size	Cat.	NFC's price	Landed price of Imported Matl. with 40% C.D-	With 33% C.D
304	33.41 × 2.77	P2	102	62.6	149 4
304L	33.41 × 3.38	P1	125	75.3	180
304L	21.3 × 2.77	P2	138	80 22	191.6
321	51 × 5	P1	112	53.8	128.4
316	57 × 5	P1	140	77.9	186
316L	57 × 5	P1	201	82.7	197 6

RATES—BB TUBES

Sl. No.	Typical Tube Dia (MM)	NFC's supply condition	NFC's rates Rs/Kg	Imported Tubes Rs/Kg	
				Landed cost with 95% costoms duty	Supply condition
1.	30 to 45	CR	36.0	27.6	CR
2.	47 to 55	CR	29.2	20.5	CR
3.	56 to 85	CR	29.2	17.0	HR
4.	90 to 150	HR	21.4	15.0	HR

NOTE : CR—Cold rolled/pilgered
HE—Hot Extruded
HR—Hot Rolled.

5.25 The Committee find that as the extrusion press of the Nuclear fuel complex, Hyderabad had spare capacity, the Tubes Division undertook manufacture of stainless steel tubes and ball-bearing tubes as a commercial activity of the complex and as an import substitution venture. The Committee are concerned to note the gross under utilisation of the capacity in the Tubes Division and consequential loss suffered. The Committee were informed that the stainless steel Tubes Plants suffered losses of 1.2 crores in 1980-81 and Rs. 2.3 crores in 1981-82. In the case of ball-bearing tubes plant the low production is stated to have resulted in losses to the extent of Rs. 6.70 lakhs and Rs. 84 lakhs respectively during this period. The representative of the Department of Atomic Energy disclosed in evidence that this commercial venture had been taken up by them at the instance of the Ministry of Industry. He was of the view, that unless high import duty was imposed by Government on the import of such tubes it would not be possible for the Tubes Division to be commercially viable. The reason for the indigenouse tubes being costlier is because of high costs of billets in India which go into the production of these tubes. The Committee feel that the Nuclear Fuel Complex should not be made to suffer losses year after year on production of these tubes on the plea that they have developed the technology for such manufacture. The basic question that arises in this context is how spare capacity arose in the extrusion press of the Nuclear Fuel complex, Hy-

derabad and how far it has been economically, if not financially, justified in deciding to make use of this capacity to produce stainless steel tubes and ball-bearing tubes. While the Committee would await an answer to this, they would suggest that it should be examined whether by adjustment in fiscal levies the unit could be made viable or whether the spare capacity could be used for some other productive purpose profitably.

CHAPTER VI

HEAVY WATER PLANTS

6.1 There are three Heavy Water plants in operation at Nangal, Tuticorin and Baroda, two are under construction at Talcher and Kota and two are under construction at That Vaishet (Maharashtra) and Manugru (Andhra Pradesh Nangal Heavy Water Plant is part of Nangal Fertiliser Complex and is under the Ministry of Chemicals & Fertilizers. Details of project cost, installed capacity and actual/anticipated date of commissioning of the remaining 6 plants as furnished by the Deptt. of Atomic Energy are given below :—

Plant	Estimates Cost (Rs. crores)	Installed Capacity (M.T./Yr.)	Actual/Anticipated date of Commissioning
1. HWP, Tuticorin	37.37	71.30	July, 1978
2. HWP, Baroda	33.87	67.20	July, 1980
3. HWP, Kota	68.61	100.00	March, 1983
4. HWP, Talcher	60.50	62.70	March, 1983
5. HWP, Thal Vaishet	187.65	140.00	February, 1987
6. HWP, Manuguru	461.60	200.00	1988
		641.20	

6.2 The Nangal Heay Water Plant is based on electrolysis and Hydrogen distillation process. The plants at Baroda, Talcher and Tuticorin are based on ammonium hydrogen exchange process. Kota plant is based on hydrogen sulphide water exchange process developed by Bhaba Atomic Research Centre.

6.3 In a Note the Department of Atomic Energy have stated that the capacity utilisation at Baroda ond Tuticorin Heavy water Plants had been as under :—

Heavy Water Projects	*HWP (Baroda)*	*HWP (Tuticorin)*
(i) Capacity (metric tonnes/Year)		
Installed	67.2	71.3
Effective	45.0	45.0
(ii) Date of commissioning	21 July, 80	17 July, 78.

6.4 As regards the reasons for underutilisation of capacity, Department of Atomic Energy have intimated as under :—

(a) **HWP (Tuticorin)**

The optimum performance of the plant could not be achieved due to several technical problems such as high frequency of voltage dips and non-availablility of continuous supply of requisite quantity of syn. gas from the fertilizer plant of SPIC, lower concentration of deuterium in the feed gas low recovery in the exchange tower and outage to due to plant problems such as failure of pumps, damages to bearings etc., Various measures to improve the performance are in hand. Some of these problems have already been overcome, while measures have been thought of, for solving the rest of the problems in a phased manner to achieve the effective production of 45 tonnes per year based on irremediable constraints.

(b) **HWP (Baroda)**

The optimum performance could not be achieved due to various technical problems such as low concentration of deuterium in feed gas, failure of sealing rings of STD valves, limitation of cracker lead due to excessive vibrations in the discharge line of liquid ammonia pump feed to the cracker, low recovery in the exchange tower, high shell temperature of the convertor and other plant problems. The technical problems are under constant study for remedial measures. Some of these problems overcome, while measures have been thought of, for solving the rest of the problems in a phased manner, to achieve the effective production of 45 tonnes per year based on irremediable constraints.

6.5 In a Note the Department of Atomic Energy have stated that the cumulative demand for heavy water for the next 10 years was likely to be as follows :—

	(Figures refer to $D^0 2$ in Tonnes)
1984—85	256
1985—86	558
1986—87	620
1987—88	1014

1988—89	1343
1989—90	1429
1990—91	1845
1991—92	2449
1992—93	3078
1993—94	4062
1994—95	5083

6.6 It has been stated that substantial part of this requirement can be met from the indigenous production. However, in the initial stages, there may be a shortfall due to the production not matching with the demand. This gap is proposed to be bridged from imports from sources like USSR. The import of heavy water from USSR and its cost during the last 3 years was as follows :—

Year	Quantity (tonnes)	CIF Value (Rs. Crores)
1980	41	8.17
1981	40	9 26
1982	50	13.36
Totat :	131	30.79

6 7 The Committee find that the Heavy water Plants at Tuticorin and Baroda which were commissioned in July 1978 and in July 1980 with an installed capacity of 67.2 MT and 71.3 MT respectively have not been working at full capacity because of technical problems. The Committee have been informed that some of these problems have already been overcome while measures have been thought of for solving the rest of the problems in a phased manner to achieve optimal production of 45 tonnes per year based on irremedial constraints. The Committee view the under-utilisation of capacities in these plants with serious concern because any shortfall between demand and indigenous production has to be made good by the import of heavy water. During the last 3 years ending 1982 the total quantity of 131 tonnes of the total CIF value of Rs. 30.79 crores had to be imported from USSR. The Committee recommend that the technical problems confronting the two heavy water Projects at Tuticorin and Baroda may be examined in depth by a Technical Committee who may be asked to suggest solutions to these problems within a specified period. The Committee are of the firm view that when the demand for heavy water to support the nuclear energy programme is picking up so fast, we cannot afford to let the existing heavy water plants languish. If, however, the constraints of these plants are really found 'irremediable' augmenting of the available capacity for production of Heavy water should be considered forthwith.

APPENDIX

Statement of Recommendations and Observations

Sl. No.	Para No.	Recommendations and Observations
1.	1.6	Section 22(1) (a) of the Atomic Energy Act 1962 (33 of 1962) has vested powers in the Union Government "to develop a sound and adequate National Policy in regard to Atomic Power." The Committee recommend that Government should formulate a comprehensive and sound National Policy on Atomic Power and place it before Parliament.
2.	1.15	The Committee understand that nearly 9% of all World electricity is being generated from nuclear power. The corresponding figure for India is 2.5% only. As against this, the share of electricity generated from nuclear power in other countries in 1981 was about 37.7% in France, 35.7% in Finland, 35.3% in Sweden, 28.1% in Switzerland, 25.3% in Belgium, 24.7% in Bulgaria, 17.3% in Japan, 14.6% in Federal Republic of Germany, 12.7% in U. K., 11.9% in U.S.A., 10.0% in Canada and 5.5% in Pakistan. Even though India is producing 30 times more nuclear power than Pakistan, in terms of percentage, electricity generated from nuclear power in India is less than half of that of Pakistan. In this connection, the Committee wish to recall that late Dr. Bhabha had claimed that 70% of energy requirements of India could be met by Atomic Energy. Although capital cost of nuclear power plants is estimated to be 25% more than Thermal Plants the overall cost in respects of nuclear energy is quite less. In view of this the Committee see no reason why India should not tap the atomic energy source for generating electricity in a big way to meet evergrowing power needs of the country.

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3.	1.16	The Committee find that though the Atomic Energy Commission had in 1968 envisaged commissioning of 2700 MW of nuclear power capacity by the end of 1980, so far only a total capacity of 860 MW (i.e. 420 MW at Tarapur Atomic Power Station and 420 MW at Rajasthan Atomic Power Station) has been established indicating a shortfall of as much as 68%. According to the Department of Atomic Energy, this shortfall had been due to two constraints viz. limited industrial infrastructure capable of supporting the nuclear programme and the restrictive practices in international trade in nuclear materials. The Department has assured the Committee that, on a reassessment of the programme, they have now set a target of generating 10000 MW of nuclear power (i.e. 10 per cent of power from all sources) by the turn of the century. The Committee hope and trust that the Department would make concerted efforts to achieve this target.
4.	1.17	The Secretary, Department of Atomic Energy informed the Committee in evidence that countries with whom India had entered into an agreement for supply of enriched uranium had not only failed to ensure uninterrupted supply of that material but had started placing restrictions on supply of heavy water and spare parts for Tarapur Atomic Power Plant. The Committee could well imagine the extent to which all this inhibits our progress towards enlarging nuclear power generation for constructive purposes. Nevertheless they hope that Government would take suitable steps to get over the situation. It is needless to say that it would be prudent to diversify our sources of supply to avoid dependence on one source.
5.	1.23	The Committee find that at present the designing, construction and operation of the nuclear power stations in the country is being administered by a Central Board of Management, though the primary

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		responsibility thereof continues to be that of the Power Projects Engineering Division of the Department of Atomic Energy. Recently Government have set up an atomic Energy Regulatory Board. Under the Atomic Energy Act, the Department of Atomic Energy is required to coordinate its policy on Atomi Energy with the Central Electricity Authority and the State Electricity Boards etc., to implement schemes for the generation of electricity, and to operate atomic power stations in consulation with the Boards or Corporations concerned. However, while there is a good measure of coordination with the Central Electricity Authority this cannot be said of the coordination with the State Electricity Boards. The Committee recommend that the existing machinery for coordination should be strengthened in order that planning and execution as well as generation of electricity from nuclear power projects may not in any manner be inhibited.
6.	1.28	The Committee find that the size of the Plan outlays for development of Atomic Power has been going up in every successive Five Year Plan. In the Third Five Year Plan, a modest allocation of Rs. 31 crores for development of Atomic Power Generation was made. This was increased to Rs. 132 crores in the Fourth Five Plan and to Rs. 331 crores in the Fifth Five Year Plan. In the year 1978-79 and 1979-80 funds to the extent of Rs. 16 crores and Rs. 55 crores respectively were allocated for this programme. In the Sixth Five Year Plan, a still larger outlay viz. Rs. 450 crores was made. It has been reported to the Committee that during the first two years of the Sixth Five Year Plan an expenditure of Rs. 135,05 crores had already been incurred and that the expenditure during the remaining 3 years of the plan was likely to be of the order of Rs. 359.12 crores aggregating to a total expenditure of Rs. 491.17 crores during the entire plan period. There will be thus an excess of

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		Rs. 41.17 crores (about 10 per cent) over the plan provision. The Committee are not clear as to what extent this increase has been due to cost escalation and whether the physical achievement would be higher than contemplated initially in the Sixth Plan. In any case, they would impress on the Department the need for a realistic projection of requirements to the Planning Commission for formulation of Five Years Plans in future.
7.	2.9	The Committee find that during the last 3 years (1981-82 to 1983-84) while the Tarapur Atomic Power Station worked to a capacity factor ranging between 39 to 53 per cent, the capacity utilisation that Rajasthan Atomic Power Station ranged between 27 and 45%. According to the Deptt. of Atomic Energy the under utilisation at Tarapur had been due to uncertainty in supplies of enriched uranium requiring reduction in operating power level to conserve available fuel. In the case of Rajasthan Atomic Power Station the major factor inhibiting full utilisation of installed capacity has been stated to be equipment problems both of conventional and nuclear equipment in the Station and grid operating conditions. The Committee were assured in evidence that the fuel constraint at Tarapur has since been overcome and that they will now be getting fuel from France for that Station. It has however been stated that it would be better to restrict the power level of the Tarapur reactor at 160 MW as against its installed capacity of 210 MW. As a matter of fact, Tarapur had in earlier years achieved a capacity factor of as much as 75 to 77% and the Committee hope that optimal production will be ensured in future.
8.	2.10	The Committee are perturbed to find that while Unit No. 2 at Rajasthan Atomic Power Station had been working somewhat smoothly, Unit No. I had been posing equipment problems. This Unit worked

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		upto August-September, 1981 and when the equipment problem surfaced; it was temporarily fixed up and the Unit started functioning again in January, 1982. but as that particular fixing did not last the Unit had to be taken out for servicing in March, 1982. Since then this Unit is reported to be out of operation. According to the Committee headed by Dr. N.V. Prasad which had gone into the working of the Rajasthan Atomic Power Station the location of this plant was not a right one. That Committee has also pointed out that the fact that the reactor at Rajasthan was only a prototypical reactor was lost sight of by the authorities concerned. It has also been pointed out that another constraint in the case of this plant has been that all the power for this plant came from only one source. The Committee were assured during evidence that most of the technical recommendations made by the Prasad Committee have already been implemented at an estimated cost of Rs. 20 crores. The Committee recommend that the Prasad Committee's recommendations relating to Organisational weaknesses may also be processed and conclusive action taken without further loss of time.
9.	2.13	The Committee are concerned to note that during the last four years both Tarapur Atomic Power Station and the Rajasthan Atomic Power Station have suffered a number of outages resulting in loss of working days. In 1982 alone Unit II of Tarapur Atomic Power Station lost as many as 113.5 days, Unit-I and Unit-II of Rajasthan Atomic Power Station lost 222.27 days and 180.36 days respectively. The Committee recommend that effective steps may be taken to see that whatever equipment we have is maintained well by periodical inspections and rectifications of defects as and when they occur. In any case it should be ensured that there is no lapse or element of human error in keeping the eqipment at these plants in working order.

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10.	2.20	The Committee find that the current tariff rate for supply of power by Tarapur Atomic Power Station to Maharashtra and Gujarat Electricity Boards is 18.91 paise/KWH. the tariff for power supplied by Rajasthan Atomic Power Station is 28 36 paise/KWH. The Committee have been informed that the actual return in the case of Tarapur Atomic Power Station has been 15.83% in 1978-79, 6.83% in 1979-80 and 6.23% in 1980-81 and in the case of Rajasthan Atomic Power Station it was (—) 1.58% in 1978-79 8.25% in 1979-80 and 3.90% in 1980-81. Thus although it was expected to have 12 per cent return it has not materialised except in one year and that too in the case of Tarapur Station only. The Committee feel that it should be possible to achieve the desirable rate of return if only the cost of operation is controlled and sustained power production at the optimal level of capacity utilisation ensured in future.
11.	2.23	The Committee cannot resist the impression that adequate attention was not paid by Project Authorities to ensure that the units meant for management of radioactive wastes generated during the operation of nuclear Power Station and for ensuring that release of radioactivity to the environment is well below the stringent criteria laid down by the safety authorities, were completed on time and without any cost overrun. For example, the Waste Immobilisation Project and the Solid Storage Surveillance Facility Unit at Tarapur which were expected to be completed by August, 1983 and September, 1983 respectvtely are so much behind Schedule that they are expected to be operational only at the end of 1984. The Committee recommend that project implementation machinery Should be geared up to ensure that such important units for the Atomic Power Plants are not held up. The Committee also recommend that in future it should be ensured that waste management units ab-ibitio become part of an Atomic Power Project and are set up alongwith the project.

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12.	3 8	It is a matter of great concern that the Atomic Power Projects under constru tion in the country viz. Madras Atomic Power Project (Unit I & II) Narora Atomic Power Projects (Unit I & II) are behind schedule by periods varying from 5 to 10 years resulting in f.equent increases in projects costs estimates. The original project cost of Unit I & II at Madras was Rs. 61.78 crores and Rs. 70.63 crores respectively. According to the 3rd revision of cost estimates in October, 1982, the revised cost of Unit I will be around Rs. 180.83 crores and according to the Second revision (October, 1982) of cost estimates of Unit II the revised cost will by Rs. 127.04 crores. As against this the expenditure incurred upto 31.3.82 on Unit I amounted to Rs. 105.64 crores and that on Unit II Rs. 86.82 crores. In the case of Narora Atomic Power Project, the original project cost of Rs. 209.89 crores has had to be revised to Rs. 399.64 crores. Besides, general inflation, the main reasons for increase in projects cost have been attributed to (i) increase in scope of work including design changes (ii) increases in cost of fuel and heavy water (iii) augmentation of upgrading facilities and (iv) increases/augmentation of housing facilities. In any case delays in execution of project result in not only pushing up the project cost but also in loss of production. The Committee, therefore, recommend that the implementation of Atomic Power Projects may be streamlined and modern techniques of management to ensure that Atomic Power projects taken in hand are completed and commissioned on time in future.
13.	3.15	It tanspired during examination by the Committee that Government have given up their earlier idea of having four reactor clusters of 235 MW each in Southern, Westarn and Northern region and that now the Department of Atomic Energy propose to go in for nuclear power stations of 2000 MW in clusters in each of the four regions *viz.* South, East, North and West.

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		It was claimed that setting up of nuclear power stations in large numbers and putting them in clusters would be cheaper. The putting up of nuclear power stations in the Eastern region also has been justified on the basis that it could help to have a mix of thermal and nuclear power stations to cater to the needs of the region just in case sufficient coal is unavailable for any reason. The Committee welcome this approach.
14.	3.16	The Secretary Department of Atomic Energy observed in evidence that "power is for the whole of India. We should plan our Strategy in such a manner that one day there should one common grid for the whole country. That should be an ideal situation." The Committee would recommend that the feasibility and the advisibility of setting up an integrated power grid for the entire country may be examined in consultation with the State Governments.
15.	4.5	The three nuclear power projects *viz.* Madras Atomic Power project (Unit I & II), Narora Atomic power project (Units I & II) and Kakrapara Atomic power project (Units I & II) which are under construction at present in the country are of "natural uranium fuelled, pressurised heavy water reactor design." The Committee find that though no foreign collaboration has been entered into for these projects the import content in these projects is likely to be about 10%. According to the Department of Atomic Energy "100% indigenisation though technically achievable would not be economically viable." The Committee are not impressed by this view. The Committee feel that by importing a part of the critical equipments, howsoever small it may be in value, we would be completely dependent on the foreign suppliers for servicing and replacement and that this would amount to repeating the same mistake we did in the case of Tarapur Plant. Unfortunately, the experience in the case of Tarapur Plant has not been a happy one. The Committee would therefore, urge Government to consider seriously why even this 10% of import content should be there especially when

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		100% indiginisation is not only desirable but also achieveable.
16.	4.10.	The Committee recall that based on the limited Uranium deposits and more abundant thorium deposits in the country an integrated strategy of first using natural uranium with heavy water type reactors followed by a fast breeder reactor was visualised at the outset of India's nuclear power programme. It has been reported by the Department of Atomic Energy that India's first Fast Breeder Reactor being constructed at the Reactors Research Centre at Kalpakam is expected to be completed by 1984. However, the Fast Breeder Prototype reactor is expected to be commissioned only by the middle of 1990. The design and construction of this Prototype Reactor would entail an expenditure of Rs. 750 crores spread over 15 years. When the Committee referred to the doubts expressed in certain quarters that the Fast Breeder reactors were neither safe nor stable, the Secretary Department of Atomic Energy pointed out that such reactors have been working satisfac.orily in France and Russia and that such fears were unfounded. The Committee agree that setting up of fast breeder reactor is perhaps the only way of using our thorium deposits. The Committee stress the need to see that the programme of design and construction of Prototype fast breeder reactor is completed on schedule and there is no let up at any stage.
17.	5.13	The Nuclear Fuel Complex was set up in Hyderabad in 1972 to cater to the Fuel requirements of India's power reactor programme. The power reactor programme in India is based on the use of natural uranium as fuel and only the Tarapur Atomic Power Station uses enriched uranium. The complex comprises of two Divisions namely the Fuel Division and the Tubes Division. The main production plants of this fuel division *viz.* Natural Fuel Fabrication plant, the Zircalloy Fabfication Plant and the Enriched

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		Fuel Fabricating Plant of the Complex were commissioned during the year 1972-73. The Committee find that these 3 plants of the Fuel Division have not been working to their full capacity. During the last 3 years (1980-81 to 1982-83) the capacity utilisation at the natural Uranium Oxide Fuel Plant had been 50%, 60% and 85% respectively. In the enriched Uranium Fuel Plant, the utilisation was only 10 per cent in 1980-81, 50% in 1981-82 and 15% in 1982-83. In the Zircalloy Plant the capacity utilisation in 1980-81 was about 32%, in 1981-82 about 50% and in 1982-83 it was more than 50 per cent. The Committee were given to understand that the fuel production at the nuclear fuel complex had been regulated keeping in view the fuel needs of the different reactors and that all through ever since the commissioning of the Complex in 1972 the fuel has been available in sufficient reserves at the reactors including the Tarapur reactor.
		The Committee were assured that even at Tarapur Plant where there was set back in terms of utilisation because of non-availability of the enriched uranium from U.S., the working of that Plant was not allowed to suffer.
18.	5.14	The Committee are glad to note that the Development work on MOX (Mixed Oxide Fuel Platinum Oxide and Uranium Oxide) as alternative fuel for nuclear reactor has been carried out and the possibility of using it in the light water reactors has been established. The Committee would await the steps taken to abopt this technology in view of its obvious advantages.
19.	5.25	The Committee find that as the extrusion press of the Nuclear fuel complex, Hyderabad had spare capacity, the Tubes Division undertook manufacture of stainless steel tubes and ball-bearing tubes as a

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		commercial activity of the complex and as an import substitution venture. The Committee are concerned to note the gross under-utilisation of the capacity in the Tubes Division and consequential loss suffered. The Committee were informed that the stainless steel Tubes Plants suffered losses of 1.2 crores in 1980-81 and Rs. 2.3 crores in 1981-82. In the case of ball-bearing tubes plant the low production is tated to have resulted in losses to the extent of Rs. 6.70 lakhs and Rs. 84 lakhs respectively during this period. The representative of the Department of Atomic Energy disclosed in evidence that this commercial venture had been taken up by them at the instance of the Ministry of Industry. He was of the view that unless high import duty was imposed by Government on the import of such tubes it would not be possible for the Tubes Division to be commercially viable. The reason for the indigenous tubes being costlier is because of hight costs of billets in India which go into the production of these tubes. The Committee feel that the Nuclear Fuel Complex should not be made to suffer losses year after year on production of these tubes on the plea that they have developed the technology for such manufacture. The basic question that arises in this context is how spare capacity arose in the extrusion press of the Nuclear Fuel Complex, Hyderabad and how far it has been economically, if not financially, justified in deciding to make use of this capacity to produce stainless steel tubes and ball-bearing tubes. While the Committee would await an answer to this, they would suggest that it should be examined whether by adjustment in fiscal levies the unit could be made viable or whether the spare capacity could be used for some other productive purpose profitably.
20.	6.7	The Committee find that the Heavy Water Plants at Tuticorin and Baroda which were commissioned in July 1978 and in July 1980 with an installed capecity of 67.2 MT and 71.3 MT respectively

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		have not been working at full capacity because of technical problems. The Committee have been informed that some of these problems have already been over-come while measures have been thought of for solving the rest of the problems in a phased manner to achieve optimal production of 45 tonnes per year based on irremedial constraints. The Committee view the under-utilisation of capacities in these plants with serious concern because any shortfall between demand and indigenous production has to be made good by the import of heavy water. During the last 3 years ending 1982 the total quantity of 131 tonnes of the total CIF value of Rs. 30.79 crores had to be imported from USSR. The Committee recommend that the technical problems confronting the two heavy water Projects at Tuticorin and Baroda may be examined in depth by a Technical Committee who may be asked to suggest solutions to these problems within a specified period. The Committee are of the firm view that when the demand for heavy water to support the nuclear energy programme is picking up so fast, we cannot afford to let the existing heavy water plants languish. If, however, the constraints of these plants are really found 'irremediable' augmenting of the available capacity for production of Heavy water should be considered forthwith.

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