DEPARTMENT OF ATOMIC ENERGY

NUCLEAR POWER GENERATION - TARGETS AND ACHIEVEMENTS

TWENTY FIFTH REPORT

Presented to Lok Sabha on 7.3.2002

Laid in Rajya Sabha on 7.3.2002

LOK SABHA SECRETARIAT
NEW DELHI
December, 2001/Pausa, 1923(Saka)

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Shri Sontosh Mohan Dev - Chairman

MEMBERS

Lok Sabha

2. Shri Basudeb Acharia
3. Shri Prasanna Acharya
4. Shri Prakash Yashwant Ambedkar
5. Shri Rajbhar Babban

6. Shri Vijayendra Pal Singh Badnore
7. Shri Jagmeet Singh Brar
8. Shri Lal Muni Chaubey
9. Shri A.B.A.Ghani Khan Choudhury
10. Shri Bikash Chowdhury
11 Shri M.Durai
12. Kumari Bhavana Pundlikrao Gawali
13. Shri Sanat Kumar Mandal
14. Shri K.Muraleedharan
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16. Shri Ravindra Kumar Pandey
17. Shri Dalpat Singh Parste
18. Shri B.V. N. Reddy
19. Shri Chada Suresh Reddy
20. Shri B.Satyanarayana
21. Shri C.K.Jaffer Sharief
22. Shri Chandra Pratap Singh
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24. Shri Manoj Sinha
25. Shri Ramji Lal Suman
26. Prof. Ummareddy Venkateswarlu
27. Shri P.R.Khunte
28. Shri Girdhari Lal Bhargava
29. Shri Trilochan Kanungo
30. Shri Harpal Singh Sathi

Rajya Sabha

31. Shri Lakhiram Agarwal
32. Shri Gandhi Azad
33. Shri Santosh Bagrodia
34. Shri Brahamakumar Bhatt
35. Shri Dara Singh Chauhan
36. Shri Manohar Kant Dhyani
37. Shri Aimaduddin Ahmad Khan (Durru)
38. Shri R.P.Goenka
39.* Shri Vedprakash P.Goyal
40. Shri Rama Shanker Kaushik
41. Shri B.J.Panda
42. Shri V.V. Raghavan
43. Dr. Akhtar Hasan Rizvi
44. Shri Ramamuni Reddy Sirigireddy
45. Ven'ble Dhamma Viriyo

Secretariat

1	Shri John Joseph	-	Additional Secretary
2.	Shri P.K.Bhandari	-	Director
3.	Shri R.S.Kambo	-	Under Secretary
4.	Shri P.C. Tripathy	-	Assistant Director

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* Ceased to be Member of the Committee w.e.f 1.9.2001 consequent upon his induction in Union Cabinet.

Composition of Sub-Committee on Atomic Energy of the Standing Committee on Energy (1996-97)

1.	**Shri Jagmohan**	**-**	**Chairman**
2.	**Shri Prithviraj D. Chavan**	**-**	**Alternate Convenor**
3.	Shri Lalit Oraon		
4.	Shri G. Venkataswamy		
5.	Shri Parasram Bhardwaj		
6.	Shri A.K. Panja		
7.	Shri V. Ganesan		
8.	Shri Prem Singh Chandumajra		
9.	Shri Madhavsinh Solanki		
10.	Shri S.M. Krishna		

Composition of Sub-Committee on Atomic Energy of the Standing Committee on Energy (1997-98)

1.	**Shri Jagmohan**	**-**	**Chairman**
2.	**Shri Prithviraj D. Chavan**	**-**	**Alternate Convenor**
3.	Shri Lalit Oraon		
4.	Shri G. Venkataswamy		
5.	Shri Parasram Bhardwaj		
6.	Shri A.K. Panja		
7.	Shri V. Ganesan		
8.	Shri Prem Singh Chandumajra		
9.	Shri Madhavsinh Solanki		
10.	Shri S.M. Krishna		
11.	Shri. P. Kodanda Ramiah		

Composition of Sub-Committee on Atomic Energy of the Standing Committee on Energy (1998-1999)

1.	**Shri K. Karunakaran**	**-**	**Chairman**
2.	**Shri Bangaru Laxamn**	**-**	**Convenor**

3. Shri K.C. Kondaiah
4. Shri Rajbanshi Mahto
5. Shri Som Marandi
6. Shri Kanumuru Bapi Raju
7. Shri Anantha Venkatrami Reddy
8. Shri Nuthana Kalva Ramakrishna Reddy
9. Shri Sushil Chandra Verma
10. Shri Lakkhiram Agarwal
11. Shri Gandhi Azad
12. Shri. Sushil Barongpa
13. Shri Ramashanker Kaushik
14. Shri S.M. Krishna
15. Shri Nabam Rebia

Composition of Sub-Committee on Atomic Energy of the Standing Committee on Energy (1999-2000)

1. Shri Sontosh Mohan Dev - Chairman
2. Shri C.K. Jaffer Sharief - Convenor
3. Shri Rajbhar Babban
4. Shri Jagmeet Singh Brar
5. Shri Bikash Chowdhury
6. Shri M. Durai
7. Shri B.V. N. Reddy
8. Shri Chandra Pratap Singh
9. Shri R.P. Goenka

Composition of Sub-Committee on Atomic Energy of the Standing Committee on Energy (2001)

1. Shri Sontosh Mohan Dev - Chairman
2. Shri Vijayendra Pal Singh Badnore - Convenor
3. Shri Rajbhar Babban
4. Shri Jagmeet Singh Brar
5. Shri Bikash Chowdhury
6. Shri M. Durai
7. Shri B.V. N. Reddy
8. Shri Chandra Pratap Singh
9. Shri C.K. Jaffer Sharief
10. Shri R.P. Goenka

INTRODUCTION

I, the Chairman, Standing Committee on Energy having been authorised by the Committee (2001) to present the Report on their behalf, present this Twenty Fifth Report on the subject, " Nuclear Power Generation – Targets and Achievements". The Standing Committee on Energy (1996-97) had selected the subject "Nuclear Power Generation - Targets and Achievements" and entrusted the same to the Sub-Committee on Atomic Energy for examination and Report thereon. The Sub-Committee could not finish the task and their unfinished work was entrusted to the subsequent Sub-Committees on Atomic Energy of the Standing Committee on Energy pertaining to the years 1997-98, 1998-99, 1999-2000 and 2001.

2. The Sub-Committee on Atomic Energy of the Standing Committee on Energy (2001) took oral evidence of the representatives of the Department of Atomic Energy on 28th November, 2001.

3. The Sub-Committee on Atomic Energy of the Standing Committee on Energy (1997-98) held informal discussions with the representatives of the Department of Atomic Energy, Kaiga Atomic Power Station and Bhabha Atomic Research Centre (BARC) on the subject during their Study Tour to Mumbai and Goa during November, 1997. The Standing Committee on Energy (1999-2000) also held informal discussions with the representatives of the Nuclear Fuel Complex (NFC) and Electronics Corporation of India Limited (ECIL) during their Study Tour to Hyderabad, Cochin and Bangalore during June-July, 2000 and with the representatives of the Rajasthan Atomic Power Station and Nuclear Power Corporation of India Limited (NPCIL) during their Study Tour to Jaipur, Bhopal and Mumbai during July, 2000. Again, the Sub-Committee on Atomic Energy of the Standing Committee on Energy (2001) undertook a Study Tour to Cochin, Goa and Mumabi during November, 2001 and held informal discussions with the representatives of the Department of Atomic Energy, NPCIL and Indian Rare Earths Limited (IREL) in connection with the examination of the subject. The Committee wish to express thanks to these organisations for furnishing the requisite information as desired by the Sub-Committee/Committee.

4. The Committee wish to thank in particular the representatives of the Department of Atomic Energy who appeared before the Sub-Committee for oral evidence and placed their considered views before the Sub-Committee.

5. The Sub-Committee on Atomic Energy and the Standing Committee on Energy considered and adopted this Report at their sittings held on 18th December, 2001.

6. The Committee place on record their appreciation for the work done by the Sub-Committees on Atomic Energy of the Standing Committee on Energy pertaining to the years 1997-98 and 2001.

7. For facility of reference and convenience, the observations and recommendations of the Committee have been printed in bold letters in the body of the Report.

NEW DELHI;
December 24, 2001
Pausa 3 , 1923 (Saka)

SONTOSH MOHAN DEV,
Chairman,
Standing Committee on Energy.

CHAPTER-I

INTRODUCTORY

Assessment of the demand for electricity at the national level indicates that future, a generation capacity of about 10,000 MWe per year needs to be added during the 10^{th} and 11^{th} Five Year Plan periods to the present total capacity of about 100000 MWe. No single source of energy can cater to this huge demand for electricity in India: an optimal mix of different energy resources is required. Hydro power needs to be developed at places where such potential exists. Gas and liquid fuel have their own importance at specific locations. Non- Conventional Sources of Energy can meet the decentralised needs. Coal will continue to be the major contributor for quite some time to come. Nuclear Energy has its role at locations away from coal mines and near the load centres. Its long- term potential has to be kept in view in the context of depleting fossil resources. Being environmentally benign, it has a distinct edge over other sources of energy.

1.2 While India has limited resources of uranium, it has one of the largest resources of thorium in the world. The utilisation of these energy resources for electricity generation in the long term is envisaged through the strategy of a three-stage nuclear power programme of Pressurised Heavy Water Reactors (PHWRs) in the first stage, Fast Breeder Reactors (FBRs) in the second stage and thorium-uranium^{233} based reactors in the third stage. It is also proposed to take up a programme of addition of Light Water Reactor (LWR) units in the first stage based on imported technology with the intent to progressively indigenise it in the long term.

1.3 As a first step towards meeting the electricity demand of the country by utilisation of nuclear energy, construction of a Nuclear Power Station comprising 2 units of 210 MWe (present capacity of 160 MWe) each of Boiling Water Reactors (BWRs) using enriched uranium as fuel and light water as moderator and coolant was launched at Tarapur (Maharashtra) in 1964. These units became operational in 1969.

1.4 Thereafter, DAE commenced construction of a Nuclear Power Station comprising 2 units of 220 MWe each (presently 100 MWe and 200 MWe) capacity at Rawatbhata (Rajasthan) in 1964/1967. The PHWR technology involved the use of natural uranium as fuel and heavy water as moderator and coolant. The Rajasthan Atomic Power Station (RAPS) units –1&2 commenced commercial operation in 1973 and 1981 respectively.

1.5 Approval and project financial sanction was accorded by the Government of India for setting up of units – 1&2 of 220 MWe each (presently 170 MWe each) at Kalpakkam (Tamil Nadu) during December, 1967 and May 1971 respectively. These units at Madras Atomic Power Station (MAPS) which have nearly 90% of indigenous content, commenced commercial operation successfully in January, 1984 and March, 1986 respectively, even though a rigorous nuclear control regime was in force by developed countries after India's Peaceful Nuclear Experiment (PNE) in 1974.

1.6 With the valuable feed back of experience gained through RAPS and MAPS and also with the intention of being in line with the evolving international safety standards, a new series of PHWRs was developed indigenously involving significant upgradation in terms of design, fabrication and operation to achieve high level of plant safety and reliability. Two units each of 220 MWe of PHWRs at Narora (U.P) were accorded project financial sanction in 1974. NAPS-1&2 commenced commercial operation in January, 1991 and July, 1992 respectively.

1.7 Project financial sanction was accorded in July, 1981 for the two units, each of 220 MWe, of the standardised design at Kakrapar, Gujarat. The first pour of reactor concrete was achieved in 1984. Kakrapar units – 1&2 commenced commercial operation in May, 1993 and September, 1995 respectively.

1.8 Apart from the above 10 units, 4 units – two each at Kaiga and Rajasthan –, each of 220 MWe capacity were installed during the 9th Plan period. Kaiga 1&2 and RAPP 3&4 commenced commercial operation in the year 2000. Thus, at present there are 14

operating units of Nuclear Power Stations in the country with a combined capacity of 2720 MWe.

CHAPTER – II

NUCLEAR POWER PROGRAMME

The Nuclear Power Programme of the Department of Atomic Energy (DAE)involves setting up of Pressurised Heavy Water Reactors (PHWRs) in the first stage, Fast Breeder Reactors (FBRs) in the second and Thorium based reactors in the third stage. DAE has achieved the capabilities in the design, construction and operation of PHWRs. The design of 220 MWe PHWR has been standardised and scaled to 500 MWe capacity. The nuclear fuel cycle, supporting the Nuclear Power Programme, has been indigenised.

A. GROWTH OF NUCLEAR POWER

2.2 Total nuclear power capacity was a meagre 1840 MWe at the of end of March, 1997 with 10 units in commercial operation. The details of the plants in operation at the end of the 8th Plan were as under:

NUCLEAR POWER PLANTS IN OPERATION AT THE END OF 8TH PLAN

Unit-Location	Reactor Type	Present Capacity (MWe)	Date of Commercial Operation
1. TAPS-1, Tarapur, Maharashtra	BWR	160	28-Oct-1969
2. TAPS-2, Tarapur, Maharashtra	BWR	160	28-Oct-1969
3. RAPS-1, Rawatbhata, Rajasthan	PHWR	100	16-Dec-1973
4. RAPS-2, Rawatbhata, Rajasthan	PHWR	200	01-Apr-1981
5. MAPS-1, Kalpakkam, Tamilnadu	PHWR	170	27-Jan-1984
6. MAPS-2, Kalpakkam, Tamilnadu	PHWR	170	21-Mar-1986
7. NAPS-1, Narora, Uttar Pradesh	PHWR	220	01-Jan-1991
8. NAPS-2, Narora, Uttar Pradesh	PHWR	220	01-Jul-1992
9. KAPS-1, Kakrapar, Gujarat	PHWR	220	06-May-1993
10. KAPS-2, Kakrapar, Gujarat	PHWR	220	01-Sep-1995
Total		**1840**	

BWR: Boiling Water Reactor,
PHWR: Pressurised Heavy Water Reactor

2.3 During the 9th Plan period, a capacity addition of 880 MWe was achieved. Four units, two at Kaiga (Kaiga-1&2) and two at Rajasthan (RAPP-3&4), each of 220 MWe, commenced commercial operation during this period. The details are as under :-

9th PLAN NUCLEAR POWER CAPACITY ADDITION

Unit	Installed Capacity MWe	Commercial Operation Schedule	
		Target IX Plan	Achievement
KAIGA-2	220	October 1999	16 Mar 2000
KAIGA-1	220	April 2000	16 Nov 2000
RAPP-3	220	Jan 2000	1 June 2000
RAPP-4	220	June 2000	23 Dec 2000

2.4 Thus, it may be seen from the above that the growth of nuclear power in the country has been rather slow. The present installed capacity of Nuclear Power Stations in the country is a meagre 2720 MWe.

2.5 When asked to give reasons for tardy growth of nuclear power in the country, the Department, in a written reply, have stated that indigenous technology development phase had to be gone through. Design of plants went through evolution in line with the practices prevailing world over. Manufacturing technology, methods, tools, etc., had to be developed indigenously. Significant development efforts were necessary in the context of restrictive controls prevalent in this field at the international level on technology, supply of materials, equipments, etc. The Department have also stated that the problem of inadequate financial resources during the 8th Plan also contributed to the slow progress of the Nuclear Power Sector.

B. NUCLEAR POWER PROJECTS

2.6 As of now there are two projects under construction, one at Tarapur in Maharashtra with two units each of 500 MWe (now proposed to be revised to 540 MWe) capacity and another at Kaiga also with two units each of 220 MWe capacity. In addition, two units of 2x1000 MWe (LWRs) are in the pipeline which are proposed to be constructed with Russian co-operation at Kudankulam and their construction expected to commence towards the end of the 9th Plan period. In addition, proposal to commence construction of 2x220 MWe PHWR units at Rawatbhata (RAPP-5&6) has been initiated and is under the consideration of Government of India. This construction is also expected to commence towards the end of the 9th Plan.

2.7 Department of Atomic Energy (DAE) has drawn up a long - term perspective plan with the objective of setting up of 20,000 MWe of nuclear power capacity by the year 2020. The existing nuclear power capacity in operation in the country is 2,720 MWe. With the implementation of the proposed perspective programme, the total nuclear power capacity by the end of 10th Pan (31 March 2007) is anticipated to reach 4020 MWe (addition of 1300 MWe during 10th plan, from TAPP-3&4 - 2x540 MWe and Kaiga-3 - 220 MWe). By the end of 11th Plan (31 March 2012), the total nuclear power capacity is projected to grow to 9935 MWe (addition of 5915 MWe during 11th plan). The capacity addition details of 10th and 11th Plans are given in the Table below. Beyond 11th Plan, the specific project locations need to be firmed up.

Nuclear Power Programme - Projected Capacity Addition X &XI Plan

Scheme	**Capacity (MWe)**	**Cumulative Capacity (MWe)**
Capacity under operation (As of end IX Plan)		2720
Proposed Capacity Addition- X Plan TAPP-3&4 (2X540 MWe) – 1080 MWe Kaiga-3 (220 MWe)* - 220 MWe	1300	4020

Proposed Capacity Addition – XI Plan Kaiga-4 (220 MWe)* - 220 MWe Kudankulam –1&2 (2x1000 MWe) -2000 MWe RAPP-5&6 (2x220 MWe) - 440 MWe LWR-3 (1000 MWe) @ - 1000 MWe RAPP-7&8 (2x540 MWe) - 1080 MWe Kaiga-5&6 (2x220 MWe) - 440 MWe PFBR (500 MWe) # - 500 MWe AHWR-1 (235 MWe)# - 235 MWe	5915	9935
Total		9935

NOTE:

* Sanctioned together

@ LWR-3&4 to be sanctioned together of which U-4 planned for completion in XII plan.

Apart from the NPCIL programme, PFBR would be set up by Indira Gandhi Centre for Atomic Research (IGCAR) and AHWR will be set up by Bhabha Atomic Research Centre (BARC).

2.8 The proposed capacity addition includes Pressurised Heavy Water Reactors (PHWR), Light Water Reactors (LWRs) and Fast Breeder Reactors (FBRs). The LWR Programme would be based on imports (8 Units each of 1000 MWe included in the 20000 MWe programme) with the long-term objective of progressively indigenising the setting up of LWR units. A prototype fast breeder reactor (PFBR) is proposed to be set up initially and after commissioning this unit, it is proposed to be followed by setting up of more FBR units. In addition to the above, it is also envisaged that a 235 MWe Advanced Heavy Water Reactor (AHWR) would be set up as a technology demonstration project for utilisation of thorium for electricity generation. The activities of the associated nuclear fuel cycle facilities forming the front and back end of the cycle, such as fuel, heavy water, fuel reprocessing, waste management and recycle fuel fabrication, have also been delineated.

2.9 The indicative financial outlay required for the entire programme including nuclear fuel cycle and other activities has been worked out to be Rs 1,11,941 crore with a Budgetary support of Rs 33,507 crore from Government of India, at 2000-01 constant price level. The outlay required for implementing the Nuclear Power Corporation of India Limited (NPCIL) schemes is estimated at Rs. 83,040 crore with the Budgetary

support of Rs 16,677 crore at 2000-01 price level. The programme of setting up PHWR, LWR, FBR (excluding PFBR and AHWR) is proposed to be financed through a combination of Government budgetary support, domestic borrowings, Russian/foreign credit for LWR units and internal surplus. PFBR and AHWR are proposed to be set up based on full budgetary support. For the 20,000 MWe programme, budgetary support from Government of India is required for setting up nuclear power projects till the end of 11th Plan. Thereafter, commencing construction of 1000 MWe nuclear power project each year can be financially self supporting (apart from continuing schemes of the 20000 MWe programme) from the end of 12th Plan taking into account availability of internal surpluses from the anticipated nuclear power capacity at that time combined with borrowings.

2.10 The Department have stated that the success of the above programme will depend on the availability of the required budgetary support from the Government of India during the 10th and 11th Plan periods.

2.11 The Department have stated that they are taking the following measures to expand the Nuclear Power Programme :

(i) Plan proposals have been made in the 10th Plan to initiate construction of the projects as per the programme. A clear picture would emerge after the finalisation of 10th Plan.

(ii) Possibility of joint ventures for nuclear power projects is being explored. The Atomic Energy Act is proposed to be amended to enable such participation. The approach in this regard will have to be gradual.

(iii) Action is being taken by NPCIL towards reducing construction periods of projects. The project implementation strategy has been changed by formulating large supply-cum-erection packages to minimise interfaces for speedy completion of the project. The development in this area will be monitored. Experience of

construction of previous projects has been taken into account in planning project construction to meet shorter planned construction schedules.

(iv) Development of additional manufacturing sources is also on hand. Efforts are also being made to reduce capital costs to the extent feasible and also increase power output wherever such scope exists.

(v) Nuclear Power Stations are being operated at high capacity factors.

(vi) Efforts are being intensified for recovering current bills and arrears from State Electricity Boards (SEBs).

C. NUCLEAR POWER GENERATION IN THE WORLD

2.12 At the end of the year 2000, there were three units in operation with a net total capacity of 2167 MWe* in China. In addition, eight units with a net capacity of 6420 MWe are under construction. More units are also being planned for addition in China.

2.13 There are 2 nuclear power reactors with a total net capacity of 425 MWe in operation in Pakistan at the end of the year 2000. During the calendar year 2000, these reactors supplied 1080 Million Units, amounting to about 1.65% of the total electricity supply. KANUPP is a 125 MWe (net) Pressurised Heavy Water Reactor (PHWR) which commenced commercial operations in October 1972. CHASNUPP-1 is a 300 MWe (net) Pressurised Water Reactor (PWR) which commenced commercial operations in September 2000.

2.14 The Share of Nuclear Power, number of operating Nuclear Power Stations and the net capacity in MWe in the year 2001 in respect of some of the countries are given in the following graphic presentation: -

D. SHARE OF NUCLEAR POWER

2.15 The existing share of nuclear power in the total electricity generation in the country is less than 3 percent. By the year 2012, the total installed electric power generating capacity in the country is expected to grow to about 2,00,000 MWe. Based on the proposals being made for 10th Plan in the Nuclear Power Sector, a cumulative nuclear power capacity of about 9935 MWe is envisaged by the end of 11th Plan. This is expected to constitute about 5% of the total power capacity at that time (end of 11th plan).

2.16 In order that nuclear power grows at a faster rate to reach a share of 10%, it is essential that larger capacity nuclear power reactors are set up. It is in this context that introduction of second line of LWRs with 1000 MWe unit size as an additionality, apart from PHWRs, is important. The first 2x1000 MWe units are being set up at Kudankulam in co-operation with the Russian Federation. Based on the global political situation in regard to easing of restrictive controls in the area of nuclear power, more units are proposed to be set up in the country. Even if more LWRs do not materialise for any reason, PHWRs are proposed to be set up in their place. In addition, work is in progress for increasing the rating of PHWR units from 540 MWe to 680 MWe by allowing partial boiling in the channels. Moreover, the FBR programme will also be undertaken. With all these measures, efforts will be made to reach a nuclear share of about 7% by the year 2020.

2.17 Emphasising the importance of setting of higher capacity projects for increasing the share of nuclear power, the Secretary, DAE stated during evidence as under:-

> "We also have kept a place for the advanced light water reactor technologies imported from abroad. We have made a beginning in this direction through the initiation of two reactors at Kudankulam. These are 1000 MWe VVER type reactors which are similar to the more popular pressurised water reactors. We are also working on several other possibilities. Of course, these are in the realm of diplomacy. As you know, there are problems in the area of nuclear technology transfer. But some efforts are on. If that succeeds, we can have more such reactors brought on stream to enhance the share of nuclear power".

2.18 The Department have stated that power reactors beyond 1000 MWe unit size are not presently contemplated.

E. ON-GOING PROJECTS AND NEW STARTS

2.19 In addition to Kaiga-1&2 and RAPP-3&4, constructions of the following new PHWR units as indicated below commenced during the 9th Plan period:

IX PLAN Scheduled Construction Starts

Project	Capacity	Scheduled Start (Ground break)	Actual Start (Ground break)
TAPP-3 & 4	2 X 500 MWe *	1997-98	October 1998
KAIGA-3&4	2 X 220 MWe	1999-00	March 2001**

* Now proposed to be revised to 2x540 MWe.

** Delay in obtaining project financial sanction.

2.20 The Department have informed that TAPP- 3&4 and Kaiga –3&4 projects have registered shortfalls in achieving the financial targets as per details given below: -

(Rs in crore)

PROJECT	APPROVED OUTLAY AS PER IX PLAN FORMULATION (1997-2002)	ANTICIATED UTILISATION	SHORTFALL IN UTILISATION
TAPP -3&4	1973.15	1409.75	563.40
KAIGA- 3&4	300.00	161.06	138.94

2.21 The reasons for shortfall in achieving the financial target in respect of above projects are given below:

2.22 In case of TAPP 3&4, the project was to commence in 1997-98. However, the project commenced only in December, 1998 after obtaining approval for the revised cost estimates in December, 1997. It took time to reactivate the old orders which were kept in abeyance earlier. Also the shift in strategy to go in for large work packages resulted in additional time to restructure the packages.

2.23 In case of Kaiga 3&4, the project were to commence during the year 1999-2000 Plan but actual work commenced in May, 2001 on receipt of project financial sanction from Government in May, 2001.

2.24 Since these are major projects, it took some time to consider all aspects and getting the required clearances before the project financial sanction can be accorded.

2.25 However it is submitted that the schedule of TAPP-3&4 is being maintained as per the proposal. Also in the case of Kaiga-3&4, the schedule has been advanced.

2.26 The DAE/ NPCIL is confident that both units of Kaiga 3&4 would be completed with reduced costs and ahead of the original schedule as indicated above. The reduction in cost is due to following factors:-

(i) Prevailing rates of inflation is much lower than 8% per year that was assumed in estimates of original cost estimates.
(ii) Mega project concession.
(iii) Reduction in gestation period

2.27 The project schedule was revised on the basis of achievements in the later part of project implementation at Kaiga-1 and RAPP-4 by reduction in commissioning time and experience on pace of civil construction achieved in TAPP 3&4. There is an added advantage in Kaiga 3&4 that nuclear components such as Calandria , End shields, Steam generators etc, requiring long delivery time, are already available.

2.28 The break-up of 25 months of preponement of project completion is as follows:

7 months Preponement of start of project (First pour of concrete)

12 months	Reduction in gestation period from 72 months to 60 months
6 months	Reducing the phasing between the two units from 12 m to 6 m

2.29 Excavation work for main plant is in progress. 'Main plant civil works contract' has been awarded. Procurement activities for major supply cum erection packages are being taken. With the above progress of work, NPCIL will endeavor to achieve the revised targets.

2.30 The details about the on-going and new projects are given in the succeeding paragraphs.

Tarapur Atomic Power Project (TAPP-3&4, 2X540 MWe)

2.31 The construction of TAPP-3&4 project commenced in 1998 after approval of the revised cost estimates by the Government of India. The actual physical progress achieved up to Aug-2001 is 32% as against the target of 36%. The marginal gap is due to transition time for change in project implementation strategy for the ultimate objective of meeting the scheduled completion dates of the project. Now this project is being implemented through large size supply cum erection packages. It took some time to reformulate the work packages and qualifying vendors for large size supply- cum- erection packages, but the marginal gap in progress would be made up by a reduction in execution time in downstream activities due to elimination of inter phases of various agencies and single point responsibilities for most of the work packages.

2.32 The major packages pertaining to main plant civil works, electrical, Nuclear Piping works and others have been awarded. Pre-qualified and chosen vendors for these packages are expected to perform well in execution of these contracts. Main plant civil works are progressing in full swing. 3.05 lakhs out of estimated 4.9 lakhs cubic metres of concreting has been completed. The approved schedule for the completion (achieving criticality) of the project is October-2005/July-2006 for both the units respectively. The project is expected to be completed as scheduled. TAPP-4 & TAPP-3 are expected to

come online in 2006/07. After a thorough analysis of the plant design, the unit capacity of each of the two units is proposed to be increased to 540 MWe from 500 MWe. Thus benefit that will accrue from this project will now be 1080 MWe instead of 1000 MWe.

Kaiga Atomic Power Project (Kaiga-3&4, 2X220 MWe)

2.33 The proposal for the project financial sanction for setting up of the 2X220 PHWR units at Kaiga-3&4 was approved by Government of India in May, 2001. As part of the pre-project activities, excavation for main plant civil works commenced in March, 2001. Contract for main plant civil works has been awarded in September, 2001.

2.34 Actions for ordering main plant systems / equipment packages are in progress. The anticipated schedule for the completion (achieving criticality) of the project has been advanced from the originally approved dates of April 2008/April 2009 to Dec.2006/June 2007 for both the units respectively. One 220 MWe unit (Kaiga-3) will now come online during the last year of the 10^{th} Plan and the other unit Kaiga-4 in the first year of the 11^{th} Plan. Advancement has been possible by preponing of the start of construction of the project by 7 months and compressing the construction schedule by 9 months and reducing the time phasing between the two units from the original 12 months to 6 months. This has been possible based on the experiences gained during later part of project implementation and commissioning of Kaiga-1&2 and RAPP-3&4.

Kudankulam (KK) Project (2X1000 MWe)

2.35 An Inter Government Agreement (IGA) was signed between the Government of India and the erstwhile Soviet Union on November 20,1988. The IGA provided for the construction of 2x1000 MWe VVER type nuclear Power Station in India on a turnkey basis by the Soviet organisations. Subsequently, a "Supplement" to the IGA was signed between the Republic of India and the Russian Federation on June 21, 1998 to incorporate the revised terms for the implementation of the project on a technical co-operation basis instead of on a turnkey basis. As a first step towards the implementation

of the project, a Detailed Project Report (DPR) was to be prepared by the Russian organisation within a period of two years after signing of the Contract for the DPR.

2.36 The Russian side have submitted the first version of almost all the DPR packages. All the 35 PSAR packages, which have to be reviewed and cleared by AERB, have been submitted to AERB.

2.37 Due to extensive review procedure adopted by AERB, there has been some delay in submitting the comments to the Russian side. This has resulted in delay in finalisation of some of the PSAR packages. The finalisation of some of the DPR packages was postponed till acceptance of the techno- commercial offer (TCO) by the Indian side and agreement on the final price terms, as these packages are to contain the agreed cost parameters. These packages are now under finalisation, subsequent to the acceptance of the TCO and agreement on the final price terms in end August, 2001. It is expected that the review of all the PSAR and DPR packages shall be completed within next 2-3 months. In view of the above, Indian and Russian sides have agreed to extend the contract period till March, 2002. A letter of exchange in this regard has been signed by both sides.

2.38 The delay in finalization of some of these packages will not affect the project schedule, as all the required documentation for obtaining the clearance from AERB for excavation have already been obtained.

2.39 The broad features of DPR are:

(i) The proposed reactors (2x1000 MWe) are of VVER type (similar to Pressurised Water Reactors) and shall meet the international safety requirements and these will be subjected to clearance from our Atomic Energy Regulatory Board (AERB).
(ii) The Russian organisation shall supply the entire design of the plant for the project
(iii) They will also supply all the major equipments.

(iv) They will be responsible for supervision of construction, project implementation, commissioning and guarantee of operational performance.

2.40 In a written reply to a Parliamentary Question on 28.11.2001, it has been informed that the Government of India has accorded financial sanction for the construction of Kudankulam Atomic Power Project (unit 1&2) 2x1000. Advanced Light Water Reactors at a cost of Rs. 13,171 crore which comprises of Russian credit and Indian funding at a debt: equity ratio of 1:1 with equity in the form of Government budgetary support, considering Russian credit as debt. The scheduled date for start of construction of Kudankulam project is May, 2002. The setting up of essential infrastructure works has been taken up and the same is in progress. The Atomic Energy Regulatory Board (AERB) has given the clearance for construction of Kudankulam Atomic Power Project. The design of Kudankulam Atomic Power Project embodies appropriate, reliable and diverse safety with redundancy features incorporated. The Russian organisation will carry out the entire design of the plant and also supply material and equipments for the entire plant. The Indian side is responsible for design and development of infrastructure, construction, erection, commissioning, operation and maintenance of the plant. As per the standard practice, the full township with all necessary facilities including hospital, water supply, education, etc. are planned. These facilities will meet the requirements during construction as well as subsequently, during operation and maintenance.

Prototype Fast Breeder Reactor (PFBR, 500 MWe) and Advanced Heavy Water Reactor (AHWR)

2.41 40 MWe Fast Breeder Test reactor (FBTR) has been set up at Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam. 'FBTR' an experimental Fast Reactor has given experience in design, engineering, construction, commissioning and operation of Fast reactors. Its operation, since 1985, has enabled to take up development of fuel, structural materials etc required for fast reactor technology and sodium technology. Based on this experience, IGCAR have embarked upon design of 500 MWe Prototype Fast Breeder Reactor (PFBR). Development of Nuclear Steam Supply System (NSSS)

components of PFBR is in an advanced stage of completion. Detailed project report has been prepared and is under review. PFBR being prototype commercial scale fast reactor, no prototype is developed for PFBR. PFBR will be front-runner of FBR technology, which is successor to PHWR programme.

2.42 Apart from the activities of NPCIL, the 9th Plan proposals envisaged commencement of construction of the 500 MWe PFBR by Indira Gandhi Centre for Atomic Research towards the end of 9th Plan. Design and development of manufacturing technology of PFBR has reached an advanced stage. The preparation of the Detailed Project Report for obtaining project financial sanction is in progress. The plan is to submit the proposal during the year 2001 and obtain project financial sanction by the end of 9th Plan, to enable commencement of construction work during 9th Plan itself.

2.43 Regarding setting up of Prototype Fast Breeder Reactor, the Secretary, Department of Atomic Energy deposed as under:-

> "We are also on the threshold of taking up the Fast Breeder technology into commercial domain. For that, we will have to set up the first Proto-type Fast Breeder Reactor (PFBR) for which the design is ready. Technology development has been done. We have accumulated considerable experience in the running of the small Fast Breeder Test Reactor at Kalpakkam. But being the first of its kind, a commercial demonstration proto-type is necessary. What we are doing is that this will be constructed by the Indira Gandhi Centre for Atomic Research, an institution dedicated to Fast Breeder Reactor development, But the Nuclear Power Corporation will also join it in terms of bringing in the experience in the construction of large projects. When the reactor is completed, its operation will be taken over by the NPCIL. Subsequently, a series of Fast Breeder Reactors would be constructed by the NPCIL. So, our request is that we should take the PFBR as an important national project and hundred per cent budgetary support should come from the Government because it is a new technology that we have to implement".

2.44 Advanced Heavy Water Reactor (AHWR) is being developed in BARC to provide a focus for India for development of technology for large scale utilisation of thorium for nuclear power generation. This reactor incorporates several advanced features such as passive safety features, in tune with the requirements for next generation nuclear energy system now being internationally stipulated. Considering the resource position of nuclear fuel in India thorium based nuclear power generation is essential for

long-term energy sustainability of our country. At present this reactor is being designed, as a 9th Plan project, with the objective of preparing a detailed project report (DPR) by the end of current plan period on the basis of detailed analytical studies and experimental programme. Subsequently, a proposal for obtaining financial sanction for initiating construction of this reactor in 10th Plan period will be put up for approval of the Government of India.

F. GESTATION PERIOD OF NUCLEAR POWER PROEJCTS

2.45 The Department have stated that they have taken following steps to reduce the gestation period of Nuclear Power Projects: -

(i) Formulation of large size supply – cum - erection packages with an objective to minimise the number of interfaces, to enable speedy execution.
(ii) Parallel working to maximum extent of civil, mechanical and electrical works at site.
(iii) Upgradation of construction technology.
(iv) Round the clock working.
(v) Effective monitoring of the project.

2.46 With the above-mentioned measures, completion of work with a reduced gestation period (First pour of reactor concrete to commercial operation) of 5 years for the first unit of 220 MWe unit, with a phasing of 6 months for second unit at the same site is reasonably certain. For the 500 MWe units, it is estimated at 5 years and 6 months for the first unit with a phasing of 6 months for second unit at the same site.

2.47 Commenting on the gestation period of the recently completed and on-going Nuclear Power Projects, the Department have stated that in the last two years, four 220 MWe units were commissioned and commercial operations commenced. In spite of initial delays in these units arising out of de-lamination of the IC dome at Kaiga, during the later phase of the project implementation, significant progress was achieved in a speedy manner. Significant reduction in commissioning time in comparison to earlier reactors has been achieved. In construction of TAPP-3&4, concreting works are progressing at a faster rate as compared to the earlier projects. Manufacturers also have gained experience and are able to deliver material/ components with a reduced manufacturing time cycle.

The project is progressing as per schedule. In Kaiga-3&4, which was accorded project financial sanction in May 2001, civil works are progressing well. The strategy for project implementation has also been changed by using large size supply cum erection packages to minimise the co-ordination and interfacing problems. This has been possible due to learning, experience gained, upgradation of construction technology and effective contract management.

2.48 The Department have also stated that the commissioning time from hydro test to commercial operation has been getting progressively reduced in the Nuclear Power Projects in India. The time taken from PHT hydro test to commercial Operation for the Kakrapar Atomic Power Project (KAPP) 2, Kaiga Project – 1&2 and Rajasthan Atomic Power Project (RAPP) 3&4 is given below:

Project	No. of Days					
	Hydro test to Hot Conditioning	Hot Conditioning to Fuel loading	Fuel loading To Criticality	Criticality to Synchro-nisation	Synchro-nisation to Commercial Operation	Total (PHT hydro test to commercial Operation)
KAPP-2	214	273	131	81	155	854
Kaiga-2	194	110	72	69	105	550
RAPP-3	92	71	58	77	83	381
Kaiga-1	64	27	30	16	35	172
RAPP-4	56	35	27	14	29	161

2.49 The progressive reduction in commissioning time from hydro test to commercial operation has been possible on account of parallel working for commissioning and construction activities. The utilisation of experienced manpower from other nuclear power plants and skilled manpower from industry for completion of the remaining jobs towards the later part of the completion of projects also contributed significantly in reducing the time for completion of the activities.

2.50 The Department have further stated that the commissioning experience of Kaiga - 2 & RAPP-3 was fully absorbed and utilised in reducing the commissioning time of Kaiga-1 & RAPP-4 to a significant extent. The time taken from Hydro test to commencement of commercial operation in the case of Kaiga-1 and RAPP-4 was significantly reduced as compared to Kaiga-2 and RAPP-3. Kaiga-1 and RAPP-4 were synchronized with the grid within record times of 16 and 14 days respectively from first criticality.

In this connection, CMD, NPCIL stated during evidence as under:-

> "We have given a proposal to the Government that because of low gestation period, which we have selected, the total cost of Kaiga – 3&4 Project will be Rs. 1000 crore lesser. Earlier we wanted to make it within the sanctioned time. It was six and a half years to seven and a half years for the first and second units but now it is five and five and a half years. This is for the first time that we propose to make them in a short time. Similarly, for Rajasthan it is proposed at five and five and a half years and in fact it is three months lesser than five years for the first unit. The gestation period is very important. We are having bigger and bigger contracts. We used to have thousands of small contractors earlier and that never worked. So, now we have altogether a different management strategy for these projects".

2.51 Regarding the importance of pre-project activities in reducing the gestation period of nuclear power project, the Department have stated that NPCIL is obtaining partial financial sanctions for pre-project activities include site investigations, detailed site specific studies & design activities, setting up of infrastructure site and where necessary, advance procurement of special materials for long delivery and critical equipment. This will help in formulating the projects in a proper manner and gain lead time by which once the project sanction is accorded, implementation will be without any holds or impediments. The Department have further stated that separate provision of a Corpus Fund for the pre-project activities will help to a great extent in speedier implementation of the projects.

G. PRIVATE SECTOR PARTICIPATION

2.52 Participation of private companies in the Nuclear Power Sector has been a topic of discussion for quite some time. In this connection, the Department, in a written reply,

have stated that NPCIL is exploring the possibilities of forming joint ventures with SEBs/ PSUs/ Reputed Corporates for setting uup 220 MWe PHWRs in which, considerable expertise and operating experience have been gained. NPCIL has appointed Power Finance Corporation of India Limited as a Consultant to advise NPCIL in regard to joint ventures for 2x220 MWe units at Kaiga –3&4. There is a proposal to set up 2x220 MWe PHWRs (RAPP-5&6) at Rawatbhata, Rajasthan under the consideration of Government of India. The State Government of Rajasthan has shown interest in participating in a joint venture to implement the project. The Government of Rajasthan had responded positively to NPCIL's initiative of setting up a Joint Venture Company for RAPP-5 & 6 (2 x 220 MWe units at Rawatbhata in addition to existing RAPP 1 to 4 units). As desired by them, a project profile of RAPP- 5 & 6 has been sent to them and further discussions are underway.

2.53 The Department have also stated that amendment to the Atomic Energy Act,1962 will be necessary to enable any joint venture formation / private participation. An internal Review Committee constituted by DAE has completed the review of Atomic Energy Act, 1962 and DAE has initiated the process of making a comprehensive amendment to the Atomic Energy Act. DAE has consulted Law Ministry in the matter. The views of the Law Ministry in this regard have not yet been formally received.

2.54 Asked about the reasons for choosing Kaiga-3 & 4 project for consultancy, the Department stated, in a written reply, that Kaiga –3&4 project was chosen as a candidate for a possible Joint Venture project because NPCIL has significant experience in setting up and operating 220 MWe PHWR units. Therefore, 220 MWe units were considered as more appropriate initially for exploring possible Joint Ventures. Since Kaiga-3&4 are the 220 MWe units presently under construction, they became the natural choice. This could very well extend to 220 MWe units at RAPP-5&6 subsequently.

2.55 When asked as to what advice has been given by the PFC in regard to joint ventures for the Kaiga 3&4 project, the Department informed that PFC has given its interim report on the process of Joint Venture formation for Kaiga 3 & 4. The report has recommended, among other things, some amendments to Atomic Energy Act and the

proposed/ suggested possible structures of ownership patterns for Joint Venture Company. These suggestions/ recommendations are under review by NPCIL.

2.56 Visualising the prospects of private sector participation in the Nuclear Power Sector, the Secretary, Department of Atomic Energy stated during oral evidence as under:

> "We are also working towards attracting the participation of private sector. That, of course, would also require some amendments to Atomic Energy Act for which we are carrying out the work. But it looks to me that while we are taking a lot of efforts in sensitising the prospective investors in participating in development of atomic energy programmes, it would be only a gradual process because even in the conventional sector, participation has not come up to the expected level".

H. SELECTION OF SITES

2.57 As stated earlier, presently there are only 14 reactors operating at 6 locations viz. Tarapur, Rawatbhata, Kalpakkam, Narora, Kakrapar and Kaiga with a total capacity of 2720 MWe. This has not proved adequate for NPCIL as far as generation of internal resources is concerned. Therefore, selection of additional sites for setting up Nuclear Power Projects assumes added significance.

2.58 In this connection, the Department have stated that the Site Selection Committee (SSC) constituted by them has submitted its report on "Additional potential of existing sites for location of Nuclear Power Plants" to DAE in January 2001. This report covers the scope for setting up of additional units at existing sites where nuclear power stations are in operation / under construction. This is essentially to take advantage of the availability of land and infrastructure without any displacement of population and rehabilitation. In addition, a number of new sites are also being investigated by the SSC. The following table indicates the status of various new sites being investigated for locating Nuclear Power Plants:-

Status of New Sites for locating Nuclear Power Plant

Site	State	Electricity Region	Status
Kovvada (Dist.Srikakula	Andhra Pradesh.	Southern	Site visited. Data Collected. Evaluation in progress.

m)			
Bargi - Chutka (Dist. Mandala)	Madhya Pradesh	Western	Site visited. Data awaited from Madhya Pradesh State Electricity Board (MPSEB)
Rajapur (Dist. Shivpuri)	Madhya Pradesh	Western	Site visited. Data awaited from Madhya Pradesh State Electricity Board (MPSEB)
Jaitapur (Dist. Ratnagiri)	Maharashtra	Western	Site visited. Data awaited from Maharashtra State Electricity Board (MSEB)
Patran (Dist. Patiala)	Punjab	Northern	Site visited. Liquefaction studies are being done by Punjab State Electricity Board (PSEB). Evaluation in progress.
Kumharia (Dist. Hisar)	Haryana	Northern	Site visited. Liquefaction and Seismotectonics studies are being done. Evaluation in progress.
Mahi-Banswara (Dist. Banswara)	Rajasthan	Northern	Updated data awaited from Rajasthan Vidyut Prasaran Nigam. (RVPN)
Rundhgajapura (Dist. Dholpur)	Rajasthan	Northern	Detailed Data awaited from Rajasthan Vidyut Prasaran Nigam. (RVPN).

2.59 The Department have further informed that the Site Selection Committee has also taken up work in regard to sites in the Eastern Electricity Region. Proposals from Orissa and Bihar are awaited. West Bengal has proposed a number of sites in North and South 24 Parganas, Darjeeling and Purulia Districts. As per the preliminary screening of data, the sites in North and South 24 Parganas as well as in Darjeeling district have not been found suitable. Based on the initial study of site data of Purulia site, it has been suggested to relocate the site to avoid geological fault and mining. A visit was also made to Kolkata to explain to the State authorities the details of siting guidelines in exploration of sites for Nuclear Power Plants. The State authorities are looking for additional sites in other districts for presenting to the Committee. The data in this regard is awaited.

2.60 When asked to give reasons for delay in finalising sites, the Department stated that the site investigation process involves different agencies, where from data is requested to be collected. In addition, analysis on aspects such as seismicity requires to be done by experts. A working group associated with the SSC carries out detailed evaluation.

2.61 In view of the significant work involving a number of agencies, it is taking time to complete the report of the Committee. Based on the present status it is expected that the Site Selection Committee would complete the work progressively by June 2002.

2.62 As regards the selection of sites for the 10^{th} and 11^{th} Plan capacity addition programmes, the Department have stated that during the 10^{th} Five Year Plan 1300 MWe capacity of nuclear power is planned to be added by completion of TAPP – 3&4 (2x540 MWe) and Kaiga –3 (one 220 MWe, out of 2x220 MWe of Kaiga –3&4 under construction) units. These are cleared sites. During the 11^{th} Five Year Plan 5915 MWe capacity of nuclear power is proposed to be added subject to the availability of financial resources. For this programme existing sites at Kaiga, Rawatbhata, Kudankulam and Kalpakkam are available. Thus no constraints are foreseen in the near future, on availability of sites.

I. INDIGENISATION

2.63 The import content in setting up a PHWR nuclear power station is only about 10%. Most of the equipment / components are now indigenously manufactured. The import is restricted to proprietary components / special materials which are not available indigenously or are imported based on economic consideration. Inputs like fuel, heavy water for the PHWR programme are from infrastructure developed within DAE units.

2.64 The country is self - sufficient in the inputs of heavy water and nuclear fuel for the production of power from nuclear substances for the proposed nuclear power programme.

2.65 To achieve self reliance, DAE have established dedicated facilities in the field of special nuclear material like heavy water, fuel, zirconium alloy components and reactor control & instrumentation systems.

2.66 Manufacturing capability for different critical components and equipment of nuclear power projects has been developed over a period of time in a number of private/ public sector organisations in the country. The Indian industry has also gained significant experience. When a nuclear power programme, like 20,000 MWe by 2020, is undertaken, it would be necessary to develop additional manufacturing sources to get concurrent manufacturing capability. With experience gained so far, and the growth in engineering industry in India, it is possible to develop additional suppliers and also augment manufacturing capability of the existing suppliers. This will be progressively developed to meet the needs of the programme. However, the industry will look for continued assurance of load for utilising the special facilities. For this a committed programme is necessary.

J. ADVANCE PROCUREMENT OF EQUIPMENTS

2.67 The Department had formulated a "Nuclear Power Profile" in 1984 for reaching a capacity of 10,000 MWe by 2000 for which a number of critical and long-delivery equipments were procured by them. However, the programme could not be pursued owing to lack of adequate budgetary resources. In this connection, the Department, in a written reply, have stated that advance procurement actions for long delivery and critical equipments were taken, with due approvals from Government of India, for 10 (4x220 MWe and 6x500 MWe PHWRs) units. These actions were taken to meet the needs of the "Nuclear Power Profile" formulated in the year 1984 which envisaged setting up of 10,000 MWe of nuclear power capacity by the year 2000. However, as against the proposed outlay of Rs. 14,400 crore in the 8^{th} Plan, the approved outlay was Rs. 4,119 crore. The approved budgetary support was only Rs. 619 crore. Thus, there was a severe constraint of financial resources and the project construction as envisaged in the "Nuclear Power Profile" could not be subsequently commenced. There had been no change in the policy of the Government in the Nuclear Power Sector. The programme, as envisaged

then, could not be pursued mainly due to fund constraints and competing claims of financial resources in equally important sectors. Advance procurement of special raw material and critical equipment was essentially for reducing the gestation period of projects so that equipment delivery is not a constraint. The inventory carrying costs for advance procurement is offset against escalation in cost and exchange rate variation.

2.68 It has also been stated by the Department that 77% of the total advance procured equipment/ materials, meant for 2x 500 (being uprated to 540) MWe PHWRs at TAPP-3&4 and 2x 220 MWe PHWRs at Kaiga have been put to use in these projects which are under construction. The balance of the advance procured material/ equipment, representing about 23% of the total advance procurement, are meant for 2x220 MWe and 4x 500 MWe PHWR projects. RAPP-5&6 (2x220 MWe) is already under consideration of the Government of India for approval. 4x500 (being uprated to 540) MWe units are included for commencement of construction in the 10th Five Year Plan proposals.

2.69 The Department have further stated that the materials purchased are special raw material and critical equipment which have no shelf life restrictions. These are being stored properly for use in the projects which are expected to be taken up soon.

K. ACQUISITION OF LAND AND WELFARE MEASURES

2.70 As regards acquisition of land for the projects presently under construction, the Department, in a note, have stated that land has already been acquired in the case of Kaiga–3&4 Project at the time of setting up of Kaiga-1&2. The land acquisition at Kudankulam is also completed. In the case of TAPP-3&4 Project, land for locating the plant buildings and structures is already in possession since it was acquired as part of TAPS-1&2. In regard to establishing the exclusion zone for TAPP-3&4 Project, land to the extent of about 206 ha: is being acquired. Notification and most of the awards have been declared by the State Government. However, rehabilitation plan and compensation for land is under discussion between State Government and project affected persons (PAPs). Land required for setting up of the nuclear power plants is acquired through the concerned State Governments. They are generally co-operating in this regard. The State

Government decides the compensation for land and rehabilitation package as per its guidelines to the different projects that are being executed in the State. The land acquisition and implementation of the rehabilitation package are carried out by the respective State Governments. NPCIL only provides the funds as agreed to with the State Government.

2.71 NPCIL has a corporate policy of undertaking welfare measures in the surrounding areas of Nuclear Power Plants. As per this policy, NPCIL supports and actively participates in a variety of activities mainly in the area of education, health care, medical assistance and awareness, hygiene, repair of roads and furniture for schools, medical camps, etc. Such facilities have been extended at all power stations and project sites. Though basic responsibility of area development mainly rests with the respective State Governments, assistance is extended for community welfare activities around the Plant site. This is being done basically with the objective of integrating NPCIL activities with local population.

L. ESTABLISHMENT OF EVACUATION FACILITY AT KAIGA PROJECT

2.72 Regarding the establishment of evacuation facility at the Kaiga Project, the Department, in a note, have stated that as per MOU signed in 1991 between NPCIL & Power Grid Corporation of India Limited (PGCIL), the transmission lines for Nuclear Power Projects are to be provided by PGCIL. The transmission scheme for power evacuation from TAPP – 3&4 has been principally approved by Standing Committee of CEA for power system planning in Western Region. This would be reviewed after finalisation of exact share of beneficiary states. Letter of comfort from the beneficiary State Electricity Boards, as indicated by Ministry of Power, is being obtained by NPCIL. The transmission scheme at 400 KV for Kaiga –3&4 was finalised along with Kaiga – 1&2 units. The work for first 400 KV double circuit line has already been completed by PGCIL and is presently operating at 220 KV.

2.73 However, the work on the second 400 KV double circuit line in respect of Kaiga-1&2 has been held up for about two years for want of clearance from the Ministry of Environment and Forests (MoEF). Forest Advisory Committee of MoEF have called for

additional four alternatives. PGCIL have already carried out the alternative route survey and submitted the report to Department of Forests, Government of Karnataka. Similarly, relevant reports regarding Site Selection and Environment Impact Assessment have also been furnished by NPCIL to PGCIL for onward transmission to Department of Forests, Government of Karnataka. NPCIL and PGCIL are constantly in touch with the Department of Forests, Government of Karnataka and MoEF for expeditious clearance.

2.74 Elucidating further, the Secretary, Department of Atomic Energy stated during oral evidence as under:-

> "Right now, we have a single- double circuit line and we are looking forward to an additional line, which got delayed because of various issues of environmental clearance. As you are aware, we are working with the Power Grid Corporation, which is implementing this project very closely. We are aware that now the situation probably would come under control".

2.75 The Department have also informed that non-availability of adequate power evacuation outlet lines is creating problem in Kaiga –1& 2 Project. There have been many short shut downs in case of Kaiga which are mainly attributed to grid failures and high vibrations on TG sets. Kaiga-1 had also to take a shut down from 2.9.2001 to 22.10.2001 to attend to the ground fault problems in generator rotor, inspection of turbines and replacement of seven HP Turbine blades which are mainly attributed to grid failures. The Department have further informed that the subject matter of grid disturbances at kaiga is being actively followed up with the regional grid authorities.

M. FIXATION OF TARIFF FOR ELECTRICITY GENERATED FROM NUCLEAR POWER STATIONS

2.76 The Department, in a written reply, have stated that as per clause 22 (b) of the Atomic Energy Act, "the Central Government shall have the authority to fix rates for and regulate the supply of electricity from Atomic Power Stations either by itself or through any authority or corporation established by it or a Government company in consultation with the CEA." Further, as per clause 49 of the Electricity Regulatory Commission Act, 1998, "any provision of this Act shall not have any effect if it is inconsistent with the

provisions of Atomic Energy Act." The Department have further stated that during a meeting held in July, 2000 among NPCIL, DAE, Ministry of Power and CERC, it was decided that NPCIL would not come under the purview of CERC as far as fixation of tariff is concerned and that the present practice of fixation of tariff by DAE in consultation with the CEA would continue. Since the present procedure of fixation of tariff in consultation with CEA as per the norms notified by the Government of India has been found convenient and prompt, it is proposed to continue this procedure.

N. R&M WORK IN NUCLEAR POWER PLANTS

2.77 The Department, in a note, have stated that they undertake survey of components/equipments in Nuclear Power Stations for assessment of health and for condition monitoring. These in-service inspections are carried out during planned annual shutdowns. The critical components which determine the service life of the plant, are coolant channel assemblies in Pressurised Heavy Water Reactors. The extensive in-service inspection is carried out for these channels on completion of seven Effective Full Power Years (EFPY) of operation. The inspection is repeated based on safe assessed life of coolant channels. The renovation and modernisation of the Plant is decided based on above in-service inspections. At the end of specified number of Effective Full Power Years (EFPY) of operation, the plant operation has to be stopped.

2.78 Coolant Channels of MAPS-2 reactor are expected to be due for replacement during the year 2001-02. Presently, planning and procurement jobs have been undertaken. The replacement programme will be implemented during a long shutdown of the plant. During this period, up-gradation of the safety systems of the plant, installation of supplementary control room and modification of certain other systems to enhance the safety are proposed to be implemented. Similar exercise for MAPS-1 will also be carried out during the year 2003-06.

2.79 Earlier, R&M activities had been undertaken at RAPS-2 for en-mass Coolant Channel replacement and up-gradation of balance plant systems during the years 1996-98. An expenditure of Rs. 228.71 crore was incurred. After these renovations, the unit has

been operating at full output of 220 MWe. The plant up-gradations are required for their compliance to the requirements of safety and as such there is no change in the output.

2.80 TAPS-1&2 is the oldest power station in operation since October, 1969 and enhanced in-service-inspection programme has been instituted at these units. The plant condition is good and the units are operating at high capacity factors. To meet the current standards for station power supply, an additional 800 KW diesel generator has been provided. An improved scheme of spent resin fixation in polymer matrix is being incorporated.

O. ENCOURAGEMENT TO YOUNG SCIENTISTS

2.81 The Department, in a written reply, have stated that recruitment of graduate engineers in DAE units to man the nuclear installations, is through the Training School of the Bhabha Atomic Research Centre (BARC). In addition, different units of DAE also have their own recruitment and training programmes for diploma holders and tradesmen. After passing through a selection procedure, the trainees are given specialised training in the nuclear field and after completion of the training period, they are allocated to different units. On successful completion of training in BARC Training School, the trainees are given up to four increments while they join DAE units in the officers grade. A scheme exists to sponsor candidates for the M. Tech. Programme before they are finally selected for posts in the Department. As a result the response from talented young scientists/engineers is encouraging. Recruited manpower is put through a structured training and qualification programme before they take up positions for operations. Adequate technical manpower is in place to man the Nuclear Power Stations in operation and other installations. In regard to future Nuclear Power Plants, programme of recruitment is in place ahead of the timings of the plants going into operation. In order to improve professional knowledge and skill, large number of training programmes for different levels are conducted periodically at Station Training Centre/Nuclear Training Centre. Similar training courses are also arranged in co-operation with international organisations like WANO/IAEA, etc. The Qualification Incentive Scheme (QIS) of NPCIL recognises enhancement of skills of operating and maintenance personnel by way

of appreciation and monetary benefits. In addition, there are award schemes for good performance both as individuals and groups. The career opportunities in DAE are comparable to other contemporary organisations in the country.

2.82 The Committee note that the saga of the Indian Nuclear Programme started with setting up of 2x200 MWe Boiling Water Reactor (BWR) units at Tarapur. Now at the beginning of the 21st century, the capacity has reached 2,720 MWe in spite of Technology Control Regime. The somewhat tardy growth in the Nuclear Power Sector has also been attributed to time taken for development of indigenous technology so much so that the import contents in a PHWR Nuclear Power Station is only about 10%. Most of the equipments / components are now indigenously manufactured. The import is restricted to proprietary components/ special materials which are not available indigenously or imported based on economic consideration. Inputs like fuel, heavy water for the PHWR programme are also from the infrastructure developed within DAE units. The lack of financial resources too contributed in retarding the growth of nuclear power. The Committee find that during the 8th Plan period, it was proposed to achieve a nuclear power capacity of 10,000 MWe by the year 2000 AD. Accordingly, the outlay for the Sector was projected at Rs. 9,037 crore. Rs. 4,908 crore was proposed as budgetary support for the Plan period. However, due to resource crunch, only Rs. 761 crore was approved. For IEBR component, Rs. 15,125 crore was proposed as outlay and only Rs. 3,500 crore was approved. This resulted in shelving of the Tarapur Atomic Power Station - 3&4 and other future projects of the 8th Plan, for which advance procurement action had been initiated and substantial financial commitments made. Kudankulam Project was also not taken up owing to resource crunch. Similarly, in the 9th Plan, as against the proposed outlay of Rs. 6640.90 crore, only Rs. 5187 crore was approved. Taking into consideration that the Nuclear Power Programme in the country has matured with the capacity factor being as high as 80%, technological innovations underway and associated Indian industrial base, both under public and private sectors, to support the programme widened, the Committee desire that in order to sustain the programme, total budgetary support is a pre-requisite. The budgetary support also becomes inevitable due to limitation of NPCIL in mobilising external resources due to Technology Control Regime. The resources mobilised internally are not adequate to meet the requirement. The Committee, therefore, recommend that the Government should continue to extend adequate budgetary support for the programme. This will not only tempt DAE to achieve self–reliance but also trigger the growth in the associated engineering industry for developing additional supports and augmenting manufacturing capabilities of the existing suppliers. The Committee hope and trust that DAE will leave no stone unturned in ensuring faster growth of the Nuclear Power Sector.

2.83 The Committee note that the growth in the Nuclear Power Sector in the country has not been encouraging. Capacity addition through nuclear power began in the 1960s with the setting up of 2x210 MWe (present capacity is 2x160 MWe) plant at Tarapur. In the 1970s, there was an addition of only 220 MWe (present capacity is 100 MWe) through the Rajasthan Atomic Power Station (RAPS)-1. The eighties saw an addition of 660 MWe (present capacity is 540 MWe) through the RAPS – 2 and Madras Atomic Power Station (MAPS) – 1&2 units. There was an addition of 880 MWe through Narora Atomic Power Station (NAPS)- 1&2 and Kakrapar Atomic Power Station (KAPS)- 1&2 units in the 1990s. Recently, an addition of 880 MWe has been made through Kaiga 1&2 and RAPS –3&4 units. Thus, not a single decade has seen a capacity addition of 1000 MWe till date. The Committee feel that this trend has to be reversed by the Department through concerted efforts.

2.84 The Committee note that the present installed capacity of Nuclear Power Plants in the country is 2720 MWe which is less than 3 per cent of the total electricity generation. As per perspective plan drawn by DAE, the capacity of Nuclear Power Stations may go up to 9,935 MWe by the end of the 11th Plan i.e. 2012. The Nuclear Power Stations proposed for 10th and 11th Plans have been identified and include TAPP –3&4, Kaiga 3,4,5&6, Kudankulam – 1&2, RAPP – 5,6,7&8. The Committee further note that the Department have a programme of achieving 20,000 MWe by the year 2020. This would approximately constitute 5 per cent of the total electricity generation in the country. The Committee have further noted that the financial outlay required for the entire programme would be to the tune of Rs. 1,11,941 crore with budgetary support of Rs. 33,507 crore from the Central Government. If the plan of DAE to attain 20,000 MWe materialises, the share of nuclear power in the total electricity generation would go up to around 7 per cent at that time. Thus, there may not be any significant increase in the share of nuclear power in the years to come. In this context, the Committee would like to point out that by the end of 8th Plan, the average capacity of Atomic Power Stations ranged between 160 and 220 MWe. Similar position may prevail by the end of 9th Plan. However, as per the perspective plan drawn by DAE, we may go in for capacity up to 540 MWe (TAPP- 3&4, RAPP–7&8 and PFBR) and 1000 MWe (Kudankulam- 1&2, LWR-3) during 10th and 11th Plans. Though delayed, yet it is a healthy sign in our march towards attaining high degree of nuclear energy. But we may not be able to catch up with the countries like France, Lithuania, Belgium, Slovak Republic, Ukraine, Bulgaria, Korea, etc. who have 76,73,56,53,47,45 and 40 per cent share from nuclear energy respectively. Taking into consideration the projected generation by non-nuclear projects by the end of 2020, DAE should redouble their efforts to achieve their targeted capacity addition. The Committee, therefore, would like to recommend that the Department should also consider the uprating of existing Nuclear Power Stations as well as go in for super and more mega Atomic projects in future. This will not only result in increasing the much needed share of atomic power but also conferring mega status to Atomic Power Stations, thereby resulting in cheaper power.

2.85 The Committee note that there are 6 operating Nuclear Power Stations with 14 units in the country with a net capacity of 2503 MWe. Thus, the average net capacity comes to about 179 MWe. The average net nuclear capacity of countries like France, Lithuania, Belgium etc. is over 1000 MWe. Even countries like Brazil, China and Pakistan, whose nuclear power share in the total electricity generation is less than that of India, are having an average net nuclear capacity of 927 MWe, 722 MWe and 212 MWe respectively. The Committee, therefore, recommend that the Department of Atomic Energy should endeavour to increase the average net nuclear capacity by concentrating on higher capacity Nuclear Power Projects.

2.86 The Committee find that taking into consideration the limited resources of uranium and vast resources of thorium, the Department of Atomic Energy have embarked upon a three stage nuclear power programme in the country. In the first stage, Pressurised Heavy Water Reactors are to be built up using uranium as feed stock and heavy water as moderator and coolant. Thorium – Uranium fired Fast Breeder Reactors are proposed to be taken up in the second stage. The third and ultimate stage would use thorium fired Light Water Reactors. The Committee have also noted that the country is on the threshold of entering into the second stage and accordingly, a 40 MW FBTR has been set up at Indira Gandhi Centre for Atomic Research (IGCAR). The FBTR, an experimental Fast Reactor, has given experience in design, engineering, construction, commissioning and operation of Fast Reactors. It is also proposed to design 500 MW Prototype Fast Breeder Reactor (PFBR). Taking into consideration that PFBR will be the precursor to Fast Breeder Reactor Technology, the Committee recommend that total budgetary support should be extended for this venture. The Committee are of the view that such hi-technology be promoted and patronised and constraints of funds should not come in the way of implementation of the second and third stages of the Nuclear Power Programme. The Committee also desire that the Department should make an assessment of fuel, heavy water and other inputs needed for different stages of the Nuclear Power Programme and fine tune their plans and policies accordingly.

2.87 The Committee note that the Central Government has accorded financial sanction for the construction of the Advanced Light Water Reactor Project (2x1000 MWe) at Kudankulam. The Project has also got the clearance from the Atomic Energy Regulatory Board (AERB). The Committee have been informed that Russia has agreed to tie up with India in the construction of the project. While the Russian side will carry out the entire design of the plant besides supplying material and equipments, the Indian side will be responsible for the design and development of infrastructure, construction, erection, commissioning, operation and maintenance of the plant. The Committee feel that it is the track record of the Department that has enabled them to get co-operation from the Russian side. If the Department/NPCIL had not been on a strong footing, perhaps the Russian side would not have come forward to offer assistance. The Committee hope that the project would be completed expeditiously.

2.88 The Committee appreciate that the Government have taken a number of measures such as formulation of large size supply-cum-erection package, parallel working of civil, mechanical and electrical works, upgradation of construction technology, etc. for reducing the gestation period of Nuclear Power Projects in the country. Their efforts seem to have borne fruit considering the fact that Kaiga – 1&2 and RAPP- 3&4 Projects have been effectively completed in six and a half years instead of the earlier trend of eight years. The Committee are further pleased to note the resolve of the Department to complete the TAPP -3&4 and Kaiga – 3&4 Projects ahead of schedule and with a reduced cost as well. It will be a great achievement on the part of the Department if that can be done and would act as a model for other Ministries/Departments of the Government. It has been brought to the notice of the Committee that as a result of shortening of gestation periods of Kaiga- 3&4/RAPP- 3&4 Projects, there has been a saving of more than Rs. 1000 crore. The Committee recommend that the savings effected should be utilised for the execution of their future projects such as Kaiga - 5&6 and RAPS 5&6.

2.89. The Committee note that the Nuclear Power Corporation India Limited (NPCIL) is obtaining partial financial sanctions for pre-project activities of specific projects prior to obtaining project financial sanctions. This would no doubt go a long way in reducing the gestation period of Nuclear Power Projects to quite some extent. The Committee recommend that the Ministry of Finance / Planning Commission should consider the feasibility of setting up a separate Corpus Fund for pre- project activities relating to Nuclear Power Projects in the country.

2.90 The Committee have observed that the future plan of the Department of Atomic Energy for capacity addition reveals that new units have been proposed in the existing or under construction Atomic Power Stations, except Kudankulam. The Committee have further observed that a Site Selection Committee has been constituted which is in the process of investigating new sites. The Committee desire that the Government should expedite the process of investigation and select new sites.

2.91 The Committee are unhappy to note that adequate power evacuation outlets for evacuation of power from the Kaiga Atomic Power Station have not yet been put in place and that frequent grid failures/ disturbances have resulted in many shut downs in case of the two units of the project. Though the first 400 KV double circuit line in respect of Kaiga 1& 2 Project has been completed by the Power Grid Corporation of India Limited, the second 400 KV line has been held up for about two years for want of clearance from the Ministry of Environment and Forests (MoEF). The Department have stated that NPCIL and PGCIL are in constant touch with the Department of Forests, Government of Karnataka and MoEF for expeditious clearance. However, the Committee feel that NPCIL / PGCIL have not taken timely action in the matter. They are of the opinion that the process of establishment of evacuation outlets should have been thought of ab-initio and completed much earlier. This demonstrates lack of co-ordination and faulty planning process on the part of NPCIL and PGCIL. The Committee recommend that the Department should intensify their efforts and settle the issue without any further delay. The Committee also desire that on the lines of NTPC and PGCIL, NPCIL should enter with an Indemnification Agreement with transmission utility, whereunder utility is compensated in the event of delay in the commissioning of the projects. The Department should vigorously pursue the matter of frequent grid disturbances with regional grid authorities as unstable grid conditions would not only damage critical equipments but also adversely affect the Plant Load Factor (PLF) of the project.

2.92 The Committee note that the work relating to acquisition of land for the Kundankulam and Kaiga –3&4 Projects has already been completed, while land for establishing the exclusion zone for TAPP- 3&4 Project is yet to be acquired. The Committee have been informed that the Government of Maharashtra has already issued the Notification and declared most of the awards in connection with acquisition of land for TAPP – 3&4 exclusion zone development. They have also been informed that negotiations between the State Government and the project affected persons are on in regard to rehabilitation package and compensation for land. The Committee desire that the Department should take an active interest in the matter and impress upon the Government of Maharashtra to complete the necessary formalities expeditiously. As regards undertaking of welfare measures in the surrounding areas of Nuclear Power Plants, the Committee have been informed that NPCIL actively participates in a variety of welfare activities in the areas of education, health care, repair of roads, furniture for schools etc. and that such facilities have been extended at all the Nuclear Power Project sites in the country. The Committee appreciate this policy of the Government. The Committee find that taking into consideration that Atomic Power Stations are located in secluded, far-flung and remote areas, the welfare schemes become all the more important. The Committee recommend that the Department should make a periodic review of the welfare / community development measures undertaken by them in the various Nuclear Power Plants in the country, especially in the recently completed Kaiga Plant.

2.93 The Committee have noted that advance action was taken by DAE duly approved by the Government of India to procure long delivery and critical equipments and materials required for TAPP – 3&4 and other Atomic Power Projects. However, due to severe resource crunch during 8th Plan, whereunder as against an outlay of Rs. 14,400 crore, only Rs. 4119 crore was approved resulting in the deferment of commissioning of the units of TAPP – 3&4 to 10th Plan. The Committee are of the firm view that this injudicious action on the part of the Government cost NPCIL heavily in terms of burden on account of inventory expenditure and locking-up of scarce resources in unproductive ventures. The Committee cannot but deplore the action of the Central Government which led to time and cost overruns of Atomic Power Projects. The Committee recommend that the Government should take corrective measures and ensure that such incidents do not recur in future. The Committee would like to be apprised of the corrective measures taken in this regard.

2.94 The Committee are contented to note that NPCIL is exploring the possibilities of forming Joint Venture with State Electricity Boards/ Public Sector Undertakings / Reputed Corporates for setting up of Atomic Power Stations. The Committee have noted the proposal of the Department to set up Kaiga-3&4 (2x220 MW) and RAPP-5&6 (2x220 MW) Projects under Joint Venture, subject to amendment in the Atomic Energy Act, 1962. In this context, the Committee would like to point out that nuclear power generation is largely in private hands in the USA and U.K. The Committee welcome the efforts of DAE to invite private sector. They would like to recommend that tie-up with them should be limited to only non-strategic components of the Nuclear Power Programme. It should be left to the discretion of DAE entirely to determine as to which component of the Nuclear Power Programme are strategic in nature. The Committee also desire that DAE should take proactive role in enthusing reputed corporates / MNCs in the country and abroad for investing in the Indian Nuclear Power Programme. This will not only meet the obligation on the part of DAE to reduce the gestation period but also infuse much needed resources for the projects.

2.95 The Committee have noted that unlike Central Power Generating Stations, the tariff in Atomic Power Stations is not within the purview of the Central Electricity Regulatory Commission (CERC). In terms of clause 22 (b) of the Atomic Energy Act, the Central Government decides the tariff in consultation with the Central Electricity Authority(CEA). In this context, the Committee would like to point out that while determining the tariff of Atomic Power Stations, the Central Government/ CEA should take into consideration the factors which encourage competition, efficiency, economic use of resources, good performance, optimum investment and similar other parameters governing tariff fixation by CERC so that uniformity in tariff fixation between nuclear and non-nuclear power stations, is achieved. The Committee would like to be apprised of the action taken by the Government in this regard within 3 months of the presentation of this Report.

2.96 The Committee note that the designed life of the Nuclear Power Stations in the country is 40 years. The operating Nuclear Power Stations are subjected to monitoring for assessing the health of equipments and systems. In service inspections are also carried out regularly. Based on the results of such inspections, replacement, repair and renovation programmes are taken up as may be necessary. The Committee would like to point out that through R&M, the designed life of a power station can be increased and is the least cost option available with the Plant Authorities to increase production. RAPP-1&2 has already undergone R&M indigenously and successfully. TAPS- 1&2 is in the process of undergoing R&M. The Committee desire that taking into consideration the resource crunch in NPCIL, the Department should avail concessional finance available under the Accelerated Power Development Programme (APDP) being implemented by the Ministry of Power/ Power Finance Corporation for undertaking R&M. The Committee would like to be apprised of the outcome thereof.

2.97 The Committee have noted that to attract the best talent amongst the young scientists and engineers to the Nuclear Power Programme, up to four increments are sanctioned to the trainees who passed out from the Bhabha Atomic Research Centre (BARC) Training School. Moreover, to improve knowledge and skill, a large number of training programmes for different levels are conducted periodically in the country and abroad. It has been brought to the notice of the Committee that a large number of scientists have deserted the organisation for want of incentives, proper facilities and benefit. The Committee strongly recommend that there is an imperative need to offer suitable incentives like flexible working hours, mobility of scientists, deputation abroad for further study/research, housing, crèche facilities, etc. The Committee are of the firm opinion that human resources development should form a thrust area of any organisation. Accordingly, the Committee recommend that the Government should review the incentives/remunerations paid to young scientists and engineers lest the Nuclear Power Programme is derailed for want of adequate technically qualified manpower.

CHAPTER –III

NUCLEAR POWER CORPORATION OF INDIA LIMITED (NPCIL)

The Nuclear Power Corporation of India Limited (NPCIL), a Public Sector Undertaking (PSU) under the Department of Atomic Energy, was registered as a public limited company under the Companies Act in September, 1987 with the objective of operating the Atomic Power Stations and implementing the Atomic Power Projects for the generation of electricity in pursuance of the schemes and programmes of the Government of India under the Atomic Energy Act, 1962. The mission of the organisation is to develop nuclear technology and to produce nuclear power in safe, environmentally benign and economical manner and to provide expert assistance to the power and allied sector.

A. PHYSICAL PERFORMANCE

3.2 The operating units of Nuclear Power Corporation of India Limited (NPCIL) performed well during 9th Plan period (1997-2002) and the anticipated generation is 67,067 MUs (actual up to August 2001 + targets for balance period) which is about 29% higher than the set target of 51,854 MUs. In addition, the annual targets set during Annual Plan formulation during every year of the Plan have also been exceeded. The company registered overall annual capacity factors of 71%, 75%, 80% and 82% during the initial four years of the 9th Plan. During the current financial year up to August 2001, overall average capacity factor of the company is 80%. The year-wise performance of NPCIL is indicated below:

9th PLAN –YEARLY GENERATION TARGET Vs ACTUAL

(Million Units-MUs)

Year	IX Plan Target +Mus	Annual Plan Target MUs	Actual Generation * MUs	Capacity factor(%)
1997-98	9209	8515	9618	71
1998-99	9795	9795	11174	75
1999-00	9800	10979	12460	80
2000-01	11150	12158	16696	82
2001-02	11900	15518	17116 $	#
Total	51854	56696	67067	

* Includes generation during infirm power period in respect of Kaiga-1&2, (32MUs in 1999-00 & 48 MUs in 2000-01) RAPS-3&4. (15 MUs in 1999-00 and 145 MUs in 200-01).

$ Estimated generation for 2001-2002 includes actual up to Aug 2001 and target from Sep 2001 to March 2002.

Actual capacity factor up to August 2001 is 80%.

3.3 The details, stationwise, are given below:-

OPERATING PERFORMANCE OF NPCIL STATIONS DURING 9th PLAN PERIOD

Stations	1997-98		1998-99		1999-2000		2000-01		2001-02 Projected	
	Gen. (MUs)	C.F (%)	Gen. (MUs)	C.F (%)	Gen. (MUs)	C.F (%)	Gen. (MUs)	C.F (%)	Gen. (MUs)	C.F. (%)
TAPS	2134	76	2294	82	2155	77	2408	86	2157	77
RAPS-2	0	0	990	69	1405	80	1600	91	1329	76
MAPS	1892	64	2188	73	2232	75	2515	84	2006	67
NAPS	3450	90	2808	73	3131	81	3044	79	2943	76
KAPS	2141	56	2894	75	3396	88	3495	91	3118	81
Kaiga	-	-	-	-	128 @	4	1900 $	70	2886	75
RAPS -3&4	-	-	-	-	15 #	-	1735 *	75	2678	69
Total NPCIL	9618	71	11174	75	12460	80	16696	82	17116	##

@ Includes 32 MUs of infirm power from Kaiga-2.

Infirm Power Generation.

Achieved capacity factor in the year 2001-2002 up to end August 2001 is 80 %.

$ Includes 48 MUs of infirm power from Kaiga-1.

* Includes 114 MUs and 31 MUs infirm power from RAPS-3 & RAPS-4 respectively. RAPS-1 owned by DAE not included.

B. FINANCIAL PERFORMANCE AND BUDGETARY PROVISION.

3.4 The company has registered a good financial performance during the last few years. The profit before tax (PBT) of NPCIL during the last three years has been as under :-

(Rs. in crores)

Year	**PBT**	
1999-2000	**223.07**	
2000-2001	**1122.60**	
2001-2002	**520.00**	**(upto September, 2001)**

3.5 When asked as to whether the Department were getting long-maturity loans to sustain their Nuclear Power Projects, the Department stated, in a written reply, that NPCIL has been obtaining debt funds through issue of bonds in the capital market for execution of its projects. Normally, bonds with short or medium term maturity (3 to 7 years) have good demands in the Indian capital market. Long term bonds (10 to 15 years) have comparatively lower demands and, therefore, long term bonds have higher interest rates to be acceptable in the market thereby increasing the cost of borrowing. NPCIL, during the past, has mobilised bonds with 15 years maturity as given below:

Year	**Amount (Rs. in crore)**	**Maturity (Years)**	**Interest rate**	**Remarks**
1998-1999	125	15	10.5% Tax free	Put & call option after 7 years
1999-2000	100	15	9% Tax free	Put & call option after 7 years
2000-2001	60	15	8.25% Tax free	Put & call option after 7 years

3.6 The Department have further stated that the bonds issued by NPCIL have the highest credit rating (AAA) given by CRISIL and, therefore, NPCIL is able to mobilise debt funds through issue of bonds at competitive rates.

3.7 The Committee have been informed that NPCIL has mobilised Rs. 330 crore by issuing bonds through private placement during December, 2000. The bonds were over-subscribed 6 times and NPCIL could finalise competitive coupon rates. In addition, NPCIL has issued bonds worth Rs. 329.40 crore during March, 2001. Out of the total funds mobilised in these two issues, an amount of Rs. 145 crore has been through infrastructure bonds. NPCIL would be making more efforts to issue bonds under this category for its future resource mobilisation programme.

3.8 The Department have informed that the present operating base of NPCIL is 2720 MWe which is not sizeable to generate adequate internal surpluses to finance a large nuclear power programme. Therefore, until a nuclear power capacity of 10,000 MWe is reached, budgetary support from the Government of India is essential. The Department, visualise that the internal surplus of NPCIL would be available towards the end of the 12th plan even after meeting the repayments towards borrowings and investments towards the on-going schemes. This can be financially supplemented by proportionate borrowings and can enable NPCIL to commence construction of 1000 MWe capacity project per year without budgetary support from the Government starting towards the end of 12th Plan (apart from the on - going schemes as per the 20,000 MWe programme to be in progress at that time).

3.9 The Department have informed that presently, adequate budgetary resources are made available to the Department for undertaking its schemes on hand.

3.10 The Department, in a written reply, have stated that the 9th Plan approved outlay for NPCIL is Rs. 5187.43 crore, out of which Rs 4764.50 crore is expected to be utilised by March, 2002. The anticipated utilisation of the Government Budgetary Support is Rs

3852.14 crore, which is more than the approved Budgetary Support of Rs. 3083.93 crore for the Plan period.

3.11 The approved outlay, the budgetary support and the actual utilisation for the last four financial years in respect of NPCIL is tabulated below:

(Rs. in crores)

	OUTLAY	BUGETARY SUPPORT	UTILILISATION
1997-98	**860.00**	**448.52**	**734.42**
1998-99	**1021.91**	**776.41**	**835.54**
1999-00	**1281.00**	**854.00**	**927.52**
2000-01	**1272.00**	**749.00**	**1085.46**

3.12 It may be seen from the above tabulation that the actual expenditure has fallen short of the approved outlay in all the four years. Though the Budgetary Support provided by the Government has been utilised by NPCIL, it has registered shortfall in the utilisation of the Internal and Extra Budgetary Resources (IEBR).

3.13 The Department have assigned the following reasons for the shortfall in expenditure during these years:

(i) Delay in preparation of Detailed Project Reports and other preparatory works relating to the Kudankulam project (This has since been completed); Non utilisation of approved Russian credit due to delay in establishment of technical procedures with regard to release of payment of Russian credit through Ministry of Finance to Russian Bank (This has since been resolved).

(ii) Delay in obtaining financial sanction in respect of Kaiga-3&4 project. (This has since been obtained).

(iii) Decrease in IDC due to early redemption of high interest rate bonds with bonds bearing lower interests.

(iv) Time taken for revival of orders short closed earlier due to deferment of the TAPP-3&4 project; Non - materialisation of advance payment along with placement of order as anticipated earlier.

(v) Deferment of taking up coolant channel replacement and upgradation work of MAPS-1 unit, due to the results of In Service Inspection.

3.14 The Department have informed that they have further strengthened the internal control procedures to ensure better utilisation of allocated funds. Adequate attention is being given at appropriate levels in formulating and reviewing budgets. The present approach of larger supply-cum-erection packages would enable better progress and enhanced budget utilisation.

C. OUTSTANDING DUES FROM STATE ELECTRICITY BOARDS

3.15 NPCIL has been plagued by the problem of non-payment of arrears by the State Electricity Boards/Power Utilities for the last several years. The total outstanding amount, which was Rs. 3349 crore as on 30.9.2001, increased to Rs. 3387 crore as on 31.10.2001. The Department have informed that the non-payment of huge amounts of arrears by the various State Electricity Boards / Power Utilities to NPCIL has been affecting the liquidity position of the latter. The outstanding dues to NPCIL from various SEBs/ utilities, as on 30.9.2001, were about Rs. 3349 crore, out of which Rs. 1275 crore was on account of delayed payment charges. The SEB- wise details of the dues, as on 30.9.2001, are given in the Table below:

Outstanding dues from SEBs/ Utilities (as on 30/9/2001)

(Rs. in lakhs)

SEB	Energy	DPC*	Total
MPEB(Madhya Pradesh)	77556	58571	136127
UPPCL(Uttar Pradesh)	17898	16430	34348
J&K (Jammu & Kashmir)	22959	11079	34037
HVPNL (Haryana)	22616	12300	34917
DVB (Delhi)	10408	11304	21712
APTransco (Andhra Pradesh)	16626	6557	23183
GEB(Gujarat)	10525	3254	13779
KPTCL(Karnataka)	6331	3335	9666
TNEB(Tamil Nadu)	8206	960	9166
MSEB(Maharashtra)	1334	2234	3566
RRVPNL(Rajasthan)	7242	126	7369
PSEB(Punjab)	4332	113	4446

HPSEB(Himachal)	1193	543	1736
KSEB(Kerala)	119	651	770
Chandigarh	108	3	111
Pondicherry	0	2	2
CSEB(Chattisgarh)	0	0	0
Total	**207453**	**127461**	**334914**

*** DPC-Delayed Payment Charges**

3.16 The Department have further stated that on account of the incomplete realisation of the revenue towards the supply of power from NPCIL's stations, the outstanding dues payable by SEBs to NPCIL as on 31.10.2001 have accumulated to about Rs 3387 crore.

3.17 When asked as to how the Department propose to resolve the issue in case the outstandings continue to increase, the Department, in a written reply, stated that if the outstanding dues from the SEBs to NPCIL continue to increase, it would mean that not only the past dues are not recovered, but also even in the subsequent years, revenue will not be fully recovered. This situation will seriously affect the liquidity of the company in its business operations particularly in the activities of new capacity additions. It is noted that a few of the Electricity Boards are the main defaulters in payment of dues and NPCIL will try and divert power from the defaulting SEBs to those SEBs which are capable and willing to pay. NPCIL would also have to negotiate and settle the outstanding dues with each Electricity Board by giving certain concessions, if needed, with regard to waiver of a part of the accumulated interests. NPCIL would also try and persuade each SEB to open a Letter of Credit for the payment so that regular payment for the supply of electricity is guaranteed. NPCIL would also approach the Government of India to deduct the dues of the SEBs to NPCIL from the Central Plan devolutions to the respective states, in case the defaulted amount is significant.

3.18 The M.S.Ahluwalia Committee, which was set up to suggest, inter- alia, measures for the recovery of arrears of PSUs, has since submitted its Report. As per the recommendations of the M.S. Ahluwalia Committee, which have been by and large accepted by the Central and State Governments, principal outstandings and 40% of the delayed payment charges would be settled through issue of bonds by the respective state Governments. These bonds are redeemable at the rate of 10 % per year starting from the

6 th year from the date of issue. Therefore, within a period of 15 years from the date of issue of the bonds, the entire outstanding so far (principal and 40% of the interest) would be recovered. This in itself would be a relief. However the 60% delayed payment charges payable by the SEBs to the central PSUs are waived off. To this extent, the NPCIL would incur a loss of income, like other central PSUs.

3.19 In view of the decision of the Government of India to settle the outstanding dues of the SEBs paybale to CPSUs as per the recommendations of Mantok Singh Ahluwalia Committee, NPCIL is interacting with the SEBs / respective State Government for settlement by issue of bonds.

3.20 On being asked to suggest alternative measures to recover the arrears, the Department have informed that it has been proposed by NPCIL that the arrears, including the current year's payables, by NPCIL to the Department of Atomic Energy on account of fuel and heavy water may be adjusted against the outstanding dues payable by SEBs to NPCIL. This is proposed to be done by earmarking the bonds that would be issued by SEBs under the custody of the Department of Atomic energy so that the redemption proceeds of these bonds could be utilized for payment of these arrears to the department.

3.21 Another alternative suggested by the Department is the recovery through the appropriation of Central Plan Assistance (CPA) to States. Presently, the yearly recovery being effected through appropriation of the central plan assistance is meagre and, therefore, will take more years for complete liquidation. The recovery of dues from SEBs through CPA route from all Central PSUs together is restricted to 15 % of the value of the total Plan assistance to the States. This ceiling may be removed so as to liquidate the entire amount in three to four yearly installments.

3.22 The Committee are happy to observe that the physical performance of the Nuclear Power Corporation of India Limited (NPCIL) has been quite satisfactory during the 9th Plan period. The anticipated generation during the 9th Plan is likely to be 29 per cent higher than the target set in this regard. Besides, the annual targets set for each year of the Plan during the Annual Plan formulations have also been exceeded. Moreover, the company registered an average annual capacity factor of 77 per cent during the first 4 years of the Plan. This is no doubt a very encouraging sign for which NPCIL deserves to be congratulated. At the same time, the Committee note that the projected generation and capacity factor of almost all the operating stations during 2001-02 are less than the actual generation and capacity factor during 2000-01. The Committee would like to know reasons for the reversal of the positive trend during the terminal year of the 9th Plan.

3.23 The Committee are constrained to note that out of the approved 9th Plan outlay of Rs. 5187.43 crore in respect of NPCIL, an amount of Rs. 4764.50 crore only is expected to be utilised by March, 2002. The actual expenditure has fallen short of the approved outlay during each of the first four years of the Plan. Though the budgetary support provided to NPCIL during this period has been utilised, the company has registered shortfalls in the utilisation of the Internal and Extra Budgetary Resources (IEBR). The Committee have, on numerous occasions in the past, advised the Department to set realistic and achievable IEBR targets for its Public Sector Undertakings. They reiterate the same so that there is no setback to the Plan activities of the Department.

3.24 The Committee are, however, pleased to note that the overall financial performance of NPCIL has been very encouraging during the 9th Plan period. The company earned a profit before tax amounting to Rs. 223.07 crore, Rs. 1122.60 crore and Rs. 520.00 crore during 1999-2000, 2000-01 and 2001-02 (up to September, 2001) respectively. This speaks volumes of the efficacy of the company. The Committee are further pleased to note that NPCIL has been able to mobilise Rs. 330 crore by issuing bonds through private placement during December, 2000 and a further amount of Rs. 329.40 crore during March, 2001. More pleasing is the fact that CRISIL has given the triple 'A' rating to the bonds issued by NPCIL. This is indicative of credit worthiness and strong bottom lines of the company. The Committee hope that the amounts raised by NPCIL through issue of bonds would give a boost to the Nuclear Power Programme being undertaken by the company.

3.25 The Committee have been informed that NPCIL is presently having an operating base of 2720 MWe which is not sizeable to generate adequate internal surpluses to support its Nuclear Power Programme. The Committee have further been informed that the provision of adequate budgetary support would be essential until a nuclear power capacity of 10,000 MWe is achieved. The Department aim to reach this capacity towards the end of the 11th Plan. The Committee, therefore, recommend that adequate budgetary support be provided to the Department until the end of the 11th Plan period.

3.26 The Committee are concerned to note that NPCIL has been plagued by the problem of non-realisation of huge arrears from the various State Electricity Boards (SEBs)/Power Utilities. The total outstanding amount has accumulated to a whopping Rs. 3387 crore as on 31st October, 2001. This will not only have a deleterious impact on the liquidity position of the company but also adversely affect the upcoming power stations. The Committee recommend that NPCIL should negotiate with SEBs for settlement of such dues and persuade them to open a Letter of Credit to ensure regular payment. The company should also approach the Central Government to deduct the dues from the Central Plan devolutions to the respective States. If all such efforts fail to yield the desired results and some SEBs continue to be persistent defaulters, NPCIL may divert power from such defaulting SEBs to those SEBs who are willing and able to pay. The Committee also recommend that NPCIL should explore the possibilities and feasibility of supply of power to such bulk consumers as Railways, Municipalities, Industrial Estates, etc. who are willing to pay. This would enable better revenue realisation for NPCIL.

3.27 The Committee find that M.S. Ahluwalia Committee has suggested some measures for the recovery of arrears of PSUs. These suggestions, which have by and large been accepted by the Central and State Governments, inter-alia, provide that the principal outstandings and 40 per cent of the delayed payment charges would be settled through issue of bonds by the respective State Governments. These bonds shall have a lock-in period of 5 years and are redeemable at the rate of 10 per cent beginning with the sixth year from the date of issue. Thus, the principal amount and 40 per cent of the interest can be recovered in a period of 15 years from the date of issue of bond. The acceptance of Ahluwalia Committee Report may result in some loss to NPCIL since 60% delayed payment charges payable by SEBs would be waived off. Taking into consideration the precarious financial health of SEBs, the Committee is inclined to accept the contention of the Ahluwalia Committee and advise NPCIL to vigorously pursue with the SEBs for the expeditious issue of such bonds.

3.28 The Committee have noted the proposal of NPCIL that the arrears, including the current year's payables, by NPCIL to the Department of Atomic Energy on account of fuel and heavy water may be adjusted against the outstanding dues payable by SEBs to NPCIL. For this purpose, the bonds to be issued by SEBs have to be earmarked under the custody of the Department of Atomic Energy. The Committee feel that it is a reasonable suggestion and should, therefore, be considered for implementation.

3.29 The Committee note that the recovery of dues from SEBs through CPA route is presently restricted to 15 per cent of the value of the total Plan assistance to the States. The Department of Atomic Energy have viewed that this recovery is meagre and suggested that the ceiling of 15 per cent should be removed so that the entire outstanding amount is liquidated in three to four yearly installments. The Committee do not concur with the view of the Department as they feel that removal/increase in the ceiling of 15 per cent would tell upon the already precarious financial health of the State Governments, leading to avoidable hardships for them.

NEW DELHI;
December 24, 2001
Pausa 3, 1923 (Saka)

SONTOSH MOHAN DEV,
Chairman,
Standing Committee on Energy.