

RESEARCH REACTOR
DHRUVA

DEPARTMENT OF ATOMIC
ENERGY

HUNDRED AND SIXTY-THIRD
REPORT

LOK SABHA



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LOK SABHA SECRETARIAT
NEW DELHI

HUNDRED AND SIXTY-THIRD REPORT

PUBLIC ACCOUNTS COMMITTEE (1988-89)

(EIGHTH LOK SABHA)

RESEARCH REACTOR DHRUVA

DEPARTMENT OF ATOMIC ENERGY



Presented in Lok Sabha on 28-4-1989

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**LOK SABHA SECRETARIAT
NEW DELHI**

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and 27-4-1989.

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(1988-89)

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* Appointed as Chairman w.e.f. 5-9-1988 *vice* Shri C. Madhav Reddy resigned from Chairmanship of the Committee.

@ Appointed w.e.f. 7-12-1988 *vice* Shri Kalpnath Rai ceased to be a member of the Committee on his appointment as a Minister of State.

INTRODUCTION

1. The Chairman of Public Accounts Committee, as authorised by the Committee, do present on their behalf, this 163rd Report on Paragraph 3 of the Report of the Comptroller and Auditor General of India for the year ended 31 March, 1987—No. 7 of 1988, Union Government (Scientific Departments) regarding Reserach Reactor, Dhruva.

2. The Report of the Comptroller and Auditor General of India for the year ended 31 March, 1987—No. 7 of 1988, Union Government (Scientific Departments) was laid on the Table of the House on 25 April, 1988. The Public Accounts Committee 1988-89 examined the Audit Paragraph at their sitting held on 12 January, 1989. This Committee considered and finalised the Report at their sitting held on 27 April, 1989. Minutes of the sitting of the Committee form (Part—II)* of the Report.

3. Research Reactor, Dhruva was indigenously built and commissioned by the Bhabha Atomic Research Centre in about 13 years with an expenditure of Rs. 106.85 crores upto the end of September 1988. The Committee have observed that there were avoidable delays in various sectors during execution of the project. The Committee have expressed the view that the Department of Atomic Energy had not properly analysed the progress of work at the time of revising the date of commissioning of the Reactor in 1977 as is evident from the fact that there were substantial delays even against the revised target dates in completion of both the civil works and the manufacture of nuclear equipments for the Project.

The Committee have also observed that an amount of Rs. 27.89 crores. over and above, the total sanctioned project cost of Rs. 76.30 crores, was incurred in 1984-85 which was not covered by proper financial sanction for several years. Taking a serious view of this matter, the Committee have desired that responsibilities be fixed for irregularities committed in this regard.

4. For facility of reference and convenience, the observations and the recommendations of the Committee have been printed in thick

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

(vi)

type in the body of the Report and have also been reproduced in a consolidated form in Appendix—II to the Report.

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

6. The Committee also place on record their appreciation of the assistance rendered to them in the matter by the office of the Comptroller and Auditor General of India.

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

AMAL DATTA.
Chairman,
Public Accounts Committee.

REPORT

INTRODUCTORY

1.1 Research reactors are powerful tools in carrying out basic and applied research in a number of disciplines. These reactors are also used for producing radioisotopes which could be applied in industry, agriculture and medicine. So far six research reactors have been built at Trombay by the Department of Atomic Energy (DEA). The details of these reactors are as under:

S. No.	Name of Reactor	Power Level	Date of Commissioning	Uses
1	Apsara	1 MW	August 1956	Production of isotopes; basic research; shielding experiments.
2	Cirus*	40 MW	July 1960	Isotopes production; R&D in reactor technology; operator training.
3	Zerlina**	Negligible	January 1961	Lattice studies.
4	Purnima-I**	Negligible	May 1972	Fast reactor physics studies.
5	Purnima-II**	Negligible	May 1984	U-233 fuel studies; futuristic reactor evaluation.
6	Dhruva	100 MW	August 1985	Basic research; reactor technology; isotope production; training.

1.2 Dhruva Reactor was initially set up as R-5 project and was later christened 'Dhruva'. The decision to set up this research reactor was taken in July 1972 and the objectives were:

- (i) to provide engineering facilities to test prototype fuel elements for power reactors.
- (ii) to further the scope of research in the fields of physics, chemistry, etc., and

* Designed and built by Canada.

** Now decommissioned.

- (iii) to enlarge the isotope production facilities and also produce radio isotopes of specific activity higher than those produced with CIRUS reactor set up earlier.

1.3 Giving the justification for building another research reactor when the Department already had four reactors operating at Trombay, the Director, Bhabha Atomic Research Centre (BARC), informed the Committee during evidence that the research capability of any establishment depends upon the availability of a high flux reactor and that the Department had to take the decision of building a new research facility with a flux ten times higher than the CIRUS facility which was concurrent with the state-of-the-art at that time compared to the CIRUS reactor. The witness also stated that the atmosphere in 1972 was that there were lot of restraints put on the development of nuclear technology. The CIRUS reactor being on a bilateral agreement between India and Canada, it was mentioned that the country must have its own system designed and built indigenously if CIRUS failed to function or broke down. According to the witness, these considerations made the Department to go for Dhruva reactor.

1.4 In reply to a specific query of the Committee as to whether the Department had a precise research programme for the reactor at the time of making the proposal in 1972, the Director, BARC stated that when the decision was taken to build a new research reactor, groups were established to find out what its characteristics should be from the point of view of experiments to be conducted in various disciplines. According to the witness various objectives of the research programmes for the reactor were well discussed and it took two to three years to formulate these because each group came out with certain modifications to the system.

1.5 Research reactor Dhruva was built in about 13 years and was commissioned in August 1985 and the various aspects relating to the execution of project Dhruva and the performance of the reactor were examined by Audit. The audit observation as appearing in Paragraph 3 of the Report of the Comptroller and Auditor General of India for the year ended 31 March 1987—No. 7 of the 1988, Union Government (Scientific Department), which form the basis of this Report, are reproduced in Appendix—I.

Delay in completion of the Project

1.6 The proposal to build a 100 MW Thermal Research Reactor at the Bhabha Atomic Research Centre, Trombay was considered by the Atomic Energy Commission in July 1972. Consequently, a

note seeking approval for the project was submitted to the Cabinet in September 1972. In this original note submitted to the Cabinet, it was anticipated that the detailed project report on the proposed reactor would be ready by early 1973. It was also expected that the major civil works would be completed by the end of 1975 and that the reactor would be commissioned by the end of 1976. However, the date of commissioning of the reactor was revised to December 1981 at the time of revision of the project cost in June 1977. But even this revised date could not be adhered to and the reactor could become critical only in August 1985 leading to a time overrun of 57 per cent.

1.7 In their reply to Audit, DAE stated (February 1988) that the date of commissioning of the reactor had to be revised since the project report itself could not be sanctioned earlier. According to the information made available to the Committee, the conceptual report on the research reactor was prepared in July 1972 and it was envisaged at that time that the project report would be ready by April 1973. There was no formal revision of the target date for completion of the project report and the same was completed in May 1974 with the changes necessitated by refinements in design, plan lay-out etc. Among these, the most important change is stated to be the change in the reactor building from a cylindrical structure to a rectangular structure which was based on the feed back obtained from the utilisation experience of the CIRUS Reactor Experimental Facilities. Further, the rectangular building concept was also considered necessary for facilitating plant equipment layout and for speeding up the project from the point of view of civil works.

1.8 On being enquired about the basis for the initial expectation in the note to the Cabinet that the major civil works would be completed by the end of 1975 and the reactor commissioned by the end of 1976, DAE stated that the major reasons for fixing the target of 4 to 5 years were that the research reactor would be based on the NRU type of reactor operating in Canada and that the Department could perhaps get some help from Canadians which would have enabled the Department to complete the construction of the reactor within the proposed time frame. According to DAE, the nuclear politics changed considerably due to the Pokharan Explosion in 1974 and it became obvious that the Department would not get any further help from Canada and that the Department would also not be able to buy sub-systems and equipments from many of the developed countries.

1.9 The Committee have also been informed that after 1974, when the design of the new reactor was in progress, several changes were made in order to provide for facilities under the changed nuclear politics at that time and this took a longer time for the design and development of sub-systems for the Dhruva Reactor. When enquired as to what extent the design of the reactor was completed in 1974, DAE stated that while the conceptual design for the new reactor was finalised in 1974, detailed engineering had to be evolved by group discussions and detailed calculations which took time upto 1978 when the Department had a good understanding of what the reactor was going to look like. According to DAE, the detailed engineering design parameters for all the system were completed by 1977 and the detailed designs were completed sometimes in 1978 but it is difficult to define a date by which the final design was completed.

1.10 On being enquired as to why the Department could not visualise at the time of submitting the proposal that they would require a certain time for deciding the applications and the designs of the reactor, the Director, BARC informed the Committee during evidence that from 1974, the Department had to have their own research and development and decisions making at all levels including the one of deciding the purpose of the reactor should they incorporate all the newest facilities in the reactor. According to the witness, the Department had a limited scope for an NRU type of reactor when the proposal was submitted to the Cabinet in 1972 but due to changed political situation, the Department decided to go on their own and build a facility incorporating all that was done with CIRUS plus research capabilities in 70s and 80s.

1.11 As regards the subsequent enlargement of scope of the Dhruva Reactor, DAE stated in a note that the core geometry and reflector of the Dhruva reactor are different from those of the NRU reactor. Further, it was also decided to use indigenous materials, fabrication techniques as well as in house construction of the calandria so as to obtain full benefit of indigenous design and construction of the research reactor. New techniques like electron beam welding and very high precision manufacturing of the tube sheets holding the fuel channels are stated to have been used besides designing of a computer aided control system.

1.12 According to DAE, the work on this project started soon after the receipt of the Government approval in 1972. Preliminary work such as site preparation, establishment and manning of project office, inviting tenders for long delivery items etc. were undertaken.

The excavation for the reactor building was started in May 1974 on the basis of *ad-hoc* sanction. The sanction for Rs. 30.84 crores for setting up the project was issued on 1 July, 1975 by the Department. In 1977, the Department revised the date of commissioning of the reactor to December 1981 after taking into account the factors relating to the progress of works under 24 major areas for which revised bar charts for completing the activities by specified dates were prepared. Based on the information made available by DAE, the following table shows the initial target, revised target and the actual date of completion of some of the major activities in project Dhruva.

Sl. No.	Description of Major activity in Project Dhruva	Initial target date proposed in 1972	Revised target date envisaged in 1977	Actual date of completion
1	Reactor Building	Dec., 75	Nov., 77	April, 82
2	Service Building	Dec., 75	Aug., 78	April, 80
3	Reactor Annexe, attached Lab. and G.T. Lab.	Dec., 75	June, 79	Jan., 82
4	Calandria and Shields	June, 76	April, 81	Nov., 83
5	Ventilation and A.C. Works	Aug., 76	March, 80	July, 85
6	Commissioning	Nov., 76	Dec., 81	Aug., 85

1.13 According to audit paragraph, the major areas where delay with reference to revised target date had occurred were: completion of reactor building (53 months), service building (20 months), air-conditioning and ventilation for reactor building (61—65 months), supply of fuel assemblies (60 months), fabrication of calandria (49 months) and fabrication of shield block (55 months). The causes for delay in execution of the project beyond the scheduled dates are discussed in succeeding paragraphs under the headings 'Civil Works' and 'Nuclear Equipments/items'.

Civil Works

(A) Reactor Building:

1.14 According to the information made available to the Committee, the completion of the Reactor Building was delayed by 53 months due to the following reasons:

- (i) There was a delay of about 12 months in the formulation of tender specifications, tender documents etc. by the

consultants, issuing of the same and placing of work order.

- (ii) There was a delay of about 8 months due to mobilisation of the labour force by the contractor and putting up of the labour camp within the security zone. The onset of the monsoon also contributed to the delay.
- (iii) Since the location of the reactor is very closed to CIRUS reactor, every care had to be taken during construction and the work also called for a very high level of precision particularly the provision for embedments like PAL, VAL in perimeter wall, beam whole embedments in pile block. A delay of 12 months was attributable to this.
- (iv) The design of roof was also changed based on economic considerations to pre-stressed concrete beams.
- (v) There was a delay of about 12 months due to the intricate fabrication and stringent quality control and testing which included 100 per cent radiography testing of all welding jobs. The problem was compounded by the fact that M/s. HCC Ltd.—the Contractor had to encounter a labour strike in their Vikhroli Works.

1.15 When asked as to why was there a delay in formulation of tender specifications etc. by the Consultants. DAE replied that the detailed design parameters could not be supplied to the Consultants (M/s. Tata Consultancy Engineers) at one stretch in order to enable them to formulate the tender specifications completely. According to DAE, this being the first major project undertaken indigenously, concerted efforts by engineers and scientists of various disciplines in finalising the design parameters had to be undertaken on a consensus basis to avoid technical risks. Some hold-ups are stated to have been occurred in the course of critical examination of problems which called for decision making, improving critical design aspects, procurement of correct type of equipment from local and foreign vendors etc. with the result that these could not be finalised in advance. Thus, all the design parameters could not be supplied to the Consultants at one stretch. It has also been stated by the Department that the tenders being for a large magnitude with many conditions to be stipulated, it took time to process the tenders through the Tender Committee and to obtain final approval of the Competent Authority. The Committee have been informed that M/s. Hindustan Construction Co. Ltd. (HCC) were the contractors for construction of the Reactor Building. The stipulated date of

completion was 1-12-1977. However, nine extensions were granted to them for completing the work as per details given below:

Sr. No.	Extension	Reasons
1	upto 31-5-78	Work started late due to security clearance required for setting up the labour camp in restricted areas. More time taken for concreting of the perimeter wall, because of site conditions, and because of extra pours of concrete necessitated by the functional requirements.
2	upto 31-11-78	Change of design from ordinary RCC beam for the roof system to pre-stressed concrete beam. Non-availability of 36 mm diameter steel for reinforcement for more than one month. Roof-hold completed later, since it could be taken up only after completion of the perimeter wall. Non-availability of good quality cement for casting the second beam leading to transportation of cement from Narora.
3	upto 31-3-79	Necessity to dismantle and shift the tower crane outside the storage block, which was not envisaged earlier. More time taken for pile block structure since the mock-up studies for installation of embedments had to be carried out.
4	upto 30-6-79	Delay due to 100 per cent radiographic testing of joints. Storage Block could be commenced only in May 1978, after completion of the preceding activities.
5	upto 31-12-79	Manufacture of base plates embedded parts could not be completed by the Central Workshop BARC, in the time due to non-availability of raw material of the required quality.
6	upto 30-6-80	Strike and go-slow agitations in the Vikhroli Works of contractor.
7	upto 31-12-80	Changes in design of girder and ducting systems: Clearance could be given for ducting system only after joint inspection by various specialist groups, such as Fuel Handling Group, Pile Group, Construction Group etc., had been completed.
8	upto 30-4-82	Ion exchange embedded plates could not be supplied in time by the Central Workshop, BARC, as they had several commitments to be met for the power programmes at that time. Time taken for freezing of design and supply of drawings for the casting of heavy concrete blocks and rectangular blocks.
9	upto 30-9-82	Time taken for deciding on the location of cut outs in sub-basement, basement, etc., based on functional requirements. Additional works viz. (a) casting of heavy concrete blocks of beam hole chase blocks and cold neutron shielding tank walls and slab; (b) making internal walls out of heavy concrete blocks, and (c) removal of support steel works provided for roof beams by the contractor, not contemplated at the time of awarding the contract. Delay due to the shortage of cement.

According to DAE, these extensions had to be granted for completion of work due to the reasons beyond the control of the contractor.

(B) Spent Fuel Storage Building:

1.16 There was a delay of 24 months in the completion of the spent fuel storage building due to revised location of the emergency storage tank. According to DAE, it was originally envisaged that the CIRUS overhead water storage tank would also be used for emergency cooling for the Dhruva Reactor. However, studies indicated that this was not feasible owing to the existing pipe-size limitation and the site constraints. Accordingly, a design scheme involving the construction of an overhead water storage tank was drawn up in the project report and a decision on its exact location was taken in 1977. This entailed revision of the drawings for the building, the construction of which had not commenced at that time. The revised drawings were approved in September 1977 and the construction of spent fuel storage building was completed in April 1982.

(C) Service Building:

1.17 According to DAE, the delay of 20 months in the completion of the service building was mainly due to the presence of hard rock in the northern section in addition to the problems due to complicated nature of the job. When enquired about the specific problems of complicated nature in this case, DAE informed the Committee that the presence of hard rock required blasting and various formalities had to be complied with, for obtaining permission to carry out the blasting work. The work had to be carried out under controlled conditions due to the proximity of both the CIRUS Reactor and the reactor wall of the Dhruva Project which was already in progress. Further, the nature of the strata met with in the central area of the building was different from what had been given in the tender specifications and this necessitated the redesigning of the foundations. In the southern area, soft rock was encountered and it necessitated redesigning of the basement raft. According to DAE, these problems could not be foreseen as the presence of hard rock/soft rock was not revealed by the site conditions as per the random bore holes taken during the site investigations.

(D) Air-conditioning and Ventilation System:

1.18 It is learnt from Audit that the reactor building was not ready till April 1982 and yet the work for air-conditioning and ventilation system for the reactor building was awarded in December 1978

and March 1979 with the date of completion as June 1980 and February 1980 respectively. Ultimately, this work was completed in July 1985.

1.19 Explaining the position in this regard, DAE stated that the reactor building was in an advanced stage of construction at the time of awarding the contracts for air-conditioning and ventilation systems. The contract involved procurement of equipment for which adequate lead time was to be provided. According to the Department, the work relating to air-conditioning and ventilation was of a specialised nature involving, among other things, ducting and embedments to be done alongwith civil works. The contracts for this work were awarded keeping in view the expected date of completion of civil works which, however, got delayed due to the reasons already mentioned in this Report.

Nuclear Equipment/Items

(A) Fabrication of Calandria:

1.20 According to the information made available to the Committee, the delay of 49 months in the fabrication of calandria was mainly due to the following reasons:

- (i) Supply of stainless steel plates meant for the manufacture of calandria was tied with French Credit and there was delay from different foreign manufacturers in effecting delivery.
- (ii) The large diameter zircaloy re-entrant cans needed extensive development efforts and called for coordination with a large number of agencies including the Defence R & D.
- (iii) Slippage in delivery of various equipment by vendors and consequent delays in scheduled completion.

1.21 The calandria for Dhruva was fabricated departmentally due to high precision complex fabrication job and the main raw materials were stainless steel plates and forgings. The orders for the stainless steel plates were placed on M/s. Crensol Loire, France in December 1974. The orders for the forgings were placed on M/s. Metal Forgings, India in March 1976 and on M/s. Aubert Duval, France in June 1976 and February 1978.

1.22 In the case of receipt of stainless steel plates, there was a ~~slippage~~ of more than one and half years as may be seen from the ~~statement~~ given below:

18-6-1974 Telex and letter of intent sent to M/s. Creusot Loire.

10-7-1974 M/s. Creusot Loire intimated certain social problems at their ends and heavy bookings in their mills.
Regretted to book the order immediately that time.

15-11-1974 M/s. Creusot Loire sent their revised offer indicating willingness to book the order.

25-11-1974 DAE confirmed M/s. Creusot Loire by telex acceptance of revised offer and requested to book the order immediately. Also intimated that regular contract as required under French Credit will be issued shortly.

30-12-1974 Contract released to the supplier.

31-12-1974 M/s. Creusot Loire issued their acknowledgement for the order indicating that delivery will commence end April 1975 or May 1975 beginning.

1.23 In the case of forgings, some of the forgings supplied by M/s. Metal Forgings could not meet the stringent quality requirements and as such these had to be imported from M/s. Aubert Duval, France after a delay of one and a half years. According to DAE, there was provision for penalty clause in case of default by vendors. However, this could not be enforced since the manufacture of forgings was being attempted indigenously for the first time by M/s. Metal Forgings, India.

The zircaloy re-entrant cans were also fabricated departmentally after extensive development in cooperation with the Defence Research and Development Organisation and this also took time.

1.24 The Committee pointed out during evidence that the Department was aware of fabrication of calandria right from the beginning and desired to know the specific reasons for delay in fabrication of calandria for the Dhruva Reactor. The Secretary, DAE explained that the calandria used in Dhruva is different from the one used in atomic power projects as these are used for different purposes. According to the witness, in the case of Dhruva Calandria, the Department had extensively used electron beam techniques not used in Narora project. The new technique in case of Dhruva was used because the Department wanted to get a structure which had extremely high geometrical tolerance. According to the Secretary, the Department had to make a lot of developmental work for that

reason and it took a long time. He also informed the Committee that a large number of zirconium alloy components of different shapes and sizes were used in Dhruva calandria and it required a lot of technology to make a large number of tubes of different shapes and sizes.

(B) *Heat Exchangers:*

1.25 Audit has informed the Committee that the orders for heat exchangers were placed in September 1975 with delivery date in December 1978. However, the Department could not make the free supply of materials for fabricating heat exchangers and ended up paying a compensation of Rs. 14.10 lakhs on the original cost of Rs. 9.28 lakhs.

1.26 The Committee have been informed that the compensation was paid to M/s. Bridge & Roof who were the piping contractors. Under the contract, the heat exchangers were to be given as free issue materials to the contractor. Since the supply of heat exchangers by BHEL got delayed, the piping contractor was paid the compensation for maintaining his work force idle pending delivery of the heat exchangers for erection. According to the Department, closing this piping contract before delivery of the heat exchangers would have resulted in greater expenditure and time delay since another contractor would have to be employed later to do the erection job. However, the Department could not recover this compensation from BHEL since their delay was covered by 'force majeure' clause.

1.27 Explaining the reasons for delayed manufacturing of heat exchangers, the Secretary, DAE informed the Committee during evidence that the nuclear heat exchangers require very small diameter tubes for which holes have to be drilled in a closed lattice. In order to do this job, BHEL bought a drilling machine at great expense from the United States. This machine was put in a building which required air-conditioning. While putting up the false roof in that building some of the roof application concrete slabs fell on this machine and it took two years for the machine and about one year for the building to be rehabilitated and three years delay had occurred due to this mishap. The witness also informed the Committee that BHEL had to send the tube sheets to Japan to get these drilled and the cost involved on this count had to be compensated otherwise the work could get stuck.

1.28 When pointed out during evidence that the heat exchangers are manufactured in the country and there should not be difficulty in getting the supply of this item, the Secretary, DAE stated that the manufacture of the heavy water heat exchangers was not simple for a number of reasons. Firstly, the holes are extremely closely packed and the two holes would intersect if the drilling is not done correctly. According to the witness, there were low accuracy machines in the country and it had been a problem to get the heavy water heat exchangers due to certain limitations. Secondly, the Department had to take a lot of precautions for vibrational control which is not normally provided in other heat exchangers.

1.29 The Committee note that the Department of Atomic Energy, in their note submitted to the Cabinet in 1972 for seeking approval for setting up of a 100 MW Thermal Research Reactor at Trombay, had expected the proposed reactor to be commissioned by the end of 1976 on the premise that the project report would be ready by early 1973. The Committee however, find that the project report could be completed only in May 1974 with changes stated to have been necessitated by refinements, plan lay-out etc. on the basis of the feed back obtained from the utilisation experience of CIRUS reactor. Considering the fact that the Department had been operating the CIRUS reactor since 1960 and thus had utilisation experience available instantly, the Committee feel convinced that the Department did not make serious and time bound efforts from the initial stages itself in meeting the time schedules envisaged in the original note furnished to the Cabinet. The Committee find no justification for this delay of more than a year in preparing the project report.

1.30 The Committee further note that while the conceptual design for the new reactor was finalised in 1974, the detailed design parameters were completed only in 1978. The Committee have been informed that the design and development of the sub-systems for the reactor took a longer time as several changes were made in order to provide for facilities under the changed nuclear situation after Pokhran Explosion in 1974 when it was realised that the Department would not be able to buy sub-systems and equipments from many of the developed countries. It has also been stated that the Department had a limited scope for an NRU type of reactor when the proposal was submitted to the Cabinet in 1972 but the Department, under the changed nuclear situation, decided to go on their own for building a facility incorporating latest research capabilities. The Committee however, feel that the Department did not bestow

proper care and attention on planning the project even in 1977 when the dates of completion of various activities for commissioning the reactor by December 1981 were revised. It is obvious that the Department did not properly analyse the progress of work at the time of revising the date of commissioning of the reactor in 1977 as is borne out by the fact that there were substantial delays even against the revised target dates in completion of both the civil works and the manufacture of nuclear equipments for the project.

1.31 Among the important reasons which were advanced for the delay in completion of the civil works, are delay in formulation of tender specifications and issuing of the same; changes in design and increase in scope of work during construction, inadequate sub-soil investigations; and complexity of the nature of the job to be executed.

1.32 As regards delay in tender formulation etc., the Committee have been informed that the detailed design parameters could not be supplied to the consultants at a time to enable them to formulate tender specifications completely as the design parameters had to be finalised by the engineers and Scientists of various disciplines and some hold-ups had occurred in the course of critical examination of problems which could not be finalised in advance. Yet another reason advanced by the Department for delay on this count is that the tenders were for a large magnitude with many conditions to be stipulated therein and it took time to process the tenders and obtain final approval of the competent authority. The Committee are not convinced by the reasons advanced to explain delay in completing the stage prior to commencing and during execution. On the other hand, the Committee feel convinced that the work on this project was undertaken in a casual manner and the project languished for want of coordination among various project authorities involved in its execution.

1.33 The Committee note that the completion of reactor building was delayed mainly due to the changes in the design of the roof and of girder and ducting systems and also because of the time taken for deciding on the location of the cut outs in basements etc. Similarly, the spent fuel storage building was delayed because the location of the emergency storage tank had to be revised on the basis of subsequent studies. The Committee feel convinced that the subsequent changes in the design as also the increase in scope of work during execution of the project highlight another facet of poor planning on the part of project authorities. It is clear that

design parameters were not adequately taken care of at the pre-construction stage with the result that the project schedule was thrown out of gear. At this stage, the Committee can only hope that Department of Atomic Energy would draw procedures for working out the details of the projects, to be taken in hand, well in advance by ensuring proper coordination among the project authorities so as to obviate delay in the execution of the projects due to in-house failures.

1.34 The Committee are distressed to note the substantial delay in completion of the service building mainly due to the presence of hard/soft rock at the site which was not revealed by the random bore holes taken during the site investigations. Considering the fact that foundation soil problems were also encountered during the execution of Madras Atomic Power Project, the Committee are of the view that the geological investigations carried out by the Department of Atomic Energy appear to be inadequate. They believe that the Department should pay serious attention towards this aspect and would also ensure in future that adequate geological investigations of the project sites are made at the pre construction stages.

1.35 The Committee note that the calandria for Dhruva reactor was fabricated departmentally. However, the fabrication of calandria was delayed by 49 months mainly due to slippages in delivery of various equipments by vendors and development efforts required for fabricating zircaloy re-entrant cans. The Committee understand that while certain amount of development work becomes inevitable in manufacture of certain items, the Department must draw up a realistic time bound package for such activities having due regard to the existing technological competence so that the project schedules may not go awry subsequently.

1.36 It is regrettable that the manufacture of heat exchangers for project Dhruva was substantially delayed due to the dislocation of machinery at BHEL—the manufacturer and the Department had to pay a compensation of Rs. 14.10 lakhs to the piping contractor for maintaining his work force idle. The Committee are surprised that the Department could not recover this compensation from BHEL since their delay was covered by 'force majeure' clause. The Committee do not find adequate justification in the plea of the Department that the closing of the piping contract before delivery of the heat exchangers would have resulted in greater expenditure and time delay since another contractor had to be employed later to do

the erection job. They regret that the Department did not take adequate care to safeguard interests of the Government at the time of entering into contract with the piping contractor.

Capital outlay of the Project

(a) *Cost estimates and escalations*

1.37 The preliminary estimates prepared by DAE in 1972 showed an estimated project cost of Rs. 30.84 crores with a foreign exchange component of Rs. 4.79 crores. The project data was updated in May 1974 and the revised cost was calculated as Rs. 49.88 crores. In June 1977, the project cost was revised to Rs. 76.30 crores with a foreign exchange component of Rs. 9.07 crores. This was approved by Government in 1978. However, the Department had incurred an expenditure of Rs. 106.79 crores by March 1988 and the revised sanction for Rs. 107.88 crores was accorded only in May 1988. The aspect of excess expenditure over sanctioned cost of the project has been dealt with elsewhere in this Report.

1.38 A comparative statement showing item-wise expenditure on the project *vis-a-vis* the project cost estimated in 1974 and the revised cost of June 1977 alongwith the reasons for variation is given below:

(Rs. in lakhs)

Item-wise	Estimated in 1974	Estimated in 1977	Actual Exp. upto Sept. 88	Remarks
1	2	3	4	5
1. Salaries	163.47	220.00	297.88	Increases due to extension of the Project period
2. Travel Expense	14.80	17.60	12.59	Increase in air fare and railfare
3. Office Expenses	7.87	30.00	25.97	Office Expenses such as telephone, telex, stationery etc. had not been provided for in the original estimates
4. Payment for Prof. & Spl. services	50.00	50.00	57.34	No variations

1	2	3	4	5
5. Major Works	993·91	1518·28	1652·81	Many Structures required to be designed as nuclear structure, due to change in the code requirement. Further, there was considerable escalation in the cost of material & labour compared to 1973 prices. Additional requirements in certain areas.
6. Machinery and Equipment	1794·37	2597·52	4045·22	Considerable escalation in cost of imported materials like SS plates, Valves, pipes, tubes, fittings etc. Increase in installation costs due to higher labour rates. Additional requirements in certain areas.
7. Materials and Supplies	683·46	1959·09	4580·97	Increase in cost of Uranium metals aluminium, stainless steel etc. Increase in cost of Heavy water from Rs. 600 per Kg. to Rs. 1920 per Kg.
8. Motor Vehicles	16·25	18·50	8·34	Increase in cost of fuel.
9. Other Charges—				
(a) Custom duty	332·76	577·43	..	
(b) Contingency	372·42	320·56	..	
(c) Price escalation	558·63	320·56	..	
	4987·94	7629·62	10681·12	

1.39 It would be seen from the above table that the project estimates of 1974 were substantially increased in 1977 under the heads 'Office Expenses', 'Major Works', 'Machinery and Equipment' and 'Materials and Supplies'. The estimates under 'Office Expenses' had to be increased because provision for expenses such as telephones, stationery etc. had not been provided for in the original estimates. In the case of provisions under 'Major Works' and 'Machinery and

Equipments', the increase is stated to be on account of cost escalations besides additional requirements in certain areas.

1.40 In reply to a question as to why office expenses such as telephones, stationery etc. were not provided for in the original estimates, DAE stated that the project being under construction within BARC, it was initially envisaged that the existing facilities could be utilised. However when the existing facilities were not found to be adequate for the project needs, separate provisions had to be made in the subsequent estimates.

1.41 As regards the additional requirements under 'Major Works' and 'Machinery and Equipments', DAE have furnished the following statement on the additional items, their cost and the reasons thereof under the two heads separately:

Additional Requirements under Major Works		(Rs. in lakhs)	
S.No.	Item	Cost	Main reasons
1	2	3	4
1	Reactor Building	41.32	(a) Shape of building revised (b) Floor height increased (c) Service Trench added
2	Reactor Annexe. Control Room and Attached Lab.	65.90	(a) Change in code & hence design as nuclear structure (b) Increase in floor area
3	Service Building	59.70	(a) Basement added (b) Floor area increased
4	Spent Fuel Storage Building	49.77	Revision in concrete design
5	Filter House & Stack	28.38	(a) Revision in concrete design (b) Increase in floor area
6	Waste Storage Tanks	10.00	New requirement
7	Guide Tube Lab.	5.00	New requirement
8	Dump Tank	10.33	Change in design
9	Overhead Storage Tank	8.00	Change in design
10	Roads	11.99	New requirement
11	Electrical Power systems	218.82	(a) Safety considerations (b) Increase in cost of raw materials

1	2	3	4
12	A/c. & Ventilation	137.68	(a) Change in design (b) Increase in cost of raw-materials (c) New systems like, fire detection, LP gas etc.
Total Major Works		646.89	

Additional Requirements under Machinery & Equipment (M&E)

(In lakhs of Rs.)

S.No.	Item	Cost	Main Reasons
1	EB Welding Machine	52.00	Had to be imported
2	LOCA Addl. equipment	71.50	Safety requirement
3	Pumps & Valves	120.99	Safety requirement
4	Commissioning Equipment	22.00	Existing BARC Equipment could not be utilised as envisaged earlier
5	Spare Guide Tubes	12.00	New requirement
6	Failed Fuel Detectors	12.00	Design augmentation employing neutron detectors (i ^y -n ⁿ -s) in addition to gamma detector _s
Total M&E		290.49	

1.42 According to DAE, the following were the reasons why additional new requirements could not be visualised earlier:

- (a) The detailed design engineering and the construction were being done in parallel.
- (b) The safety philosophy in nuclear industry had become more stringent in the 1970's and this led to additional requirements.
- (c) After the peaceful nuclear experiment in May, 1974 many Western countries imposed a ban on export of equipment to the Indian Nuclear Programme, necessitating procurement of such equipment from elsewhere. Indigenous development had to be done for a large number of items. Incorporation of changes in design led to additional requirements.

1.43 According to the information made available to the Committee, the cost details for major works and machinery and equipments for Dhruva reactor are as under:

(Rs. in lakhs)			
Item	1974 estimates	1977 estimates	Final sanctioned cost 1988
Major works	993.91	1518.28	1640.80
Machinery & Equipment	1794.37	2597.52	3997.22
Special Materials and Others	2199.66	3513.82	5150.48
Total	4987.94	7629.62	10788.50

1.44 The cause-wise break-up of cost increase in 'Major Works' and 'Machinery and Equipment' is furnished below:—

(In lakhs of Rupees)		
Item	Major Works	Machinery & Equipment
Additional requirements	464.86	290.49
Cost escalation between 1974 and 1977	10.03	682.16
Cost escalation between 1977 and 1988	44.40	547.38
Other reasons	42.62	154.00
Customs Duty	250.00
Miscellaneous items	84.98	278.82
Total	646.89	2202.85

1.45 It is also learnt from Audit that the provision for heavy water in the estimates prepared in 1977 was Rs. 17.28 crores but an expenditure of Rs. 44.10 crores was debited for heavy water by March 1987.

Explaining the reasons for substantial increase in the expenditure of heavy water, DAE stated that there was an abnormal increase in the cost of the material at the time of its delivery as against the prices which were prevalent at the time of preparation of the estimates in 1977.

(b) *Financial impropriety*

1.46 It is seen from the information made available to the Committee that the Department had incurred an expenditure of Rs. 106.79 crores by the end of March 1988 as against the sanctioned project cost of Rs. 76.30 crores approved by the Government in April 1978. According to DAE, the expenditure beyond the sanctioned cost of Rs. 76.30 crores was incurred pending regularisation by issue of revised sanction since Dhruva was an on-going project in an advanced state of completion. The Department also stated that the proposal for revision of the sanctioned cost of the project was under consideration from 1985 onwards and the revised sanction for Rs. 107.88 crores was accorded in May 1988 after examination of various aspects.

1.47 When asked about the reasons for incurring excess expenditure without proper sanction, the Director, BARC informed the Committee during evidence that Rs. 44 crores were spent on heavy water out of the total expenditure of Rs. 107 crores. According to the witness, if the expenditure on heavy water is taken out, the remaining expenditure would come to about Rs. 60 and odd crores as against the sanction of about Rs. 59 crores in 1978 and the excess, therefore, worked out to 6 per cent only.

1.48 When enquired whether the Department had not considered the cost of heavy water for capitalisation, the Director, BARC stated that the cost of heavy water of the order of Rs. 17 crores was included but it went up to Rs. 44 crores when the debit came in 1984 and the Department had to get the sanction for that.

1.49 In a subsequent note on the excess expenditure incurred beyond sanctioned amount on project Dhruva, it has been stated by DAE that the heavy water inventory for all the units of DAE is being managed centrally by the Department. At one time, it was expected that heavy water would be leased to Dhruva. However, in 1984-85, it was decided not to go in for leasing and a book debit of Rs. 44 crores towards the cost of heavy water was raised against project Dhruva. This was based on the cost which had been fixed at that time for the supplies of heavy water made to the reactors. According to DAE, the project cost had gone up to Rs. 103.89 crores in view of the increased cost of heavy water alone.

1.50 On being pointed out that the Department in their earlier written replies, had stated that it was an on-going project and as such the Department could spend beyond the sanctioned amount, the Director, BARC stated during evidence that there was a convention according to which they could incur excess expenditure upto 10 per cent or Rs. one crore.

1.51 A statement showing the progressive expenditure against the sanctioned cost of project Dhruva is given below:

(Rs. in crores)

Financial position to end of	Sanctioned cost	Progressive Expenditure
1979-80	76.30	32.86
1980-81	76.30	38.99
1981-82	76.30	44.42
1982-83	76.30	50.71
1983-84	76.30	56.85
1984-85	76.30	104.19*
1985-86	76.30	106.13
1986-87	76.30	106.58
1987-88	76.30	105.79
1988-89	107.89	106.82

(upto Nov., 1988)

*Due to debit for Heavy Water raised against the project.

It may be seen from the above table that in addition to the debit for heavy water raised in 1984-85 excess expenditure had also been incurred in the years 1985-86, 1986-87 and 1987-88.

1.52 According to DAE, the expenditure incurred in the years 1985-86 to 1987-88 was on inevitable payments on items which were essential for bringing the project to a stage of fruition.

1.53 A comparative statement showing the original and revised financial allocations made in each of the financial years since incep-

of Project Dhruva to date as against the actual expenditure incurred in the corresponding years is given below:

S.No	Financial Year	(In Lakhs of Rupees)		
		B.E.	R.E.	Actuals
1	1972-73	10	15	4
2	1973-74	58	45	41
3	1974-75	228	190	224
4	1975-76	400	546	479
5	1976-77	700	632	598
6	1977-78	738	600	440
7	1978-79	674	673	750
8	1979-80	850	740	750
9	1980-81	839	650	613
10	1981-82	675	570	543
11	1982-83	600	600	629
12	1983-84	500	548	614
13	1984-85	4621	4635	4734
14	1985-86	270	237	194*
15	1986-87	120	101	45*
16	1987-88	6	52	21*
17	1988-89	42	22	—

*NOTE: The expenditure is less than BE/RE due to non-materialisation of purchase order.

It would be seen from this statement that the expenditure during the financial years 1973-79 and 1982-83 to 1984-85 had exceeded the corresponding budget and revised estimates.

(C) Accounting aspects

(i) Cost of heavy water

1.54 The details of heavy water received for project Dhruva in different years are as under:

Year	Quantity (Kgs)
1984-85	71,417.874
1985-86	Nil
1986-87	10,008.501
1987-88	8,509,625
	89,936.020 Kg.

1.55 However, the debit to the project on account of expenditure on heavy water was made for the entire quantity in 1984-85 when the first supply was affected. According to DAE, the receipt of heavy water for Dhruva have been about 90 tonnes and the cost of heavy water, therefore, works out to Rs. 4900/- per kg.

1.56 According to DAE, the heavy water inventory required for the power reactors is built up by the Department over a period of time and is not acquired initially for any particular project. When Dhruva became ready for being charged with heavy water, 71.42 MT of heavy water was issued during the year 1984-85 from the Departmental Pool. As the estimated requirement for Dhruva was 90 MT, the debit for that quantity was charged to the project and the balance quantity was issued to the reactor in the subsequent years.

1.57 It is, however, seen from the information available with the Committee that the cost of heavy water taken into account for the purposes of calculation of tariff for the power supplied from Madras Atomic Power Station was Rs. 4200/- per kg. for the year 1984-85 and the same was Rs. 4291.69 per kg. for the year 1986-87 (as intimated by Commercial Manager, Nuclear Power Board).

(ii) *Transfer of Machinery and Equipments*

1.58 It is learnt from Audit that credit for Rs. 85.97 lakhs on account of machinery and equipments purchased initially for project Dhruva and subsequently transferred to other Divisions has not been afforded to the project cost pending closure of the accounts.

1.59 According to DAE, no credit for Rs. 85.97 lakhs has so far been raised in the project cost for these item and necessary adjustments will be made at the time of closing the accounts which are expected to be completed by March 1990. DAE also stated that this was not done earlier due to the following reasons:

- (a) The common practice has been to make all the adjustments at the time of closure of the project accounts by crediting Receipts and Recoveries of Capital Accounts after making necessary budget provisions.
- (b) The details of the equipments have been worked out only in 1987-88.

Performance of the Reactor

1.60 The reactor was commissioned in August 1985 but had to be shut down in February 1986 on account of vibrational problems and sustained power operation was found not feasible.

1.61 The Department has furnished a note on the technical aspects of vibrations caused in Dhruva Reactor and the solutions that were found by BARC Scientists and the same is reproduced below:

“The reactor was commissioned in August 1985, but had to be shut down in February 1986 on account of flow induced excessive vibration of fuel assemblies which was leading to undue mechanical wear of the aluminium cladding of the uranium fuel elements exposing the uranium to the coolant and raising the radioactivity level in the coolant circuit and hence making sustained high power operation difficult. This necessitated redesigning of the fuel assemblies through incorporation of springy aluminium bulges which ensures a snug fit of the fuel assembly in its coolant channel housing in the reactor and through inversion of the direction of the fuel cluster suspension. After modification of the fuel assemblies, the reactor was successfully restarted in October 1986 and was initially operated at 40 MW round-the-clock with a partially loaded core employing a minimum number of fuel assemblies as a matter of abundant caution. This mode of operation was decided upon to prove satisfactory performance of the redesigned fuel assemblies without resorting to a full reactor loading. Since the performance of these designed fuel assemblies was satisfactorily established at 40 MW, the reactor was subsequently fully loaded and the power was progressively raised beginning from August 1987 to the rated power level of 100 MW on January 17, 1988. Since then, operation of the reactor and its various systems has been quite satisfactory and the irradiation performance of the redesigned fuel assemblies has been excellent”.

1.62 In reply to a question about the estimated loss on account of discarding of defective fuel assemblies in the reactor core due to vibrational problems, DAE stated that there is no loss due to defective fuel assemblies as these were not discarded but were re-processed.

1.63 However, it has been observed by Audit that the recovery of plutonium etc. from discarded fuel assemblies would be at a cost. Also the original cost of fabricating the fuel assemblies, cost of recovery of by-products etc. less the cost of material recovered would have to be written off in case of reprocessing of defective fuel assemblies.

1.64 The Committee note that the cost of the project Dhruva which was estimated as Rs. 49.88 crores in 1974 had to be revised to Rs. 76.30 crores in 1977 and again to Rs. 107.88 crores in May 1988. The Committee are distressed to find that the increase in project cost due to price escalation under the two heads 'Major Works' and 'Mechinery and Equipments' alone has accounted for an increase of Rs. 13.84 crores i.e. about 23 per cent of the total increases in project cost over that estimated in 1974. Similarly the cost of heavy water has also gone up from the estimated cost of Rs. 17.00 crores in 1977 to Rs. 44.00 crores in 1984-85 due to price escalations. The Committee cannot but express their unhappiness over the failure of the Department in completing the project Dhruva within the stipulated time frame. Despite the various reasons and explanations offered for the increase in project cost, the Committee consider that much of the escalation was due to project planning being faulty and without perspective.

1.65 The Committee are constrained to observe that an expenditure of Rs. 7.55 crores had to be incurred towards additional new requirements under the heads 'Major Works' and 'Machinery and Equipment'. The Committee have been informed that the additional new requirements could not be visualised earlier as the detailed design engineering and the construction work for the project were being done in parallel. The Committee feel that the project planning in the case of Dhruva Reactor left much to be desired right from the beginning. It is clear that the additional new requirements reflect nothing but a case of poor planning on the part of the project authorities. In the opinion of the Committee, this resulted in substantial increases in the quantities of work required to be done with consequent increases in cost and delay in execution of the project.

1.66 The Committee are surprised to find that the project estimates for 1974 under the head 'Office Expenses' had to be substantially increased in 1977 because the expenses such as telephone, stationary etc., were not provided for in the initial stages as the Department had envisaged that the existing facilities available within BARC could be utilised for the project Dhruva. The Committee consider that the present case is indicative of the casual approach displayed by the Department in preparing the project estimates since utilisation of the facilities at the cost of other Divisions of BARC would not have reflected the true cost of project Dhruva. The Committee expect the Department to be more cautious in preparing and processing the project estimates.

1.67 The Committee observe that as against the sanctioned project cost of Rs 76.90 crores, the expenditure incurred on the project upto the end of 1983-84 was only Rs. 56.85 crores. The Committee however, find that the expenditure registered a sudden rise in 1984-85 when it touched the figure of Rs. 104.19 crores i.e., Rs. 27.89 crores over and above the sanctioned cost. The rise in expenditure during 1984-85 has been stated to be due to debit for heavy water raised against the project. It has also been stated that the excess expenditure was incurred because of the on-going nature of the project nearing completion. But the fact remains that the Department had continued to incurred expenditure which was not covered by sanction for several years. Since the Department themselves were the suppliers of heavy water, they should have anticipated the expenditure and provided for the same at the appropriate time. Clearly, there was lack of financial discipline and vigilance on the part of the Department. Although, the Department is stated to have initiated proposal for revision in the sanctioned cost of the project in 1985, the revised sanction for Rs. 107.88 crores was accorded only in May 1988 i.e., after three years of the incurring of excess expenditure, obviously when the audit observations were made known to the Department. The Committee take a serious view of this matter and they desire that responsibilities be fixed for budgetary irregularities committed in this regard.

1.68 The Committee also note that the research reactor Dhruva which was commissioned in August 1985, had to be shut down in February 1986 on account vibrational problems. Although the reactor is stated to be working at the rated power level of 100 MW from January, 1988, the Committee regret that it took the Department two years to remove the defects and achieve the desired power level with the result that the facility could not be utilised for about two years. The Committee trust that concerted efforts would be made to keep the closure of the reactor to the barest minimum and full advantage is taken of the reactor.

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

AMAL DATTA
Chairman.
Public Accounts Committee.

APPENDIX I

(Vide para 1.5 of the Report)

Paragraph 3 of the Report of the C and AG of India for the year ended 31 March 1987-No. 7 of 1988, Union Government (Scientific Departments)

Research Reactor Dhruva

Department of Atomic Energy (DAE) decided in July 1972 that Bhabha Atomic Research Centre (BARC) could set up a natural uranium fuelled and heavy water moderated and cooled thermal research reactor "DHRUVA" at Trombay. The reactor has a rated power of 100 MW with a high neutron flux in the region of 100 trillion neutrons per sq. cm/sec.

The objectives were:

- (i) to provide engineering facilities to test prototype fuel elements for power reactors;
- (ii) to further the scope of research in the fields of physics, chemistry, etc. and
- (iii) to enlarge the isotope production facilities and also produce radio isotopes of specific activity higher than those produced with CIRUS reactor set up earlier.

The estimated cost was Rs. 30.84 crores with a foreign exchange component of Rs. 4.79 crores. In May 1974 the project data were updated and on that basis the revised cost came to Rs. 49.88 crores. Piecemeal financial sanctions to the extent of Rs. 4.30 crores were issued during the period January 1973 to April 1975. In June 1977, the project cost was revised to Rs. 76.30 crores with a foreign exchange component of Rs. 9.07 crores. The project cost included Rs. 17.28 crores for heavywater. This was approved by the Government in April 1978. However, by March 1987 Rs. 107.85 crores had been expended of which Rs. 41.10 crores was debited for heavy water.

The reasons for the extra expenditure of Rs. 31.55 crores over the revised project cost of June 1977 are attributable to escalation

in cost of heavy water, imported raw materials such as stainless steel plates, etc., increase in the cost of the fuelling machine additional items found necessary as the design progressed and increase in customs duty.

In September 1972, it was anticipated that the research reactor would be commissioned by December 1976. This was on the premise that the project report would be ready by April 1973 and the major civil construction would be completed by December 1975. This was revised to December 1981 at the time of revising the project cost in June 1977. However, the reactor could become critical only in August 1985.

The delays were due to delays that occurred in completion of reactor building (53 months), service building (20 months), air-conditioning and ventilation for reactor building (61-65 months), supply of fuel assembly (60 months), fabrication of calandria (49 months), fabrication of shield block (55 months) etc. The Department stated (October 1987) that the project execution had a time overrun of about 57 per cent and a cost over-run of 6.2 per cent (excluding cost of heavy water) as compared to the projections approved by the Government in April 1978. Including cost of heavy water the extra expenditure was 41.42 per cent.

As regards performance, the reactor was commissioned in August 1985 but had to be shut-down in February 1986 on account of vibrational problems and sustained power operation was found not feasible. This necessitated redesigning of fuel assemblies (October 1986) and the reactor was operated only at 40 MW (May 1987).

Department accepted (May/October 1987) this and said it was done as a matter of abundant precaution and also to ensure satisfactory performance of the redesigned fuel assemblies. Subsequently power level of the reactor was upgraded to 75-80 MW (October 1987) and preparations are in progress to reach 100MW.

Due to vibrational problems mentioned above, a number of fuel assemblies had to be discarded at a low fuel-burn-up. Department stated (May 1987) that those low-burn-up fuel rods may be reprocessed for recovering plutonium and the unburnt natural uranium could be used for new fuel fabrication. Though recovery of plutonium etc. may be attempted in future from discarded fuel assemblies it would be at a cost. Also the original cost of fabricating the fuel assemblies, cost of recovery of by-products etc. less the cost of material recovered will have to be written off.

Due to delay in commissioning the reactor, basic research facilities and isotope technology could not be established. The expenditure on these facilities would also go up as and when these facilities are established. The Department accepted this and stated that some of the basic research facilities could not be established due to budgetary constraints. Apart from the cost escalation it also meant non-fulfilment of objectives even as of date (October 1987).

The proforma accounts maintained by the Department revealed that till 30th June 1986 there was loss of 1.43 tonnes of heavy water in respect of Dhruva. At a notional price of Rs. 4200 per kilogram this meant a loss of Rs. 60.04 lakhs. The Department stated (May 1987) that the loss of heavy water during operation between June 1985 and April 1987 together with quantity of below-reactor-grade heavy water used in pre-commissioning stages was normal.

Bhabha Atomic Research Centre (BARC) is the only producer of radio isotopes and equipment in the country and in July 1980 CIRUS reactor (40 MW) had been commissioned for this purpose. The total sale value of radio isotopes produced and the value of services rendered was on an average worth Rs. 1.68 crores per annum during 1980-81 to 1985-86.

The Department had not fixed the targets of production for radio isotopes of higher specific activity from Dhruva reactor on the plea that their production would depend upon the demand and it would not be possible to give realistic estimates of production. The production of isotope Iodine-125 used in radio immunoassay has not been started so far and the Department state that the radiation facility necessary for its production has not been installed in the reactor. The Department stated (October 1987) that it is true the production of radio isotopes got delayed due to delayed commissioning of the reactor and that sale value of radio isotopes produced in the reactor would take some years to pick up since longlived radio isotopes like Cobalt-60 require long irradiation time (years) in the reactor.

In sum, the project which was expected to be completed in 4 years 3 months took more than 8 years 3 months to be completed; the actual expenditure upto March 1987 was Rs. 107.85 crores against sanctioned amount of Rs. 76.30 crores issued in April 1978, the reactor has not functioned at the designed power level so far; due to delay in commissioning of the reactor; the production of radio isotopes has been delayed; and projects for basic research facilities have not been completed till October 1987.

APPENDIX-II

Statement of recommendation and observations

Sl. No.	Para No.	Ministry/ Department	Recommendation/Observation
1	2	3	4
1	1.29	Deptt. of Atomic Energy (DAE)	<p>The Committee note that the Department of Atomic Energy, in their note submitted to the Cabinet in 1972 for seeking approval for setting up of a 100 MW Thermal Research Reactor at Trombay, had expected the proposed reactor to be commissioned by the end of 1976 on the premise that the project report would be ready by early 1973. The Committee however, find that the project report could be completed only in May 1974 with changes stated to have been necessitated by refinements, plan lay-out etc., on the basis of the feed back obtained from the utilisation experience of CIRUS reactor. Considering the fact that the Department had been operating the CIRUS reactor since 1960 and thus had utilisation experience available instantly, the Committee feel convinced that the Department did not make serious and time bound efforts from the initial stages itself in meeting the time schedules envisaged in the original note furnished to the Cabinet. The Committee find no justification for this delay of more than a year in preparing the project report.</p>

2.

1.30

DAE

The Committee further note that while the conceptual design for the new reactor was finalised in 1974, the detailed design parameters were completed only in 1978. The Committee have been informed that the design and development of the sub-systems for the reactor took a longer time as several changes were made in order to provide for facilities under the changed nuclear situation after Pokhran Explosion in 1974 when it was realised that the Department would not be able to buy sub-systems and equipments from many of the developed countries. It has also been stated that the Department had a limited scope for an NRU type of reactor when the proposal was submitted to the Cabinet in 1972 but the Department, under the changed nuclear situation, decided to go on their own for building a facility incorporating latest research capabilities. The Committee however, feel that the Department did not bestow proper care and attention on planning the project even in 1977 when the dates of completion of various activities for commissioning the reactor by December 1981 were revised. It is obvious that the Department did not properly analyse the progress of work at the time of revising the date of commissioning of the reactor in 1977 as is borne out by the fact that there were substantial delays even against the revised target dates in completion of both the civil works and the manufacture of nuclear equipments for the project.

3.

1.31

Do.

Among the important reasons which were advanced for the delay in completion of the civil works, are delay in formulation of

tender specifications and issuing of the same; changes in design and increase in scope of work during construction, inadequate sub-soil investigations; and complexity of the nature of the job to be executed.

4.

1.32

DAE

As regards delay in tender formulation etc., the Committee have been informed that the detailed design parameters could not be supplied to the consultants at a time to enable them to formulate tender specifications completely as the design parameters had to be finalised by the engineers and scientists of various disciplines and some hold-ups had occurred in the course of critical examination of problems which could not be finalised in advance. Yet another reason advanced by the Department for delay on this count is that the tenders were for a large magnitude with many conditions to be stipulated therein and it took time to process the tenders and obtain final approval of the competent authority. The Committee are not convinced by the reasons advanced to explain delay in completing the stage prior to commencing and during execution. On the other hand, the Committee feel convinced that the work on this project was undertaken in a casual manner and the project languished for want of coordination among various project authorities involved in its execution.

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5; 1.33

Do.

The Committee note that the completion of reactor building was delayed mainly due to the changes in the design of the roof and of girder and ducting systems and also because of the time taken for deciding on the location of the cut outs in basements etc. Similarly, the spent fuel storage building was delayed because the location of the emergency storage tank had to be revised on the basis of subsequent studies. The Committee feel convinced that the subsequent changes in the design as also the increase in scope of work during execution of the project highlight another facet of poor planning on the part of project authorities. It is clear that design parameters were not adequately taken care of at the pre-construction stage with the result that the project schedule was thrown out of gear. At this stage, the Committee can only hope that Department of Atomic Energy would draw procedures for working out the details of the projects to be taken in hand, well in advance by ensuring proper coordination among the project authorities so as to obviate delays in the execution of the projects due to in-house failures.

6. 1.34

Do.

The Committee are distressed to note the substantial delay in completion of the service building mainly due to the presence of hard/soft rock at the site which was not revealed by the random bore holes taken during the site investigations. Considering the fact that foundation soil problems were also encountered during the execution of Madras Atomic Power Project, the Committee are of the view that the geological investigations carried out by the De-

partment of Atomic Energy appear to be inadequate. They believe that the Department should pay serious attention towards this aspect and would also ensure in future that adequate geological investigations of the project sites are made at the pre construction stages.

7. 1.35 Do.

The Committee note that the calandria for Dhruva reactor was fabricated departmentally. However, the fabrication of calandria was delayed by 49 months mainly due to slippages in delivery of various equipments by vendors and development efforts required for fabricating zircaloy re-entrant cans. The Committee understand that while certain amount of development work becomes inevitable in manufacture of certain items, the Department must draw up a realistic time bound package for such activities having due regard to the existing technological competence so that the project schedules may not go awry subsequently.

8. 1.36 Do.

It is regrettable that the manufacture of heat exchangers for project Dhruva was substantially delayed due to the dislocation of machinery at BHEL the manufacturer and the Department had to pay a compensation of Rs. 14.10 lakhs to the piping contractor for maintaining his work force idle. The Committee are surprised that the Department could not recover this compensation from BHEL since their delay was covered by 'force majeure' clause. The Com-

mittee do not find adequate justification in the plea of the Department that the closing of the piping contract before delivery of the heat exchangers would have resulted in greater expenditure and time delay since another contractor had to be employed later to do the erection job. They regret that the Department did not take adequate care to safeguard interests of the Government at the time of entering into contract with the piping contractor.

9.

1.64

DQ.

The Committee note that the cost of the project Dhruva which was estimated as Rs. 49.88 crores in 1974 had to be revised to Rs. 76.30 crores in 1977 and again to Rs. 107.88 crores in May 1988. The Committee are distressed to find that the increase in project cost due to price escalation under the two heads 'Major Works' and 'Mechinery and Equipments' alone has accounted for an increase of Rs. 13.84 crores i.e. about 23 per cent of the total increase in project cost over that estimated in 1974. Similarly the cost of heavy water has also gone up from the estimated cost of Rs. 17.00 crores in 1977 to Rs. 44.00 crores in 1984-85 due to price escalations. The Committee cannot but express their unhappiness over the failure of the Department in completing the project Dhruva within the stipulated time frame. Despite the various reasons and explanations offered for the increase in project cost, the Committee consider that much of the escalation was due to project planning being faulty and without perspective.

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10.	1.65	Do.	<p>The Committee are constrained to observe that an expenditure of Rs. 7.55 crores had to be incurred towards additional new requirements under the heads 'Major Works' and 'Machinery and Equipment'. The Committee have been informed that the additional new requirements could not be visualised earlier as the detailed design engineering and the construction work for the project were being done in parallel. The Committee feel that the project planning in the case of Dhruva Reactor left much to be desired right from the beginning. It is clear that the additional new requirements reflect nothing but a case of poor planning on the part of the project authorities. In the opinion of the Committee, this resulted in substantial increases in the quantities of work required to be done with consequent increases in cost and delay in execution of the project.</p>
11.	1.66	Do.	<p>The Committee are surprised to find that the project estimates for 1974 under the head 'Office Expenses' had to be substantially increased in 1977 because the expenses such as telephone, stationery etc., were not provided for in the initial stages as the Department had envisaged that the existing facilities available within BARC could be utilised for the project Dhruva. The Committee consider that the present case is indicative of the casual approach displayed by the Department in preparing the project estimates since utili-</p>

sation of the facilities at the cost of other Divisions of BARC would not have reflected the true cost of project Dhruva. The Committee expect the Department to be more cautious in preparing and processing the project estimates.

12. 1.67 D.

The Committee observe that as against the sanctioned project cost of Rs. 76.30 crores, the expenditure incurred on the project upto the end of 1983-84 was only Rs. 56.85 crores. The Committee however, find that the expenditure registered a sudden rise in 1984-85 when it touched the figure of Rs. 104.19 crores i.e., Rs. 27.89 crores over and above the sanctioned cost. The rise in expenditure during 1984-85 has been stated to be due to debit for heavy water raised against the project. It has also been stated that the excess expenditure was incurred because of the on-going nature of the project nearing completion. But the fact remains that the Department had continued to incur expenditure which was not covered by sanction for several years. Since the Department themselves were the suppliers of heavy water, they should have anticipated the expenditure and provided for the same at the appropriate time. Clearly, there was lack of financial discipline and vigilance on the part of the Department. Although, the Department is stated to have initiated proposal for revision in the sanctioned cost of the project in 1985, the revised sanction for Rs. 107.88 crores was accorded only in May 1988 i.e., after three years of the incurring of excess expenditure, obviously when the audit observations were made known to the Department. The Committee take a serious view

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of this matter and they desire that responsibilities be fixed for budgetary irregularities committed in this regard.

13.

1.68

Do.

The Committee also note that the research reactor Dhruva which was commissioned in August 1985, had to be shut down in February 1986 on account of vibrational problems. Although the reactor is stated to be working at the rated power level of 100 MW from January, 1988, the Committee regret that it took the Department two years to remove the defects and achieve the desired power level with the result that the facility could not be utilised for about two years. The Committee trust that concerted efforts would be made to keep the closure of the reactor to the barest minimum and full advantage is taken of the reactor.

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

Sl. No.	Name of Agent	Sl. No.	Name of Agent
ANDHRA PRADESH		UTTAR PRADESH	
1.	M/s. Vijay Book Agency, 11-1-477, Mylargadda, Secunderabad-500361	12.	Law Publishers, Sardar Patel Marg, P.B. No. 77, Allahabad, U.P.
BIHAR		WEST BENGAL	
2.	M/s. Crown Book Depot, Upper Bazar, Ranchi (Bihar)	13.	M/s. Manimala, Buys & Sells, 123, Bow Bazar Street, Calcutta-1.
GUJARAT		DELHI	
3.	The New Order Book Company, Ellis Bridge, Ahmedabad-380006. (T.No. 79065)	14.	M/s. Jain Book Agency, C-9, Connaught Place, New Delhi (T.No. 351633 & 350806).
MADHYA PRADESH		15.	M/s. J.M. Jaina & Brothers, P.Box 1020, Mori Gate, Delhi- 110006. (T.No. 2915064 & 230936).
4.	Modern Book House, Shiv Vilas Palace, Indore City. (T. No. 352229)	16.	M/s. Oxford Book & Stationery Co., Scindia House, Connaught Place, New Delhi-110001. (T.No. 3315308 & 45896).
MAHARASHTRA		17.	M/s. Bookwell, 2/72, Sant Niran- kari Colony, Kingsway Camp, Delhi-110009. (T.No. 7112309).
5.	M/s. Sunderdas Gian Chand, 601, Girgaum Road, near Princess Street, Bombay-400002.	18.	M/s. Rajendra Book Agency, IV-D/50, Lajpat Nagar, Old Double Storey, New Delhi-110024. (T. No. 6415362 & 6412131).
6.	The International Book Service, Deccan Gymkhana, Poona-4.	19.	M/s. Ashok Book Agency, BH-82, Pocrvi Shalimar Bagh, Delhi-110033.
7.	The Current Book House, Maruti Lane, Raghunath Dadaji Street, Bombay-400001.	20.	M/s. Venus Enterprises, B-2/85, Phase-II, Ashok Vihar, Delhi.
8.	M/s. Usha Book Depot, 'Law Book Seiler and Publishers' Agents, Govt. Publications, 585, Chinabazar, Khan House, Bom- bay-400002.	21.	M/s. Central New Agency Pvt. Ltd., 23/90, Connaught Circus New Delhi-110001. (T.No. 344448, 322705, 344478 & 344508).
9.	M&J Services, Publishers, Re- presentative Accounts & Law Book Sellers, Mohan Kunj, Ground Floor, 68, Jyotiba Fuels Road, Nalgaum-Dadar, Bom- bay-400014.	22.	M/s. Amrit Book Co., N-21, Connaught Circus, New Delhi.
10.	Subscribers Subscription Service India, 21, Raghunath Dadaji Street, 2nd Floor, Bombay- 400001.	23.	M/s. Books India Corporation Publishers, Importers & Ex- porters, L-27, Shastri Nagar, Delhi-110052. (T.No. 269631 & 714465).
TAMIL NADU		24.	M/s. Sangam Book Depot, 4378/4B, Murari Lal Street, Ansari Road, Darya Ganj, New Delhi-110002.
11.	M/s. M.M. Subscription Agencies, 14th Murali Street, (1st Floor), Mahalingapuram, Nungambak kam, Madras-600034. (T.No. 476558).		

